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COVID-19 vaccination attitudes, values and intentions among United States adults prior to emergency use authorization



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ABSTRACT

Introduction: Safe and effective vaccines against Coronavirus Disease 2019 (COVID-19) provide the best opportunity to control the pandemic. Having safe and efficacious vaccines available is only half the equation; people must also take them. We describe a study to identify COVID-19 vaccine attitudes, values and intentions immediately preceding authorization of COVID-19 vaccines in the US.

Methods: A national panel survey was conducted to measure intent to receive COVID-19 vaccines as well as disease and vaccine attitudes, values and trust in local, state and federal public health authorities.

Results: Greater than 80% of respondents reported confidence they could adhere to COVID recommendations such as mask wearing, social distancing and hand washing. The majority of respondents (70%) reported believing that current drugs were somewhat or very good at treating COVID-19 infection.

Vaccine intent fell into three groups: Intenders (50%), Wait and Learn (40%), and Unlikelies (10%). Intent to get vaccinated was substantially lower among African American (32%), and higher among men (56%), those over 60 years of age (61%), those with a Bachelor's degree or higher (63%), and Democrats (63%). The Wait and Learn group, compared to the Intenders, were less likely to report being diagnosed with a high risk condition for COVID-19, receiving an influenza vaccine in the past 12 months, discussing COVID-19 vaccine with their healthcare provider, perceiving COVID-19 as severe, considering a COVID-19 vaccine important to stop the spread of infection, and wearing a mask usually or almost always.

Conclusion: Only half of US adults intend to accept COVID-19 vaccines; most others (40%) are uncertain. Levels of immunity associated with community protection will not be achieved without reaching those who are currently uncertain. Characterizing COVID-19 vaccine attitudes and intentions and ascertaining values and trust in local, state, and federal public health authorities that impact vaccine decision-making are essential.

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1. Introduction

Safe and effective vaccines against Coronavirus Disease 2019 (COVID-19) provide the best opportunity to control the pandemic, both nationally and globally. Two COVID-19 vaccines received Emergency Use Authorization (EUA) from the United States (US)

Food and Drug Administration (FDA) in December 2020,^[1,2] with several other candidates already being used elsewhere likely to soon follow. Operation Warp Speed may be successful in its principal objective: “ensuring that every American who wants to receive a COVID-19 vaccine can receive one, by delivering safe and effective vaccine doses to the American people beginning January 2021.”^[3] However, COVID-19 vaccines may have a limited impact on controlling the pandemic and returning to normal social and economic activity if they are not widely received. Having safe and efficacious vaccines available is only half the equation; people must also take them.

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Population level immunity to control COVID-19 is estimated to be 70% or higher and is based on the assumption of homogeneity of protection.[4,5] Because children under age 16 are excluded from vaccination (this age group is not approved to receive COVID-19 vaccine as of the time of publication), achieving this goal would require about 90% of adults to be vaccinated with extremely effective vaccines or to have immunity following infection. Coverage of about 80% will be necessary if and when children can be vaccinated, even with vaccine effectiveness equaling 95%. COVID-19 variants that are more transmissible or less impacted by the vaccine will require higher levels of immunity in a population to achieve community (herd) immunity. Social and geographical clustering of under-vaccination has undermined community immunity for measles and pertussis and, similarly, would be problematic for control of COVID-19.[6,7,8] Consequently, COVID-19 vaccination programs must have extremely high support and willingness to be vaccinated across and within subpopulations in order to be successful in controlling the pandemic.

The US response to COVID-19 has been politicized, leading to conflicting messaging.[9] A substantial proportion of the population questions the gravity of COVID-19 and the value of mitigation measures.[10] The US response to COVID-19 has been further complicated by narratives that prioritize personal autonomy without consideration of community benefit around mask wearing and social distancing. Increased focus on racial injustices in the US may have contributed to greater distrust of government among those in the African American community, which has been disproportionately impacted by the pandemic. Confidence in public health agencies also may have been affected by political interference in their work. During the early COVID-19 response, the FDA was scrutinized for the appearance of politics impacting their decision to grant an EUA for hydroxychloroquine and convalescent plasma.[11] The Centers for Disease Control and Prevention (CDC), which normally leads efforts around pandemic response and related communications, had a less prominent role during the COVID-19 response, with accounts of political officials interfering with MMWR reports related to COVID-19.[12] Political interference has undermined public health agencies' credibility.[13,14] These agencies must now authorize use, make vaccine recommendations, and launch a massive immunization program that reaches nearly every American.

The percentage of US adults reporting intent to vaccinate against COVID-19 decreased substantially from over 70% in late spring to only about 50% in September 2020 before rebounding to above 60% by late fall when media reports widely discussed 95% vaccine efficacy. Although the starting and ending points varied, this u-shaped pattern was generally seen regardless of race/ethnicity, political affiliation, gender, age, and education. Common concerns among those not intending to vaccinate were safety, efficacy, and the perceived rushed timeline for development.[15,16,17] Factors associated with lower intention to vaccinate include: younger age, African American race, lower education, and conservative political ideology.[4,5,9,10,11,12,18,19,20,21] Having more fear of COVID-19 and receiving a provider recommendation were both associated with greater intention to vaccinate.[13]

Many of the surveys reporting COVID-19 vaccination attitudes and intentions are not published in the peer reviewed literature.[10,11,12,22] Among those that are published, the racial and ethnic distribution of the sample was not always reported,[8,23,24] and methods varied [7,10–14,17,19], which may influence results. Among the few studies that enrolled people of color in similar proportions to their representation nationally, few examined factors associated with vaccine intention.[13,14,15,19]

Herein we describe a study to identify COVID-19 vaccine attitudes and intentions immediately preceding authorization of

COVID-19 vaccines in the US. We were particularly interested in characterizing these factors among populations of color and having the capacity to generalize nationally. We also focused beyond vaccine intent to explore values that are likely to impact vaccine decision-making and trust in local, state, and federal public health authorities.

2. Methods

2.1. Panel survey

A national panel survey was conducted in English and Spanish between November 25 and December 7, 2020 using Ipsos KnowledgePanel[®],[25] a probability-based web panel, sampled from all US households, with panel members having a known probability of participation. To increase the sample's representativeness to the US population, households without internet access were given tablet computers and internet access. Latinx individuals were supplementally recruited through random digit dialing of area codes with concentrated Latinx populations. Enrollment quotas ensured the sample's sociodemographic distribution approximated that of the US, with 50% oversampling of African American and Latinx respondents.

3. Survey content

The survey was largely based on the Health Belief Model and the Social Ecological Model.[26] The survey measured intent to receive COVID-19 vaccines (respondents selected one of the following answer choices: definitely get it as soon as possible, probably get it as soon as possible, probably get it but not as soon as possible, probably not get it, definitely not get it). We divided the population into the following three groups on the basis of their willingness to get vaccinated: 1) definitely or probably get it as soon as possible (**Intenders**); 2) probably get it but not as soon as possible and probably not get it (**Wait and Learn**); and 3) definitely not get it (**Unlikelysts**).

We also measured six constructs: 1) self-efficacy (an individual's belief in personal ability) to enact behaviors for COVID-19 prevention (4 question scale); 2) support for individualism (favoring freedom of action for individuals) vs communitarianism (responsibility of individual's action to the community, 6 question scale); [27] 3) support for hierarchy (systems that favor people or groups ranked above or below others) vs egalitarianism (systems that favor equality between people and groups, 6 question scale); 4) confidence in vaccines (6 question scale); 5) trust in local and state public health authorities (14 question scale); and 6) trust in the CDC (14 question scale). The survey also measured other attitudes about COVID-19 disease and vaccines, such as disease susceptibility and severity, mask wearing, value of drugs to treat COVID-19, importance of vaccines to control the pandemic, requirements for sharing personal information to get the vaccine, and vaccine effectiveness and safety. The survey was pilot-tested and took 11 min to complete (on average). Sociodemographic characteristics including gender, race, age, education, region, metropolitan statistical area (MSA), income, and political affiliation were available for all panel members.

4. Data analyses

Ranking procedure was used to adjust the design weights so that the sample was weighted to the US population of adults aged ≥18 years. African American and Hispanic respondents were over-sampled, so were down-weighted to reflect their proportion in the population. Finer geodemographic adjustments were made to the

Non-Hispanic White, Other or ≥2 Races, Non-Hispanic African American, and Hispanic subgroups. Benchmark data used in these adjustments were mostly obtained from the 2020 March Supplement of the Current Population Survey (CPS),[28] including race/ethnicity, Hispanic origin, gender, education level, Census region, and metropolitan status. Household income and language preference (among Hispanics) were obtained from the 2019 American Community Survey (ACS).[29] Weights were examined and trimmed so that the weighted sample equaled the total number of respondents.

For each of six construct scales, a composite, linear score was generated. This score was dichotomized at the median creating “high” and “low” groups for each construct. The linear score used to create these variables was calculated to account for missing values. The numerator equaled the sum of responses to all answered items within the scale, where strongly disagree = 4, disagree = 3, agree = 2, strongly agree = 1. All scores were transformed to a score out of 100 to facilitate comparisons across scales.

Unweighted and weighted univariate analyses were conducted for sociodemographic factors (gender, race/ethnicity, region, metropolitan statistical area status), influenza vaccination status, current employment status, household size, political affiliation, physical health, and levels of education and household income. For all other variables, only weighted analyses were performed. Sociodemographic variables were cross-tabulated against COVID-19 vaccination intention.

For all weighted proportions, Taylor-linearized variance estimation was used to estimate standard errors; p-values were estimated using Pearson chi-squared proportion test at significance level of (α) 5%. Cronbach alpha coefficients of reliability were estimated for the 6 construct scales.

Bivariate odds ratios were estimated using *glm* family(logit) between sociodemographic variables, binary variables for the 6 scale constructs, and affirmative responses to select survey questions about COVID-19 diagnosis, exposure history, and prevention behaviors, and vaccine expectations; influenza vaccination in the past 12 months; vaccine-related concerns; trust in the CDC and local health departments (separate items) to inform the public about the risk and benefits of medicines, and factors influencing the decision to get a COVID-19 vaccine, including disease rates in the respondent’s community, perceived severity of COVID-19 infection, effectiveness of drugs to treat COVID-19. P-values were estimated with Wald Tests of general association. Household size was included as a linear term in all models and p-values for this variable were calculated using a test for linear trend. Data were analyzed using Stata®, version 16.[30]

5. Results

Sociodemographic characteristics of the study population (N = 2525), unweighted and weighted, are presented in Table 1. Generally, weighting had limited impact other than by race and ethnicity (with oversampling of African American and Latino populations), given the panel was designed to represent the US population. Adjusted data are generalizable to the US adult population. About a third of respondents reported they thought it likely they would be infected with COVID-19 in the next year (37%) or, if infected, would experience severe illness (35%). Greater than 80% of respondents reported confidence they could adhere to COVID-19 recommendations such as mask wearing, social distancing and hand washing. The majority of respondents (70%) reported

Table 1
Sociodemographic characteristics and influenza vaccine status of the study population: unweighted and weighted.

Sociodemographic characteristics	Unweighted N = 2525 (%)	Weighted ^a %	Sociodemographic characteristics	Unweighted N = 1925 (%)	Weighted ^a %
Gender			Household Annual Income		
Male	1216 (48.2)	48.5	< \$50 K	778 (30.8)	30.2
Female	1309 (51.8)	51.5	\$50–85 K	631 (25.0)	24.9
Race/Ethnicity^b			\$85–150 K	615 (24.4)	25.0
Non-Hispanic White	1003 (39.7)	62.8	\$150 K+	501 (19.8)	19.9
Non-Hispanic Black	610 (24.2)	11.9	Current Employment Status		
Hispanic	801 (31.7)	16.7	Working - as a paid employee	1374 (54.4)	55.2
Non-Hispanic Other	111 (4.4)	8.6	Working - self-employed	222 (8.8)	7.8
Age (years)			Not working - looking for work	132 (5.2)	5.6
18–29	385 (15.2)	20.7	Not working - other	797 (31.6)	31.3
30–44	602 (23.8)	25.2	Household Size^d		
45–59	673 (26.7)	24.1	1	513 (20.3)	19.3
≥60	865 (34.3)	30.0	2	878 (34.8)	36.5
Region			3	420 (16.6)	16.7
Northeast	422 (16.7)	17.3	≥4	714 (28.3)	27.6
Midwest	439 (17.4)	20.7	Political Affiliation		
South	1037 (41.1)	38.0	Republican	524 (20.8)	26.7
West	627 (24.8)	23.9	Democrat	1130 (44.9)	37.1
Metropolitan Statistical Area Status			Independent	645 (25.6)	27.5
Non-Metro	252 (10.0)	13.4	Something else	218 (8.7)	8.8
Metro	2273 (90.0)	86.6	Physical Health		
Education			Excellent	285 (11.3)	11.9
Less than high school	244 (9.7)	9.8	Very good	910 (36.2)	36.8
High school	698 (27.6)	27.8	Good	939 (37.3)	36.6
Some college	696 (27.6)	27.6	Fair	329 (13.1)	12.5
Bachelor’s degree or higher	887 (35.1)	34.8	Poor	54 (2.1)	2.2
Influenza Vaccination Status^c					
No	1147 (45)	44.5			
Yes	1367 (55)	55.5			

^a Weights produced using iterative proportional fitting so that respondents were weighted to represent US adults; African American and Hispanic respondents were weighted to adjust for the oversampling that was done to allow for stratified analyses with sufficient power.

^b Race/Ethnicity: “Non-Hispanic other” includes n = 45 “Non-Hispanic 2 or more races”.

^c Respondents reported having received influenza vaccination within the past 12 months or not; this data was collected between June and December 2020, so does not necessarily reflect data for the current influenza season.

^d Household size: range 1–12, median = 2 (IQR 2–4).

Table 2
Composition and Properties of Six Construct Scales.

Constructs and Scale Items ^a	Weighted (%)				Median (IQR) ^b	Cronbach Alpha (Covariance) ^c
	Strongly Agree	Agree	Disagree	Strongly Disagree		
Confidence in COVID-19 Prevention					31.25 (25.00, 43.75)	0.77 (0.19)
I am confident that I can wear a mask each time I leave my home.	74	18	5	3		
I am confident that I can maintain a distance of 6 feet from others whenever I am outside my home.	43	40	15	3		
I am confident I can remember to wash my hands with soap and water for at least 20 s each time I come home from outside.	60	32	6	1		
When I need to sneeze, I am confident I can do so into my elbow or sleeve.	69	28	2	1		
Support for Communitarianism (vs. Individualism)					58.00 (50.00, 70.83)	0.84 (0.38)
The government interferes far too much in our everyday lives. ^a	24	31	38	8		
Sometimes government needs to make laws that keep people from hurting themselves.	28	49	16	8		
It's not the government's business to try to protect people from themselves. ^a	15	30	43	12		
The government should stop telling people how to live their lives. ^a	21	32	38	9		
The government should do more to advance society's goals, even if that means limiting the freedom and choices of individuals.	13	33	33	21		
Government should put limits on the choices individuals can make so they don't get in the way of what's good for society.	12	36	32	20		
Support for Egalitarianism (vs. Hierarchy)					50.00 (37.50, 62.50)	0.87 (0.50)
We have gone too far in pushing equal rights in this country. ^a	14	23	36	27		
Our society would be better off if the distribution of wealth was more equal.	26	38	21	15		
We need to dramatically reduce inequalities between the rich and the poor, whites and people of color, and men and women.	34	36	18	12		
Discrimination against minorities is still a very serious problem in our society.	43	33	18	7		
It seems like blacks, women, homosexuals and other groups don't want equal rights, they want special rights just for them. ^a	20	26	27	27		
Society as a whole has become too soft and feminine. ^a	17	26	35	22		
Confidence in Vaccines					60.00 (50.00, 70.83)	0.83 (0.32)
I am confident in the safety of vaccines.	21	48	23	8		
I do not trust a vaccine unless it has already been safely given to millions of other people. ^a	15	41	36	8		
I am concerned about some of the ingredients in vaccines. ^a	17	39	34	10		
Vaccine recommendations from the Centers for Disease Control and Prevention (CDC) are a good fit for me.	18	55	20	7		
I am concerned that the government and drug companies experiment on people like me. ^a	15	32	41	12		
The benefits of vaccines are much bigger than their risks.	32	48	17	4		
Trust in the Centers for Disease Control and Prevention (CDC)					55.36 (51.79, 60.71)	0.91 (0.22)
They do everything they should to protect the health of the population. Agree = high trust	15	56	24	5		
They are partly responsible for the illegal drug problems in this country.	8	24	51	17		
They recommend things for the public that aren't helpful. ^a	7	27	55	11		
They use resources well.	12	59	24	5		
They waste money on health problems. ^a	7	20	56	17		
They keep trying the same things to help the public, even when they don't work very well. ^a	8	38	49	5		
They come up with new ideas to solve health problems.	15	65	18	3		
They base recommendation on the best available science.	25	58	14	3		
They accurately inform the public of both health risks and benefits of medicines.	17	56	23	5		
They believe in what they recommend for the public.	20	62	15	3		
They quickly help the public with health problems.	12	54	29	4		
They are concerned about all people, without caring about who has more or less money.	23	53	19	5		
They are more concerned about some racial and ethnic groups than other groups. ^a	7	19	58	15		
They ensure the public is protected against diseases.	17	60	20	3		
Trust in Local and State Health Departments					57.14 (53.57, 62.50)	0.90 (0.21)
They do everything they should to protect the health of the population.	12	55	29	4		
They are partly responsible for the illegal drug problems in this country.	6	25	52	16		
They recommend things for the public that aren't helpful.	6	32	54	8		
They use resources well.	9	56	31	5		
They waste money on health problems. ^a	6	26	57	11		

(continued on next page)

Table 2 (continued)

Constructs and Scale Items ^a	Weighted (%)				Median (IQR) ^b	Cronbach Alpha (Covariance) ^c
	Strongly Agree	Agree	Disagree	Strongly Disagree		
They keep trying the same things to help the public, even when they don't work very well.	7	42	45	6		
They come up with new ideas to solve health problems.	8	56	32	4		
They base recommendation on the best available science.	16	61	19	4		
They accurately inform the public of both health risks and benefits of medicines.	12	55	28	4		
They believe in what they recommend for the public.	15	65	17	3		
They quickly help the public with health problems.	9	55	31	4		
They are concerned about all people, without caring about who has more or less money.	17	54	24	5		
They are more concerned about some racial and ethnic groups than other groups. ^a	7	26	54	13		
They ensure the public is protected against diseases.	11	61	25	4		

^a Responses to 4-point Likert scale items used as the basis for composite scales centralized around the middle options of “agree” and disagree” compared to “strongly agree” and “strongly disagree.” Response options were scored and summed to create linear scores and dichotomized at the median for further analyses: strongly agree = 1, agree = 2, disagree = 3, strongly disagree = 4. Selected items (^a) were reversed: strongly agree = 4, agree = 3, disagree = 2, strongly disagree = 1.

^b IQR: Inter Quartile Range. On a scale of 0–100, the median values and IQRs were: Confidence in COVID-19 Prevention 31.25 (IQR 25.00, 43.75), Support for Government Decision-Making (vs. Individual) 58.00 (IQR 50.00, 70.83), Support for Equality (vs. Discrimination) 50.00 (IQR 37.50, 62.50), Confidence in Vaccines 60.00 (IQR 50.00, 70.83), Trust in CDC 55.36 (IQR 51.79, 60.71), and Trust in Local and State Health Departments 57.14 (IQR 53.57, 62.50).

^c Cronbach’s alpha is a measure of internal consistency. Scales with Cronbach alpha values greater than 0.80 are generally considered to have good reliability; however, there is disagreement in the field about what cut off value should be used for good reliability (some social scientists use 0.70 as the threshold), though values closer to 1.0 are universally preferred.

believing that current drugs were somewhat or very good at treating COVID-19 infection.

The majority of respondents reported they were confident in the safety of vaccines (69%), believed the benefits of vaccines are much bigger than the risks (80%), and that CDC vaccination recommendations are a good fit for them (73%). Vaccine concerns were prevalent, including concerns about vaccine ingredients (44%) and that the government and drug companies “experiment on people like me” (53%). Many respondents reported favorable trust toward local and state health departments and the CDC, such as 67% indicating local and state health department and 71% indicating CDC does everything they should to protect the health of the population. However, between a quarter to a third of respondents reported unfavorable trust toward local and state health departments and the CDC, such as they recommend things for the public that are not helpful (38% state and local, 33% CDC), they do not base recommendations on the best available science (23% local and state, 17% CDC), and they do not believe in what they recommend to the public (20% local and state, 18% CDC). Our six constructs had very good to excellent internal consistency (Cronbach Alpha range 0.77–0.91; Table 2) and varied by demographics (Table 3).

Based on reported intent to get vaccinated against COVID-19, we categorized respondents into three groups (Tables 3–6):

“Intenders” - This group reported intent to definitely or probably get vaccinated as soon as they are able and represented 50% of the population. Intent to get vaccinated was substantially lower among African Americans (32%) and comparable among White non-Hispanics (55%), Hispanics (52%) and Other non-Hispanics (53%). This group of Intenders also included a significantly higher proportion of men compared with women (56% vs. 48%); individuals over 60 years of age (61%) compared with younger persons; and those with greater education (Bachelor’s degree or higher, 63%) compared with those who had less education. Intenders were also more likely to be Democrats (63%) versus Republicans (46%) or Independents (48%) (Table 3). Intenders (compared to the rest of the population) were more likely to live in a metropolitan than a non-MSA (odds ratio (OR): 1.43; 95% Confidence Interval (CI) 1.07–1.93) and have high income compared to low income (OR: 1.60; 95% CI 1.22–2.10).

Intenders, compared to the rest of the population (Tables 5 and 6) were more likely to report having been diagnosed with a high

risk condition for COVID-19 (OR: 1.48; 95% CI 1.19–1.84), receiving a flu shot in the past 12 months (OR: 3.87; 95% CI 3.17–4.73), being likely to discuss COVID-19 with their healthcare provider (OR: 6.07; 95% CI 4.61–7.99), perceiving COVID-19 as severe (OR: 2.08; 95% CI 1.70–2.53), considering a COVID-19 vaccine important to stop the spread of infection (OR: 44.37; 95% CI 18.07–108.97), and usually or almost always wearing a mask (OR: 3.20; 95% CI 2.33–4.59). Intenders were more likely to hold a communitarian worldview (vs. individualism; OR 2.74; 95% CI 2.25–3.35), support egalitarianism (vs. hierarchy; OR 2.03; 95% CI 1.68–2.46), and trust the CDC (OR 2.72; 95% CI 2.24–3.32) and local/state health department (OR 2.50; 95% CI 2.06–3.03) compared to the rest of the population. Intenders were much more likely to be confident in vaccine safety than the rest of the population (OR 10.27; 95% CI 8.26–12.77).

“Wait and Learn” - This group includes those who indicated they probably will get vaccinated but not right away and those who probably will not get vaccinated and represented 40% of the population. However, 52% of African Americans fall into this Wait and Learn group. While less than the survey respondents as a whole, a substantial proportion of persons 60 years and older (33%) also were in the Wait and Learn group. Compared to the Intenders, the Wait and Learn group were more likely to be African American (OR: 2.51; 95% CI 1.98–3.18). The Wait and Learn group, compared to the Intenders, were less likely to live in a metropolitan than non-metropolitan statistical area (OR: 0.71; 95% CI 0.52–0.98), report high vs. low income (OR: 0.68; 95% CI 0.50–0.90), and to be Democrats versus Republicans (OR: 0.58; 95% CI 0.45–0.75) (Table 7).

The Wait and Learn group, compared to the Intenders, were more likely to report being in good (OR: 1.72; 95% CI 1.20–2.46) or fair (OR: 1.64; 95% CI 1.07–2.52) health compared to excellent health, having known someone with a previous serious vaccine reaction (OR: 2.74; 95% CI 1.83–4.10), being worried about the government requiring personal information to get a COVID-19 vaccine (OR: 1.86; 95% CI 1.52–2.29) and being concerned that the government and drug companies “experiment on people like me” (OR: 3.74; 95% CI 3.03–4.63). The Wait and Learn group, compared to the Intenders, were less likely to report having been diagnosed with a high risk condition for COVID-19 (OR: 0.68; 95% CI 0.54–0.85), receiving an influenza vaccine in the past 12 months (OR: 0.32; 95% CI 0.26–0.39), discussing COVID-19 vaccine with their

Table 3
Frequency of Intention to Get COVID-19 Vaccine by Sociodemographic Characteristics.

Survey Questions/Responses	Total Sample, % ^a	COVID-19 Vaccine Intentions, % ^b			p ^c
		Intenders	Wait and Learn	Unlikelys	
All	100	50	40	10	
Sociodemographic Characteristics					
Gender					<0.01
Female	52	48	40	11	
Male	48	56	36	8	
Age					<0.01
18–29	21	50	39	12	
30–44	25	48	41	11	
45–59	24	46	42	12	
≥60	30	61	33	6	
Education					<0.01
< High School	10	48	38	14	
High School	28	42	44	14	
Some College	28	50	40	10	
Bachelor or Higher	35	63	33	4	
Race/Ethnicity					<0.01
White, Non-Hispanic	63	55	35	10	
Black, Non-Hispanic	12	32	52	15	
Hispanic	17	52	39	9	
Other, Non-Hispanic	9	53	43	4	
Region					0.21
Northeast	17	50	38	12	
Midwest	21	53	39	8	
South	38	50	39	11	
West	24	56	37	7	
Metropolitan Statistical Area Status					0.05
Non-Metro	13	44	44	12	
Metro	87	53	37	9	
Household Income					<0.01
< \$50 K	30	49	39	12	
\$50–85 K	25	50	38	11	
\$85–150 K	25	49	42	8	
\$150 K+	20	60	32	7	
Current Employment Status					0.01
Working - as a paid employee	55	49	41	9	
Working - self-employed	8	59	29	12	
Not working - looking for work	6	45	40	14	
Not working - other	31	56	34	9	
Household Size					<0.01
1	19	54	37	9	
2	36	59	34	8	
3	17	47	45	8	
≥4	28	45	42	13	
Political Affiliation					<0.01
Republican	27	46	40	13	
Democrat	37	63	32	6	
Independent	28	48	41	11	
Something else	9	40	47	13	
Physical Health					<0.01
Excellent	12	57	28	14	
Very Good	37	54	38	8	
Good	37	49	42	9	
Fair	13	48	41	11	
Poor	2	71	19	10	

^a Column percentages (of total sample), weighted according to survey weights to achieve national representativeness.

^b Row percentages (of selected characteristic), weighted according to survey weights to achieve national representativeness.

^c P-value for the Pearson chi-squared proportion test at significance level of (α) 5%; boldface indicates statistical significance (p < 0.05).

healthcare provider (OR: 0.23; 95% CI 0.17–0.31), perceiving COVID-19 is severe (OR: 0.54; 95% CI 0.44–0.67) considering a COVID-19 vaccine important to stop the spread of infection (OR: 0.04; 95% CI 0.02–0.11), and wearing a mask usually or almost always (OR: 0.39; 95% CI 0.27–0.58). The Wait and Learn group were less likely to support communitarianism (vs. individualism - OR: 0.45; 95% CI 0.36–0.55) and egalitarianism (vs. hierarchy - OR: 0.52; 95% CI 0.43–0.64)), trust local/state health departments

(OR: 0.47; 95% CI 0.38–0.57) and CDC (OR: 0.41; 95% CI 0.33–0.50), and to be confident in vaccine safety (OR: 0.12; 95% CI 0.10–0.16) compared with Intenders (Table 8).

“Unlikelys” - This group includes those who indicate they definitely will not get vaccinated and represented 10% of the population. The Unlikelys include 15% of African Americans and 14% of persons with a high school education or less. The Unlikelys were less likely than Intenders to be elderly (OR: 0.38; 95% CI 0.23–

Table 4
Frequency of Intention to Get COVID-19 Vaccine by COVID-19 Disease and Vaccination Attitudes and Values.

Survey Questions/Responses	Total Sample, % ^a	COVID-19 Vaccine Intentions, % ^b			P ^c
		Intenders	Wait and Learn	Unlikelys	
All	100	50	40	10	
Constructs					
<i>High Construct Score^d</i>					
Confidence in Ability to Avoid COVID-19 Infection	34	56	35	8	<0.01
Support for Communitarianism (vs. Individualism)	39	67	31	3	<0.01
Support for Egalitarianism (vs. Hierarchy)	39	62	31	6	<0.01
Confidence in Vaccines	54	76	23	1	<0.01
Trust in the Centers for Disease Control and Prevention (CDC)	42	66	29	5	<0.01
Trust in Local and State Health Departments	47	64	31	4	<0.01
Affirmative Responses to Survey Questions					
<i>Responding “Yes”^e</i>					
Have you been diagnosed with COVID-19?	4	50	46	5	0.17
Do you have any immediate family members (spouse, sibling, parent or child) who were diagnosed with COVID-19?	16	48	41	11	0.39
Do you have any other relatives (not immediate family) who were diagnosed with COVID-19?	33	54	38	8	0.29
Do you have any friends, acquaintances or co-workers who have been diagnosed with COVID-19?	61	51	40	9	0.07
Do you personally know anybody who has been hospitalized or died from COVID-19?	34	52	40	8	0.18
Have you been diagnosed with any of the following health conditions? ^f	25	60	32	8	<0.01
Have you or anyone you know ever had a serious reaction to a vaccine?	9	29	50	22	<0.01
During the past 12 months, have you had a flu shot?	55	66	31	3	<0.01
<i>Responding “Somewhat Likely”, “Likely” or “Very Likely”</i>					
How likely do you think it is that you will be infected with COVID-19 over the next year?	37	54	38	7	0.02
How likely are you to discuss COVID-19 vaccine with your healthcare provider?	76	62	35	3	<0.01
<i>Responding “Somewhat Severe” or “Very Severe”</i>					
If you become infected with COVID-19, how severe do you think the infection will be?	35	63	32	5	<0.01
<i>Responding “Important” or “Very Important”</i>					
How important do you think a COVID-19 vaccine is to stop the spread of infection in the US?	88	58	37	4	<0.01
<i>Responding “Somewhat Good” or “Very Good”</i>					
How good do you think current drugs are in treating COVID-19?	70	54	37	8	<0.01
<i>Responding “Usually” or “Almost Always”</i>					
How often do you wear a mask when you are not at home and may come in contact with other people?	90	54	38	8	<0.01
<i>Responding “Agree” or “Strongly Agree”^g</i>					
I worry about the government requiring personal information (name, address, phone number, insurance card) in order to get a COVID-19 vaccine.	39	41	44	15	<0.01
I am confident in the safety of vaccines. ^h	68	69	29	2	
I do not trust a vaccine unless it has already been safely given to millions of other people. ^h	56	35	53	12	<0.01
I am concerned about some of the ingredients in vaccines. ^h	57	36	50	15	<0.01
Vaccine recommendations from the Centers for Disease Control and Prevention (CDC) are a good fit for me. ^h	73	66	32	2	<0.01
I am concerned that the government and drug companies experiment on people like me. ^h	47	33	49	17	<0.01
The benefits of vaccines are much bigger than their risks. ^h	80	61	33	4	<0.01
The CDC accurately informs the public of both health risks and benefits of medicines. ⁱ	73	61	34	5	<0.01
Local and state health departments accurately inform the public of both health risks and benefits of medicines. ^j	68	62	34	5	<0.01
Importance in decision whether to take a COVID-19 vaccine^k					
<i>Responding “Somewhat Important” or “Very Important”</i>					
Rates of COVID-19 infection in my community.	76	54	39	6	<0.01
How serious COVID-19 is for people like me.	82	56	39	6	<0.01
Effectiveness of drugs to treat COVID-19.	87	53	40	7	<0.01
Effectiveness of the COVID-19 vaccine.	92	55	39	6	<0.01
Number of doses of COVID-19 vaccine needed.	71	51	42	7	<0.01
COVID-19 vaccines are very safe.	94	55	39	7	<0.01

^a Column percentages (of total sample), weighted according to survey weights to achieve national representativeness.
^b Row percentages (of selected characteristic), weighted according to survey weights to achieve national representativeness.
^c P-value for the Pearson chi-squared proportion test at significance level of (α) 5%; boldface indicates statistical significance (p < 0.05).
^d Summary scores created for each construct by quantifying and adding together the responses to the survey questions assessing each construct; most of these individual survey questions are not described in this table, and those that are were chosen based on specific interest and denoted as such with footnotes; scales assessing constructs dichotomized above (“high”) and below (“low”) the median scale score.
^e Those who responded “Don’t know” or “Don’t care to answer” coded as missing, dichotomous variable created comparing “Yes” to “No”.
^f Cancer, chronic kidney disease, chronic lung disease, a heart conditions (such as heart failure, coronary artery disease, or cardiomyopathy), a weakened immune system (such as from an organ transplant, HIV, or from medicine you take), diabetes, obesity, sickle cell disease.
^g Likert scale response options (strongly agree, agree, disagree, strongly disagree) dichotomized to agree/disagree, results for agreement show.
^h Included in the construct summary score “Confidence in Vaccines”.
ⁱ Included in the construct summary score “Trust in the Centers for Disease Control and Prevention (CDC)”.
^j Included in the construct summary score “Trust in Local and State Health Departments”.
^k Importance scale response options (very important, important, not very important, not at all important) dichotomized to important/not important, results for importance shown.

Table 5
Unadjusted Odds Ratios for Intentions to Vaccinate Against COVID-19 by Sociodemographic Characteristics.

Survey Questions/ Responses	Comparisons between COVID-19 Vaccine Intentions, OR (95% CI) ^a			
	Likely to Vaccinate ASAP vs. not	Likely to Vaccinate Eventually vs. not	Unlikelys vs. Likely to Vaccinate ASAP	Wait and Learn vs. Likely to Vaccinate ASAP
Sociodemographic Characteristics^b				
Gender				
Female	ref ^b	ref ^b	ref ^b	ref ^b
Male	1.35 (1.11–1.63)^c	1.28 (1.01–1.62)	0.66 (0.48–0.92)	0.76 (0.62–0.93)
Age				
18–29	ref ^b	ref ^b	ref ^b	ref ^b
30–44	0.94 (0.70–1.28)	0.81 (0.57–1.17)	0.97 (0.60–1.55)	1.09 (0.78–1.51)
45–59	0.88 (0.65–1.18)	0.73 (0.51–1.04)	1.04 (0.65–1.66)	1.16 (0.85–1.60)
≥60	1.60 (1.20–2.12)	1.85 (1.27–2.70)	0.38 (0.23–0.63)	0.70 (0.52–0.95)
Education				
< High School	ref ^b	ref ^b	ref ^b	ref ^b
High School	0.77 (0.54–1.09)	0.97 (0.64–1.47)	1.20 (0.69–2.07)	1.34 (0.92–1.95)
Some College	1.05 (0.74–1.49)	1.19 (0.78–1.82)	0.72 (0.41–1.26)	1.04 (0.71–1.51)
Bachelor or Higher	1.81 (1.29–2.53)	2.37 (1.54–3.64)	0.24 (0.13–0.44)	0.67 (0.46–0.96)
Race/Ethnicity				
White, Non-Hispanic	ref ^b	ref ^b	ref ^b	ref ^b
Black, Non-Hispanic	0.39 (0.31–0.49)	0.61 (0.47–0.79)	2.73 (1.90–3.93)	2.51 (1.98–3.18)
Hispanic	0.90 (0.74–1.10)	1.11 (0.86–1.44)	1.04 (0.73–1.48)	1.13 (0.92–1.40)
Other, Non-Hispanic	0.94 (0.60–1.46)	1.96 (1.04–3.71)	0.41 (0.16–1.06)	1.25 (0.79–1.97)
Region				
Northeast		ref ^b	ref ^b	ref ^b
Midwest	ref ^b	ref ^b	ref ^b	ref ^b
South	1.12 (0.82–1.53)	1.05 (0.71–1.55)	0.65 (0.38–1.10)	0.97 (0.69–1.35)
West	0.99 (0.76–1.30)	0.77 (0.55–1.06)	0.94 (0.61–1.45)	1.03 (0.77–1.38)
	1.25 (0.93–1.68)	1.30 (0.89–1.91)	0.56 (0.34–0.92)	0.88 (0.64–1.21)
Metropolitan Statistical Area Status				
Non-Metro	ref ^b	ref ^b	ref ^b	ref ^b
Metro	1.43 (1.07–1.93)	1.50 (1.06–2.11)	0.65 (0.40–1.04)	0.71 (0.52–0.98)
Household Income				
< \$50 K	ref ^b	ref ^b	ref ^b	ref ^b
\$50–85 K	1.04 (0.80–1.34)	1.07 (0.78–1.46)	0.96 (0.63–1.45)	0.97 (0.73–1.27)
\$85–150 K	0.99 (0.76–1.28)	1.20 (0.88–1.64)	0.70 (0.44–1.09)	1.11 (0.84–1.46)
\$150 K+	1.60 (1.22–2.10)	2.04 (1.41–2.94)	0.46 (0.28–0.74)	0.68 (0.50–0.90)
Current Employment Status				
Working - as a paid employee	ref ^b	ref ^b	ref ^b	ref ^b
Working - self-employed	1.49 (1.06–2.11)	0.97 (0.63–1.48)	1.08 (0.62–1.88)	0.58 (0.40–0.84)
Not working - looking for work	0.86 (0.56–1.32)	0.59 (0.36–0.96)	1.69 (0.86–3.31)	1.05 (0.66–1.65)
Not working - other	1.32 (1.07–1.64)	1.40 (1.06–1.85)	0.87 (0.60–1.27)	0.73 (0.58–0.91)
Increase in Household Size ^d	0.87 (0.82–0.93)	0.87 (0.81–0.94)	1.20 (1.08–1.34)	1.13 (1.06–1.21)
Political Affiliation				
Republican	ref ^b	ref ^b	ref ^b	ref ^b
Democrat	1.93 (1.52–2.46)	2.89 (2.16–3.87)	0.33 (0.22–0.49)	0.58 (0.45–0.75)
Independent	1.07 (0.82–1.40)	1.44 (1.06–1.97)	0.79 (0.51–1.21)	0.98 (0.74–1.30)
Something else	0.79 (0.54–1.16)	1.16 (0.75–1.79)	1.09 (0.59–1.99)	1.32 (0.88–1.99)
Physical Health				
Excellent	ref ^b	ref ^b	ref ^b	ref ^b
Very Good	0.89 (0.65–1.23)	1.46 (1.00–2.13)	0.58 (0.36–0.95)	1.39 (0.97–1.99)
Good	0.72 (0.52–0.99)	1.39 (0.96–2.03)	0.75 (0.47–1.22)	1.72 (1.20–2.46)
Fair	0.71 (0.48–1.05)	1.33 (0.83–2.13)	0.93 (0.51–1.68)	1.64 (1.07–2.52)
Poor	1.81 (0.86–3.78)	1.97 (0.76–5.10)	0.57 (0.17–1.96)	0.54 (0.24–1.21)

^a OR = Odds Ratio; 95%CI = 95% Confidence Interval; response options for survey question assessing intention to receive vaccine against COVID-19 dichotomized as follows from: Definitely Get It ASAP, Probably Get It ASAP, Probably Get It But Not ASAP, Probably Not Get It, and Definitely Not Get It; “Likely to Vaccinate ASAP vs not” indicates responses of either Definitely Get It ASAP or Probably Get It ASAP compared to all other responses; “Likely to Vaccinate Eventually vs not” indicates responses of either Definitely Get It ASAP, Probably Get It ASAP, or Probably Get It But Not ASAP compared to all other responses; “Unlikely to Vaccinate vs Likely to Vaccinate ASAP” indicates responses of Definitely Not Get It compared to Definitely Get It ASAP or Probably Get It ASAP; “Uncertain vs Likely to Vaccinate ASAP” indicates responses of Probably Get It But Not ASAP or Probably Not Get It compared to Definitely Get It ASAP or Probably Get It ASAP; these dichotomous intention categories used as dependent variables in simple logistic regression analyses; boldface indicates statistical significance (p < 0.05); weighted according to survey weights to achieve national representativeness.

^b Most sociodemographic characteristics coded as dummy variables with the initial response option as the reference variable for other options to compare to.

^c Example interpretation of OR: Males have 35% greater odds of intending to vaccinate than females.

^d Average OR for an increase in household size of one.

Table 6
Unadjusted Odds Ratios for Intentions to Vaccinate Against COVID-19 by COVID-19 Disease and Vaccination Attitudes and Values.

Survey Questions/Responses	Comparisons between COVID-19 Vaccine Intentions, OR (95% CI) ^a			
	Likely to Vaccinate ASAP vs. not	Likely to Vaccinate Eventually vs. not	Unlikely vs. Likely to Vaccinate ASAP	Wait and Learn vs. Likely to Vaccinate ASAP
Constructs				
<i>High (scales dichotomized above the median scale score)^b</i>				
Confidence in Ability to Avoid COVID-19 Infection	1.35 (1.11–1.64)	1.45 (1.13–1.86)	0.61 (0.43–0.85)	0.78 (0.63–0.96)
Support for communitarianism (vs. individualism)	2.74 (2.25–3.35)	4.81 (3.56–6.50)	0.12 (0.08–0.18)	0.45 (0.36–0.55)
Support for egalitarianism (vs. hierarchy)	2.03 (1.68–2.46)	2.82 (2.20–3.62)	0.37 (0.27–0.52)	0.52 (0.43–0.64)
Confidence in Vaccines	10.27 (8.26–12.77)	19.80 (13.08–29.99)	0.02 (0.01–0.04)	0.12 (0.10–0.16)
Trust in the Centers for Disease Control and Prevention (CDC)	2.72 (2.24–3.32)	3.40 (2.57–4.50)	0.22 (0.15–0.33)	0.41 (0.33–0.50)
Trust in Local and State Health Departments	2.50 (2.06–3.03)	3.59 (2.76–4.66)	0.20 (0.14–0.29)	0.47 (0.38–0.57)
Affirmative Responses to Survey Questions				
<i>Responding “Yes”^c</i>				
Have you been diagnosed with COVID-19?	0.91 (0.58–1.43)	0.89 (0.52–1.54)	0.48 (0.17–1.39)	1.26 (0.79–2.01)
Do you have any immediate family members (spouse, sibling, parent or child) who were diagnosed with COVID-19?	0.84 (0.66–1.08)	0.90 (0.66–1.24)	1.26 (0.82–1.94)	1.17 (0.90–1.52)
Do you have any other relatives (not immediate family) who were diagnosed with COVID-19?	1.08 (0.88–1.32)	1.53 (1.17–2.00)	0.75 (0.52–1.08)	0.98 (0.79–1.22)
Do you have any friends, acquaintances or co-workers who have been diagnosed with COVID-19?	0.99 (0.81–1.22)	1.32 (1.03–1.68)	0.73 (0.52–1.01)	1.10 (0.88–1.36)
Do you personally know anybody who has been hospitalized or died from COVID-19?	1.02 (0.84–1.24)	1.27 (0.99–1.62)	0.75 (0.53–1.06)	1.05 (0.85–1.29)
Have you been diagnosed with any of the following health conditions? ^d	1.48 (1.19–1.84)	1.46 (1.09–1.96)	0.67 (0.44–1.02)	0.68 (0.54–0.85)
Have you or anyone you know ever had a serious reaction to a vaccine?	0.31 (0.21–0.46)	0.26 (0.18–0.38)	5.16 (3.10–8.59)	2.74 (1.83–4.10)
During the past 12 months, have you had a flu shot?	3.87 (3.17–4.73)	5.97 (4.52–7.88)	0.10 (0.06–0.14)	0.32 (0.26–0.39)
<i>Responding “Somewhat Likely”, “Likely” or “Very Likely”</i>				
How likely do you think it is that you will be infected with COVID-19 over the next year?	1.15 (0.94–1.41)	1.50 (1.15–1.95)	0.59 (0.41–0.85)	0.95 (0.77–1.18)
How likely are you to discuss COVID-19 vaccine with your healthcare provider?	6.07 (4.61–7.99)	12.47 (9.37–16.61)	0.04 (0.02–0.06)	0.23 (0.17–0.31)
<i>Responding “Somewhat Severe” or “Very Severe”</i>				
If you become infected with COVID-19, how severe do you think the infection will be?	2.08 (1.70–2.53)	3.04 (2.28–4.06)	0.29 (0.19–0.43)	0.54 (0.44–0.67)
<i>Responding “Important” or “Very Important”</i>				
How important do you think a COVID-19 vaccine is to stop the spread of infection in the US?	44.37 (18.07–108.97)	34.69 (22.93–52.48)	0.00 (0.00–0.01)	0.04 (0.02–0.11)
<i>Responding “Somewhat Good” or “Very Good”</i>				
How good do you think current drugs are in treating COVID-19?	1.30 (1.06–1.61)	1.53 (1.19–1.96)	0.53 (0.38–0.75)	0.85 (0.68–1.06)
<i>Responding “Usually” or “Almost Always”</i>				
How often do you wear a mask when you are not at home and may come in contact with other people?	3.20 (2.23–4.59)	4.18 (2.98–5.87)	0.16 (0.10–0.25)	0.39 (0.27–0.58)
<i>Responding “Agree” or “Strongly Agree”^e</i>				
I worry about the government requiring personal information (name, address, phone number, insurance card) in order to get a COVID-19 vaccine.	0.47 (0.38–0.57)	0.36 (0.28–0.45)	3.76 (2.68–5.26)	1.86 (1.52–2.29)
I am confident in the safety of vaccines. ^f	13.20 (10.10–17.26)	13.83 (10.35–18.47)	0.02 (0.01–0.03)	0.10 (0.08–0.13)
I do not trust a vaccine unless it has already been safely given to millions of other people. ^f	0.20 (0.16–0.25)	0.36 (0.27–0.47)	3.95 (2.76–5.65)	5.29 (4.21–6.65)
I am concerned about some of the ingredients in vaccines. ^f	0.20 (0.16–0.25)	0.16 (0.12–0.22)	11.10 (6.73–18.29)	4.28 (3.44–5.33)
Vaccine recommendations from the Centers for Disease Control and Prevention (CDC) are a good fit for me. ^f	13.35 (9.97–17.88)	20.51 (15.25–27.57)	0.01 (0.01–0.02)	0.11 (0.08–0.14)
I am concerned that the government and drug companies experiment on people like me. ^f	0.22 (0.18–0.27)	0.18 (0.13–0.24)	12.69 (8.08–19.91)	3.74 (3.03–4.63)
The benefits of vaccines are much bigger than their risks. ^f	9.51 (6.98–12.96)	9.81 (7.49–12.86)	0.03 (0.02–0.05)	0.14 (0.10–0.20)
The CDC accurately informs the public of both health risks and benefits of medicines. ^g	3.97 (3.14–5.01)	4.69 (3.65–6.03)	0.11 (0.08–0.16)	0.31 (0.25–0.40)
Local and state health departments accurately inform the public of both health risks and benefits of medicines. ^h	3.20 (2.58–3.98)	3.96 (3.09–5.07)	0.15 (0.10–0.21)	0.38 (0.30–0.48)
Importance in decision whether to take a COVID-19 vaccineⁱ				
<i>Responding “Somewhat Important” or “Very Important”</i>				
Rates of COVID-19 infection in my community.	1.47 (1.18–1.85)	3.28 (2.54–4.23)	0.23 (0.16–0.33)	0.96 (0.74–1.23)
How serious COVID-19 is for people like me.	2.37 (1.80–3.12)	4.21 (3.19–5.57)	0.14 (0.10–0.20)	0.62 (0.46–0.84)
Effectiveness of drugs to treat COVID-19.	1.36 (1.00–1.85)	2.92 (2.11–4.03)	0.23 (0.15–0.34)	1.23 (0.85–1.79)
Effectiveness of the COVID-19 vaccine.	10.41 (5.81–18.65)	22.83 (14.26–36.55)	0.02 (0.01–0.04)	0.23 (0.12–0.44)

Table 6 (continued)

Survey Questions/Responses	Comparisons between COVID-19 Vaccine Intentions, OR (95% CI) ^a			
	Likely to Vaccinate ASAP vs. not	Likely to Vaccinate Eventually vs. not	Unlikely vs. Likely to Vaccinate ASAP	Wait and Learn vs. Likely to Vaccinate ASAP
Number of doses of COVID-19 vaccine needed.	0.88 (0.71–1.09)	1.78 (1.38–2.29)	0.48 (0.34–0.67)	1.48 (1.16–1.88)
COVID-19 vaccines are very safe.	9.08 (4.78–17.24)	14.74 (8.90–24.40)	0.03 (0.01–0.05)	0.25 (0.12–0.51)

^a OR = Odds Ratio; 95%CI = 95% Confidence Interval; response options for survey question assessing intention to receive vaccine against COVID-19 dichotomized as follows from: Definitely Get It ASAP, Probably Get It ASAP, Probably Get It But Not ASAP, Probably Not Get It, and Definitely Not Get It; “Likely to Vaccinate ASAP vs not” indicates responses of either Definitely Get It ASAP or Probably Get It ASAP compared to all other responses; “Likely to Vaccinate Eventually vs not” indicates responses of either Definitely Get It ASAP, Probably Get It ASAP, or Probably Get It But Not ASAP compared to all other responses; “Unlikely to Vaccinate vs Likely to Vaccinate ASAP” indicates responses of Definitely Not Get It compared to Definitely Get It ASAP or Probably Get It ASAP; “Uncertain vs Likely to Vaccinate ASAP” indicates responses of Probably Get It But Not ASAP or Probably Not Get It compared to Definitely Get It ASAP or Probably Get It ASAP; these dichotomous intention categories used as dependent variables in simple logistic regression analyses; boldface indicates statistical significance ($p < 0.05$); weighted according to survey weights to achieve national representativeness.

^b Summary scores created for each construct by quantifying and adding together the responses to the survey questions assessing each construct; most of these individual survey questions are not described in this table, and those that were chosen based on specific interest and denoted as such with footnotes; scales assessing constructs dichotomized above (“high”) and below (“low”) the median scale score.

^c Those who responded “Don’t know” or “Don’t care to answer” coded as missing, dichotomous variable created comparing “Yes” to “No”.

^d Cancer, chronic kidney disease, chronic lung disease, a heart conditions (such as heart failure, coronary artery disease, or cardiomyopathy), a weakened immune system (such as from an organ transplant, HIV, or from medicine you take), diabetes, obesity, sickle cell disease.

^e Likert scale response options (strongly agree, agree, disagree, strongly disagree) dichotomized to agree/disagree, results for agreement show.

^f Included in the construct summary score “Confidence in Vaccines”.

^g Included in the construct summary score “Trust in the Centers for Disease Control and Prevention (CDC)”.

^h Included in the construct summary score “Trust in Local and State Health Departments”.

ⁱ Importance scale response options (very important, important, not very important, not at all important) dichotomized to important/not important, results for importance shown.

0.63), have a bachelor’s degree or more compared to less than high school education (OR: 0.24; 95% CI 0.13–0.44), to have a high versus low income (OR: 0.46; 95% CI 0.28–0.74), and to be Democrats compared with Republicans (OR: 0.33; 95% CI 0.22–0.49).

The Unlikelies were less likely to think they will be infected with COVID-19 (OR: 0.59; 95% CI 0.41–0.85), discuss COVID-19 vaccine with their healthcare providers (OR: 0.04; 95% CI 0.02–0.06), perceive COVID-19 as severe (OR: 0.29; 95% CI 0.19–0.43), consider COVID-19 vaccine important to stop the spread of infection (OR < 0.01; 95% CI < 0.00–0.01), have received influenza vaccine in the past 12 months (OR: 0.10; 95% CI 0.06–0.14), and to usually or almost always report wearing a mask (OR: 0.16; 95% CI 0.10–0.25) compared with Intenders. The Unlikelies were also far less likely to support communitarianism (vs. individualism - OR: 0.12; 95% CI 0.08–0.18) and egalitarianism (vs. hierarchy - OR: 0.37; 95% CI 0.27–0.52), trust local/state (OR: 0.20; 95% CI 0.14–0.29) and federal (OR: 0.22; 95% CI 0.15–0.33) health authorities and be confident in vaccine safety (OR: 0.02; 95% CI 0.01–0.04) compared with Intenders.

6. Discussion

This nationally representative panel survey was conducted soon after there was widespread media attention of COVID-19 vaccine Phase 3 trial results that showed high efficacy, but prior to vaccine authorization. We found half of the adult US population intended to get a vaccine as soon as it was available for them. This segment of the population saw the value in vaccinating against COVID-19 (as they did for influenza vaccine), had favorable attitudes toward vaccines, relied on their healthcare provider for guidance, and trusted local, state and federal health authorities. Messages that reinforce the value of COVID-19 vaccination coupled with clear guidance on when they should get vaccinated and adequate access to the vaccine should support their vaccination decision-making regarding process.

A substantial proportion of US adults (40%) were uncertain when or if they will accept COVID-19 vaccines. While the size of the Wait and Learn group varied among demographic subgroups,

all subgroups, even the elderly, were represented. More than half of African Americans were classified as Wait and Learn, likely reflecting historical injustices and ongoing racism that make achieving high vaccine uptake among African Americans challenging. Our findings regarding differences in vaccine intent by race/ethnicity and political affiliation are consistent with other studies.^[31,32] The Wait and Learn population was also less likely to rely on their healthcare provider for COVID-19 vaccine information.

Additional factors contribute to uncertainty regarding vaccination in the Wait and Learn group. A leading factor was the need for more information with 53% endorsing waiting until vaccine has been safely given to millions of other people. Other factors influencing decision-making in this group included their experience with the pandemic, along with prior vaccination, and their values and worldviews. Lack of trust in local, state, and federal health authorities among many in the Wait and Learn population pose challenges for these public health agencies to impact the vaccination decision of this group.

Immunization programs can meet the immediate needs of the Intenders by making vaccines available and accessible; however, additional approaches will be needed to effectively meet the needs of the Wait and Learn population. Sharing information about the speed of vaccine development, the inclusion and experience of racial and ethnic minority populations in vaccine clinical trials, and side-effects of vaccination would address their needs. Because of low trust in healthcare providers and public health, other sources such as community leaders may be effective in amplifying these messages. Emphasizing equity in reaching those most vulnerable to COVID-19 and the value of vaccination as a step toward protecting the community would speak to those who hold egalitarian and communitarian worldviews.

Many survey respondents expressed interest in waiting until millions of others had been vaccinated; sharing the number and experience of people who have been vaccinated may be influential. This is a particularly important point, one that public health agencies need to be proactive about. In the absence of public health leadership, the disproportionately few people who believe they have experienced an adverse event following vaccination, whether

Table 7
Distribution of Race/Ethnicity by Other Sociodemographic Characteristics Among Those Uncertain in Their Vaccine Intentions (Wait and Learn).

Survey Questions/Responses	Total Sample, % ^a	Race/Ethnicity, % ^b				P ^c
		White (Non-Hispanic)	Black (Non-Hispanic)	Hispanic	Other (Non-Hispanic)	
All	–	34	32	5	30	
Sociodemographic Characteristics						
Gender						0.67
Female	55	53	56	57	59	
Male	45	47	44	43	41	
Age						<0.01
18–29	21	18	19	34	19	
30–44	27	23	28	31	37	
45–59	27	27	30	21	26	
≥60	26	32	22	14	18	
Education						<0.01
< High School	10	8	11	19	0	
High School	32	33	32	33	19	
Some College	29	28	29	29	38	
Bachelor or Higher	30	31	28	19	43	
Region						<0.01
Northeast	17	18	17	12	23	
Midwest	21	27	16	10	10	
South	39	38	61	38	9	
West	23	17	6	40	57	
Metropolitan Statistical Area Status						<0.01
Non-Metro	15	22	9	7	4	
Metro	85	78	91	93	96	
Household Income						<0.01
< \$50 K	30	30	38	34	13	
\$50–85 K	25	24	27	28	20	
\$85–150 K	28	29	23	26	33	
\$150 K+	17	16	12	12	33	
Current Employment Status						0.12
Working - as a paid employee	60	57	65	60	66	
Working - self-employed	6	5	5	10	3	
Not working - looking for work	6	6	8	7	3	
Not working - other	28	32	22	23	28	
Household Size						<0.01
1	19	18	24	15	15	
2	32	34	28	20	47	
3	19	21	19	17	16	
≥4	30	27	28	47	21	
Political Affiliation						<0.01
Republican	28	40	4	13	23	
Democrat	31	17	64	48	26	
Independent	30	32	19	27	36	
Something else	11	10	13	11	15	
Physical Health						<0.01
Excellent	9	8	9	10	10	
Very Good	36	36	35	38	42	
Good	40	42	41	37	33	
Fair	13	13	11	14	15	
Poor	1	1	3	2	0	

^a Column percentages (of those uncertain in their vaccine intentions), weighted according to survey weights to achieve national representativeness.

^b Column percentages (of race/ethnicity), weighted according to survey weights to achieve national representativeness.

^c P-value for the Pearson chi-squared proportion test at significance level of (α) 5%; boldface indicates statistical significance (p < 0.05).

it be something expected and uncomfortable like a sore arm or fever or a true adverse event, like anaphylaxis, will garner significant media attention, further perpetuating negative information and mistrust of vaccines. Public health leaders need to educate the public about expected post-vaccination symptoms and the rarity of serious adverse events. Successfully addressing the needs of the large Wait and Learn group, along with making vaccine available and easily accessible, are key foci for public health if levels of vaccination needed for community immunity are to be achieved.

While COVID-19 vaccination intention is, in part, affected by specific information about the COVID-19 vaccines, intention is also determined by values, culture and experiences. Cultural cognition

defines people’s approach to managing risk based on communitarian versus individual and egalitarian versus hierarchical worldviews.[23] We found respondents with communitarian and egalitarian worldviews significantly more likely to intend to receive COVID-19 vaccination as soon as they were able. While trust may be influenced by recent events it also is influenced by historical and ongoing experiences such as medical experimentation on members of African American communities and impacts of racism.[33,34] It will be important to acknowledge the role of trust in vaccine decision-making; enlist trusted voices to communicate within that community; and leveraging opportunities for public health and other community partners to demonstrate trust-

Table 8
Distribution of Race/Ethnicity by COVID-19 Disease and Vaccine Attitudes and Values Among Those Uncertain in Their Vaccine Intentions (Wait and Learn).

Survey Questions/Responses	Total Sample, % ^a	Race/Ethnicity, % ^b				P ^c
		White (Non-Hispanic)	Black (Non-Hispanic)	Hispanic	Other (Non-Hispanic)	
All	–	34	32	5	30	
Constructs						
<i>High Construct Score</i> ^d						
Confidence in Ability to Avoid COVID-19 Infection	32	24	47	42	33	<0.01
Support for Government Decision-Making (vs. Individual)	31	25	40	36	41	<0.01
Support for Equality (vs. Discrimination)	31	21	66	37	23	<0.01
Confidence in Vaccines	33	38	19	30	31	<0.01
Trust in the Centers for Disease Control and Prevention (CDC)	32	33	32	36	17	0.05
Trust in Local and State Health Departments	39	37	43	44	32	0.26
Affirmative Responses to Survey Questions						
<i>Responding “Yes”</i> ^e						
Have you been diagnosed with COVID-19?	5	6	3	7	2	0.12
Do you have any immediate family members (spouse, sibling, parent or child) who were diagnosed with COVID-19?	17	16	16	22	13	0.31
Do you have any other relatives (not immediate family) who were diagnosed with COVID-19?	33	29	40	45	22	<0.01
Do you have any friends, acquaintances or co-workers who have been diagnosed with COVID-19?	63	64	60	72	50	0.05
Do you personally know anybody who has been hospitalized or died from COVID-19?	35	30	46	42	37	0.01
Have you been diagnosed with any of the following health conditions? ^f	21	23	24	15	15	0.13
Have you or anyone you know ever had a serious reaction to a vaccine?	12	12	8	10	17	0.33
During the past 12 months, have you had a flu shot?	44	44	43	36	57	0.06
<i>Responding “Somewhat Likely”, “Likely” or “Very Likely”</i>						
How likely do you think it is that you will be infected with COVID-19 over the next year?	38	40	31	46	22	<0.01
How likely are you to discuss COVID-19 vaccine with your healthcare provider?	68	65	74	76	63	0.08
<i>Responding “Somewhat Severe” or “Very Severe”</i>						
If you become infected with COVID-19, how severe do you think the infection will be?	29	29	29	30	30	0.59
<i>Responding “Important” or “Very Important”</i>						
How important do you think a COVID-19 vaccine is to stop the spread of infection in the US?	86	83	92	89	88	0.11
<i>Responding “Somewhat Good” or “Very Good”</i>						
How good do you think current drugs are in treating COVID-19?	69	71	67	68	61	0.35
<i>Responding “Usually” or “Almost Always”</i>						
How often do you wear a mask when you are not at home and may come in contact with other people?	87	84	93	92	90	0.06
<i>Responding “Agree” or “Strongly Agree”</i> ^g						
I worry about the government requiring personal information (name, address, phone number, insurance card) in order to get a COVID-19 vaccine.	45	45	42	52	33	0.13
I am confident in the safety of vaccines. ^h	51	55	39	52	45	0.03
I do not trust a vaccine unless it has already been safely given to millions of other people. ^h	76	71	85	84	80	<0.01
I am concerned about some of the ingredients in vaccines. ^h	73	71	75	76	74	0.72
Vaccine recommendations from the Centers for Disease Control and Prevention (CDC) are a good fit for me. ^h	60	59	56	64	62	0.62
I am concerned that the government and drug companies experiment on people like me. ^h	61	54	75	69	67	<0.01
The benefits of vaccines are much bigger than their risks. ^h	70	72	65	70	69	0.462
The CDC accurately informs the public of both health risks and benefits of medicines. ⁱ	64	63	69	71	54	0.12
Local and state health departments accurately inform the public of both health risks and benefits of medicines. ^j	59	57	66	69	47	0.02
Importance in decision whether to take a COVID-19 vaccine ^k						
<i>Responding “Somewhat Important” or “Very Important”</i>						
Rates of COVID-19 infection in my community.	79	76	85	84	74	0.07
How serious COVID-19 is for people like me.	82	78	89	90	82	0.02
Effectiveness of drugs to treat COVID-19.	91	88	96	94	92	0.09
Effectiveness of the COVID-19 vaccine.	94	92	96	94	96	0.49
Number of doses of COVID-19 vaccine needed.	77	73	87	85	74	<0.01
COVID-19 vaccines are very safe.	95	94	97	96	96	0.67

^a Column percentages (of those uncertain in their vaccine intentions), weighted according to survey weights to achieve national representativeness.
^b Column percentages (of race/ethnicity), weighted according to survey weights to achieve national representativeness.
^c P-value for the Pearson chi-squared proportion test at significance level of (α) 5%; boldface indicates statistical significance (p < 0.05).
^d Summary scores created for each construct by quantifying and adding together the responses to the survey questions assessing each construct; most of these individual survey questions are not described in this table, and those that were chosen based on specific interest and denoted as such with footnotes; scales assessing constructs dichotomized above (“high”) and below (“low”) the median scale score.
^e Those who responded “Don’t know” or “Don’t care to answer” coded as missing, dichotomous variable created comparing “Yes” to “No”.
^f Cancer, chronic kidney disease, chronic lung disease, a heart conditions (such as heart failure, coronary artery disease, or cardiomyopathy), a weakened immune system (such as from an organ transplant, HIV, or from medicine you take), diabetes, obesity, sickle cell disease.
^g Likert scale response options (strongly agree, agree, disagree, strongly disagree) dichotomized to agree/disagree, results for agreement show.
^h Included in the construct summary score “Confidence in Vaccines”.
ⁱ Included in the construct summary score “Trust in the Centers for Disease Control and Prevention (CDC)”.
^j Included in the construct summary score “Trust in Local and State Health Departments”.
^k Importance scale response options (very important, important, not very important, not at all important) dichotomized to important/not important, results for importance shown.

worthiness through expertise, consistency, and positive relationships.[35] For example, having public health and knowledgeable community partners available to share information and discuss trade-offs and consequences of vaccination with the Wait and Learn group would serve to provide information *and* build trust.

A minority of the population (10%) report having already made up their mind to not vaccinate. While some Unlikelysts may eventually choose to get vaccinated, their attitudes, beliefs and experiences make them unlikely to change their mind. Therefore, public health efforts are presently better focused on supporting the needs of the Intenders and the Wait and Learn group than on Unlikelysts who have made their decisions and are unlikely to change, even if additional information about COVID-19 vaccines becomes available. Due to low levels of trust, medical and public health personnel may have a difficult time effectively communicating with them without laying the groundwork over time. Easy access to vaccination will be unlikely to impact their vaccine decision-making.

Finally, a word of caution is also in order as it pertains to how media portrayals of Wait and Learn and Unlikely can have deleterious effects. Recently, a number of stories in the mass media have focused on people who mistrust vaccines and have refused to get vaccinated,[36,37] including those who work in the healthcare sector.[38,39] Attention to the Wait and Learn and Unlikely groups may lead people to believe that attitudes opposed to vaccination are widespread and that if these are shared in the media, they may have an adverse effect on people choosing to get vaccinated.

The biggest limitation of this study is that it provides a snapshot at a single point in time. However, we fielded the survey after widespread publicity suggested high levels of efficacy (~95%) of the Pfizer BioNTech and Moderna vaccines and their favorable safety profile, with subsequent EUA in December 2020.[1,2] We were not able to examine changes that might have occurred during the two weeks of survey administration. We are planning additional serial, cross-sectional surveys using the same mechanism and many of the same questions as the vaccine is rolled out more broadly to the general population. This paper provides baseline data that aims to rapidly inform the medical and public health community of the existing landscape and measure changes over time as the COVID-19 vaccine program is implemented.

Since the time of this survey, public attitudes and intentions may have shifted. The EUA has included the Vaccine Related Biological Product Advisory Committee (VRBPAC) of the FDA which included sharing of detailed clinical trial data and public review of all data by independent, non-governmental experts.[40] The Advisory Committee on Immunization Practices (ACIP) of the CDC made vaccine recommendations regarding who should get which vaccines, also by independent, non-governmental experts through public deliberations.[41] The transparency of these processes may assist in overcoming perceptions that the vaccine has been rushed to market, demonstrate trustworthiness of federal agencies responsible for vaccination authorization and recommendations, and may be impactful for vaccine hesitant members of the public. Additionally, millions of doses of vaccine have been administered.[42]

Despite a large amount of publicly available survey data around COVID-19 vaccine intentions, most have not undergone peer review and are of variable quality in terms of internal and external validity. Additionally, comparisons of COVID-19 vaccine intentions between surveys has been limited by differences in study methodologies, the manner in which questions have been asked and the timing of the surveys. Strengths of our work include the following features: 1) quality of the Ipsos panel as a well-established, probability-based panel; 2) the oversampling of racial and ethnic minorities to increase the precision in estimates for the subgroups; and 3) how we formulated our questions and analyses.

Of particular strength was our ability to capture and characterize the Wait and Learn group by including persons who would probably get vaccinated after seeing others do so, a group missed by many other panel surveys.

The rapidly changing COVID-19 vaccine environment is coupled with a transition of presidential administrations. Many anticipate this change in administration may afford CDC the opportunity to demonstrate their competence and trustworthiness to the public. Similarly, state and local public health authorities have started receiving additional resources to implement COVID-19 vaccination efforts. This may afford an opportunity for local and state health departments, in close collaboration and coordination with CDC, to improve their capacity for working within their communities around COVID-19 vaccination. Given that the success of COVID-19 vaccine programs to control the pandemic is dependent on widespread vaccine acceptance, it is essential to characterize COVID-19 vaccine attitudes and intentions among subpopulations. Additionally, ascertaining values and trust in local, state, and federal public health authorities that impact vaccine decision-making are critical for developing and implementing programs that can improve informed decision-making and ultimately increase acceptance of COVID-19.

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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References

- [1] Food and Drug Administration, FDA Takes Key Action in Fight Against COVID-19 By Issuing Emergency Use Authorization for First COVID-19 Vaccine; 2020.
- [2] Food and Drug Administration, FDA Takes Additional Action in Fight Against COVID-19 By Issuing Emergency Use Authorization for Second COVID-19 Vaccine; 2020.
- [3] U.S. Department of Health and Human Services. From the Factory to the Frontlines: The Operation Warp Speed Strategy for Distributing a COVID-19 Vaccine; 2020 [cited 2020 November 19]; Available from: <https://www.hhs.gov/sites/default/files/strategy-for-distributing-covid-19-vaccine.pdf>.
- [4] Fontanet A, Cauchemez S. COVID-19 herd immunity: where are we?. *Nat Rev Immunol* 2020 Oct;20(10):583–4.
- [5] Salmon D, Opel DJ, Dudley MZ, Brewer J, Breiman R. Reflections On Governance, Communication, And Equity: Challenges And Opportunities In COVID-19 Vaccination. *Health Aff (Millwood)* 2021. Feb 4:101377h1thaff202002254.
- [6] Feikin DR, Lezotte DC, Hamman RF, Salmon DA, Chen RT, Hoffman RE. Individual and community risks of measles and pertussis associated with personal exemptions to immunization. *JAMA* 2000 Dec 27;284(24):3145–50. <https://doi.org/10.1001/jama.284.24.3145>. PMID: 11135778.
- [7] Atwell JE, Van Otterloo J, Zipprich J, Winter K, Harriman K, Salmon DA, et al. Nonmedical vaccine exemptions and pertussis in California, 2010. *Pediatrics* 2013;132:624–30.
- [8] Omer SB, Pan WK, Halsey NA, Stokley S, Moulton LH, Navar AM, et al. Nonmedical exemptions to school immunization requirements: secular trends and association of state policies with pertussis incidence. *JAMA* 2006;296:1757–63.
- [9] Salmon D, Opel DJ, Dudley MZ, Brewer J, Breiman R. Reflections On Governance, Communication, And Equity: Challenges And Opportunities In COVID-19 Vaccination. *Health Aff (Millwood)* 2021 Mar;40(3):419–25. <https://doi.org/10.1377/hlthaff.2020.02254>. Epub 2021 Feb 4 PMID: 33539178.
- [10] Niepel C, Kranz D, Borgonovi F, Emslander V, Greiff S. The coronavirus (COVID-19) fatality risk perception of US adult residents in March and April 2020. *Br J Health Psychol*. 2020 Nov;25(4):883–888. doi: 10.1111/bjhp.12438. Epub 2020 Jun 10. PMID: 32519364; PMCID: PMC7300951.
- [11] Kupferschmidt K, Cohen J. In FDA's green light for treating COVID-19 with plasma, critics see thin evidence—and politics. 2020 August 24, 2020 [cited 2020 November 19]; Available from: <https://www.sciencemag.org/news/2020/08/fda-s-green-light-treating-covid-19-plasma-critics-see-thin-evidence-and-politics>.

- [12] Diamond D. Trump officials interfered with CDC reports on Covid-19. 2020 September 11, 2020 [cited 2020 November 19]; Available from: <https://www.politico.com/news/2020/09/11/exclusive-trump-officials-interfered-with-cdc-reports-on-covid-19-412809?nname=playbook&nid=0000014f-1646-d88f-a1cf-5f46b7bd0000&nrid=00000164-80ed-d782-af64-f2ff034c0000&nlid=630318>.
- [13] Bokemper SE, Huber GA, Gerber AS, James EK, Omer SB. Timing of COVID-19 vaccine approval and endorsement by public figures. *Vaccine*. 2020 Dec 16;39(5):825–9. doi: 10.1016/j.vaccine.2020.12.048. Epub ahead of print. PMID: 33390295; PMCID: PMC7744009.
- [14] Silverman E. Poll: Most Americans believe the Covid-19 vaccine approval process is driven by politics, not science. 2020 August 21, 2020 [cited 2021 January 10, 2021]; Available from: <https://www.statnews.com/pharmalot/2020/08/31/most-americans-believe-the-covid-19-vaccine-approval-process-is-driven-by-politics-not-science/>.
- [15] Funk C, Tyson A. Intent to Get a COVID-19 Vaccine Rises to 60% as Confidence in Research and Development Process Increases. 2020 December 3, 2020 [cited 2021 January 6]; Available from: <https://www.pewresearch.org/science/2020/12/03/intent-to-get-a-covid-19-vaccine-rises-to-60-as-confidence-in-research-and-development-process-increases/>.
- [16] Brennan, M. Willingness to Get COVID-19 Vaccine Ticks Up to 63% in U.S. 2020 December 8, 2020 [cited 2021 January 6]; Available from: <https://news.gallup.com/poll/327425/willingness-covid-vaccine-ticks.aspx>.
- [17] Hamel L, Kirzinger A, Muñana C, Brodie M. KFF COVID-19 Vaccine Monitor: December 2020. 2020, Kaiser Family Foundation [cited 2021 January 22]; Available from: <https://www.kff.org/coronavirus-covid-19/report/kff-covid-19-vaccine-monitor-december-2020/>.
- [18] Head KJ, Kasting ML, Sturm LA, Hartsock JA, Zimet GD. A National Survey Assessing SARS-CoV-2 Vaccination Intentions: Implications for Future Public Health Communication Efforts. *Sci Commun* 2020;42(5):698–723. <https://doi.org/10.1177/1075547020960463>.
- [19] Fisher KA, Bloomstone SJ, Walder J, Crawford S, Fouayzi H, Mazor KM. Attitudes Toward a Potential SARS-CoV-2 Vaccine : A Survey of U.S. Adults. *Ann Intern Med*. 2020 Dec 15;173(12):964–973. doi: 10.7326/M20-3569. Epub 2020 Sep 4. PMID: 32886525; PMCID: PMC7505019.
- [20] Malik AA, McFadden SM, Elharake J, Omer SB. Determinants of COVID-19 vaccine acceptance in the US. *EClinicalMedicine*. 2020 Sep;26:100495. doi: 10.1016/j.eclinm.2020.100495. Epub 2020 Aug 12. PMID: 32838242; PMCID: PMC7423333.
- [21] Reinhart R. More Americans Now Willing to Get COVID-19 Vaccine. 2020 November 17, 2020 [cited 2021 January 6]; Available from: <https://news.gallup.com/poll/325208/americans-willing-covid-vaccine.aspx>.
- [22] Ipsos. Public Opinion on the COVID-19 pandemic [29th December]. 2021 December 29, 2020 [cited 2021 January 10, 2021]; Available from: <https://www.ipsos.com/en/public-opinion-covid-19-outbreak>.
- [23] Anaki D, Sergay J. Predicting health behavior in response to the coronavirus disease (COVID-19): Worldwide survey results from early March 2020. *PLoS ONE* 2021 Jan 7;16(1):. <https://doi.org/10.1371/journal.pone.0244534>. PMID: 33411827; PMCID: PMC7790278e0244534.
- [24] Lin C, Tu P, Beitsch LM. Confidence and Receptivity for COVID-19 Vaccines: A Rapid Systematic Review. *Vaccines (Basel)* 2020 Dec 30;9(1):E16. <https://doi.org/10.3390/vaccines9010016>. PMID: 33396832.
- [25] Ipsos. KnowledgePanel. 2021 [cited 2021 January 20]; Available from: <https://www.ipsos.com/en-us/solutions/public-affairs/knowledgepanel>.
- [26] Kumar S, Quinn SC, Kim KH, Musa D, Hilyard KM, Freimuth VS. The social ecological model as a framework for determinants of 2009 H1N1 influenza vaccine uptake in the United States. *Health Ed Behavior: Off Publ Soc Public Health Ed* 2012;39(2):229–43.
- [27] Kahan DM. Cultural Cognition as a Conception of the Cultural Theory of Risk. In: Roeser S, Hillerbrand R, Sandin P, Peterson M, editors. *Handbook of Risk Theory*. Dordrecht: Springer; 2012. https://dpo.org/10.1007/978-94-007-1433-5_28.
- [28] United States Census Bureau. Current Population Survey (CPS). 2021 [cited 2021 January 20]; Available from: <https://www.census.gov/programs-surveys/cps.html>.
- [29] United States Census Bureau. American Community Survey (ACS). 2021 [cited 2021 January 20]; Available from: <https://www.census.gov/programs-surveys/acs/>.
- [30] StataCorp LLC. STATA. 2021 [cited 2021 January 20]; Available from: <https://www.stata.com/>.
- [31] Kreps S, Prasad S, Brownstein JS, et al. Factors Associated With US Adults' Likelihood of Accepting COVID-19 Vaccination. *JAMA Netw Open* 2020;3(10):. <https://doi.org/10.1001/jamanetworkopen.2020.25594>e2025594.
- [32] Largent EA, Persad G, Sanganito S, Glickman A, Boyle C, Emanuel EJ. US Public Attitudes Toward COVID-19 Vaccine Mandates. *JAMA Netw Open* 2020;3(12):. <https://doi.org/10.1001/jamanetworkopen.2020.33324>e2033324.
- [33] Gamble VN. Under the shadow of Tuskegee: African Americans and health care. *Am J Public Health* 1997 Nov;87(11):1773–8. <https://doi.org/10.2105/ajph.87.11.1773>. PMID: 9366634; PMCID: PMC1381160.
- [34] Brandon DT, Isaac LA, LaVeist TA. The legacy of Tuskegee and trust in medical care: is Tuskegee responsible for race differences in mistrust of medical care? *J Natl Med Assoc*. 2005 Jul;97(7):951–6. PMID: 16080664; PMCID: PMC2569322.
- [35] Zenger J, Folkman J. The 3 Elements of Trust Available from. *Harvard Business Review* 2019 February 5. <https://hbr.org/2019/02/the-3-elements-of-trust>.
- [36] Kluger J. Too many Americans still mistrust the COVID-19 vaccines. *Here's Why Time* 2021.
- [37] Hoffman J. Mistrust of a coronavirus vaccine could imperil widespread immunity. *The NY Times* 2020.
- [38] Hopkins CD, Valentine A. Some Health Care Workers Are Hesitant About Getting COVID-19 Vaccines. 2021 January 1 [cited 2021 January 20]; Available from: <https://www.npr.org/2021/01/01/952716705/some-health-care-workers-are-hesitant-about-getting-covid-19-vaccines>.
- [39] Shaw J, Stewart T, Anderson KB, Hanley S, Thomas SJ, Salmon DA, Morley C. Assessment of U.S. health care personnel (HCP) attitudes towards COVID-19 vaccination in a large university health care system. *Clin Infect Dis*. 2021 Jan 25;ciab054. doi: 10.1093/cid/ciab054. Epub ahead of print. PMID: 33491049.
- [40] U.S. Department of Health and Human Services, Food and Drug Administration, and Center for Biologics Evaluation and Research. Emergency Use Authorization for Vaccines to Prevent COVID-19: Guidance for Industry. 2020 October 2020; Available from: <https://www.fda.gov/media/142749/download>.
- [41] Dooling K, Marin M, Wallace M, et al. The Advisory Committee on Immunization Practices' Updated Interim Recommendation for Allocation of COVID-19 Vaccine — United States, December 2020. *MMWR Morb Mortal Wkly Rep* 2021;69:1657–60. <http://dx.doi.org/10.15585/mmwr.mm69s152e2external-1con>.
- [42] CDC. COVID Data Tracker: COVID-19 Vaccinations in the United States <https://covid.cdc.gov/covid-data-tracker/#vaccinations> [accessed March 1, 2021].