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Deliberation, Dissent, and Distrust: Understanding Distinct Drivers of Coronavirus Disease 2019 Vaccine Hesitancy in the United States

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Background. Despite the availability of safe and efficacious coronavirus disease 2019 vaccines, a significant proportion of the American public remains unvaccinated and does not appear to be immediately interested in receiving the vaccine.

Methods. In this study, we analyzed data from the US Census Bureau's Household Pulse Survey, a biweekly cross-sectional survey of US households. We estimated the prevalence of vaccine hesitancy across states and nationally and assessed the predictors of vaccine hesitancy and vaccine rejection. In addition, we examined the underlying reasons for vaccine hesitancy, grouped into thematic categories.

Results. A total of 459 235 participants were surveyed from 6 January to 29 March 2021. While vaccine uptake increased from 7.7% to 47%, vaccine hesitancy rates remained relatively fixed: overall, 10.2% reported that they would *probably* not get a vaccine and 8.2% that they would *definitely* not get a vaccine. Income, education, and state political leaning strongly predicted vaccine hesitancy. However, while both female sex and black race were factors predicting hesitancy, among those who were hesitant, these same characteristics predicted vaccine reluctance rather than rejection. Those who expressed reluctance invoked mostly "deliberative" reasons, while those who rejected the vaccine were also likely to invoke reasons of "dissent" or "distrust."

Conclusions. Vaccine hesitancy comprises a sizable proportion of the population and is large enough to threaten achieving herd immunity. Distinct subgroups of hesitancy have distinctive sociodemographic associations as well as cognitive and affective predilections. Segmented public health solutions are needed to target interventions and optimize vaccine uptake.

Keywords. COVID-19; COVID-19 vaccine; vaccine hesitancy.

Vaccines against coronavirus disease 2019 (COVID-19) have rightfully been hailed as a remarkable scientific feat. Results from randomized control trials and real-world evidence demonstrate vaccines are highly efficacious at preventing severe disease and death, reducing transmission, and causing few adverse events [1–3]. Yet the arrival of new vaccines must confront an old problem: efficacious interventions—even when affordable and available—may have limited uptake despite proven benefit [4, 5]. Indeed, a substantial fraction of the American public does not appear immediately interested in receiving a COVID-19 vaccine, which has been referred to as *vaccine hesitancy* [6–8]. Vaccine hesitancy has long preceded the COVID-19 pandemic, with notable challenges to the uptake of vaccines for influenza, human papillomavirus, polio, and childhood illnesses such as measles, among other diseases [9–12]. Moreover, vaccine hesitancy and the public health responses to it have been long-standing areas of inquiry, and several frameworks have been developed to evaluate this phenomenon, including the widely used 4C model [13], the health belief model [14, 15], and moral foundations theory [16]. COVID-19 vaccine hesitancy, while posing some new problems, also bears resemblance to these older challenges. Public health authorities and healthcare practitioners must therefore turn urgent attention to understanding the perceptions, perspectives, and attitudes that underlie vaccine hesitancy in order to meet the public where they are. Surfacing differences in the intensities, nature, and reasons for vaccine hesitancy—and how these views vary over time and across sociodemographic groups—is imperative to designing effective public health strategies.

To date, much quantitative research on hesitation has tended to group all individuals expressing some aversion to COVID-19 vaccination together [17], yet significant heterogeneity is likely to exist [8]. First, hesitators may be simply individuals who in Rogers' "diffusion of innovations" theory tend to wait to see how things work out before adopting an innovation [18, 19]. On the other hand, a subgroup of hesitators may have more firmly formulated and fixed categorial rejection of the vaccine. In addition, existing reports have focused on sociodemographic correlates of hesitation (eg, sex and race) rather than particular reasons for not wanting

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the vaccine [17, 20]. An accounting of reasons for hesitancy can further elucidate different drivers [21]. Recent observers have noted that deliberation (indicating weighing countervailing considerations or doubts), distrust of the vaccine (expressing cynicism or suspicion toward the government or medical establishment), and dissent (drawing from categorial beliefs against vaccination) provide important subgroups within hesitators that may offer a more complete picture of the hesitancy viewpoint [22]. These categories share similarities with prior vaccine hesitancy frameworks.

In the current study, we analyze survey data from the US Census Bureau, which ascertains the social, economic, and health impacts of COVID-19 on a representative sample of the American public [23]. In the United States, vaccination was initially freely available to healthcare workers and elderly individuals as early as January 2021, and then to the public in March and April 2021. We use this publicly available data to test 3 interlinked hypotheses. First, we examine the hypothesis that vaccine hesitancy varies markedly across identifiable geographic, political, and sociodemographic groups, an observation that would underscore the importance of a segmented public health approach for optimal vaccine implementation. Second, we hypothesize that vaccine uptake to date is largely occurring in individuals who express they are probably going to get the vaccine, but that a relatively stable proportion of the population remains unconvinced and steadfast in their intention to probably or definitely *not* receive a vaccine. Third, we examine whether reasons for vaccine hesitancy differ between those with varying intensities of hesitancy. We also explore whether these associations have changed over time.

METHODS

Study Population and Sample

This study uses data from the US Census Bureau's Household Pulse Survey (HPS), a biweekly cross-sectional survey of US households measuring the social, economic, and health impacts of COVID-19. The HPS produces representative estimates at the national and state levels. Sampling was drawn from the Census Bureau Master Address File and the Census Bureau Contract Frame, containing approximately 140 million housing units with matched phone or email contacts. Households were contacted by email and/or text message, and data were collected via online survey. Survey weights were created by adjusting sampling base weights for nonresponse, undercoverage, persons within a household, and finally, by an iterative raking procedure, to match state demographics by sex, age, education, and race [23]. We used data from 6 consecutive HPS survey

Table 1. Classification Scheme for Vaccine Hesitancy

Reason	Deliberation (Expression of a Countervailing Consideration)	Dissent (Categorical Rejection Based on a More General Principle)	Distrust (Concern About the Motives of the Actor Promoting or Distributing Vaccines)	Other
1. Possible side effects	✓			
2. Don't know if a vaccine will work	✓			
3. Don't believe I need it (answer subset detailed below)				
4. Don't like vaccines		✓		
5. Doctor has not recommended it	✓			
6. Plan to wait and see if it is safe	✓			
7. Other people need it more right now	✓			
8. Concerned about the cost	✓			
9. Don't trust the COVID-19 vaccine			✓	
10. Don't trust the government			✓	
11. Other reasons				✓
Why don't you believe you need the COVID-19 vaccine?				
1. I already had COVID-19	✓			
2. I am not a member of a high-risk group	✓			
3. I plan to use masks or other precautions instead	✓			
4. I don't believe COVID-19 is a serious illness		✓		
5. I don't think vaccines are beneficial		✓		
6. Other				✓
7. Unspecified				✓

Abbreviation: COVID-19, coronavirus disease 2019.

Table 2. Characteristics of Survey Population, January–March 2021

Characteristic (N = 459 235)	Survey Respondents, No.	Survey Weighted Proportion (95% CI), %
Age, y		
18–24	13 161	9.2 (9.0–9.4)
25–39	86 562	26.4 (26.2–26.6)
40–54	123 932	25.3 (25.1–25.4)
55–64	93 837	17.4 (17.3–17.5)
≥65	141 743	21.7 (21.7–21.8)
Sex		
Female	274 798	51.6 (51.6–51.6)
Male	184 437	48.4 (48.4–48.4)
Race/ethnicity		
Black (alone)	35 463	12.4 (12.3–12.5)
White (alone)	379 059	76.0 (75.9–76.1)
Asian (alone)	23 321	5.8 (5.7–5.9)
≥2 Races + other (alone)	21 392	5.8 (5.7–5.9)
Hispanic or Latino (of any race)	44 303	17.1 (17.0–17.2)
Not Hispanic or Latino	414 932	82.9 (82.8–83.0)
Education		
High school or less	62 992	39.2 (39.2–39.2)
Some college or associate's degree	148 370	30.5 (30.5–30.5)
Bachelor's degree or higher	247 873	30.3 (30.3–30.3)
Marital status		
Married	268 145	55.3 (55.0–55.6)
Not married	186 088	44.7 (44.4–45.0)
Household income, $[a]		
<25 000	34 871	14.6 (14.3–14.8)
25 000–34 999	30 141	11.1 (11.0–11.4)
35 000–49.999	38 914	12.9 (12.7–13.1)
50 000–74 999	62 984	18.2 (17.9–18.4)
75 000–99 999	51 380	13.1 (12.9–13.4)
100 000–149 999	64 390	15.2 (15.0–15.4)
150 000–199 999	31 649	7.0 (6.9–7.1)
≥200 000	37 497	7.8 (7.7–8.0
Political affinity (state level)		
Democratic leaning	266 710	57.5 (57.5–57.5)
Republican leaning	192 525	42.5 (42.5–42.5)
Survey period		
6–18 January	68 348	16.7 (16.7–16.7)
20 January to 1 February	80 567	16.7 (16.7–16.7)
3–15 February	77 122	16.7 (16.7–16.7)
17 February to 1 March	77 788	16.7 (16.7–16.7)
3–15 March	78 306	16.7 (16.7–16.7)
17–29 March	77 104	16.7 (16.7–16.7)

Abbreviation: CI, confidence interval.
[a]Income data were missing in 23.4%; the denominator is 351 826 participants.

periods beginning with the period from week 22 (6–18 January 2021) through week 27 (17–29 March 2021), which were the first HPS surveys to incorporate questions about COVID-19 vaccine intention, corresponding with the initial availability of the vaccines in the United States. The survey does not specify a manufacturer or type of vaccine for COVID-19.

Measurements and Outcomes

The Household Pulse Survey asks participants whether they had received a COVID-19 vaccine, and, if not, whether they planned on getting a vaccine, with 4 possible responses: "definitely get a vaccine," "probably get a vaccine," "probably NOT get a vaccine," and "definitely NOT get a vaccine." Those who responded "probably get," "probably NOT get," or "definitely NOT get" were asked to select among a list of 11 reasons to explain their vaccine intention. Participants could select as many reasons as they wanted. Those who selected the reason "I don't believe I need a COVID-19 vaccine" were asked to select from 6 specific reasons why they do not believe they need a vaccine. We considered those who responded that they would "probably

Table 3. Survey-Weighted Proportions of Vaccine Uptake and Intention by Respondent Characteristics

Characteristic	Survey-Weighted Proportion by Vaccine Uptake or Intention (95% CI)					χ^2 Test Result (Pearson)
	Already Received a Vaccine	Definitely Get a Vaccine	Probably Get a Vaccine	Probably NOT Get a Vaccine	Definitely NOT Get a Vaccine	
Overall	24.6 (24.5–24.8)	39.4 (39.1–39.7)	17.5 (17.3–17.7)	10.2 (10.0–10.4)	8.2 (8.1–8.4)	…
Age, y						
18–24	9.7 (9.0–10.4)	43.0 (41.5–44.4)	24.9 (23.7–26.1)	12.9 (12.0–13.9)	9.5 (8.8–10.4)	4.26×10^4
25–39	17.1 (16.8–17.4)	37.4 (36.9–37.9)	20.3 (19.8–20.8)	13.7 (13.3–14.1)	11.5 (11.1–11.9)	
40–54	20.2 (19.9–20.6)	38.3 (37.8–38.8)	19.9 (19.5–20.3)	11.8 (11.5–12.2)	9.8 (9.4–10.2)	
55–64	24.3 (23.8–24.8)	44.5 (43.9–45.1)	16.7 (16.3–17.1)	8.3 (7.9–8.6)	6.2 (5.9–6.6)	
≥65	45.4 (44.9–45.9)	37.6 (37.1–38.0)	9.0 (8.6–9.4)	4.5 (4.2–4.8)	3.5 (3.3–3.8)	
Sex						
Female	27.1 (26.8–27.3)	36.2 (35.9–36.6)	17.5 (17.2–17.7)	11.0 (10.7–11.3)	8.2 (8.0–8.4)	2.73×10^3
Male	22.0 (21.7–22.3)	42.8 (42.3–43.2)	17.6 (17.2–17.9)	9.4 (9.1–9.7)	8.3 (8.0–8.6)	
Race/ethnicity						
Black (alone)	20.6 (20.0–21.1)	29.9 (29.1–30.8)	23.8 (23.0–24.6)	14.8 (14.1–15.5)	11.0 (10.4–11.6)	9.57×10^3
White (alone)	25.4 (25.2–25.6)	40.6 (40.2–40.9)	16.4 (16.1–167)	9.7 (9.5–10.0)	7.9 (7.7–8.1)	
Asian (alone)	29.2 (28.3–30.1)	48.0 (468–49.2)	16.4 (15.5–17.3)	4.2 (3.7–4.6)	2.2 (1.8–2.8)	
≥2 Races + other (alone)	18.5 (17.7–19.3)	35.4 (34.0–36.9)	20.0 (18.9–21.2)	12.8 (11.9–13.7)	13.2 (12.2–14.4)	
Hispanic or Latino (of any race)	18.9 (18.3–19.5)	41.9 (41.1–42.7)	22.7 (22.0–23.5)	9.4 (8.8–9.9)	7.1 (6.6–7.7)	3.08×10^3
Not Hispanic or Latino	25.8 (25.6–26.0)	38.9 (38.6–39.2)	16.4 (16.2–16.7)	10.4 (10.2–10.6)	8.5 (8.3–8.7)	
Education						
High school or less	18.8 (18.4 -19.2)	36.1 (35.5–36.6)	21.1 (20.7–21.5)	12.5 (12.1–12.9)	11.6 (11.2–12.0)	2.23×10^4
Some college or associate's degree	23.1 (22.9–23.4)	38.1 (37.6–38.6)	18.7 (18.3–19.2)	11.4 (11.2–11.7)	8.6 (8.4–8.8)	
Bachelor's degree or higher	33.6 (33.4–33.9)	45.0 (44.7–45.3)	11.7 (11.5–11.9)	6.0 (5.9–62)	3.6 (3.5–3.8)	
Marital status						
Married	28.5 (28.2–28.7)	39.8 (39.5–40.1)	15.7 (15.4–15.9)	8.9 (8.7–9.1)	7.1 (6.9–7.3)	6.23×10^3
Not married	19.8 (19.5–20.2)	39.0 (38.5–39.5)	19.8 (19.4–20.2)	11.8 (11.5–12.2)	9.6 (9.3–9.9)	
Household income, $						
<25 000	15.4 (14.6 -16.2)	36.9 (36.1–37.7)	21.8 (21.1–22.6)	13.6 (13.0–14.3)	12.3 (11.6–13.0)	1.37×10^4
25 000–34 999	20.3 (19.6–21.2)	37.5 (36.5–38.5)	20.8 (19.8–21.9)	11.7 (11.0–12.5)	9.6 (8.9–10.3)	
35 000–49.999	22.6 (22.0–23.2)	38.6 (37.6–39.6)	19.4 (18.6–20.2)	10.8 (10.2 -11.4)	8.6 (8.0–9.2)	
50 000–74 999	26.1 (25.4–26.8)	39.5 (38.7–40.2)	17.3 (16.8–17.8)	10.0 (9.4–10.6)	7.1 (6.8–7.5)	
75 000–99 999	27.7 (26.9–28.5)	39.9 (39.1–40.7)	15.5 (14.9–16.3)	9.6 (9.0–10.3)	7.3 (6.8- 7.8)	
100 000–149 999	29.4 (28.8–30.0)	43.0 (42.4–43.6)	13.9 (13.4–14.4)	8.2 (7.8–8.7)	5.4 (5.0–5.8)	
150 000–199 999	32.0 (31.0–32.9)	46.1 (45.0 -47.2)	11.6 (10.9–12.4)	6.2 (5.6–6.8)	4.1 (3.6–4.8)	
≥200 000	33.0 (32.2–33.8)	50.3 (49.4–51.3)	8.8 (8.3–9.4)	4.1 (3.8–4.4)	3.8 (3.2–4.6)	
Political affinity (state level)						
Democratic leaning	24.6 (24.4–24.9)	42.7 (42.3–43.1)	16.9 (16.7–17.2)	8.9 (8.6–9.2)	6.9 (6.6–7.1)	4.34×10^3
Republican leaning	24.6 (24.4–24.9)	34.9 (34.5–35.4)	18.3 (17.9–18.7)	12.0 (11.7–12.3)	10.1 (9.8–10.4)	
Survey period						
6–18 January	7.7 (7.5–8.0)	47.0 (46.4–47.7)	23.6 (23.0–24.2)	12.9 (12.3–13.4)	8.8 (8.4–9.3)	4.37×10^4
20 January to 1 February	13.2 (12.8–13.6)	47.6 (46.8–48.4)	19.8 (19.3–20.4)	10.9 (10.4–11.3)	8.5 (8.2–8.9)	
3–15 February	19.9 (19.5–20.4)	43.6 (43.0–44.2)	18.3 (17.6–18.9)	10.2 (9.9–10.6)	8.0 (7.6–8.4)	
17 February to 1 March	25.5 (25.0–26.0)	39.1 (38.4–39.8)	16.8 (16.3–17.3)	9.9 (9.5–10.3)	8.7 (8.2–9.2)	
3–15 March	34.2 (33.8–34.7)	33.9 (33.2–34.5)	14.6 (14.1–15.2)	9.4 (8.9–9.9)	7.9 (7.5–8.4)	
17–20 March	47.0 (46.5–47.6)	25.3 (24.7–25.9)	12.1 (11.6–12.6)	9.0 (7.6–8.4)	7.6 (7.2–8.0)	

NOT" or "definitely NOT" get a vaccine as *vaccine hesitant*. Among those who are vaccine hesitant, we labeled those who chose "probably NOT get a vaccine" as *vaccine reluctant* and those who chose "definitely NOT get a vaccine" as *vaccine rejecters*. We grouped the reported reasons for vaccine hesitancy into 3 categories: *deliberation* (defined as someone who

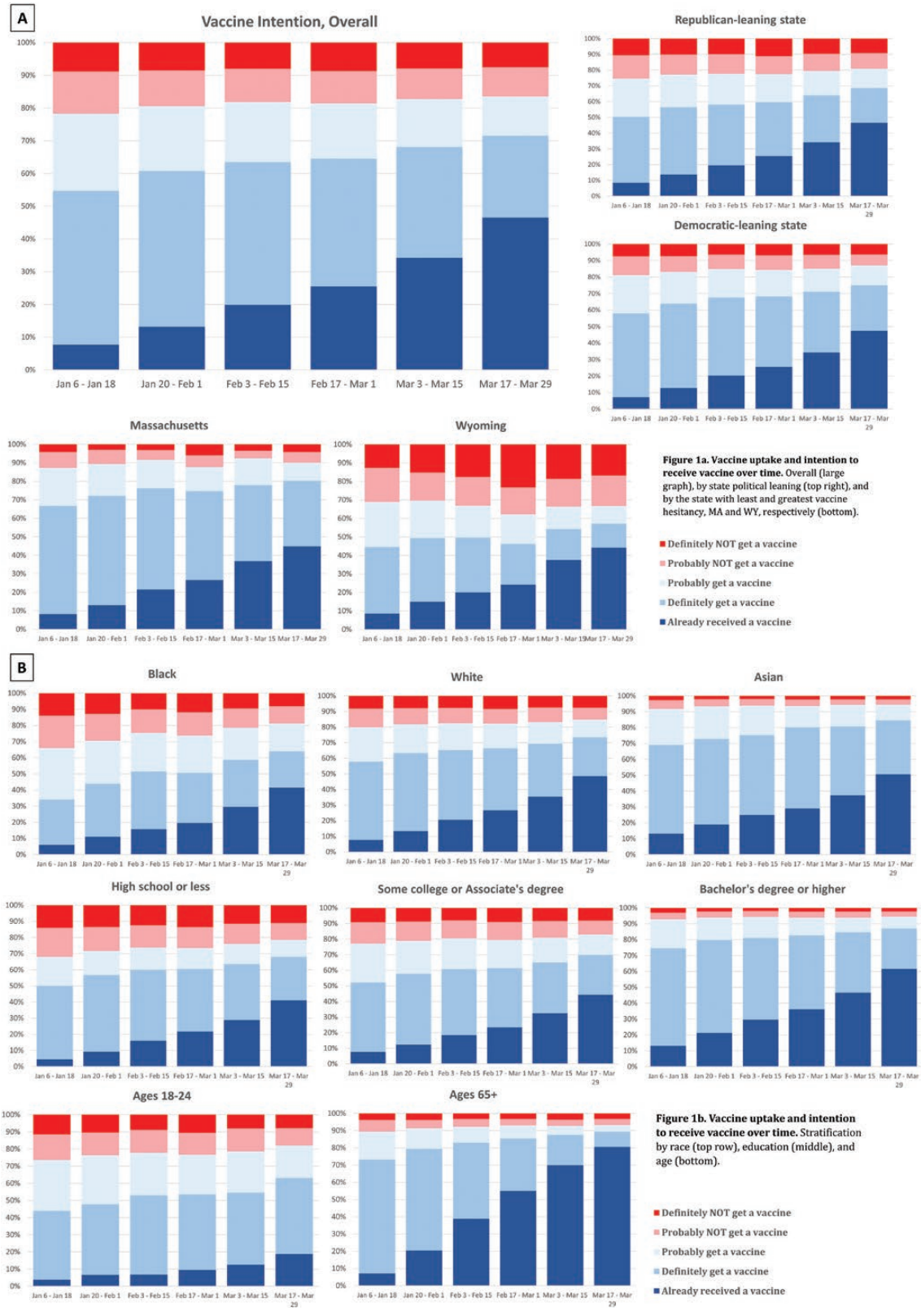

Figure 1a. Vaccine uptake and intention to receive vaccine over time. Overall (large graph), by state political leaning (top right), and by the state with least and greatest vaccine hesitancy, MA and WY, respectively (bottom).

Figure 1b. Vaccine uptake and intention to receive vaccine over time. Stratification by race (top row), education (middle), and age (bottom).

Figure 1. Vaccine uptake and intention to receive vaccine over time. *A,* Overall (*large graph*), by state political leaning (*top right*), and by the states with least and greatest vaccine hesitancy, Massachusetts and Wyoming, respectively (*bottom*). *B,* Stratification by race (*top row*), education (*middle*), and age group (*bottom*).

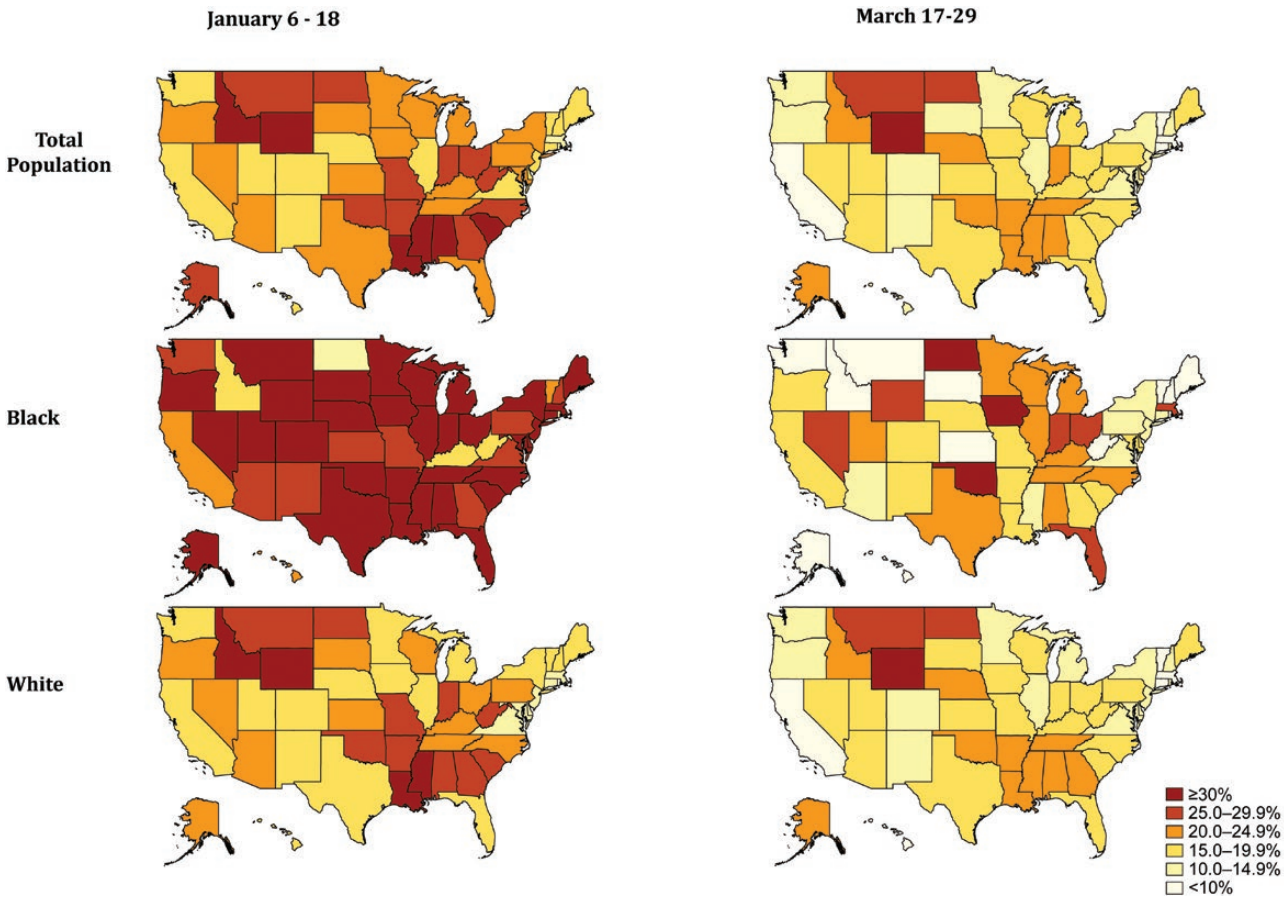

Figure 2. Vaccine hesitancy by state between January and March 2021 (defined as an intention to "probably NOT" or "definitely NOT" get a vaccine), overall and stratified by race.

expresses a countervailing consideration), *dissent* (defined as a categorial rejection of vaccines in general), and *distrust* (defined as concern about the motives of the actor promoting or distributing vaccines). Finally, we classified each state as Democratic or Republican leaning, according to their 2020 US presidential election outcome as an ecological variable.

Statistical Analysis

Descriptive statistics were produced using HPS person weights to calculate statewide and nationally representative estimates of COVID-19 vaccine uptake as well as vaccine intention among those who have not yet received a vaccine. These estimates were stratified by sex, age group (18–24, 25–39, 40–54, 55–64, or ≥65 years), race (black, white, Asian, other, or multiracial), ethnicity (Hispanic or non-Hispanic), education (high school or less, some college or associate's degree, or bachelor's degree or higher), marital status, household income, state-level political affinity (Democratic or Republican), and survey period.

To examine predictors of vaccine hesitancy, survey-weighted logistic regression models were created to estimate the adjusted odds ratios (aORs) for overall vaccine hesitancy. A separate regression model was constructed examining vaccine intention ("probably NOT" vs "definitely NOT") restricted to those who were vaccine hesitant. We used multivariate imputation by chained equations to replace missing data on income (23.4%) and marital status (1.1%). To examine reasons for vaccine hesitancy, we calculated survey-weighted proportions of participants citing each reason. We fit a regression model of vaccine rejection incorporating these reasons. Finally, we categorized each reason into 3 phenotypic categories of hesitancy (Table 1) and analyzed the proportion of these categories by vaccine intention over time.

All statistical analyses were conducted using Stata 16.1 software (StataCorp). All data is publicly available from the US Census Bureau Web site (https://www.census.gov/programs-surveys/household-pulse-survey.html). This project was reviewed by the Washington University Human Research Protection Office and was determined not to require institutional review board approval.

Table 4. Predictors of Vaccine Hesitancy[a]

Predictor	Adjusted OR (95% CI)	*P* Value
Age, y (reference: 18–24 y)		
25–39	1.58 (1.47–1.71)	<.001
40–54	1.29 (1.20–1.38)	<.001
55–64	0.75 (.68–.82)	<.001
≥65	0.51 (.47–.55)	<.001
Female sex	1.26 (1.21–1.30)	<.001
Race (reference: white [alone])		
Black (alone)	1.25 (1.19–1.32)	<.001
Asian (alone)	0.34 (.30–.38)	<.001
≥2 Races + other	1.50 (1.39–1.61)	<.001
Hispanic ethnicity	0.55 (.52–.58)	<.001
Education (reference: high school or less)		
Some college or associate's degree	0.76 (.74–.79)	<.001
Bachelor's degree or higher	0.38 (.37–.40)	<.001
Married	0.98 (.94–1.02)	.36
Household income, $ (reference: <$25 000)		
25 000–34 999	0.94 (.87–1.01)	.07
35 000–49.999	0.91 (.82–1.01)	.08
50 000–74 999	0.89 (.82–0.97)	.006
75 000–99 999	0.95 (.86–1.04)	.26
100 000–149 999	0.85 (.78–.93)	<.001
150 000–199 999	0.74 (.65–.84)	<.001
≥200 000	0.69 (.60–.78)	<.001
Republican-leaning state	1.43 (1.37–1.48)	<.001
Survey period (reference: 6–18 January)		
20 January to 1 February	0.92 (.87–.97)	.002
3–15 February	0.91 (.86–.96)	.001
17 February to 1 March	1.01 (.95–1.07)	.84
3–15 March	1.04 (.98–1.12)	.21
17–29 March	1.17 (1.10–1.24)	<.001

Abbreviations: CI, confidence interval; OR, odds ratio.
[a]Vaccine hesitancy defined as an intention to "probably NOT" or "definitely NOT" get a vaccine.

RESULTS

A total of 459 235 participants were surveyed over 6 study periods from 6 January to 29 March 2021. Their median age was 55 years (interquartile range, 41-67 years), and 59.8% were women (survey-weighted proportion, 51.6%) (Table 2). At the time of their respective survey, 151 025 individuals (corresponding survey-weighted proportions, 24.6%) had already received a COVID-19 vaccine, 184 806 (39.4%) indicated that they would "definitely" get a vaccine, 59 923 (17.5%) that they would "probably" get one, 34 642 (10.2%) that they would "probably NOT" get a vaccine, and 25 850 (8.2%) that they would "definitely NOT" one. The estimated proportion of the population who had already received the COVID-19 vaccine increased from 7.7% to 47.0% over the study period, with concurrent reductions in those expressing vaccine acceptance ("definitely get a vaccine," reduced from 47.0% to 25.3%; "probably get a vaccine," from 23.6% to 12.1%). In contrast, vaccine hesitancy remained relatively stable, with small reductions (−3.9%) in those who would "probably NOT" get a vaccine and minimal change (−1.2%) in those who would "definitely NOT" get one.

The prevalence of vaccine hesitancy was highest among younger age groups, black Americans, those of ≥2 races, those with less education, those with lower income, and those living in Republican-leaning states (Table 3). Overall and stratified vaccine uptake and intention over time are presented in Figure 1A and 1B. Mapping of vaccine hesitancy by state for the total population, black Americans, and whites demonstrated geographic differences in vaccine hesitancy and changes over time. Persistence of vaccine hesitancy in several Mountain and Southern states is noticeable among white Americans, while hesitancy among black Americans is more geographically homogenous (Figure 2).

Predictors of overall vaccine hesitancy (ie, intention to "probably NOT" or "definitely NOT" get a vaccine) included female compared with male sex (aOR, 1.26 [95% confidence interval, 1.21–1.30]), age 25–39 years (1.58 [1.47–1.71]) or 40–54 years (1.29 [1.20–1.38]) compared with a reference group aged 18–24 years, black (1.25 [1.19–1.32]) or multiracial (1.50 [1.39–1.61]) compared with white race, and living in a Republican-leaning state (1.43 [1.37–1.48]). In

Table 5. Predictors of Vaccine Rejection Among Those Who Are Vaccine Hesitant[a]

Predictor	Adjusted OR (95% CI)	*P* Value
Age, y (reference: 18–24 y)		
25–39	1.22 (1.05–1.41	.008
40–54	1.19 (1.04–1.36	.01
55–64	1.06 (.92–1.22	.45
≥65	1.08 (.92–1.27	.36
Female sex	0.87 (.81–.93)	<.001
Race (reference: white, non-Hispanic)		
Black, non-Hispanic	0.90 (.82–.99)	.03
Asian, non-Hispanic	0.70 (.54–.89)	.004
≥2 Races + other, non-Hispanic	1.29 (1.14–1.45)	<.001
Hispanic ethnicity	0.86 (.77–.96)	.006
Education (reference: high school or less)		
Some college or associate's degree	0.83 (.78–.89)	<.001
Bachelor's degree or higher	0.67 (.62–.73)	<.001
Married	1.01 (.95–1.08)	.72
Household income, $ (reference: <$25 000)		
25 000–34 999	0.91 (.79–1.06)	.22
35 000–49.999	0.90 (.77–1.05)	.18
50 000–74 999	0.85 (.74–.97)	.02
75 000–99 999	0.89 (.77–1.04)	.15
100 000–149 999	0.80 (.70–.93)	.003
150 000–199 999	0.84 (.70–1.02)	.08
≥200 000	1.06 (.81–1.39)	.66
Republican-leaning state	1.07 (1.00–1.14)	.05
Survey period (reference: 6–18 January)		
20 January to 1 February	1.15 (1.05–1.26)	.003
3–15 February	1.12 (1.02–1.24)	.02
17 February to 1 March	1.26 (1.14–1.40)	<.001
3–15 March	1.21 (1.10–1.33)	<.001
17–29 March	1.35 (1.23–1.50)	<.001

Abbreviation: CI, confidence interval.

[a]Vaccine hesitancy defined as an intention to "probably NOT" or "definitely NOT" get a vaccine, and vaccine rejection as an intention to "definitely NOT" get one. The survey-weighted logistic regression model restricted to those who are vaccine hesitant; the binary outcome variable is choosing "definitely NOT" (vs "probably NOT").

contrast, older age groups, Asian race, Hispanic ethnicity, college education, and higher income were variables more likely to be associated with vaccine acceptance (Table 4). When the analysis was restricted to those expressing hesitation, predictors of vaccine *rejection* (ie, intention to "definitely NOT" get a vaccine) as opposed to vaccine *reluctance* (ie, intention to "probably NOT" get a vaccine) were similar: age 25–39 or 40–54 years, being multiracial, and living in a Republican-leaning state. Interestingly, female sex and black race were both predictors of vaccine hesitancy but were protective against vaccine rejection (Table 5), Over time, the predictors of vaccine hesitancy remained relatively unchanged with a few key exceptions: among the unvaccinated, age >65 years switched from vaccine acceptance (aOR, 0.35) in early January 2021 to vaccine hesitance (1.69) by the end of March. On the other hand, the association between black race and hesitancy declined over the same period (aOR, 1.58 vs 0.94) (Supplementary Table 1).

Respondents who stated they would "probably NOT" get a vaccine reported a mean of 2.52 (95% confidence interval, 2.48–2.55) reasons for their hesitancy, and those who would "definitely NOT" get a vaccine reported a mean of 2.74 (2.69–2.78) reasons. The top 3 reasons cited for those who would "probably NOT" get a vaccine were deliberative in nature: 57.0% selected "Plan to wait and see if it safe is and may get it later," 52.1% selected "Concern about possible side effects," and 26.7% selected "Other people need it more than I do right now." On the other hand, 2 of the top 3 reasons cited by those who would "definitely NOT" get a vaccine were reasons relating to distrust: 49.0% do not trust the COVID-19 vaccine and 40.0% do not trust the government. Reasons categorized as dissent were more frequently expressed by vaccine rejectors (Figure 3).

In a survey-weighted logistic regression model of those who were hesitant, adjusted for sociodemographic factors, reasons that were significant predictors of vaccine rejection ("definitely NOT") were mostly related to dissent and distrust, whereas reasons that were predictors of vaccine reluctance ("probably NOT") were all deliberative (Figure 4). The proportion of categories of vaccine hesitancy reasons (deliberation, dissent,

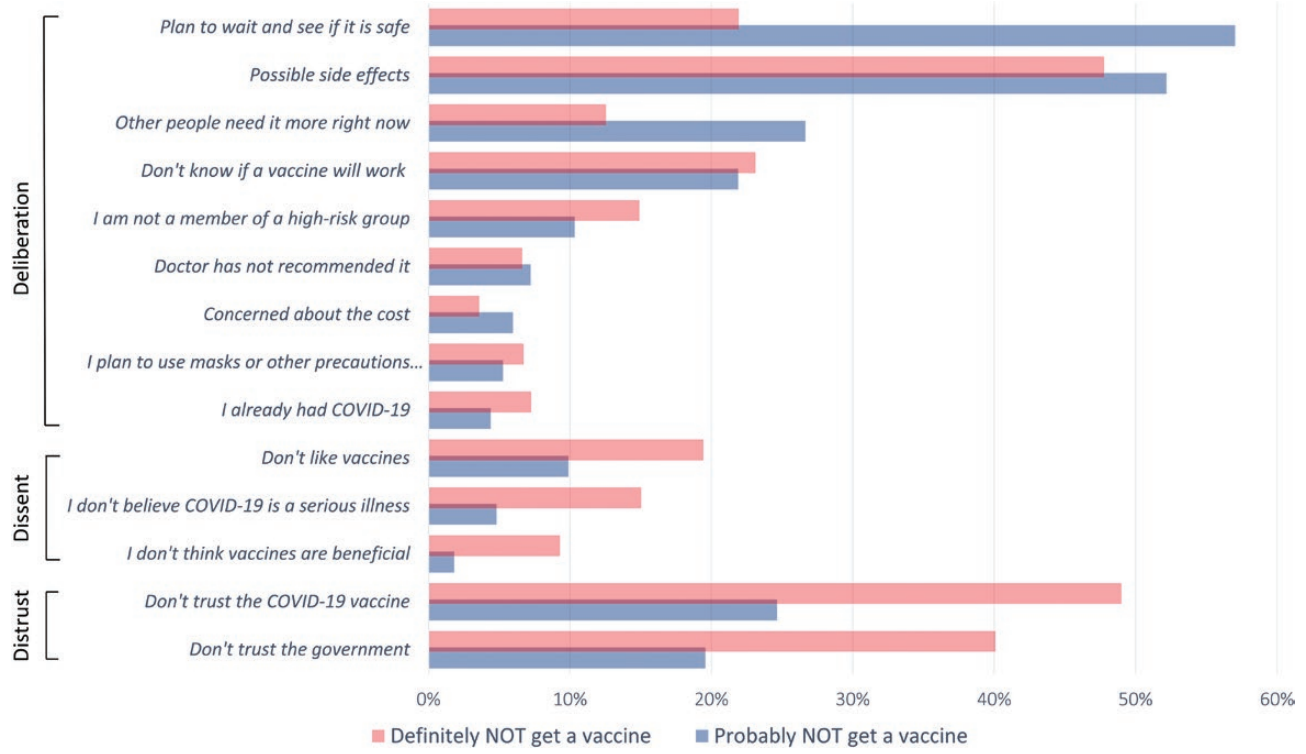

Figure 3. Reasons for vaccine hesitancy by vaccine intention. Reasons are grouped by category. Those who will "probably NOT" receive the vaccine are represented by blue bars; those who will "definitely NOT," by pink bars. Abbreviation: COVID-19, coronavirus disease 2019.

or distrust) differed significantly by vaccine intention. Overall, the majority of unvaccinated respondents expressed reasons of deliberation, with these numbers falling over time as more people became vaccinated from January through March 2021. Among vaccine rejecters, the proportion of reasons that reflect deliberation is matched by reasons related to distrust as well as higher rates of dissent. In this segment of the population, dissent and distrust remain relatively unchanged over time (Table 6 and Figure 5).

DISCUSSION

While a growing proportion of the US population has access to the COVID-19 vaccines, the fraction who are hesitant has resisted dramatic change. The proportion of individuals who are vaccine hesitant varied markedly from state to state, ranging from 10% in Massachusetts to 33% in Wyoming and showed a geographic preponderance in the South and several Mountain states. The majority of hesitators suggested they will "probably NOT" accept a vaccine, while a significant minority (45%) expressed a firm view that they will "definitely NOT" accept a vaccine. Rejecters were more likely to invoke a greater number of reasons for hesitancy, and those reasons fell into dissent and distrust categories at much higher frequency, while those who were merely reluctant to get the vaccine reported fewer reasons, which were generally deliberative (more circumstantial considerations). In sum, vaccine hesitancy is a complex phenomenon, and strategies to engage hesitant populations and win their trust must likewise be nuanced and tailored to meet diverse needs.

Importantly, people considered to have the greatest vulnerability—those who were younger, had lower education, and earned less—as well as individuals living in certain policy environments were more likely to express hesitancy. From a public health perspective, it seems at first glance a paradox that those with the most to lose from the pandemic are precisely those who might resist vaccination. Yet several factors may underlie this association. First, those with less education and income may be those who feel the most disenfranchised and cynical about government and perceived government-sponsored scientific activities, such as the development of a vaccine or public vaccination campaigns. In addition, COVID-19 has been uniquely politicized, and some political viewpoints have promoted the notion that public health measures are an intrusion into liberty with questionable motives—a perspective that is likely to create reluctance and rejection. Moreover, antivaccine attitudes as a political stance may indicate that vaccination has become an important signifier of membership in a social group, or an expression of "reactance" [24], aligned with the positionality of populist grievances or doubt as well as recent discourse undermining the credibility and veracity of science in general [25–28]. Interestingly, the influence of "ecological"

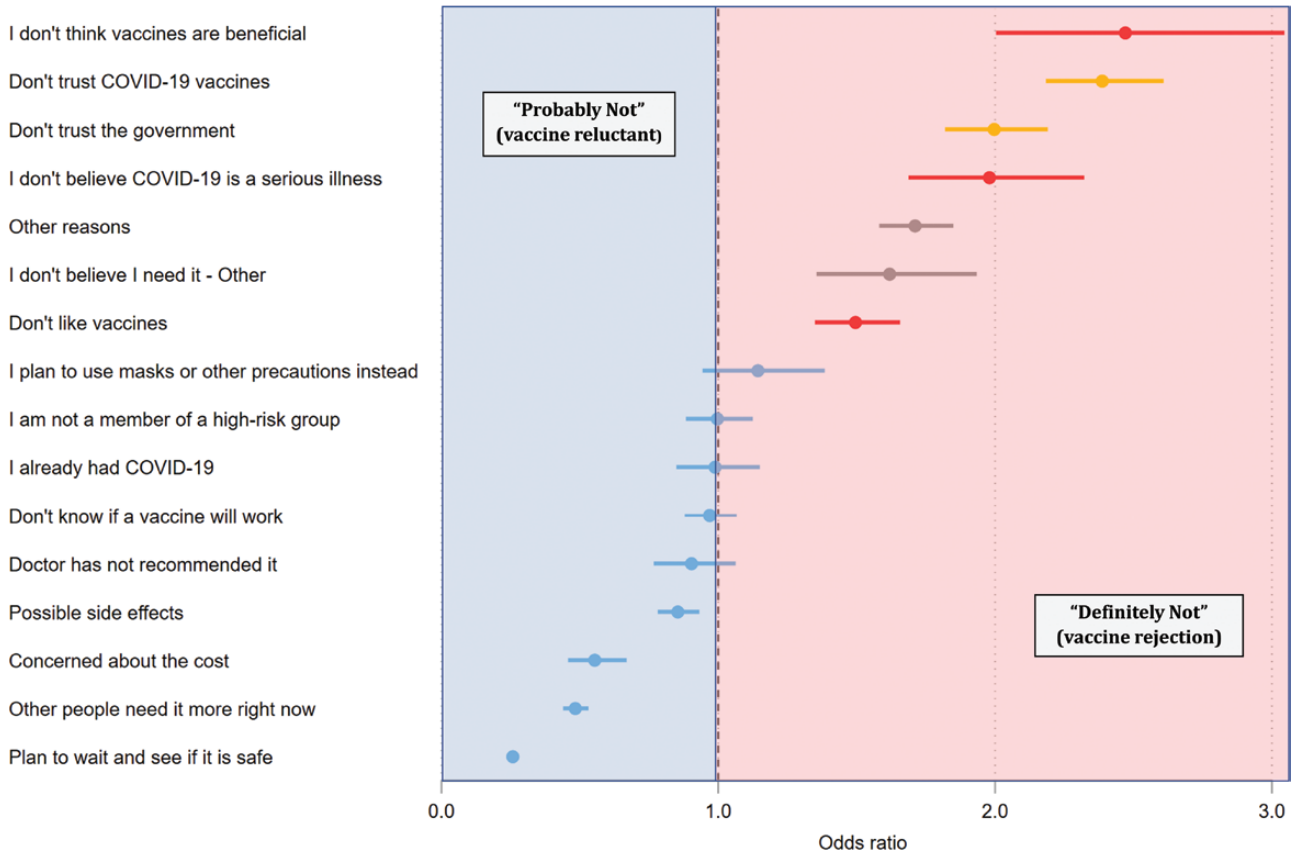

Figure 4. Reasons for vaccine rejection ("definitely NOT") versus reluctance ("probably NOT") among those who are vaccine hesitant. Odds ratios (ORs) were estimated from a survey-weighted logistic regression model, adjusted for sociodemographic factors. ORs >1 indicate significant association with vaccine rejection (*pink shaded area*); ORs <1, significant association with vaccine reluctance (*blue shaded area*). Colors of the points on the graph represent categories of reasons: dissent (*red*), distrust (*yellow*), and deliberation (*blue*). Error bars represent 95% confidence intervals (CIs). Abbreviation: COVID-19, coronavirus disease 2019.

political perspectives at the state level was not uniform among sociodemographic groups. Political partisanship appeared to be a significant driver of vaccine hesitancy among some whites and less so among black Americans (Supplementary Figure 1). These differences point again to the fact that vaccine hesitancy is a complex phenomenon and is an expression of diverse underlying perspectives. Finally, the finding that hesitancy among black Americans was less correlated with state-level political context may be explained by two observations. First, black residents in Republican-leaning states are less likely than white residents to identify or vote as Republicans, and there are numerous studies showing that vaccine hesitancy is linked to political affiliation. Second, structural racism in the United States has a long and pervasive history, and many black Americans may justifiably find the medical system, and by extension the COVID-19 vaccine, to be untrustworthy [29, 30].

Of particular note, this study contributes to the well-established concept of vaccine hesitancy existing along a continuum [11, 12, 31]. Particularly, we found evidence of vaccine reluctance and rejection as 2 distinct phenomena, even though they are both commonly characterized as "vaccine hesitancy" in the popular media, with different sociodemographic correlates as well as different belief structures, suggesting that public health efforts must approach hesitators with nuance and differentiated messaging [32, 33]. For example, while black Americans and women were more likely to be hesitant overall, these sociodemographic groups were actually less likely to be vaccine *rejecters* and more likely to be vaccine *reluctant*; this finding corroborates the narrative of community advocates that quality and community-determined access to vaccines may be sufficient to overcome disparities in vaccine uptake despite expressed initial hesitation [21]. Those reluctant to be vaccinated espoused slightly fewer number of reasons, which tended to be "deliberative" (eg, countervailing concerns such as side effects) whereas rejecters endorsed suspicion of vaccines in general or the COVID-19 vaccine in particular as well as distrust of other actors, such as the government, promoting vaccination. This distinction invokes the benefits of population segmentation in the design and prioritization of communications and mobilizing efforts for vaccine uptake. Addressing deliberative concerns may be more feasible and require different strategies than efforts to ameliorate the

Table 6. Survey-Weighted Prevalence of Respondents' Reasons for Vaccine Hesitancy by Category

Respondent Characteristics	Prevalence of Reasons for Hesitancy by Category (95% CI)		
	Deliberation	Dissent	Distrust
Overall	85.0 (84.7–85.3)	14.2 (13.8–14.6)	30.8 (30.4–31.2)
Vaccine intention			
Probably get a vaccine	92.7 (92.4–93.1)	5.7 (5.4–6.1)	14.9 (14.3–15.4)
Probably NOT get a vaccine	86.7 (85.8–87.5)	14.7 (13.9–15.5)	33.6 (32.6–34.5)
Definitely NOT get a vaccine	66.5 (65.6–67.5)	31.6 (30.4–32.9)	61.3 (60.3–62.3)
Age, y			
18–24	91.4 (90.1–92.5)	18.4 (16.9–19.9)	34.1 (32.3–36.0)
25–39	85.7 (85.0–86.3)	16.2 (15.5–16.9)	33.6 (32.7–34.6)
40–54	84.4 (83.8–85.1)	12.7 (12.1–13.3)	29.4 (28.5–30.3)
55–64	82.9 (81.9–83.8)	11.4 (10.7–12.0)	26.8 (25.9–27.8)
≥65	80.0 (78.7–81.3)	11.6 (10.5–12.7)	27.7 (26.3–29.1)
Sex			
Female	86.9 (86.5–87.3)	11.7 (11.3–12.1)	29.2 (28.6–29.8)
Male	82.9 (82.3–83.5)	17.0 (16.3–17.6)	32.6 (31.9–33.3)
Race/ethnicity			
Black (alone)	84.1 (83.0–85.2)	11.1 (10.3–12.1)	32.8 (31.5–34.2)
White (alone)	85.2 (84.8–85.6)	14.8 (14.3–15.3)	30.7 (30.2–31.2)
Asian (alone)	89.4 (87.4–91.1)	8.3 (6.9–9.9)	15.0 (13.4–16.7)
≥2 Races + other (alone)	83.3 (81.3–85.0)	18.5 (17.0–20.2)	35.1 (33.1–37.1)
Hispanic or Latino (of any race)	87.5 (86.5–88.4)	11.2 (10.2–12.3)	25.7 (24.6–26.8)
Not Hispanic or Latino	84.4 (84.1–84.8)	14.9 (14.5–15.3)	32.0 (31.5–32.5)
Education			
High school or less	82.2 (81.6–82.8)	14.2 (13.5–14.8)	31.3 (30.5–32.2)
Some college or associate's degree	86.9 (86.5–87.4)	14.5 (13.9–15.1)	32.1 (31.5–32.8)
Bachelor's degree or higher	89.0 (88.6–89.5)	13.8 (13.3–14.4)	27.0 (26.3–27.7)
Marital status			
Married	85.0 (84.4–85.6)	13.4 (13.0–13.9)	29.0 (28.4–29.7)
Not married	85.1 (84.6–85.6)	14.9 (14.4–15.5)	32.5 (31.9–33.1)
Household income, $			
<25 000	83.2 (81.9–84.5)	12.8 (11.8–13.8)	32.4 (31.0–33.9)
25 000–34 999	85.5 (84.1–86.8)	12.8 (11.5–14.2)	30.2 (28.6–31.8)
35 000–49.999	86.2 (85.0–87.3)	12.9 (11.8–14.0)	29.8 (28.5–31.2)
50 000–74 999	87.7 (86.6–88.7)	13.4 (12.7–14.2)	29.1 (27.8–30.4)
75 000–99 999	87.3 (85.9–88.5)	16.4 (14.8–18.0)	31.3 (29.8–32.9)
100 000–149 999	87.3 (86.0–88.6)	14.6 (13.6–15.7)	29.3 (27.9–30.7)
150 000–199 999	86.5 (84.4–88.4)	17.0 (15.0–19.2)	29.4 (26.6–32.3)
≥200 000	85.6 (82.8–88.1)	17.4 (15.4–19.6)	27.1 (24.9–29.6)
Political affinity (state level)			
Democratic leaning	85.7 (85.2–86.1)	13.6 (13.1–14.1)	29.3 (28.7–30.0)
Republican leaning	84.3 (83.7–84.8)	14.9 (14.2–15.5)	32.5 (31.7–33.2)
Survey period			
6–18 January	86.6 (85.7–87.4)	12.8 (12.0–13.7)	28.6 (27.6–29.5)
18 January to 1 February	86.1 (85.4–86.9)	11.8 (11.1–12.6)	29.3 (28.3–30.3)
3–15 February	86.0 (85.2–86.9)	13.7 (12.8–14.8)	30.1 (29.0–31.2)
17 February to 1 March	84.8 (83.8–85.7)	15.0 (13.9–16.1)	32.5 (31.4–33.7)
3–15 March	83.8 (82.7–84.9)	15.9 (14.6–17.3)	32.7 (31.4–34.1)
17–29 March	81.2 (79.7–82.5)	17.5 (16.3–18.8)	33.1 (31.6–34.7)

suspicion of rejecters, albeit building trust among all populations is no less an imperative but perhaps a more difficult undertaking [34].

An examination of specific reasons for hesitancy surfaces notable underlying belief structures that demand different outreach, messaging, and approaches. The reluctant who reported they would "probably NOT" receive the vaccine were more likely to invoke counterbalancing reasons as justification. For example, they were concerned about side effects, costs, safety, efficacy, or not being a member of a high-risk group, and they sought to allay their concerns by waiting for more people to get vaccinated. This group may be receptive

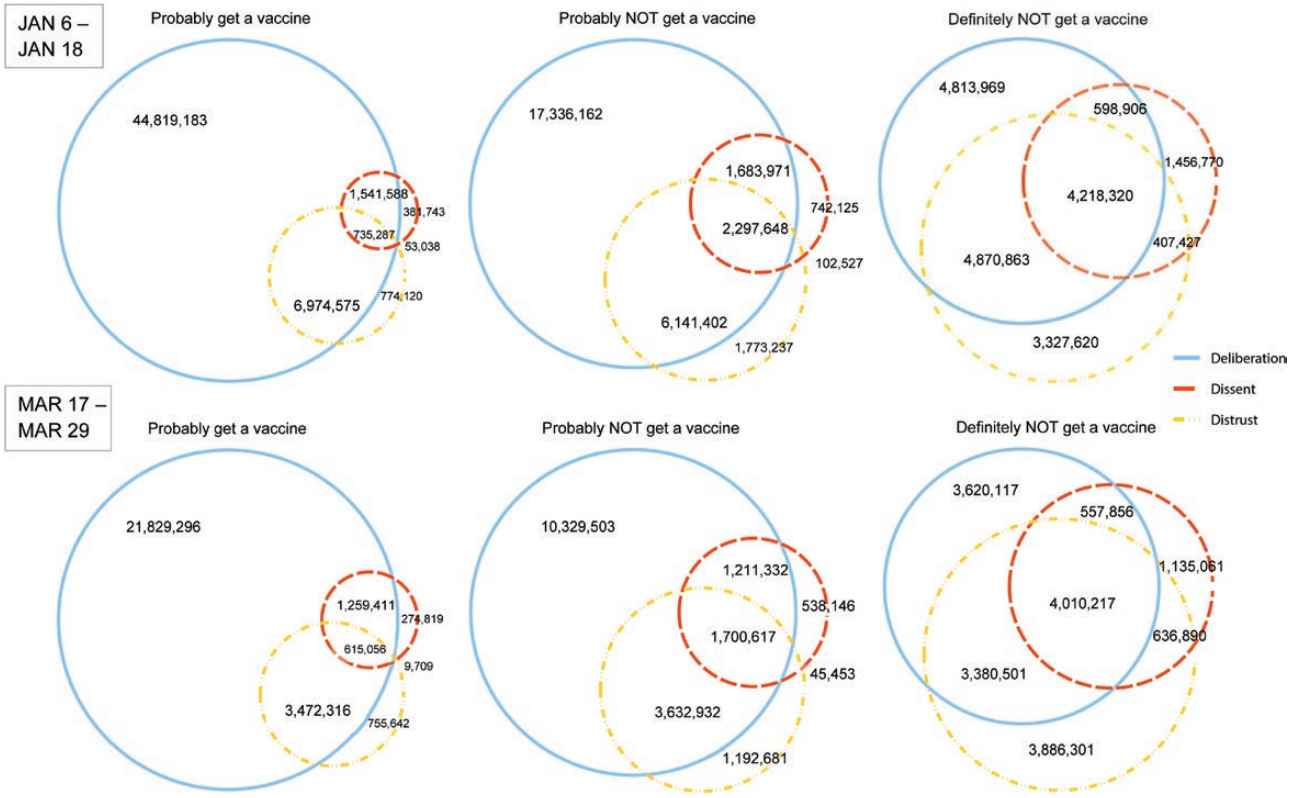

Figure 5. Proportional Venn diagram showing vaccine intentions characterized by categories of reasons: dissent (*red*), distrust (*yellow*), and deliberation (*blue*).

to information campaigns that draw on messaging emphasizing vaccine safety, social return to normalcy, and other prosocial messages [35]. Those expressing outright rejection who would "definitely NOT" obtain the vaccine invoked dismissal of potential benefits (eg, "Don't think vaccination is beneficial"), distrust of the vaccine development process (eg, "Don't trust the government"), and dissent (eg, "Don't believe COVID-19 is a serious illness"). Of note, these deeply held perspectives may stem from ethical beliefs that run counter to mainstream perspectives but nevertheless are based on "moral foundations," as elucidated by previous literature on vaccine hesitancy [16]. Building trust within these communities may require strategies that make use of peers, credible messengers outside of mainstream public health, as well as long-term structural changes to the social fabric such that all segments of society feel they are treated fairly and with dignity. Efforts to engage each distinct segment of the vaccine-hesitant population therefore must be calibrated not only to the intensity but also to the nature of their hesitancy. The reluctant deliberators may be receptive to tailored information, whereas the dissenting rejecters perhaps require affective approaches to building trust and engagement.

Limitations exist. First, these data are from an online survey with participants reached by text or email. The response rate was lower than traditional surveys conducted by the US Census Bureau, which are typically administered in person or via postal mail, and significant nonresponse rates can bias estimates [36]. Second, this analysis has been performed as a snapshot in time during a period of rapid change. Whether these associations remain relevant in the coming weeks and months is unclear. Furthermore, it is unknown to what extent the survey responses regarding intention to vaccinate are associated with actual vaccine uptake by individual participants. However, we have found that vaccine hesitancy at the state level is highly predictive of vaccine uptake rates >3 months later. In a linear regression, a 1% higher vaccine hesitancy rate during the study period (January–March 2021) is associated with a 1.5% decrease in the rates of those who are fully vaccinated on 7 July 2021 (Supplementary Figure 2). Third, our grouping of patient-reported reasons into categories of deliberation, dissent, and distrust are ad hoc and not supported by empirical analyses. Other frameworks, such as the "4C's model" (complacency, confidence, convenience, and calculation), have been widely used [13, 37]. Although other categorization schemes may map onto the categories used in this analysis, we believe that the 3 categories we selected were most applicable to the reasons available in the survey data. Fourth, although we present adjusted analyses, residual confounding could still be present. Finally, political partisanship was operationalized as an ecological variable so conclusions about the role of partisanship among individuals cannot be drawn, as associations are susceptible to ecological fallacy.

In conclusion, this analysis demonstrates that as vaccination efforts for COVID-19 accelerate, a substantial fraction of the US population remain vaccine reluctant or vaccine rejecters and that there are clear sociodemographic predictors of, as well as distinct self-reported reasons for, vaccine hesitancy. These data suggest that much more work needs to be done to enhance uptake of the vaccine. More specifically, public health and medicine must be aligned with the social realities of America experienced by different populations; health systems and government entities must also accept responsibility for the present-day stunted public engagement with public health. Segmented solutions to reach into sequestered social systems are needed to optimize vaccine uptake, but longer-term institutional building is needed to win trust and rebuild the social contract.

Supplementary Data

Supplementary materials are available at *Clinical Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

Note

Potential conflicts of interest. C. B. reports receiving payment or honoraria for Summit Plenary from CARDIS and leadership or fiduciary roles for CARDIS and PSMG. A. M. reports grants or contracts from KL2 (TR002346). E. G. reports an educational grant from ViiV Healthcare. All other authors report no potential conflicts. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

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