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## Major article

# COVID-19 vaccination hesitancy among health care workers, communication, and policy-making

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## Key Words:

Vaccine hesitancy  
Coronavirus disease 2019  
Health Belief Model

## A B S T R A C T

**Background:** Coronavirus disease 2019 (COVID-19) vaccine hesitancy in health care workers (HCWs) contributes to personal and patient risk in contracting COVID-19. Reasons behind hesitancy and how best to improve vaccination rates in HCWs are not clear.

**Methods:** We adapted a survey using the Health Belief Model framework to evaluate HCW vaccine hesitancy and reasons for choosing for or against COVID-19 vaccination. The survey was sent to 3 large academic medical centers in the Chicagoland area between March and May 2021.

**Results:** We received 1974 completed responses with 85% of HCWs receiving or anticipating receiving COVID-19 vaccination. Multivariable logistic regression found HCWs were less likely to receive COVID-19 vaccination if they were Black (OR 0.34, 95% CI 0.15–0.80), Republican (OR 0.54, 95% CI 0.31–0.91), or allergic to any vaccine component (OR 0.27, 95% CI 0.10–0.70) and more likely to receive if they believed people close to them thought it was important for them to receive the vaccine (OR 5.2, 95% CI 3–8).

**Conclusions:** A sizable number of HCWs remain vaccine hesitant 1 year into the COVID-19 pandemic. As HCWs are positively influenced by colleagues who believe in COVID-19 vaccination, development of improved communication across HCW departments and roles may improve vaccination rates.

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## BACKGROUND

The SARS-CoV-2 pandemic of 2019 has caused historic disruption to personal and public health and well-being. Despite the unprecedented rates of mortality due to coronavirus disease 2019 (COVID-19) worldwide, a large portion of frontline health care workers (HCWs) were either uncertain or did not plan to receive the COVID-19 vaccine after the U.S. Food and Drug Administration's (FDA) emergency authorization in December 2020. At the time, reports suggested that only one-half to two-thirds of HCWs were willing to be inoculated.<sup>1,2</sup> Approximately 8 months later, on August 23, 2021, the FDA approved the first COVID-19 vaccine.<sup>3</sup> At the same time, an

increasing number of US hospitals began to mandate vaccination for employment.<sup>4</sup> The Centers for Disease Control and Prevention, the National Academies of Sciences, Engineering, and Medicine, and other organizations continue to promote vaccination against COVID-19 with strategies that engage communities, address mistrust of the health care system, and build public confidence in vaccines.<sup>5</sup> However, these vaccine campaigns generally fail to address HCW vaccination concerns. Ultimately, this diminishes the utility of vaccination campaigns since low or slow uptake among HCWs is more likely to inspire concern rather than trust in the vaccine among the public. In addition, while mandating HCW vaccination directly addresses public health concerns, these types of policies can create further mistrust in the vaccine and further fray the delicate relationships between health care systems and the communities which they serve.

To mitigate these effects, it is vital to better understanding the “why” behind vaccine hesitancy among HCWs so that vaccine

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Conflicts of interest: None to report.

campaigns can be tailored appropriately to address these concerns. To that end, we adapted a survey using the Health Belief Model as a framework to assess vaccine hesitancy among HCWs and elucidate the reasons why HCWs might decide to accept or forgo COVID-19 vaccination.

## MATERIAL AND METHODS

### *Study participants and design*

This cross-sectional survey was developed by 2 authors (ST-M, ES) and distributed to hospital and/or university-affiliated personnel at 3 medical systems near Chicago, Illinois via email and/or electronic hospital newsletter between March 1, 2021 and May 20, 2021. The University of Illinois at Chicago (UIC) is a 465-bed urban hospital located in the Illinois Medical District with affiliated Colleges of Medicine, Nursing, Pharmacy, and a School of Public Health. Rush University Medical Center is a 664-bed urban hospital also located in the Illinois Medical District with affiliated Colleges of Nursing, Health Sciences, and Medicine. Advocate Aurora Health comprises 26 hospitals located in Wisconsin and Illinois. Surveys were distributed via email to various hospital mailing lists. All respondents were prompted with an informed consent script regarding the voluntary and anonymous nature of the survey prior to proceeding onto the survey. The survey was created using Qualtrics and designed so that only data from fully completed surveys was captured for analysis. A total 1971 participants responded, with institutional breakdown as follows: UIC (n = 526; 26.7%), Rush (n = 89; 4.5%), Advocate Aurora Health (n = 1268; 64.3%), and preferred not to say (n = 88; 4.5%). Suboptimal survey response rate from Rush affiliates was attributed to inadvertent omission of the survey link in the initial hospital newsletter. The study was approved by Institutional Review Boards at University of Illinois at Chicago, Rush University Medical Center, and Advocate Aurora Health.

### *Measures*

Participants self-reported their vaccination status. At the time our survey was distributed, vaccine rollout with the Pfizer-BioNTech COVID-19 vaccine was ongoing, so it was possible that some respondents had not yet received an invitation to vaccinate themselves against COVID-19. For this reason, respondents were dichotomized into 2 categories: vaccinated (or intends to be vaccinated) or not vaccinated (or does not intend to be vaccinated). For ease of reading, subsequent paragraphs will refer to those already vaccinated or intending to be vaccinated as “vaccinated,” and those not vaccinated and not intending to be vaccinated as “unvaccinated”.

Our COVID-19 Vaccine Attitude Scale survey was adapted from a questionnaire previously developed to measure behavioral determinants of vaccine uptake among health care workers in Ontario, Canada during the H1N1 influenza pandemic.<sup>6</sup> It was divided into 7 sections, 6 of which were rooted in the Health Belief Model conceptual framework, an established theoretical model positing that health behaviors can be optimized as long as constructs such as perceived barriers, benefits, self-efficacy, and threats are addressed.<sup>7,8</sup> Survey sections included: (1) sociodemographic variables; these were selected based on prior studies demonstrating an association with COVID-19 vaccine acceptance; (2) perceived susceptibility to COVID-19; (3) perceived severity of COVID-19; (4) perceived benefits of COVID-19 vaccination; (5) perceived barriers to COVID-19 vaccination; (6) cues to action, that is, internal or external stimuli that might affect one’s decision to accept vaccination against COVID-19; and (7) attitudes about COVID-19 vaccination and vaccination in general. Participants indicated on a 5-point Likert scale the extent to which they agreed or disagreed with scale items.

### *Statistical analysis*

We completed statistical analysis of the data using GraphPad Prism, version 9.0 for Mac, GraphPad Software, San Diego, California, USA, [www.graphpad.com](http://www.graphpad.com). Categorical variables were described by frequency of occurrence and percentage. Likert-type questions were dichotomized into 2 variables; responses of “agree” or “strongly agree” were defined as in “agreement” in order to be used in analysis using odds ratios and logistic regression models. We used Fisher’s exact test and  $\chi^2$  statistic to compare vaccinated and unvaccinated study populations. All tests were 2-sided, and we used a *P* value threshold for significance of <.05. We obtained odds ratios and determined 95% confidence intervals by the Gart adjusted logit interval method for vaccine attitudes scale items.

We used multivariate logistic regression analysis to create 2 models using factors significant in predicting COVID-19 vaccination. The base model included important demographic and vaccine history items with statistical significance in predicting COVID-19 vaccination including age, race, neighborhood location, political partisanship, occupational role, risk population exposure, and vaccine history. Measures in the base model were included based on past data on predictors of vaccine uptake and known statistically significant univariate predictors of COVID-19 vaccine uptake.<sup>6,9</sup> We also created another model including base measures and COVID-19 Vaccine Attitudes Scale items with statistical significance at predicting COVID-19 vaccination. We determined the area under the receiver operating curve (AUC) for both models to evaluate the discriminative power of each model.

## RESULTS

### *Participant characteristics*

A total of 1974 health care workers responded to the survey, of which 289 (15%) declined or anticipated declining vaccination. A higher percentage of respondents who received or intended to receive the COVID-19 vaccine described themselves as Democrat or leaning toward that party (63% vs 19%, *P* ≤ .001) and reported having a family member living with chronic illness (47% vs 40%, *P* < .001) (Table 1).

### *Health care worker COVID-19 vaccine attitudes scale predictors: Health belief model constructs*

#### *Perceived benefits and barriers of COVID-19 vaccination*

Compared to unvaccinated HCWs, vaccinated HCWs were far more likely to believe that COVID-19 vaccination would decrease the spread of COVID-19 infection (OR 41.59; 95% CI 29.91-57.85) and would decrease the likelihood of infection in themselves (OR 28.22; 95% CI 20.69-38.48), their patients (OR 22.45; 95% CI 16.50-30.56), and their family members (OR 27.19; 95% CI 19.97-37.03). Unvaccinated HCWs were 93% more likely to believe there was insufficient evidence to support COVID-19 vaccination (OR 0.07; 95% CI 0.05-0.09) (Table 2).

#### *Cues to action*

As a whole, vaccinated HCWs were more likely than unvaccinated HCWs to be swayed to vaccinate based on external stimuli such as the media or a personal health care provider (OR 1.83; 95% CI 1.25-2.66 and 4.77; 95% CI 3.50-6.51, respectively). They were also more likely than unvaccinated HCWs to become vaccinated because people they know, for example, close friends and family, colleagues, and supervisors, believed it was important for them to become vaccinated (OR 18.83; 95% CI 13.94-25.59, OR 8.24; 95% CI 6.29-10.79, and OR 5.52; 95% CI 4.25-7.18 respectively) (Table 2).

**Table 1**  
Health care worker characteristics by actual or anticipated COVID-19 vaccine uptake

Characteristics	Not vaccinated / does not intend to be vaccinated (n = 289), %	Vaccinated / intends to be vaccinated (n = 1685), %
Sociodemographics		
Age, y		
18-44	61.2	54.5*
45-64	37.7	39.2
≥65	1.0	6.3
Female sex	90.3	83.3*
Race		
White	88.2	84.2*
Black	5.2	3.7
Asian	2.4	9.4
American Indian or Alaska Native	1.7	0.7
Native Hawaiian or other Pacific Islander	0.3	0.1
Hispanic or Latino	5.5	7.5
In a relationship	86.5	78.2*
Dependent children <21 y old	51.6	35.3*
Home neighborhood		
Urban	17.6	35.7*
Suburban	59.2	56.0
Rural	23.2	8.2
Formal religious belief or affiliation	72.3	64.8*
Work full- or part-time	78.5	83.3
Work remotely	30.0	31.2
Time spent working remotely		
0%-24%	1.7	1.4
25%-49%	1.0	2.6
50%-74%	2.4	5.2
75%-100%	20.8	22.0
Political partisanship		
Democrat (including those who leaned toward the party)	18.7	63.2*
Republican (including those who leaned toward the party)	48.4	18.8
Other	32.9	18.0
Institution		
Advocate Health Care	78.9	61.8*
Rush	2.8	4.8
University of Illinois at Chicago	9.3	29.7
Occupational Classification		
Physician or Advanced Practice Provider	1.7	14.7*
Nurse	27.0	18.0
Allied Health Care Worker	11.4	14.7
Administrative/Clerical	28.0	23.1
Health Care Technicians	16.9	6.1
Research	2.4	10.9
Facilities and Logistics	2.1	1.2
Student	3.8	6.3
Other	7.6	4.9
COVID-19 Vaccine Consideration Factors		
Regular contact with children	62.3	51.9*
Regular contact with elderly	67.5	66.6
Family member with chronic illness	40.1	47.3*
Adverse events to prior vaccinations	32.2	21.3*
Seasonal influenza vaccination	91.0	95.8*

COVID-19, coronavirus disease 2019.

\*P value <.05.

### Modeling factors predictive of COVID-19 vaccine uptake

The ORs with 95% CIs of factors included within the final multivariate logistic regression models are presented in Table 3. The base model correctly predicted 84% of COVID-19 vaccinations or intended vaccinations (AUC 0.84, 95% CI 0.82-0.86). Addition of the COVID-19 Vaccine Attitude Scale items to the base model increased the accuracy of the model by 11%, correctly predicting 95% of COVID-19 vaccinations or intended vaccinations (AUC 0.95, 95% CI 0.94-0.97). In this latter model, respondents were less likely to receive the COVID-19 vaccine if they were Black or African American (OR 0.34, 95% CI 0.15-0.80), Republican (OR 0.54, 95% CI 0.31-0.91), allergic to any vaccine component (OR 0.27, 95% CI 0.10-0.70) or believed the vaccine might negatively impact a fetus if pregnant or planning pregnancy (OR 0.09, 95% CI 0.04-0.16). They were more likely to receive the COVID-19 vaccine if they believed people close to them thought

it was important for them to receive the COVID-19 vaccine (OR 5.2, 95% CI 3-8) or believed that all HCWs should be vaccinated against COVID-19 (OR 14, 95% CI 9-23).

### DISCUSSION

Our study identified a number of areas where attitudes contrasted significantly between willing and hesitant HCWs. As a whole, HCWs willing to be vaccinated perceived greater benefits and fewer barriers to vaccination against COVID-19 compared to vaccine hesitant HCWs. Similar to recently published studies on HCW vaccine hesitancy, our results suggest that workers who did not receive the vaccine were more likely to be younger in age, non-physicians, Black or African American, or had concerns surrounding adverse side effects affecting either their own bodies or those of a fetus or newborn.<sup>10</sup> A surprising

**Table 2**  
Likelihood of COVID-19 vaccine uptake among health care workers based on survey responses

Questionnaire items	Not vaccinated / does not intend to be vaccinated (n = 1685), %	Vaccinated / intends to be vaccinated (n = 289), %	Odds ratio (95% CI)
<b>Perceived susceptibility to COVID-19 infection</b>			
I am at high personal risk for getting COVID-19	16.6	44.5	4.00 (2.89-5.52)
It is likely that I can infect patients with COVID-19 if I don't get vaccinated	15.2	68.2	11.85 (8.48-16.58)
I am likely to get COVID-19 if I do not get vaccinated	12.8	62.2	11.13 (7.79-15.90)
Health care workers are at greater risk than the general public of catching COVID-19	44.6	83.1	6.13 (4.71-7.99)
I am at risk of catching COVID-19 from hospital patients	24.2	46.4	2.71 (2.05-3.60)
<b>Perceived severity of COVID-19 infection</b>			
COVID-19 infection may cause serious health problems	77.2	97.7	13.45 (8.77-20.61)
COVID-19 infection is dangerous for me	28.7	78.4	9.07 (6.87-11.97)
COVID-19 infection is dangerous for the patients in the hospital at which I work	56.4	89.0	6.34 (4.80-8.37)
If I were to get COVID-19, it may significantly interfere with my regular daily activities	45.7	91.0	12.22 (9.18-16.26)
Other health conditions that I have may become worse if I get COVID-19	29.1	60.2	3.68 (2.81-4.83)
The thought of getting COVID-19 scares me	24.6	74.0	8.75 (6.56-11.67)
<b>Perceived benefits of COVID-19 vaccination in preventing COVID-19 infection</b>			
If I get vaccinated against COVID-19, then I will be less likely to infect patients	22.8	86.9	22.45 (16.50-30.56)
If I get vaccinated against COVID-19, then I will be less likely to infect family members	26.0	90.5	27.19 (19.97-37.03)
Getting the COVID-19 vaccine will decrease the likelihood of me getting COVID-19	32.9	93.2	28.22 (20.69-38.48)
Getting the COVID-19 vaccine will decrease the spread of COVID-19	30.4	94.7	41.59 (29.91-57.85)
The COVID-19 vaccine cannot cause COVID-19	65.1	95.8	12.52 (8.91-17.60)
Other health care workers should be prioritized for vaccination against COVID-19, because they have a higher risk	49.5	66.8	2.06 (1.61-2.64)
<b>Perceived barriers to accepting COVID-19 vaccination</b>			
I am generally opposed to vaccinations	17.0	1.1	0.06 (0.03-0.10)
I do not have time to get the COVID-19 vaccine	3.1	1.0	0.32 (0.14-0.74)
I am concerned about side effects (eg, fatigue, muscle aches, mild fever) from the COVID-19 vaccine	59.2	24.4	0.22 (0.17-0.29)
I am concerned about severe allergic reactions after getting the COVID-19 vaccine	54.7	13.5	0.13 (0.10-0.17)
There is insufficient evidence for the efficacy of COVID-19 vaccination	73.7	15.9	0.07 (0.05-0.09)
I am currently providing breastmilk for a child and have concerns about how a vaccine against COVID-19 might negatively impact this child. <sup>a</sup>	4.2	0.9	0.21 (0.10-0.45)
I am currently pregnant or planning to become pregnant and have concerns about how a vaccine against COVID-19 <sup>b</sup>	25.6	2.7	0.08 (0.05-0.12)
<b>Cues to action</b>			
The recommendations in the mass media affect my decision whether to receive vaccination for COVID-19	11.1	18.5	1.83 (1.25-2.66)
My personal provider's recommendations affect my decision whether to receive vaccination against COVID-19	18.0	51.1	4.77 (3.50-6.51)
People close to me think it is important for me to get vaccinated against COVID-19	23.2	85.1	18.89 (13.94-25.59)
My colleagues think it is important for me to get the COVID-19 vaccine	37.4	83.0	8.24 (6.29-10.79)
My supervisors think it is important for me to get the COVID-19 vaccine	45.0	81.8	5.52 (4.25-7.18)
<b>General attitudes</b>			
All health care workers should be vaccinated against COVID-19	12.5	87.4	48.68 (33.43-70.89)
It is important that health care workers have freedom of choice in vaccination	94.5	50.2	0.06 (0.04-0.10)
I believe in immunizations	73.4	98.6	28.24 (17.15-46.49)
The COVID-19 vaccine is more important than other vaccines	7.6	45.9	10.34 (6.70-15.90)

COVID-19, coronavirus disease 2019.

<sup>a</sup>N = 177.

<sup>b</sup>N = 293.

proportion of vaccine hesitant respondents cited insufficient evidence for vaccine efficacy, a somewhat concerning finding given the survey population. In addition, our study revealed a significant divide in attitudes towards vaccination between those identifying as *Democrat* or *Republican* (63% vs 19% self-reported vaccination rate). Nearly half of those identifying as *Republican* indicated they had not been or were not intending to be vaccinated. Although we acknowledge that COVID-19 and its vaccines have been politicized more than any other disease in recent history, it is equally important to acknowledge there is more to human intersectionality, values, and experience than political affiliation.

One method supported by our data to improve vaccination rates is to include HCWs who believe in the benefits of COVID-19 vaccination in outreach planning and delivery. Our study found HCWs who received or planned to receive vaccination against COVID-19 were positively influenced by the belief that people around them believed COVID-19 vaccination was important (Table 2: Cues to Action). Our data also demonstrated that the decision of HCWs to vaccinate was least influenced by mass media marketing and highly influenced by

what their colleagues and others close to them thought about the vaccine. Rather than focusing on generalized, impersonal outreach advertisements from a hospital administration or the mainstream media, hospitals should work internally to foster relationships and trust building among employees across departments and job roles, especially among nurses and physicians who remain highly trusted in their communities.<sup>5,11</sup> It will be especially important to create safe spaces where HCWs, including clinicians, food providers, and environmental service workers can express their questions and concerns in an open and transparent forum due to inherent power structures and hierarchies that frequently serve as barriers to the agency of vulnerable persons.<sup>12</sup> In this outreach, special consideration should be considered to include HCWs from diverse backgrounds including populations underrepresented in medicine such as Black or African American HCWs who were found to have lower vaccination rates.<sup>13</sup> Once trusted messengers are identified, they need to deliver messages and data that are tailored to the needs of their intended audiences.

Differences emanating from distrust of government, media, and medical institutions to deliver safe and efficacious care reflect a long-

**Table 3**  
Multivariate regression analysis identifying variables predictive of health care worker COVID-19 vaccine uptake

Predictor variables	Base model <sup>1</sup> Odds ratio (95% CI)	Base model + attitudes scale items <sup>2</sup> Odds ratio (95% CI)
<b>Demographics</b>		
Age		
18–44	1 (Reference)	1 (Reference)
45–64	2.25 (1.65–3.09)*	1.11 (0.72–1.72)
≥65	7.62 (2.63–32.6)*	2.62 (0.71–13.12)
Race		
White	1 (Reference)	1 (Reference)
Black	0.23 (0.12–0.47)*	0.34 (0.15–0.80)*
Asian	2.06 (0.94–5.27)	1.40 (0.53–4.17)
American Indian or Alaska Native	0.45 (0.13–1.87)	0.82 (0.14–4.16)
Native Hawaiian or other Pacific Islander	0.74 (0.07–16.74)	0.14 (0.00–7.10)
Neighborhood location		
Urban	1 (Reference)	1 (Reference)
Suburban	0.59 (0.39–0.87)*	0.81 (0.47–1.40)
Rural	0.32 (0.19–0.53)*	0.55 (0.28–1.09)
Political Partisanship		
Democrat	1 (Reference)	1 (Reference)
Republican	0.13 (0.09–0.19)*	0.54 (0.31–0.91)*
Other	0.19 (0.13–0.28)*	0.59 (0.35–1.01)
<b>Occupational Classification</b>		
Physician or Advanced Practice Provider	1 (Reference)	1 (Reference)
Nurse	0.15 (0.04–0.38)*	0.14 (0.13–0.64)*
Allied Health Care Worker	0.22 (0.06–0.61)*	0.12 (0.02–0.54)
Administrative/Clerical	0.14 (0.04–0.37)*	0.12 (0.02–0.52)*
Health Care Technicians	0.06 (0.02–0.17)*	0.07 (0.01–0.31)*
Research	0.52 (0.13–1.86)	0.19 (0.03–1.09)
Facilities and Logistics	0.12 (0.03–0.51)*	0.12 (0.01–0.92)*
Student	0.18 (0.05–0.57)*	0.06 (0.01–0.34)*
Other	0.08 (0.02–0.23)*	0.05 (0.01–0.29)*
Risk Populations Exposure		
Do you have a family member living with chronic illness?	1.46 (1.09–1.96)*	1.19 (0.80–1.76)
<b>Vaccine History</b>		
Have you ever experienced side effects to the influenza vaccine or any other vaccination?	0.67 (0.48–0.94)*	0.94 (0.59–1.53)
Are you allergic to any vaccine components?	0.31 (0.16–0.60)*	0.27 (0.10–0.70)*
Did you receive a 2020 seasonal influenza vaccination?	2.56 (1.39–4.62)*	1.56 (0.70–3.41)
<b>COVID-19 Vaccine Attitude Scale Items</b>		
I am concerned about severe allergic reactions after getting the COVID-19 vaccine	-	0.30 (0.20–0.45)*
I am currently pregnant or planning to become pregnant and have concerns about how a vaccine against COVID-19 might negatively impact the fetus	-	0.09 (0.04–0.16)*
People close to me think it is important for me to get vaccinated against COVID-19	-	5.23 (3.46–7.98)*
All health care workers should be vaccinated against COVID-19	-	13.94 (8.78–22.71)*
Area Under Receiver Operating Curve	0.84 (0.82–0.86)	0.95 (0.94–0.97)*

COVID-19, coronavirus disease 2019.

\*P value <.05.

<sup>1</sup>Base model: includes key sociodemographic variables (age, race, neighborhood location, political partisanship), occupational classification, risk populations exposure, and vaccine history variables but excludes COVID-19 Vaccine Attitudes Scale items.

<sup>2</sup>Base model + COVID-19 Attitude Scale items: includes all variables in base model and COVID-19 Vaccine Attitudes Scales items with *P* < .05.

standing and palpable need for improved communication among care teams and between providers and patients. For HCWs, the focus has been more on prioritization of HCWs on the front line; however, without trustworthy communication, vaccine uptake lagged significantly among this important group who are now subject to COVID-19 vaccine mandates in many jurisdictions.<sup>14</sup> We recommend that communication regarding effectiveness and efficacy be tailored to meet the needs of and be accessible to diverse groups with different lived experiences and levels of knowledge. For example, we found that 99% of physicians at our institutions were planning to be vaccinated, whereas only 82% of nurses were. This difference highlights the importance of not assuming that all HCWs are trained in the evaluation of research and safety data regarding vaccines and that special emphasis should be placed on sharing this information such that it is accessible and meaningful to all members of the care team. This is consistent with recommendations from the National Institutes of Health that call for the application of behavioral and social sciences to foster vaccine confidence through messaging that invokes a sense of self-worth, avoids shaming and use of negative emotions, and

takes a balanced and compassionate approach aimed at long-term relationship building with trusted community members.<sup>5,11</sup>

Hospitals, health care systems, and state governments are increasingly mandating vaccination against COVID-19 for health care workers across the United States. While we support these efforts, vaccine mandates come with attendant harms and the potential to exacerbate issues of mistrust, hesitancy, communication, and inequities in agency. Although it is likely vaccine mandates for health care workers will increase uptake in the vaccine, it is also possible these mandates may lead to backlash, leaving health care workers fearful of losing their jobs or feeling obliged to receive the vaccine against their personal values or concerns.<sup>12,15</sup> Our data suggest that this may be avoided by increasing trust in COVID-19 vaccines through relationship and trust building leading to increased confidence in this group, which is essential for instilling acceptance in the community at large.<sup>11</sup>

Our study has many strengths, including its survey of a large diverse, Midwestern health care population. In addition, by using a conceptual framework that identifies “cues to action,” it can be used

to develop tailored strategies to improve vaccination rates in this HCW population. However, certain limitations should be taken into consideration when interpreting our findings. First, given how our survey was distributed, we were unable to calculate a complete survey response rate and hence cannot comment on vaccine hesitancy among non-respondents. Vaccine intention was self-reported and we were unable to confirm actual vaccine administration. A majority of our respondents were female. As our study and others have found, women are less likely to accept COVID-19 vaccination, presumably related to concerns of safety in pregnancy, lactation, fertility, etc. These findings highlight the importance of continuing to study these issues, but also more effectively sharing any known efficacy and safety data with patients and health care workers alike, for example, the presence of antibodies in cord blood following maternal immunization against COVID-19.<sup>16</sup> Our survey was only available in English and distributed in or near the Chicago region, hence decreasing the generalizability of our findings to non-English speaking HCWs or other parts of the U.S. Finally, our study was completed soon after COVID-19 vaccines became available to frontline HCWs and may represent viewpoints from this period which may have changed since the Pfizer-BioNTech COVID-19 vaccine was given full FDA approval.

## CONCLUSIONS

Approximately 3 out of every 20 HCWs we surveyed reported being vaccine hesitant. HCWs are positively influenced by close friends and colleagues who believe COVID-19 vaccination is important which may support developing communication across departments and roles with the intent to improve vaccination rates. Certain populations such as Black or African American, non-physicians, or those concerned about adverse side effects have lower likelihood of receiving vaccination against COVID-19, and should be targets to improve communication regarding COVID-19 vaccination.

## References

1. Doctors and nurses want more data before championing vaccines to end the pandemic. *Washington Post*. Accessed September 2, 2021. <https://www.washingtonpost.com/business/2020/11/21/vaccines-advocates-nurses-doctors-coronavirus/>.
2. Mar 19 P, 2021. KFF/Post survey of frontline health care workers finds nearly half remain unvaccinated. KFF. Published March 19, 2021. Accessed August 26, 2021. <https://www.kff.org/coronavirus-covid-19/press-release/kff-post-survey-of-front-line-health-care-workers-finds-nearly-half-remain-unvaccinated/>.
3. Commissioner O of the. FDA approves first COVID-19 vaccine. FDA. Published August 23, 2021. Accessed September 2, 2021. <https://www.fda.gov/news-events/press-announcements/fda-approves-first-covid-19-vaccine>.
4. 30% of US hospitals mandate vaccination for employment. Accessed September 2, 2021. <https://www.beckershospitalreview.com/workforce/covid-19-vaccination-needed-to-work-at-30-of-us-hospitals.html>.
5. Read "Strategies for Building Confidence in the COVID-19 Vaccines" at NAP.Edu.
6. Corace K, Prematunge C, McCarthy A, et al. Predicting influenza vaccination uptake among health care workers: what are the key motivators? *Am J Infect Control*. 2013;41:679–684.
7. Jones CL, Jensen JD, Scherr CL, Brown NR, Christy K, Weaver J. The Health Belief Model as an explanatory framework in communication research: exploring parallel, serial, and moderated mediation. *Health Commun*. 2015;30:566–576.
8. Becker MH. The Health Belief Model and sick role behavior. *Health Educ Monogr*. 1974;2:409–419.
9. Kreps S, Prasad S, Brownstein JS, et al. Factors associated with US adults' likelihood of accepting COVID-19 vaccination. *JAMA Netw Open*. 2020;3:e2025594.
10. Biswas N, Mustapha T, Khubchandani J, Price JH. The nature and extent of COVID-19 vaccination hesitancy in healthcare workers. *J Community Health*. 2021;46:1244–1251.
11. Chou W-YS, Gaysynsky A. COVID-19 vaccination communication.:27.
12. Hospital survey on patient safety culture: 2016 User Comparative Database Report. Accessed August 26, 2021. <https://psnet.ahrq.gov/issue/hospital-survey-patient-safety-culture-2016-user-comparative-database-report>.
13. Morris DB, Gruppuso PA, McGee HA, Murillo AL, Grover A, Adashi EY. Diversity of the national medical student body — four decades of inequities. *N Engl J Med*. 2021;384:1661–1668.
14. State efforts to ban or enforce COVID-19 vaccine mandates and passports – the National Academy for State Health Policy. Accessed September 13, 2021. <https://www.nashp.org/state-lawmakers-submit-bills-to-ban-employer-vaccine-mandates/>.
15. Persad G, Emanuel EJ. Ethical considerations of offering benefits to COVID-19 vaccine recipients. *JAMA*. 2021;326:221–222.
16. Prabhu M, Murphy EA, Sukhu AC, et al. Antibody response to Coronavirus Disease 2019 (COVID-19) messenger RNA vaccination in pregnant women and transplacental passage into cord blood. *Obstet Gynecol*. 2021;138:278–280.