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RESEARCH ARTICLE

COVID-19 Vaccination and Intent Among Healthcare Personnel, U.S.

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Introduction: Healthcare personnel are at increased risk for COVID-19 from workplace exposure. National estimates on COVID-19 vaccination coverage among healthcare personnel are limited.

Methods: Data from an opt-in Internet panel survey of 2,434 healthcare personnel, conducted on March 30, 2021–April 15, 2021, were analyzed to assess the receipt of ≥1 dose of a COVID-19 vaccine and vaccination intent. Multivariable logistic regression was used to assess the factors associated with COVID-19 vaccination and intent for vaccination.

Results: Overall, 68.2% of healthcare personnel reported a receipt of ≥1 dose of a COVID-19 vaccine, 9.8% would probably/definitely get vaccinated, 7.1% were unsure, and 14.9% would probably/definitely not get vaccinated. COVID-19 vaccination coverage was highest among physicians (89.0%), healthcare personnel working in hospitals (75.0%), and healthcare personnel of non-Hispanic White or other race (75.7%–77.4%). Healthcare personnel who received influenza vaccine in 2020–2021 (adjusted prevalence ratio=1.92) and those aged ≥60 years (adjusted prevalence ratio=1.37) were more likely to report a receipt of ≥1 dose of a COVID-19 vaccine. Non-Hispanic Black healthcare personnel (adjusted prevalence ratio=0.74), nurse practitioners/physician assistants (adjusted prevalence ratio=0.55), assistants/aides (adjusted prevalence ratio=0.73), and nonclinical healthcare personnel (adjusted prevalence ratio=0.79) were less likely to have received a COVID-19 vaccine. The common reasons for vaccination included protecting self (88.1%), family and friends (86.3%), and patients (69.2%) from COVID-19. The most common reason for nonvaccination was concern about side effects and safety of COVID-19 vaccine (59.7%).

Conclusions: Understanding vaccination status and intent among healthcare personnel is important for addressing barriers to vaccination. Addressing concerns on side effects, safety, and effectiveness of COVID-19 vaccines as well as their fast development and approval may help improve vaccination coverage among healthcare personnel.

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INTRODUCTION

Healthcare personnel (HCP) have been at an increased risk for coronavirus disease 2019 (COVID-19) from workplace exposure since the beginning of the COVID-19 pandemic. As of July 2021, >516,000 cases and 1,600 deaths owing to COVID-19 among HCP in the U.S. have been reported to the Centers for Disease Control and Prevention (CDC), which is most likely an underestimation of the actual number of cases and deaths given that only approximately 19% of reported cases have known HCP occupation status.[1] Earlier studies have documented a

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high number of COVID-19 cases among healthcare support workers, nurses, administrative staff members, environmental services workers, and physicians as well as in settings, including nursing homes and residential care facilities and hospitals.[2,3] Assessing the burden of COVID-19 disease among HCP is difficult because occupation is not reported to CDC for all COVID-19 cases.

Vaccines for COVID-19 have been available in the U. S. under Emergency Use Authorization since December 2020.[4] Given that HCP are on the front lines of the healthcare system, the Advisory Committee on Immunization Practices recommended that HCP be among the first group to be offered COVID-19 vaccines in the initial phase of the vaccination program beginning in December 2020.[5] The extent of vaccine uptake and coverage in this population is difficult to assess owing to the lack of occupation information in the vaccine administration data being reported to CDC. A survey conducted by the Kaiser Family Foundation in early March 2021 reported that 52% of 1,327 frontline healthcare workers —those who have direct contact with patients and their bodily fluids—reported having received ≥1 dose of a COVID-19 vaccine.[6] However, national estimates on COVID-19 vaccination coverage among all HCP, including those without direct patient contact, are lacking.

METHODS

Study Sample

Internet panel surveys have been conducted by CDC annually since 2011 to provide end-of-season influenza vaccination coverage estimates among HCP.[7] To assess a receipt of COVID-19 vaccine and intent for vaccination, additional questions were added to the survey fielded during March 31, 2021−April 15, 2021. Respondents were recruited from 2 pre-existing national opt-in Internet sources: Medscape (https://www.medscape.com) and Dynata (https://www.dynata.com). Current membership of Medscape, a medical website managed by WebMD Health Professional Network, was used to recruit physicians, nurse practitioners, physician assistants, nurses, dentists, pharmacists, allied health professionals, technicians, and technologists. Other HCP, including assistants, aides, and nonclinical personnel, were recruited from a general population Internet panel survey operated by Dynata. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy (e.g., 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. §241[d]; 5 U.S.C. §552a; 44 U.S.C. §3,501 et seq.).

Measures

For recruitment through the Medscape Panel, 68,894 e-mail invitations were sent; 7,606 (11.0%) panelists clicked on the invitation link and were presented with the survey. Of those, 4,581 (60.2%) answered the screening questions, and 1,571 were found to be eligible. A total of 1,525 (97.1%) of these panelists completed the survey. For recruitment through the Dynata panel, 198,213 panelists completed the screening question through the intercept method. Of these, 5,577 (2.8%) were eligible on the basis of the screening question, and 4,540 (81.4%) clicked on the invitation link to the survey. A total of 3,058 (67.4%) answered the screening questions, and 1,017 (33.3%) were found to be eligible. At last, 909 (89.4%) of these panelists completed the survey. Among 2,588 eligible participants, a total of 2,434 completed the survey (completion rate=94.0%). A total of 45 HCP were excluded from the analyses for either not meeting the study definition of HCP (n=43) or for having incomplete information about their COVID-19 vaccination status (n=2), resulting in an analytical sample of 2,389.

Quota sampling was utilized to reduce the initial recruitment imbalance by occupation. Data were weighted to the distribution of HCP by occupation, age, sex, race/ethnicity, work setting, and U.S. Census region.[8] A poststratification weight for each participant was developed through a raking calibration procedure to minimize bias in the estimates because of the disproportional representation of controlled subgroups.[9] The population totals used in raking were estimated using the most recent Bureau of Labor Statistics Occupational Employment and Wage Estimates (https://www.bls.gov/oes/current/oessrci.htm) and Current Population Survey data (https://www.bls.gov/cps/data.htm).

Respondents were considered vaccinated against COVID-19 if they answered *yes* to the question: *Have you received a COVID-19 vaccine?*. Respondents who reported not receiving a COVID-19 vaccine were asked: *How likely are you to get a COVID-19 vaccine if it were available to you today?* Response options included: *will definitely get a vaccine, will probably get a vaccine, am unsure about getting a vaccine, will probably not get a vaccine*, and *will definitely not get a vaccine*. Respondents were grouped by vaccination and intent status as follows: (1) HCP who had received a COVID-19 vaccine, (2) HCP who were definitely or probably getting vaccinated, (3) HCP who were unsure about getting vaccinated, and (4) HCP who probably or definitely did not intend to get vaccinated.

Information on sociodemographic characteristics, place of vaccination, influenza vaccination during the 2020−2021 influenza season, reasons for getting and not getting a COVID-19 vaccine, and attitudes toward COVID-19 illness and vaccination were also collected. For analyses regarding attitudes, answer options *agree* and *strongly agree* as well as *disagree* and *strongly disagree* were combined; *not sure* and *do not know* responses were set to missing.

Statistical Analysis

Weighted proportions and corresponding CIs for vaccination and each intent category are presented by work setting (respondents could select >1 work setting), occupation, demographic characteristics, and influenza vaccination status in 2020−2021. For descriptive analysis, the authors used any work setting, but HCP's primary work setting was included in regression models because approximately 20% of HCP reported working in multiple settings. To calculate the CIs for proportions in descriptive analysis, the Korn−Graubard method was used.[10] The CI assumes that the weighted estimates are approximately unbiased, which is based on the assertion that any differences between the survey sample and the target population on key survey outcomes are corrected by the sampling weight. National Center for Health Statistics reliability

criteria for proportions were applied to the estimates in the descriptive analyses of HCP characteristics, reasons for getting and not getting a COVID-19 vaccine, and attitudes toward COVID-19 illness and COVID-19 vaccination.[11] Chi-square tests were utilized to assess the differences between groups and to compare the attitudes toward COVID-19 illness and COVID-19 vaccination; $p<0.05$ was considered significant.

Multivariable logistic regression was used to determine the variables simultaneously associated with a receipt of a COVID-19 vaccine. The association was measured by adjusted prevalence ratios (APRs) calculated using average marginal predictions from the fitted logistic regression.[12] CIs for the model-adjusted prevalence ratios were obtained using a survey design−based estimate of the variance−covariance matrix of average marginal predictions and by delta method. A change-in-estimate procedure with a cut off value of 20% was employed to select the covariates for the final model.[13] Statistical significance of logistic regression parameter estimates was assessed by Wald *F*-test; *p*-values <0.05 were considered statistically significant. For all analyses, SAS, version 9.4, and SUDAAN, version 11.0.1, were used.

RESULTS

Overall, 68.2% of HCP reported having received ≥1 dose of a COVID-19 vaccine (61.3% were fully vaccinated), 9.8% would probably/definitely get vaccinated, 7.1% were unsure, and 14.9% would probably/definitely not get vaccinated (Table 1). Vaccination coverage was high among HCP aged 45−59 years (71.4%) and ≥60 years (88.2%), HCP with an associate or bachelor's degree (71.9%), HCP with more than a college degree (77.3%), HCP working in hospitals (75.0%), physicians (89.0%) and pharmacists (86.4%), and HCP who received an influenza vaccination during the 2020−2021 season (78.7%). Vaccination coverage was low among non-Hispanic Black (47.7%) and Hispanic (55.4%) HCP, assistants/aides (52.3%), nonclinical personnel (62.2%), HCP working in long-term care facilities/home health agencies (61.1%), and HCP with a primary workplace in the South region of the U.S. (63.4%). A larger proportion of Black HCP (25.7%) and HCP with primary workplace in the South region (18.0%) reported that they would probably/definitely not receive a COVID-19 vaccine (Table 1).

Findings from univariate and multivariable analysis to determine that factors associated with a receipt of a COVID-19 vaccination were generally consistent; however, work setting was no longer associated with a receipt of a COVID-19 vaccination in the multivariable analysis. HCP aged ≥60 years and those who received an influenza vaccination during the 2020−2021 season were more likely to have received a COVID-19 vaccination (APR=1.37, 95% CI=1.14, 1.65 and 1.92, 95% CI=1.53, 2.40, respectively) than their counterparts. Non-Hispanic Black HCP (APR=0.74, 95% CI=0.60, 0.92), nurse practitioners/physician assistants (APR=0.55, 95% CI=0.28, 1.07), assistants/aides (APR=0.73, 95% CI=0.64, 0.83), and nonclinical personnel (APR=0.79, 95% CI=0.68, 0.91) were less likely to have received a COVID-19 vaccine than their counterparts. Education was found to be significantly associated with receipt of a COVID-19 vaccine but was not adjusted for in the model owing to multicollinearity with occupation (Table 2).

The most common reasons for receipt of a COVID-19 vaccine among HCP included protecting self (88.1%) as well as protecting friends and family (86.3%) and patients (69.2%) from COVID-19 illness. The most common reasons for not receiving a COVID-19 vaccine among unvaccinated HCP included concerns about the side effects and safety of the COVID-19 vaccine (59.7%), desire to wait and see whether vaccines are safe (51.2%), and concerns about fast development (50.0%) and approval (50.4%) of COVID-19 vaccines (Table 3).

When examining the attitudes, beliefs, and perceptions about COVID-19 illness and vaccines, most HCP agreed/strongly agreed that COVID-19 was a serious threat to the health of people around them (88.0%) and that people around them were at-risk of getting COVID-19 (86.0%). In addition, 78.2% of HCP agreed/strongly agreed that COVID-19 vaccines are safe. Smaller proportions of HCP agreed/strongly agreed that HCP should be rewarded for getting vaccinated against COVID-19 (67.8%) or that HCP should be required to be vaccinated (58.2%) (Figure 1A). Vaccination coverage was highest, ranging from 72.4% to 84.5%, among HCP who agreed or strongly agreed with statements such as believing that COVID-19 vaccines are safe, that the vaccines could protect them from getting COVID-19, and that HCP should be required to be vaccinated. Among HCP who would probably/definitely not get vaccinated, a larger proportion disagreed/strongly disagreed that getting vaccinated against COVID-19 was worth the time and expense (59.2%); that if they got a COVID-19 vaccine, people around them would be better protected from COVID-19 (57.5%); that COVID-19 is a serious threat to the health of people around them (57.3%); and that the COVID-19 vaccine is safe (53.6%) (Figure 1B).

DISCUSSION

Although HCP were among the first group to be offered COVID-19 vaccines in the initial phase of the vaccination program,[5] only 68% of HCP in the U.S. reported having received ≥1 dose of a COVID-19 vaccine as of April 2021. In a survey conducted in early March 2021 by the Kaiser Family Foundation, 52% of 1,327 frontline healthcare workers who had direct contact with patients

Table 1. COVID-19 Vaccination and Intent Among Healthcare Personnel by Selected Characteristics–U.S., April 2021

Characteristics	Total, *N* (weighted %)	Vaccinated (*n*=1,780), weighted % (95% CI)[a]	Definitely/probably will get a vaccine (*n*=202), weighted % (95% CI)	Unsure (*n*=154), weighted % (95% CI)	Definitely/probably will not get a vaccine (*n*=253), weighted % (95% CI)
Overall[b]	2,389	68.2 (63.7, 72.5)	9.8 (7.6, 12.3)	7.1 (5.3, 9.3)	14.9 (11.1, 19.4)
Age					
18–29 years (ref)	263 (17.5)	54.3 (39.7, 68.4)	10.8 (6.1, 17.2)	7.7 (3.7, 13.7)	—[c]
30–44 years	1,007 (38.9)	64.6 (58.5, 70.3)	11.9 (7.9, 16.9)	9.0 (5.9, 13.1)	14.5 (9.9, 20.1)
45–59 years	773 (29.0)	**71.4 (64.3, 77.8)**	8.6 (5.0, 13.4)	6.8 (3.5, 11.8)	13.2 (8.2, 19.6)
≥60 years	345 (14.6)	**88.2 (81.1, 93.3)**	—[c]	**1.7 (0.3, 4.9)**	—[c]
Race/ethnicity[d]					
Non-Hispanic White (ref)	1,418 (61.4)	75.7 (71.4, 79.7)	7.3 (5.0, 10.1)	6.5 (4.5, 9.2)	10.5 (7.9, 13.6)
Non-Hispanic Black	315 (17.0)	**47.7 (33.2, 62.5)**	14.8 (8.3, 23.7)	—[c]	**25.7 (13.3, 41.8)**
Hispanic	399 (14.1)	**55.4 (40.8, 69.4)**	14.5 (6.9, 25.5)	—[c]	—[c]
Non-Hispanic other	253 (7.5)	77.4 (64.5, 87.3)	—[c]	—[c]	—[c]
Sex					
Male (ref)	794 (23.3)	64.5 (52.2, 75.5)	12.8 (7.5, 19.9)	—[c]	—[c]
Female	1,595 (76.7)	69.3 (64.7, 73.7)	8.8 (6.5, 11.6)	7.8 (5.6, 10.5)	14.0 (10.4, 18.3)
Education					
Some college education or less (ref)	540 (29.1)	54.5 (46.3, 62.6)	10.1 (6.6, 14.6)	11.8 (7.3, 17.8)	23.5 (16.0, 32.5)
Associate or bachelor's degree	767 (45.2)	**71.9 (64.4, 78.6)**	11.1 (7.4, 15.8)	**3.9 (2.6, 5.7)**	13.1 (7.2, 21.3)
More than college degree	1,081 (25.7)	**77.3 (69.8, 83.7)**	7.0 (3.6, 12.2)	7.3 (3.7, 12.7)	**8.3 (4.5, 13.9)**
Occupation[e]					
Physician (ref)	283 (3.4)	89.0 (82.8, 93.6)	—[c]	1.1 (0.1, 4.1)	—[c]
Nurse Practitioner/Physician assistant	147 (1.4)	—[c]	—[c]	—[c]	—[c]
Nurse	178 (18.4)	82.2 (73.6, 88.9)	—[c]	1.5 (0.3, 4.6)	—[c]
Pharmacist	309 (1.3)	86.4 (82.0, 90.0)	6.0 (3.6, 9.3)	3.0 (1.4, 5.7)	4.6 (2.5, 7.6)
Other clinical personnel[f]	561 (18.8)	81.2 (72.5, 88.1)	—[c]	—[c]	—[c]
Assistant/aide	577 (24.2)	**52.3 (47.8, 56.8)**	13.9 (10.9, 17.4)	**12.6 (9.8, 15.9)**	21.2 (17.6, 25.2)
Nonclinical personnel[g]	305 (32.5)	**62.2 (50.5, 73.0)**	10.5 (5.6, 17.4)	—[c]	20.9 (10.8, 34.5)
Work setting[h]					
Hospital	887 (38.6)	**75.0 (68.9, 80.5)**	8.3 (5.1, 12.6)	**3.1 (1.9, 4.7)**	13.6 (9.0, 19.3)
Ambulatory care	708 (22.6)	73.7 (61.2, 83.9)	9.0 (5.3, 14.1)	**3.5 (1.8, 6.1)**	—[c]
Long-term care facility/ Home health agency[i]	575 (41.7)	**61.1 (53.3, 68.5)**	12.6 (8.5, 17.7)	**10.6 (6.8, 15.7)**	15.7 (9.9, 23.1)
Other settings[j]	618 (10.8)	75.5 (67.1, 82.7)	6.5 (3.3, 11.4)	8.8 (4.6, 14.7)	**9.2 (5.4, 14.4)**
Area of primary workplace[k]					
Rural (ref)	308 (12.2)	70.7 (61.9, 78.5)	—[c]	9.8 (5.5, 15.9)	15.0 (10.1, 21.1)
Nonrural	2,078 (87.8)	67.9 (62.9, 72.6)	10.5 (8.0, 13.5)	6.7 (4.8, 9.2)	14.9 (10.6, 20.1)

(*continued on next page*)

Table 1. COVID-19 Vaccination and Intent Among Healthcare Personnel by Selected Characteristics–U.S., April 2021 (*continued*)

Characteristics	Total, *N* (weighted %)	Vaccinated (*n*=1,780), weighted % (95% CI)[a]	Definitely/probably will get a vaccine (*n*=202), weighted % (95% CI)	Unsure (*n*=154), weighted % (95% CI)	Definitely/probably will not get a vaccine (*n*=253), weighted % (95% CI)
Region[l]					
Northeast (ref)	455 (19.8)	76.3 (68.2, 83.3)	12.7 (7.3, 20.0)	—[c]	5.5 (2.9, 9.2)
Midwest	398 (23.3)	71.9 (62.3, 80.3)	—[c]	5.8 (3.4, 9.0)	**15.8 (8.7, 25.4)**
South	1,024 (36.1)	**63.4 (55.4, 70.9)**	9.1 (6.2, 12.7)	9.5 (6.2, 13.8)	**18.0 (11.7, 25.9)**
West	507 (20.8)	64.7 (51.9, 76.1)	11.9 (6.5, 19.6)	—[c]	—[c]
Receipt of influenza vaccine in 2020–2021					
Yes	1,920 (75.9)	**78.7 (74.7, 82.3)**	9.2 (6.7, 12.1)	**4.3 (3.0, 5.9)**	**7.9 (5.4, 11.1)**
No (ref)	469 (24.1)	35.2 (25.3, 46.0)	11.7 (6.9, 18.3)	16.0 (9.7, 24.3)	37.1 (25.8, 49.6)
Place of COVID-19 vaccination					
At work	1,070 (64.9)	NA	NA	NA	NA
Doctor's office/medical clinic or health center/ health department	481 (23.3)	NA	NA	NA	NA
Other[m]	229 (11.8)	NA	NA	NA	NA

Note: Bold text indicates statistical significance ($p<0.05$).
Respondents who reported not receiving a COVID-19 vaccination were asked how likely they are to get a COVID-19 vaccine (*n*=609); response options included definitely will, probably will, unsure, probably will not, and definitely will not get a COVID-19 vaccine.
[a]Korn-Graubard 95% CI.
[b]Vaccination and intent categories add up to 100%. Total for each of the characteristics may not add up to the overall owing to missing responses.
[c]Estimates do not meet the National Center for Health Statistic's standards of reliability. https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf.
[d]Race/ethnicity was self-reported. Respondents identified as Hispanic might be of any race. The other race category included Asians, American Indians/Alaska Natives, Native Hawaiians or other Pacific Islanders, and those who selected other or multiple races.
[e]Excluding students.
[f]Other clinical personnel include dentists, allied health professionals, technicians and technologists, emergency technicians, emergency medical technicians, and paramedics.
[g]Nonclinical personnel include administrative support staff/manager and nonclinical support staff.
[h]Respondents could select >1 work setting. Each work setting is represented by a separate variable with 2 levels (yes/no, where reference level is no) rather than 1 variable with multiple categories corresponding to each work setting. Students were excluded from work setting variables (*n*=37).
[i]Nursing home, assisted living facility, other long-term care facilities, home health agency, or home health care.
[j]Includes dentist office or dental clinic, pharmacy, emergency medical services, and other settings where clinical care or related services were provided to patients.
[k]Rurality was defined using ZIP codes where >50% of the population resides in a nonmetropolitan county, a rural U.S. Census tract, or both, according to the Health Resources and Services Administration's definition of rural population. https://www.hrsa.gov/rural-health/about-us/definition/index.html.
[l]Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. South: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. West: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.
[m]Other place of first or only COVID-19 vaccination includes other medically or nonmedically related places, such as drugstores, supermarkets, and pharmacies.
NA, not applicable.

Table 2. Factors Associated With a Receipt of ≥1 Dose of a COVID-19 Vaccine Among Healthcare Personnel–U.S., April 2021

Characteristics	Prevalence ratio (95% CI)[a]	*p*-Value	Adjusted prevalence ratio[b] (95% CI)	*p*-Value
Age				
18–29 years (ref)				
30–44 years	1.19 (0.91, 1.56)	0.17	1.02 (0.85, 1.22)	0.82
45–59 years	**1.31 (1.01, 1.71)**	0.02	1.16 (0.98, 1.38)	0.07
≥60 years	**1.62 (1.25, 2.11)**	<0.0001	**1.37 (1.14, 1.65)**	<0.001
Race/ethnicity[c]				
Non-Hispanic white (ref)				
Non-Hispanic Black	**0.63 (0.47, 0.85)**	<0.0001	**0.74 (0.60, 0.92)**	<0.01
Hispanic	**0.73 (0.57, 0.94)**	<0.01	0.90 (0.79, 1.03)	0.1
Non-Hispanic other	1.02 (0.88, 1.19)	0.78	1.06 (0.91, 1.24)	0.49
Occupation[d]				
Physician (ref)				
Nurse Practitioner/Physician assistant	**0.59 (0.33, 1.05)**	<0.01	**0.55 (0.28, 1.07)**	<0.01
Nurse	0.92 (0.83, 1.03)	0.13	0.94 (0.83, 1.07)	0.35
Pharmacist	0.97 (0.90, 1.04)	0.43	0.93 (0.81, 1.07)	0.32
Other clinical personnel[e]	0.91 (0.82, 1.02)	0.08	0.94 (0.83, 1.07)	0.34
Assistant/aide	**0.59 (0.53, 0.65)**	<0.0001	**0.73 (0.64, 0.83)**	<0.0001
Nonclinical personnel[f]	**0.70 (0.58, 0.84)**	<0.0001	**0.79 (0.68, 0.91)**	<0.01
Primary work setting[g]				
Hospital (ref)				
Ambulatory care	0.95 (0.80, 1.12)	0.52	1.07 (0.95, 1.21)	0.28
Long-term care facility or home health agency/care[h]	**0.82 (0.70, 0.95)**	<0.01	1.08 (0.95, 1.24)	0.25
Other settings[i]	1.07 (0.92, 1.26)	0.42	1.23 (1.02, 1.49)	0.07
Receipt of influenza vaccine in 2020–2021				
Yes	**2.24 (1.68, 2.98)**	<0.0001	**1.92 (1.53, 2.40)**	<0.0001
No (ref)				
Sex			Not selected	
Male (ref)			Not selected	
Female	1.08 (0.89, 1.29)	0.42	Not selected	
Education				
Some college education or less (ref)			Not selected	
Associate or bachelor's degree	**1.32 (1.10, 1.58)**	<0.01	Not selected	
More than college degree	**1.42 (1.21, 1.66)**	<0.0001	Not selected	
Area of primary workplace[j]				
Rural (ref)			Not selected	
Nonrural	0.96 (0.84, 1.10)	0.56	Not selected	
Region[k]				
Northeast (ref)			Not selected	
Midwest	0.94 (0.80, 1.12)	0.49	Not selected	
South	**0.83 (0.71, 0.97)**	0.02	Not selected	
West	0.85 (0.69, 1.04)	0.09	Not selected	

Note: Boldface indicates statistical significance ($p<0.05$).
CIs for the model-adjusted prevalence ratios were obtained using a survey design–based estimate of the variance–covariance matrix of average marginal predictions and may not correspond to *p*-values on the basis of the Wald chi-square test of regression coefficients.
[a]95% CI.
[b]Logistic regression models included age, race/ethnicity, occupation, primary work setting, and receipt of an influenza vaccine in 2020–2021 season.
[c]Race/ethnicity was self-reported. Respondents identified as Hispanic might be of any race. The Other race category included Asians, American Indians/Alaska Natives, Native Hawaiians or other Pacific Islanders, and those who selected other or multiple races.
[d]Excluding students.
[e]Other clinical personnel include dentists, allied health professionals, technicians and technologists, emergency technicians, emergency medical technicians, and paramedics.
[f]Nonclinical personnel include administrative support staff/manager and nonclinical support staff.

[g]Work setting presented in Table 2 is created differently from the work setting variable presented in Table 1. The work setting variable presented in this table represents healthcare personnel's primary work setting created as 1 variable with 4 categories that are mutually exclusive, which is different from the work setting variable presented in Table 1, where each subgroup was a separate variable that was not mutually exclusive. Primary work settings for students were excluded (*n*=37).
[h]Nursing home, assisted living facility, other long-term care facilities, home health agency, or home health care.
[i]Includes dentist office or dental clinic, pharmacy, emergency medical services, and other settings where clinical care or related services were provided to patients.
[j]Rurality was defined using ZIP codes where >50% of the population resides in a nonmetropolitan county, a rural U.S. Census tract, or both, according to the Health Resources and Services Administration's definition of rural population. https://www.hrsa.gov/rural-health/about-us/definition/index.html.
[k]Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. South: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. West: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

and their bodily fluids reported having received ≥1 dose of a COVID-19 vaccine.[6] Estimated vaccination coverage was higher in the current analyses, which may be owing to the later timing of this survey as well as the inclusion of all HCP regardless of direct patient contact. A study assessing vaccination intent among HCP conducted in September 2020 estimated that only 35% of HCP were very likely/absolutely certain about receiving a COVID-19 vaccine and that >38% were very not likely to receive a vaccine.[14] A later study assessed COVID-19

Table 3. Reasons for Receipt and Nonreceipt of COVID-19 Vaccine Among Healthcare Personnel–U.S., April 2021

Reasons	*n*	Weighted % (95% CI)[a]
Reasons for nonreceipt of a COVID-19 vaccination[b,c,d]		
Concerned about the side effects and safety of the COVID-19 vaccine	345	59.7 (50.6, 68.3)
Plan to wait and see whether it is safe and may get it later	303	51.2 (42.0, 60.3)
Concerned that the COVID-19 vaccine was developed too fast	290	50.0 (40.9, 59.1)
Concerned that the COVID-19 vaccine was approved too fast	288	50.4 (41.8, 59.0)
Plan to use masks and other precautions instead	201	37.1 (28.3, 46.5)
Concerned about having an allergic reaction to COVID-19 vaccine	160	29.2 (20.8, 38.8)
Not a member of any group that is at high risk from COVID-19	145	23.2 (15.1, 33.1)
Do not trust the government	127	16.3 (10.4, 23.9)
Do not think that the vaccine will prevent COVID-19	122	18.1 (11.7, 26.1)
Do not think that the vaccination is effective in preventing COVID-19	118	18.2 (11.7, 26.3)
Not in one of the groups recommended to get the initial doses of COVID-19 vaccine	85	—[e]
The vaccine was/is not available	83	—[e]
Already had COVID-19 and should be immune	67	14.3 (6.8, 25.3)
Reasons for receipt of a COVID-19 vaccination[c,d]		
To protect myself from COVID-19	1,581	88.1 (84.2, 91.3)
To protect my friends or family from COVID-19	1,510	86.3 (83.1, 89.1)
To protect patients from getting COVID-19	1,317	69.2 (64.0, 74.0)
Because COVID-19 was/is bad	1,258	67.3 (62.4, 71.9)
COVID-19 vaccine was offered free of charge at work	956	57.0 (51.9, 61.9)
It is easy or convenient to get COVID-19 vaccination at work	769	46.6 (41.6, 51.7)
To avoid missing work	629	31.9 (27.7, 36.4)
A doctor, nurse, or other medical professional recommended COVID-19 vaccination to me	475	30.2 (25.7, 35.0)
I have a health condition (for example, diabetes, asthma, pregnancy, age)	352	19.9 (15.9, 24.5)
Because it was mandatory, or I had to for work	123	—[e]
Because I had to for school	20	—[e]

[a]Korn-Graubard 95% CI.
[b]More than 1 reason could be selected for reasons for a vaccination with a COVID-19 vaccine.
[c]Other reasons for vaccination are not presented owing to proportions not meeting the National Center for Health Statistic's standards of reliability. https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf.
[d]More than 1 reason could be selected.
[e]Estimates do not meet the National Center for Health Statistic's standards of reliability. https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf.

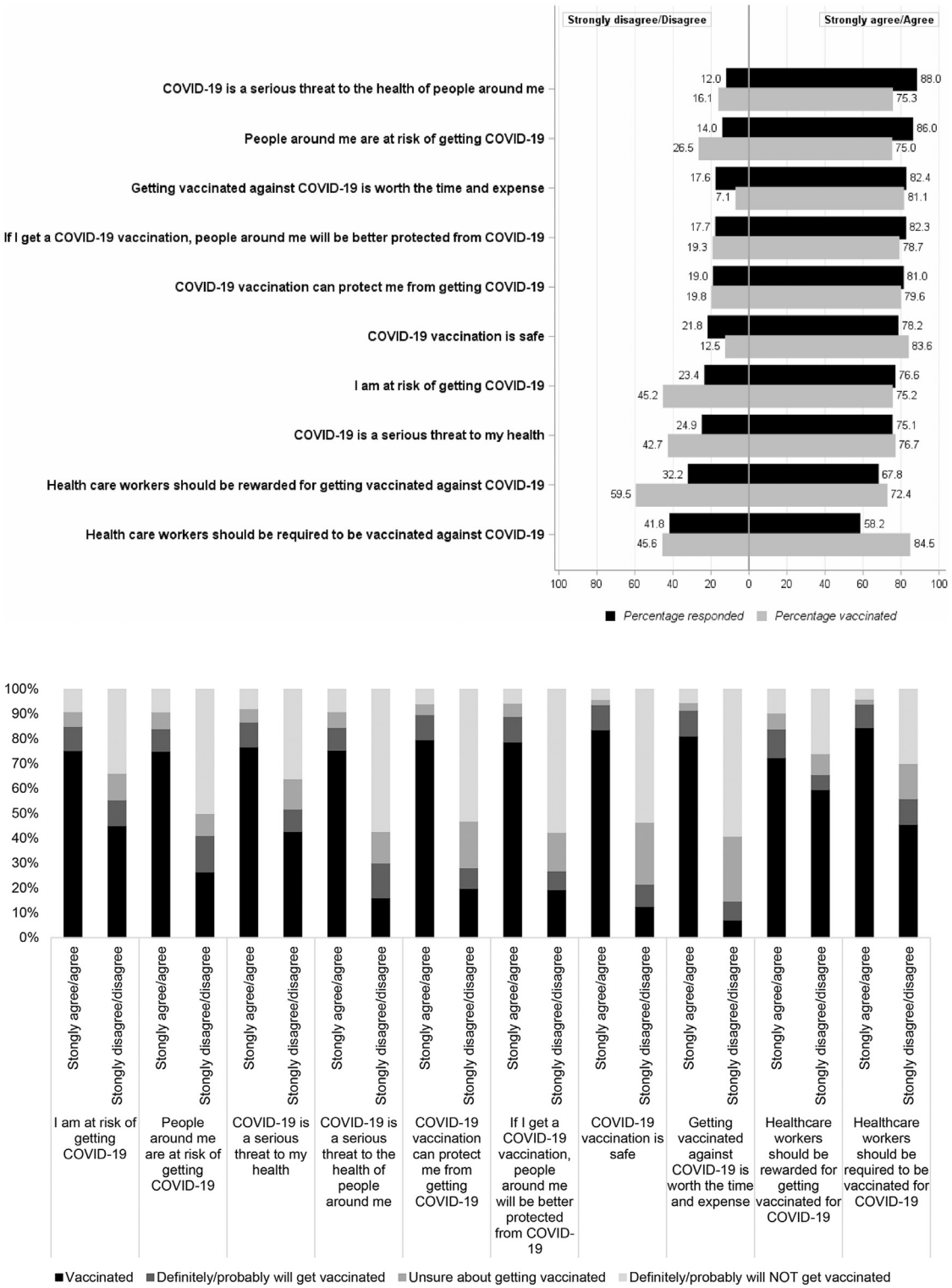

Figure 1. (A) Attitudes toward COVID-19 illness and vaccination among healthcare personnel–U.S., April 2021. (B) Healthcare providers reporting a receipt of ≥1 dose of COVID-19 vaccine and those reporting intent[a] for vaccination, by attitude—U.S., April 2021.
[a]Respondents who reported not receiving a COVID-19 vaccination were asked how likely they are to get a COVID-19 vaccine (*n*=609); response options included definitely will, probably will, unsure, probably will not, and definitely will not get a COVID-19 vaccine.

vaccination intent among HCP in November 2020 and estimated that a lower percentage (8%) of HCP would not take a COVID-19 vaccine, whereas 56% would wait for additional review before receiving a vaccine, which may have been because of the availability of additional information on COVID-19 vaccines.[15]

Although COVID-19 vaccines have been authorized and available to HCP since December 2020 and 78% of HCP have received or will definitely receive a COVID-19 vaccine, approximately twice as many HCP in this study indicated that they would not receive a COVID-19 vaccine compared with most estimates from earlier studies.[15] This increase is likely owing to concerns with side effects and safety of COVID-19 vaccines as well as the perceived fast development and approval of these vaccines, as indicated in this study. Despite the increase in the percentage of HCP who would probably/definitely not get a COVID-19 vaccine, COVID-19 vaccination uptake could likely be increased among unvaccinated HCP by addressing barriers to vaccination and ensuring that findings from studies and data on COVID-19 vaccine safety are accessible and easily understood. Finally, expanding and reinforcing strategies such as promoting free vaccinations and making them easily accessible at the workplace during work hours may increase vaccination uptake because these were identified as motivating factors for vaccinated respondents.

Similar to the demographic characteristics of people receiving ≥1 dose of a COVID-19 vaccination in the U.S., the authors observed lower COVID-19 vaccination coverage among younger, Hispanic, and non-Hispanic Black HCP.[16] Given that a larger proportion of recent COVID-19 cases has been reported among younger adults and those of Hispanic and non-Hispanic Black race where vaccination coverage is also low, it is important to address the potential barriers to vaccination and improve vaccination uptake in this population.[17] Current analyses show that the main reasons for nonvaccination include concerns with side effects and safety of COVID-19 vaccines as well as fast development and approval of the vaccines. Providing additional information and addressing the concerns on the safety and effectiveness of COVID-19 vaccines as well as the U.S. Food and Drug Administration's approval of the vaccines may contribute to an increase in vaccination uptake among unvaccinated HCP.[18]

This analysis also found that COVID-19 vaccination coverage was highest among physicians, pharmacists, and nurses and lowest among assistants/aides. Similar results have been observed previously for influenza vaccination as well as for COVID-19 vaccination.[6,7] Not only are HCP at increased risk of contracting and transmitting COVID-19, but they can also play a critical role in influencing patients' vaccination decisions and acting as vaccine champions for coworkers. Previous studies have concluded that vaccinated HCP are more likely to recommend vaccination to others and that HCP recommendation is one of the strongest predictors of vaccination.[19,20] Thus, it is important to empower HCP by promoting confidence in their decision to get vaccinated and to recommend vaccination to their patients as vaccines become more widely available in settings such as doctor's offices and clinics. In addition, it has been well documented that HCP are a trusted source of information; therefore, educating HCP regarding the importance of talking to their patients about COVID-19 vaccination is essential for increasing general COVID-19 vaccination uptake.[21,22] A set of strategies, including engagement with local and national professional associations, cultivating a culture that builds confidence in COVID-19 vaccination, and strengthening the capacity of HCP to have vaccine conversations and provide tailored information to patients, could empower HCP and promote confidence in vaccination.[22]

Finally, the lowest vaccination coverage among HCP was observed in settings such as long-term care facilities and home healthcare agencies where the population served are at increased risk of infection and severe illness from COVID-19.[23] A recent study assessing COVID-19 vaccination coverage among HCP from 300 long-term care facilities estimated that only 56.8% of HCP in these settings were fully vaccinated as of April 4 and that 25.9% had declined COVID-19 vaccination.[24] Data from CDC's National Healthcare Safety Network estimate that approximately 60% of staff in long-term care facilities have received ≥1 dose of a COVID-19 vaccine.[25] Lower COVID-19 vaccination coverage in these settings is most likely attributable to other factors such as age, race/ethnicity, and occupation of HCP and not work setting because staff at long-term care facilities were among the first to have been offered a COVID-19 vaccination on-site.[5,26] Furthermore, influenza vaccination coverage among HCP in these settings is similarly low.[7] Long-term care facilities and home healthcare agencies can use CDC's long-term care web-based toolkit, which provides access to resources, strategies, and educational materials for increasing COVID-19 vaccination among HCP and reducing COVID-19–associated morbidity and mortality among residents in long-term care settings.[27] Finally, mandatory employer influenza programs as well as workplace incentives have been associated with high vaccination rates, decreased HCP absenteeism, and decreased healthcare-associated infections among hospitalized patients.[28] Similar mandates could increase COVID-19 vaccination uptake among HCP and prevent severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) transmission in all healthcare settings.

Limitations

This analysis is among the first to estimate COVID-19 vaccination among HCP in the U.S.; however, the following limitations should be considered in interpreting the findings. First, although quota sampling and raking approaches to weighting result in adjusted point estimates that are demographically representative of the U. S. HCP population, the SEs calculated with these data assumed that a probability sample had been used. However, there is no probability of selection for each respondent owing to the opt-in nature of this survey.[29] Second, a potential for nonresponse and noncoverage bias may exist in the parameter estimates because of the self-selection process for entry into the panel and participation in the survey. Previous literature suggests that the respondents of panel surveys may be more frequent Internet users than the general population and may have attitudinal and behavioral differences that may result in different vaccination coverage.[30,31] However, in sensitivity analyses, the investigators did not find any statistically significant trend or association between COVID-19 vaccination coverage and frequency of Internet use or type of device utilized to complete the survey. Although the point estimates may be biased, the measure of association may be less affected by nonprobability sampling.[32,33] Third, vaccination status was self-reported and not validated by medical record review and might be subject to recall or social desirability bias. Fourth, some subgroups had small sample sizes, and the authors were not able to assess vaccination coverage in those groups, such as individuals of non-Hispanic Asian race/ethnicity. Finally, the survey was only administered in English, and HCP with limited English proficiency may be under-represented. Despite these limitations, Internet panel surveys are considered a useful assessment tool for timely evaluation of vaccination coverage among HCP given the limited availability of such data from other data sources.

CONCLUSIONS

This study is among the first to examine vaccination coverage, vaccination intent, and reasons for nonvaccination among U.S. HCP overall and by occupation and work setting. Understanding vaccination status and intent is important for addressing barriers to vaccination, especially among occupations and work settings where HCP vaccination is lowest. Implementing interventions that can mitigate barriers to vaccination, such as flexible scheduling, paid time off for vaccination, onsite vaccination, or incentives, may improve vaccination coverage among HCP. These efforts can help to curb COVID-19 transmission, especially with the surge of new variants,[34] and protect the health of HCP and others, such as long-term care facility residents, who may be at increased risk for COVID-19 illness.

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