

Health Care Personnel (HCP) attitudes about COVID-19 vaccination after emergency use authorization.

Jana Shaw MD, MPH^{1*}; Samantha Hanley²; Telisa Stewart DrPH²; Daniel A. Salmon PhD, MPH³, Christine Ortiz², Paula M Trief PhD⁴, Elizabeth Asiago Reddy MD⁵, Christopher P Morley PhD, MA². Stephen J Thomas MD^{5,6,7}, Kathryn B Anderson MD, PhD^{5,6,7}

¹Department of Pediatrics, Division of Infectious Diseases, Upstate Golisano Children's Hospital, SUNY Upstate Medical University, Syracuse, NY, USA.

²Department of Public Health and Preventive Medicine, SUNY Upstate Medical University, Syracuse, NY, USA.

³Institute for Vaccine Safety, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA.

⁴Department of Psychiatry and Behavioral Sciences, SUNY Upstate Medical University, Syracuse, NY, USA.

⁵Department of Medicine, SUNY Upstate Medical University, Syracuse, NY, USA.

⁶Institute for Global Health and Translational Science, SUNY Upstate Medical University, Syracuse, NY, USA.

⁷Department of Microbiology and Immunology, SUNY Upstate Medical University, Syracuse, NY, USA.

Corresponding Author: Dr. Jana Shaw, Department of Pediatrics, Division of Infectious Diseases, State University of New York Upstate Medical University, Golisano Children's Hospital, 750 East Adams Street, Syracuse, NY 13210, USA. Email: shawja@upstate.edu. Phone: 315-464-6331

Summary: The majority of HCP were vaccinated, much higher than reporting intent before vaccine was available. However, many HCP are still hesitant. Feasible and effective interventions to address the hesitant, including individually-tailored education strategies are needed, or vaccine can be mandated.

Abstract

Background: We previously reported on COVID-19 vaccination intent among HCP before emergency use authorization. We found widespread hesitancy and a substantial proportion of HCP did not intend to vaccinate.

Methods: We conducted a cross-sectional survey of HCP, including clinical and non-clinical staff, researchers, and trainees between February 21 and March 19, 2021. The survey evaluated vaccine attitudes, beliefs, intent and acceptance.

Results: Overall, 3,981 (87.7%) of respondents had already received a COVID-19 vaccine or planned to get vaccinated. There were significant differences in vaccine acceptance by gender, age, race, and hospital role. Males (93.7%) were more likely than females (89.8%) to report vaccine acceptance ($p < 0.001$). Mean age was higher among those reporting vaccine acceptance ($p < 0.001$). Physicians and scientists showed the highest acceptance rate (97.3%), while staff in ancillary services showed the lowest acceptance rate (79.9%). Unvaccinated respondents were more likely to be females, to have refused vaccines in the past due to reasons other than illness or allergy, to care for COVID-19 patients, or to rely on themselves when making vaccination decision. Vaccine acceptance was more than twice previous intent among Black respondents, an increase from 30.8% to 73.8%, and across all hospital roles with all $\geq 80\%$ vaccine acceptance.

Conclusions: The majority of HCP were vaccinated, much higher than reporting intent before vaccine was available. However, many HCP—particularly ancillary services—are still hesitant. Feasible and effective interventions to address the hesitant, including individually-tailored education strategies are needed, or vaccine can be mandated.

Keywords: COVID-19, vaccine, health care personnel, safety

Introduction

The COVID-19 pandemic has claimed 606,531 American lives as of July 9, 2021, and has led to unprecedented suffering and health care costs.[1] Two-dose mRNA COVID-19 vaccines became available to the United States (US) public in December 2020 and a single dose J&J/Janssen vaccine received authorization February 27, 2021.[2] Vaccination reduces disease, hospitalization, death and transmission and as such, remains the most impactful tool to reduce the impact of the pandemic.[3] The COVID-19 vaccination program initially targeted groups at the highest risk for contracting infection or severe disease, but as of April 16, 2021, the vaccines became available to all Americans ages 16 years and older. As of July 9, 2021, 59.7% of the US population 18 years and older have been fully vaccinated.[4]

Health care personnel (HCP) were included in the early phase of the vaccination program. We previously reported on vaccination intent among HCP in a large, university health-care system shortly before the emergency use authorization (EUA) of the Pfizer-BioNTech BNT162b2 mRNA vaccine between November 23, and December 5, 2020.[5] We found that 57.5 % of HCP intended to receive a COVID-19 vaccine. Vaccination intent differed by hospital role, race, age and gender. In January 2021, US emergency department physicians had the lowest refusal of vaccination rate (5.5%), with nurses and non-clinical support staff having the highest refusal rates (range 22.3%-24.3%).[6]

HCPs can be a very influential sources of information about COVID-19 and other vaccines.[7] Therefore, it is important to assess their attitudes and beliefs, as they will likely not only affect their own decisions about vaccination, but also decisions made by their patients and family members. The objectives of this study were to assess changes in vaccination intentions and acceptance rates among HCP, and to characterize vaccine hesitancy among HCP after vaccines became widely available.

Methods

Study Population setting

SUNY Upstate Medical University (Upstate) in Syracuse, New York State, is the only academic medical center in Central New York and the region's largest employer with almost 10,000 employees. Its catchment area includes 17 counties ranging from Canada in the north, to the Pennsylvania borders in the south.

Survey Administration/Content

We conducted an anonymous, voluntary survey of HCP, including clinical and nonclinical staff, researchers, and trainees, between February 21 and March 19, 2021. An initial email invitation was sent on February 21, 2021. We provided 6 email reminders through different institutional channels during the survey period. The survey was managed using REDCap electronic data capture tools hosted by SUNY Upstate Medical University. We developed a comprehensive survey to evaluate COVID-19 vaccine attitudes, beliefs, intent and status. We previously adapted a validated vaccine hesitancy survey developed by Opel et al. [5][8] The survey included questions about basic demographic information, occupation, perceived risk and severity of COVID-19, history of prior influenza vaccination, intent to get vaccinated, who is most influential in the decision to get vaccinated, whether respondents participated in the prior survey, and whether vaccination should be mandatory. We also inquired about reasons participants chose to either accept, delay or refuse vaccination. Three open ended questions were asked: 1) "What was positive about your experience?"; 2) "What was negative about your experience?"; and "What were your concerns?", The SUNY Upstate

Institutional Review Board determined this project did not meet the definition of human subject research under the purview of the IRB, as its primary goal was internal quality improvement.

Data Analysis

We examined descriptive statistics of vaccine attitudes, beliefs, intent and status including stratified analyses by demographics and professional role. Those who had been vaccinated or planned to were combined for analyses and referred to as vaccine acceptance. Differences in proportions were assessed via χ^2 analysis, and differences in means across response categories were assessed via analysis of variance (ANOVA). All quantitative analyses were performed using SPSS vs 27.

Qualitative Variables

The three qualitative questions were analyzed separately using opened ended content analysis. Two qualitative analysts openly coded the data and supported the coding process with the machine learning tool in ATLAS.ti version 9. The investigators randomly sampled the text with the codes to ensure the integrity of the machine learning. For each question, the codes were grouped into themes.

Results

Participants characteristics

Of the 9,565 HCP who received the email invitation, 4,537 (response rate 47.4%) provided information about their COVID-19 vaccination status or intent. The mean age of respondents was 45.5 years (range 19-86); 2,645 (75.3%) were females, 3,451 (96.6%) were non-Hispanic, 176 (5.8%) were non-Hispanic Black, 208 (5.8%) identified as Asian American and 127 (3.6%) identified as "other group." Those who chose *not to receive a vaccine*, or who were *uncertain about getting vaccinated* were more likely not to provide demographic information compared to those who reported *vaccination acceptance or intent*; 32.0% and 28.7% versus 18.2%, respectively ($p < 0.05$). Distribution of demographic factors by hospital role is detailed in table 1.

Vaccine acceptance by hospital roles and selected characteristics

Overall, 3,981 (87.7%) of respondents indicated they had already received a COVID-19 vaccine or planned to get vaccinated. There were significant differences in vaccine acceptance by gender, age, race, and hospital role (table 2). Males (93.7%) were more likely than females (89.8%) to report acceptance of vaccines ($p < 0.001$). Mean age was higher among those reporting vaccine acceptance ($p < 0.001$). The highest acceptance rates were observed among Native Hawaiian/Pacific Islander (PI) (100%), Asian (96.7%) and White (91.4%) respondents, respectively. However, only 6 respondents self-identified as Hawaiian/PI. According to hospital role, physicians and scientists showed the highest acceptance rate (97.3%), while staff in ancillary services (i.e. clerical, dietary, phlebotomy, unit support, registration, clinical support, environmental services) showed the lowest acceptance rate (79.9%). Vaccination acceptance did not differ between those who provided direct patient care and those who did not. Surprisingly, the vaccine refusal rate was higher for staff caring for COVID-19 patients ($p < 0.01$) compared to staff who did not care for COVID-19 patients. Staff who refused vaccination, or who were undecided about vaccination decisions, were more likely to have refused other vaccines for reasons other than illness or allergy compared to those who intended to or were vaccinated ($p < 0.001$).

Vaccine acceptance comparison before and after vaccine emergency use authorization
Overall, 3,032 (57.3%) of respondents intended to get vaccinated when assessed in December 2020 compared to 3,611 (79.6%) who were vaccinated and 370 (8.2%) who intended to do so at this subsequent assessment point.[5] Nurses and ancillary support staff showed the highest improvement with 538 (87.1%) nurses and 346 (79.9%) ancillary support reporting vaccine acceptance, increased from 494 (41.2%) and 433 (46.4%) in the prior survey, respectively. Vaccine acceptance was more than twice intent among Black respondents, an increase from 30.8% to 73.8% (table 3). Vaccine acceptance/intent increased across all hospital roles with all at or above 79.9%. Comparison between participants in the survey before and after authorization did not show significant differences by age, race, hospital role or direct patient care (data not shown).

Characteristics of hesitant HCPs

Among 4,537 respondents, 350 (7.7%) refused vaccination and 160 (3.5%) were undecided (table 2). Respondents who were not vaccinated were more likely to be females, to have refused vaccines in the past due to reasons other than illness or allergy, to care for COVID-19 patients, or to rely on themselves when making vaccination decision compared to those who were/intended to be vaccinated table 2, figure 1. Nurses, allied health professionals, public safety and spiritual care staff, and those in ancillary services (i.e. clerical, dietary, phlebotomy, registration, clinical support, and environmental services) each had at least 9.9% of their staff forego vaccination.

Opposition and support for COVID-19 vaccination mandate

Overall, 1,836 (47.6%) respondents reported COVID-19 vaccination should be voluntary, 538 (14%) respondents were not sure and 1,481 (38.4%) thought vaccination should be mandatory (table 4). A majority of nurses, ancillary service staff, allied health professionals and Master's level clinicians thought vaccination should be voluntary. Among those who refused vaccines or who were undecided, 248 (93.9%) and 115 (89.8%) thought vaccination should be voluntary, respectively.

Influential sources for vaccination decision

The most influential source concerning whether participants had been vaccinated was "myself," while the next most influential source varied by vaccination status (figure 1). Among those who already got vaccinated or planned on doing so, hospital leadership, CDC and local health departments were the second most influential in vaccination decisions. Among undecided, "friends and family" was second, and for those who chose not to get vaccinated, "other" was the second most influential source. Health care provider influence was the same for those who already got vaccinated or intended to do so, 5% each and lower compared to those who chose not to get vaccinated, 8%.

Themes among respondents who voiced positive vaccination experience

Overall, 2,349 participants who responded to the open-ended question described their experience as positive. Analysis determined 15 main themes emerged. The most common themes were that the process was easy (n=771); quick (n=633); and the interactions they had with staff (n=586) were a positive aspect of their vaccination experience. Other themes included efficiency of the vaccination process (n=561), and the fact that they experienced manageable to no side effects (n=457). Other themes included the process was organized (n=414), there was little to no wait time before

receiving the vaccine (n=194), being vaccinated (n=190), the vaccine was painless (n=97), vaccine availability (n=80), the process was convenient (n=56), the information they received throughout the vaccination process (n=52), the entire experience was positive for them (n=31), the vaccine is free of cost (n=7), and other reasons (n=16).

Themes among respondents who voiced negative vaccination experience.

Overall, 104 respondents reported a negative experience. Three main themes were identified: Physical symptoms (n=88), loss of work (n=9), and issues with the vaccination system at Upstate (n=10). Looking at the specific replies related to physical symptoms yielded 10 sub-themes including general negative side effects (n=52), chills (n=21), fever (n=20), fatigue (n=13), headache (n=12), pain (n=13), nausea (n=7), malaise/myalgias (n=5), heart problems (n=4), body aches (n=3) other negative aspects (n=24).

Themes among respondents who expressed concerns about SARS-CoV-2 vaccines regardless of their vaccination status

We identified 16 main themes among a total of 1,334 (44.3%) HCP who expressed concerns. The majority of responses (n=820) identified vaccine side effects or long-term effects as their major concerns. Additional themes emerged relating to: vaccine efficacy (n=242), length of immunity (n=183), vaccine research and lack of data (n=149), COVID-19 variants (n=138), fertility, pregnancy and reproduction (n=101), fear of the unknown (n=97), the vaccine not working (n=75), vaccine safety (n=74), need for vaccine boosters or additional vaccines (n=66), COVID-19 transmission after vaccination (n=57), vaccine was rushed to market (n=56), children and the vaccine (n=36), vaccine not fully licensed by the FDA (n=15) and vaccine availability/accessibility (n=15).

Additional findings

Concerns about vaccines differed by vaccination status/intent. Those who chose not to get vaccinated were more likely to express concerns about lack of vaccine research, fertility issues, rushed vaccine development, spreading COVID-19 through vaccination, and use under EUA, compared to those who chose to delay or were vaccinated, Supplemental table 1.. Interestingly, those who were vaccinated were more likely to be concerned about vaccine efficacy, length of protection, COVID-19 variants, and fear of the unknown, compared to those who chose not to get vaccinated or wanted to “wait and see”.

Discussion

In this cohort of HCP in a large tertiary medical facility affiliated with an academic medical center we found an 87.7% self-reported vaccination rate and an additional 8.1% who planned to get vaccinated. This is an increase of 38.3% above vaccination intent compared to our earlier report of 57.5% HCP who planned on getting vaccinated. Physicians and scientists had highest vaccination acceptance/intent of 97.3%. This finding is important as doctors and nurses can be very influential sources for information about COVID-19 and other vaccines.[9] A strong endorsement from a trusted health care professional may be a critical factor in swaying people who are undecided about vaccination. This was evident in our finding that individuals reporting an intent to forego vaccination were the most likely to report that they are influenced by recommendations from their healthcare provider. Among unvaccinated adults who

wanted to “wait and see” or were “definitely not” getting vaccinated, 46% and 10%, respectively expressed desire to get the COVID-19 vaccine at an HCP office.[10] These findings underscore the untapped potential for healthcare providers, and their offices, to serve as primary sources of SARS-CoV-2 vaccine information and delivery.

Vaccine acceptance/intent ranged widely between different hospital roles, and was lowest among ancillary support staff, who reported 79.9% acceptance/intent. Short term and long-term safety concerns, along with rushed vaccine development and vaccine efficacy were among the most common reasons to forgo vaccination. Similar to our prior survey, physicians and non-physician scientists had highest intent to get vaccinated. In the US, early estimates show roughly one in three adult health care workers (29%) said they probably or definitely would not get vaccinated as of December 2020.[11] Among 1,398 US emergency department staff, 86% were vaccinated as of January 2021.[6] Consistent with our findings, physicians had the lowest refusal rate of vaccination (5.5%), with nurses and non-clinical support staff having the highest refusal rates (range 22.3%-24.3%).[6] Overall vaccine uptake among HCP in the UK was similar to that in the U.S., at 89% as of February 2021.[12]

The significant increase in vaccination acceptance over intent after COVID-19 vaccine authorization suggests that hesitant HCP became more receptive to vaccination as safety and efficacy data became available and emergency use authorizations were issued allowing for vaccination. Among those who remain hesitant, tailored interventions should be developed to address common misperceptions, such as lack of research data, rushed vaccine development, and misinformation about the vaccine’s impact on fertility and reproduction.

Those who were undecided or refused vaccines were more likely not to disclose demographic information compared to those who were/intended to get vaccinated. The hesitant group may be less willing to share vaccination information about themselves making it harder for us to reach them. Even though the percentage of those who refused vaccination is small, they represent a challenge as they are usually resistant to interventions. In addition, vaccination status guides public health interventions such as masking, which depends on the honor system. Without enforcement, unvaccinated individuals may be resistant to either adhere to public health mandates or disclose their vaccination status. This group of HCP may be less likely to trust authorities and public health leaders. They mostly trust themselves (65%) and other sources (14%), figure 1. Public health efforts to modify their vaccination attitudes and beliefs may remain ineffective. We will need innovative strategies to engage this group in vaccination. Incentives, such as paid time off from work to get vaccinated or recover from side effects, provision of rides to vaccination sites, gift cards or tickets to sports events and concerts have been offered around the country. Using influenza vaccination coverage as a surrogate for vaccination behavior among HCP, influenza vaccine uptake varied broadly particularly by the type of provider. In many institutions, access and education were unable to achieve very high vaccine coverage, and workplace requirements were needed to boost coverage. In the US, overall 80.6% of HCP reported having received influenza vaccine during the 2019–20 season, and the acceptance ranged between 94.4% and 69.6% among those whose employer did or did not require vaccination, respectively.[13] The role of COVID-19 vaccination mandates in health care setting remains a topic of active discussion. Our study finds a substantial proportion of HCP are opposed to mandatory COVID-19 vaccination. A recent poll (July 2021) suggests that 6% of the public will only accept a vaccine if it is required.[7]

Our findings have limitations. Selection (non-response) or information (social desirability) bias might have led to an overestimate of vaccination acceptance or intent since those who do not plan on getting vaccinated might have not engaged in the survey or answered the questions inaccurately. Although we observed increases in the percentages of respondents in several categories who were favorably inclined toward vaccination since the last time we surveyed this population on the same question, it is possible that this effect is due to response bias, either with this follow-up survey being answered more frequently by those favorably inclined toward the vaccine, with the follow-up survey being avoided by the vaccine-hesitant, or both. Some subgroups of participants who were hesitant or planned not to vaccinate were small, making distinctions in subgroup differences potentially less reliable. Our survey took place in March 2021, 3 months after COVID-19 vaccine EUA and when vaccines became more broadly available. Vaccination attitudes are not fixed and evolve over time, especially among those who are waiting to see if vaccines are safe and work well. They should be monitored and tested as new vaccine information becomes available. Our results represent findings from a single, albeit large, tertiary care setting. It is possible that HCP vaccination attitudes will differ depending on the healthcare environment in which HCP work. In our institution, we ran a robust vaccination campaign that included diverse strategies to reach HCP through press, media, internal and regional webinars, and focused programs. We are one of the 5 largest sites for Pfizer mRNA vaccine phase III clinical trials in the US. All of this activity could have impacted vaccine acceptance, which could provide useful guidance to other institutions. We also have vaccine hesitancy and health messaging experts on site, who are considered trusted sources among HCP and leadership.

Conclusions

Our results found a large increase in vaccination acceptance over vaccine intent after vaccines became available. However, many HCP—particularly ancillary services—are still hesitant. We must develop feasible and effective interventions to address the hesitant, who may benefit from incentives, establish individually-tailored education strategies focused on the safety and benefits of vaccination, or simply vaccinate if required under a mandate.

Note

Acknowledgements: This research would not have been possible without the exceptional support of Kathleen Froio Pace, Mark Zeman and Susan Murphy. Their enthusiasm, flexibility and generous support to ensure that survey reaches as many Upstate Medical University staff was invaluable and deserves special recognition. We are also grateful to all Upstate staff who participated in our survey and shared their views to inform our vaccination strategy.

Funding: We sought no funding to support this work.

Potential Conflicts

JS reports payment/honoraria for serving on a Speaker Bureau for Pfizer, outside the submitted work. SJT reports grants/support from DOD, NIH (NIAID, NIDA), Pfizer, Janssen, and Merck (Only Pfizer contract with University as clinical trial site relates to the content of the manuscript (covid vaccine trial)); consulting fees from Takeda, Pfizer, Janssen, Merck, Sanofi, Clover Pharm., Icosavax, and Tremeau (Consulting to Pfizer for COVID vaccine); payment for serving as expert witness to inform court on infectious disease issues related to med mal cases; travel support if travel was related to consulting activities, the following patents: Zika vaccine (issued); Flavivirus vaccine (issued); Chikungunya (under review); participation in DSMB/Advisory Boards for Takeda, Merck, Sanofi, Janssen, PATH, Icosavax, and Moderna (Icosavax related to covid vaccine trial); the following leadership/fiduciary roles: BoD – Byrne Dairy; BoManagers – Skaneateles YMCA; BoD – CNY Lyme Alliance; BoD – Skaneateles Music Festival; Co-founder, Phairify Inc; Co-founder, Cormac life sciences; stock/stock options/equity for scientific advisory board membership from PrimeVax; all outside the submitted work. CPM reports grants/support from New York State Health Foundation, HRSA, and HealthResearch, Inc (NYSDOH); payments/honoraria for HRSA Grant Review, SUNY Downstate Grant Review, and STFM Journal Editorship; travel support from NAPCRG (travel to AFMAC advisory meeting); the following leadership/fiduciary roles: Member, STFM and NAPCRG representative, Academic Family Medicine Advocacy Committee; Editor, PRiMER journal (STFM); all outside the submitted work. DAS reports consulting and/or research support from Jensen and Merck, outside the submitted work. KA reports consulting fees for Steering committee member, Chikungunya vaccines from Emergent BioSolutions and chair, peer review from CDC, Dengue Branch; DSMB member for AstraZeneca and data adjudication committee for Clover pharmaceuticals; councillor for Global Health subcommittee, ASTMH. All other authors have no funding sources to disclose.

Bibliography

1. COVID-19 Map - Johns Hopkins Coronavirus Resource Center. **2020**. Available at: <https://coronavirus.jhu.edu/map.html>. Accessed 13 July 2021.
2. COVID-19 Vaccines | FDA. **2021**. Available at: <https://www.fda.gov/emergency-preparedness-and-response/coronavirus-disease-2019-covid-19/covid-19-vaccines>. Accessed 13 July 2021.
3. Science Brief: Background Rationale and Evidence for Public Health Recommendations for Fully Vaccinated People. **2021**. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/fully-vaccinated-people.html>. Accessed 13 July 2021.
4. CDC COVID Data Tracker. **2021**. Available at: <https://covid.cdc.gov/covid-data-tracker/#vaccinations>. Accessed 9 July 2021.
5. Shaw J, Stewart T, Anderson KB, et al. Assessment of US Healthcare Personnel Attitudes Towards Coronavirus Disease 2019 (COVID-19) Vaccination in a Large University Healthcare System. *Clin Infect Dis* **2021**; Available at: <https://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciab054/6118651>. Accessed 13 July 2021.
6. Schradling WA, Trent SA, Paxton JH, et al. Vaccination rates and acceptance of SARS-CoV-2 vaccination among U.S. emergency department health care personnel. *Acad Emerg Med* **2021**; Available at: <https://pubmed.ncbi.nlm.nih.gov/33608937/>. Accessed 13 July 2021.
7. Hamel L, Kirzinger A, Lopes L, Kearney A, Sparks G, Brodie M. KFF COVID-19 Vaccine Monitor: January 2021 – Vaccine Hesitancy – 9616-2 | KFF **2021**. Available at: <https://www.kff.org/report-section/kff-covid-19-vaccine-monitor-january-2021-vaccine-hesitancy/>. Accessed 13 July 2021.
8. Opel DJ, Taylor JA, Zhou C, Catz S, Myaing M, Mangione-Smith R. The relationship between parent attitudes about childhood vaccines survey scores and future child immunization status: a validation study. *JAMA Pediatr* **2013**; 167:1065–1071. Available at: <https://pubmed.ncbi.nlm.nih.gov/24061681/>. Accessed 13 July 2021.
9. Altman D. Why Doctors and Nurses Can Be Vital Vaccine Messengers | KFF **2021**. Available at: <https://www.kff.org/coronavirus-covid-19/perspective/why-doctors-and-nurses-can-be-vital-vaccine-messengers/>. Accessed 9 July 2021.
10. Sparks G, Kirzinger A, Brodie M. KFF COVID-19 Vaccine Monitor: Profile Of The Unvaccinated |

KFF **2021**. Available at: <https://www.kff.org/coronavirus-covid-19/poll-finding/kff-covid-19-vaccine-monitor-profile-of-the-unvaccinated/>. Accessed 13 July 2021.

11. Hamel L, Kirzinger A, Muñana C, Brodie M. KFF COVID-19 Vaccine Monitor: December 2020 | KFF **2020**. Available at: <https://www.kff.org/coronavirus-covid-19/report/kff-covid-19-vaccine-monitor-december-2020/>. Accessed 20 July 2021.
12. Hall VJ, Foulkes S, Saei A, et al. COVID-19 vaccine coverage in health-care workers in England and effectiveness of BNT162b2 mRNA vaccine against infection (SIREN): a prospective, multicentre, cohort study. *www.thelancet.com* **2021**; 397. Available at: <https://doi.org/10.1016/>. Accessed 13 July 2021.
13. Acero C, Razzaghi H, Black CL, et al. Influenza Vaccination Coverage Among Health Care Personnel — United States, 2019–20 Influenza Season | FluVaxView | Seasonal Influenza (Flu) | CDC **2020**. Available at: https://www.cdc.gov/flu/fluview/hcp-coverage_1920estimates.htm. Accessed 9 July 2021.

Accepted Manuscript

Figure Legend:

Trusted sources among 4,491 respondents, by vaccination intent.

Accepted Manuscript

Table 1. Demographic characteristics and hospital roles among participating respondents.

Role	N (%)	N (%) Female	N (%) Male	Mean Age (SD)	N (%) White	N (%) Black	N (%) Asian	N (%) All Other*	Latinx/ Hispanic origin	Not Latinx/ Hispanic origin
Total respondents	4537	2645 (75.3)	862 (24.6)	45.5 (13.3)	3033 (84.8)	208 (5.8)	209 (5.8)	127 (3.6)	121 (3.4)	3451 ^{&} (96.6)
Registered Nurses	619 (17.3)	557 (92.1)	48 (7.9)	44.0 (12.6)	586 (94.7)	9 (1.5)	8 (1.3)	16 (12.6)	9 (1.5)	609 (98.5)
Scientists and Physicians ¹	792 (22.1)	433 (55.8)	341 (43.9)	42.8 (15.7)	608 (76.9)	19 (2.4)	125 (15.8)	39 (30.7)	33 (4.2)	756 (95.8)
Administration and Management ²	872 (24.4)	747 (87.1)	110 (12.8)	50.6 (10.9)	803 (92.2)	36 (4.1)	10 (1.1)	22 (17.3)	16 (1.8)	856 (98.2)
Ancillary Services ³	436 (12.2)	285 (66.7)	142 (33.3)	42.4 (12.4)	263 (60.3)	121 (27.8)	24 (5.5)	28 (22.0)	48 (11.1)	386 (88.9)
Technical Support ⁴	466 (13.0)	300 (65.5)	157 (34.3)	46.1 (12.5)	412 (88.4)	13 (2.8)	30 (6.4)	11 (8.7)	7 (1.5)	459 (98.5)
Allied Health Professionals ⁵	85 (2.4)	75 (89.3)	9 (10.7)	40.9 (12.5)	81 (95.3)	0	2 (2.4)	2 (1.6)	1 (1.2)	84 (98.8)
Master's Level Clinicians ⁶	286 (8.0)	242 (86.7)	37 (13.3)	43.9 (12.8)	258 (90.5)	8 (2.8)	10 (3.5)	9 (7.1)	7 (2.5)	277 (97.5)

Public Safety and Spiritual Care	24 (0.7)	6 (25.0)	18 (75.0)	56.2 (14.4)	22 (91.7)	2 (8.3)	0	0	0	24 (100.0)
-------------------------------------	----------	----------	-----------	----------------	-----------	---------	---	---	---	------------

1 = includes research staff and medical students; 2 = includes educational support and other; 3 = includes clerical, dietary, phlebotomy, unit support, registration, clinical support, environmental services; 4 = includes laboratory, informational technology, and pharmacy services ; 5 = includes physical therapy, occupational therapy, radiology, and respiratory services ; 6 = includes nurse practitioners, physician's assistants, social workers, and registered dieticians

* = includes American Indian or Alaska Native,, Native Hawaiian/Pacific Islander, or Other. & 3451 refers to non-Hispanic overall.

Accepted Manuscript

Table 2. Distribution of respondents by demographic characteristics and role indicators, according to vaccine acceptance

Total Respondents (N)	4537			
	Did you receive the COVID-19 vaccine?			
	<i>I choose not to</i>	<i>Undecided</i>	<i>Yes or I plan to</i>	p ^a
Total, n (%)	350 (7.7)	160 (3.5)	3981 (87.7)	
Age (mean, SD)	39.7 (11.1)	39.2 (11.6)	46.1 (13.4)	<0.001
Gender, n (%)				
Male	43 (4.9)	12 (1.4)	814 (93.7)	
Female	176 (6.6)	95 (3.6)	2393 (89.8)	
Non-binary/Other	1 (14.3)	0	6 (85.7)	<0.001
Not disclosed	23 (25.3)	7 (7.7)	61 (67.0)	
Race, n (%)				
White	180 (5.9)	83 (2.7)	2801 (91.4)	
Black or African-American	35 (16.7)	20 (9.5)	155 (73.8)	
Asian	3 (1.4)	4 (1.9)	203 (96.7)	
American Indian or Alaska Native	6 (24.0)	4 (16.0)	15 (60.0)	<0.001
Native Hawaiian or Other PI	0	0	6 (100.0)	
Other	19 (16.7)	3 (2.6)	92 (80.7)	
Ethnicity, n (%)				
Latinx/Hispanic origin	8 (6.5)	7 (5.7)	108 (87.8)	
Not Latinx/Hispanic origin	230 (6.6)	107 (3.1)	3158 (90.4)	0.26
Role, n (%)				
Registered Nurses	61 (9.9)	19 (3.1)	538 (87.1)	
Scientists and Physicians ¹	13 (1.6)	8 (1.0)	767 (97.3)	
Administration and Management ²	47 (5.5)	29 (3.4)	781 (91.1)	
Ancillary Services ³	55 (12.7)	32 (7.4)	346 (79.9)	
Technical Support ⁴	20 (4.4)	14 (3.1)	420 (92.5)	<0.001
Allied Health Professionals	9 (10.8)	2 (2.4)	72 (86.7)	
Master's Level Clinicians	20 (7.0)	4 (1.4)	261 (91.6)	
Public Safety and Spiritual Care	3 (12.5)	0	21 (87.5)	
Direct Patient care, n (%)				

Yes	130 (7.4)	50 (2.9)	1565 (89.7)	0.18
No	114 (6.1)	64 (3.4)	1702 (90.5)	
Care for COVID patients, n (%)				
Yes	73 (8.8)	16 (1.9)	740 (89.3)	<0.01
No	172 (6.1)	98 (3.5)	2529 (90.4)	
For reasons other than illness or allergy, ever refused vaccine, n (%)				
Yes	79 (27.8)	22 (7.7)	183 (64.4)	<0.001
No	147 (4.5)	88 (2.7)	3018 (92.8)	
Don't know	18 (20.0)	4 (4.4)	68 (75.6)	
Prior survey participation, n (%)				
Yes	156 (6.9)	63 (2.8)	2028 (90.3)	0.29
No	89 (6.5)	51 (3.7)	1238 (89.8)	

a = Chi-Square or ANOVA p-value

1 = includes research staff and medical students; 2 = includes educational support and other; 3 = includes clerical, dietary, phlebotomy, unit support, registration, clinical support, environmental services; 4 = includes laboratory, informational technology, and pharmacy services; 5 = includes physical therapy, occupational therapy, radiology, and respiratory services ; 6 = includes nurse practitioners, physician's assistants, social workers, and registered dietician

Table 3. Difference between vaccine intent and acceptance before and after+ COVID-19 emergency use authorization by demographic characteristics and hospital role.

	Survey 1: If a vaccine was offered free of charge, I would take it <i>Agree/Strongly Agree</i>	Survey 2: Did you receive the COVID-19 vaccine? <i>Yes or I plan to</i>	P ^a
Total, n (%)	3032 (57.3)	3981 (87.7)	
Age (mean, SD)	43.8 (14.1)	46.1 (13.4)	<0.001
Gender, n (%)			
Male	992 (72.5)	814 (93.7)	
Female	2013 (52.4)	2393 (89.8)	<0.001
Non-binary/other/not disclosed	25 (41.0)	67 (68.4)	
Race, n (%)			
White	2618 (58.4)	2801 (91.4)	
Black or African-American	81 (30.8)	155 (73.8)	
Asian	234 (73.8)	203 (96.7)	<0.001
All Other*	91 (46.4)	113 (77.9)	
Ethnicity, n (%)			
Latinx/Hispanic origin	N/A	108 (87.8)	N/A
Not Latinx/Hispanic origin		3158 (90.4)	
Role, n (%)			
Registered Nurses	494 (41.2)	538 (87.1)	
Scientists and Physicians ¹	830 (80.4)	767 (97.3)	
Administration and Management ²	639 (62.8)	781 (91.1)	
Ancillary Services ³	433 (46.4)	346 (79.9)	<0.001
Technical Support ⁴	277 (62.8)	420 (92.5)	
Allied Health Professionals	169 (51.4)	72 (86.7)	
Master's Level Clinicians	165 (65.1)	261 (91.6)	
Public Safety and Spiritual Care	21 (77.8)	21 (87.5)	
Direct Patient care, n (%)			
Yes	1670 (54.0)	1565 (89.7)	
No	1359 (62.4)	1702 (90.5)	<0.001

Care for COVID patients, n (%)			
Yes	955 (52.0)	740 (89.3)	<0.001
No	2033 (60.6)	2529 (90.4)	
For reasons other than illness or allergy, ever refused vaccine, n (%)			
Yes	61 (14.2)	183 (64.4)	<0.001
No	2946 (62.4)	3018 (92.8)	
Don't know	18 (16.4)	68 (75.6)	
Prior survey participation, n (%)			
Yes		2028 (90.3)	N/A
No	N/A	1238 (89.8)	

+ = Surveys 1 and 2 were administered between November 23rd and December 5th, 2020, and February 21st and March 19th, 2021, respectively. The denominators for surveys 1 and 2 were 5,287 and 4,537, respectively." a = Chi-Square or ANOVA p-value

1 = includes research staff and medical students; 2 = includes educational support and other; 3 = includes clerical, dietary, phlebotomy, unit support, registration, clinical support, environmental services; 4 = includes laboratory, informational technology, and pharmacy services; 5 = includes physical therapy, occupational therapy, radiology, and respiratory services ; 6 = includes nurse practitioners, physician's assistants, social workers, and registered dietician

N/A = not applicable

* = includes American Indian or Alaska Native, Native Hawaiian/Pacific Islander, or Other

Table 4. Support for voluntary versus mandatory vaccination by demographic characteristics and hospital role

	Do you think COVIDS-19 vaccination should be voluntary or mandated?			p ^a
	<i>Voluntary</i>	<i>Not sure</i>	<i>Mandated</i>	
Total, n (%)	1836 (47.6)	538 (14.0)	1481 (38.4)	
Role, n (%)				
Registered Nurses	420 (67.9)	64 (10.3)	135 (21.8)	
Scientists and Physicians ¹	247 (31.2)	79 (10.0)	466 (58.8)	
Administration and Management ²	358 (41.1)	166 (19.0)	348 (39.9)	
Ancillary Services ³	262 (60.1)	56 (12.8)	118 (27.1)	
Technical Support ⁴	192 (41.2)	75 (16.1)	199 (42.7)	<0.001
Allied Health Professionals	43 (50.6)	12 (14.1)	30 (35.3)	
Master's Level Clinicians	151 (52.8)	45 (15.7)	90 (31.5)	
Public Safety and Spiritual Care	12 (50.0)	3 (12.5)	9 (37.5)	
Vaccine acceptance, n (%)				
I choose not to	248 (93.9)	13 (4.9)	3 (1.1)	
Undecided	115 (89.8)	13 (10.2)	0	<0.001
Yes or I plan to	1453 (42.5)	503 (14.7)	1465 (42.8)	

a = Chi-Square or ANOVA p-value

1 = includes research staff and medical students; 2 = includes educational support and other; 3 = includes clerical, dietary, phlebotomy, unit support, registration, clinical support, environmental services; 4 = includes laboratory, informational technology, and pharmacy services; 5 = includes physical therapy, occupational therapy, radiology, and respiratory services ; 6 = includes nurse practitioners, physician's assistants, social workers, and registered dietician

Figure 1. Trusted sources among 4,491 respondents, by vaccination intent.

