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## Brief Report

# COVID-19 vaccination coverage among hospital-based healthcare personnel reported through the Department of Health and Human Services Unified Hospital Data Surveillance System, United States, January 20, 2021–September 15, 2021



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## A B S T R A C T

To protect both patients and staff, healthcare personnel (HCP) were among the first groups in the United States recommended to receive the COVID-19 vaccine. We analyzed data reported to the U.S. Department of Health and Human Services (HHS) Unified Hospital Data Surveillance System on COVID-19 vaccination coverage among hospital-based HCP. After vaccine introduction in December 2020, COVID-19 vaccine coverage rose steadily through April 2021, but the rate of uptake has since slowed; as of September 15, 2021, among 3,357,348 HCP in 2,086 hospitals included in this analysis, 70.0% were fully vaccinated. Additional efforts are needed to improve COVID-19 vaccine coverage among HCP.

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## BACKGROUND

Healthcare personnel (HCP) are at risk of occupationally-acquired COVID-19 because of exposure to infected patients; HCP are also occasionally the source of transmission to patients and other staff.<sup>1</sup> To protect HCP and patients and to maintain workforce capacity, the Advisory Committee on Immunization Practices (ACIP) recommended HCP to be among the first groups to receive COVID-19 vaccine when it first became authorized for emergency use in the United States in December 2020.<sup>2</sup> To assess COVID-19 vaccine coverage among hospital-based HCP since introduction of the vaccine, we analyzed HCP vaccination data reported to the U.S. Department of Health, and Human Services (HHS) Unified Hospital Data Surveillance System.<sup>3</sup>

## METHODS

Since January 2021, hospitals have voluntarily reported weekly, aggregate COVID-19 vaccine coverage data among HCP (ie, total personnel, fully vaccinated personnel, partially vaccinated personnel, and unvaccinated personnel) to the HHS Unified Hospital Data Surveillance System. This system collects data on hospital capacity and patients hospitalized with COVID-19 from all U.S. hospitals registered with the Centers for Medicare & Medicaid Services (CMS) as of June 1, 2020, and hospitals not CMS-registered but reporting COVID-19 data since July 1, 2020.<sup>3</sup> All facilities that share a CMS Certification Number (CCN) with hospitals are included in the data reported. Hospitals submit data to HHS directly or through state health departments.

We assessed HCP COVID-19 vaccine coverage reported by hospitals from January 20, 2021–September 15, 2021, including the assessment of differences in vaccine coverage by hospital type (ie, children's hospitals, short-term acute care hospitals (ACH), long-term ACH, and critical access hospitals) and urbanicity. For this analysis, psychiatric, rehabilitation, and religious non-medical facilities were excluded. Because reporting is voluntary and data quality is variable, facilities were included for analysis if their reported data passed validation checks,

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specifically 1) the reported number of total HCP and the HCP vaccination fields were non-missing and non-zero, and 2) unvaccinated personnel and fully vaccinated personnel summed to within 75%–100% of the total number of HCP reported by any given facility.

We also performed an exploratory analysis investigating differences in coverage by hospital size (ie, number of staffed inpatient beds), cumulative facility-level admissions of patients with laboratory-confirmed COVID-19 per 100 beds, and characteristics of the county where the facility is located, including cumulative cases of laboratory-confirmed COVID-19 per 100,000 population and COVID-19 vaccination coverage among county residents. We used mixed effects logistic regression models with a random intercept for individual hospital to test for possible associations between HCP COVID-19 vaccination coverage and facility and county characteristics. A random intercept for hospital was used in all models to account for clustering due to workplace effects such as employer vaccination outreach strategies, mandates for employees, worksite vaccine availability, and other facility-level factors. The model assessing the association between hospital type and HCP vaccination coverage included terms for state and urbanicity to adjust for potential confounding due to heterogeneity in the proportion of each hospital type across urbanicity categories. The model assessing the association between county urbanicity and HCP vaccination coverage was adjusted by a fixed effect for state. Models with continuous predictors were adjusted for hospital type, urbanicity, and state; the fixed effect for state was removed if convergence failed. Continuous predictors were log-transformed when their distributions were heavily skewed.

All analyses were conducted in R version 4.0.3 (R Foundation for Statistical Computing, Vienna, Austria) with model fits and estimated marginal means calculated using the lme4 and emmeans packages, respectively. Confidence intervals of odds ratios comparing the 25th and 75th percentiles of continuous predictors were estimated using the MASS package. All hypothesis tests were 2-sided and used a 5% level of statistical significance. This analysis was reviewed by the Centers for Disease Control and Prevention and was conducted consistent with applicable federal law and Centers for Disease Control and Prevention policy.<sup>1</sup>

## RESULTS

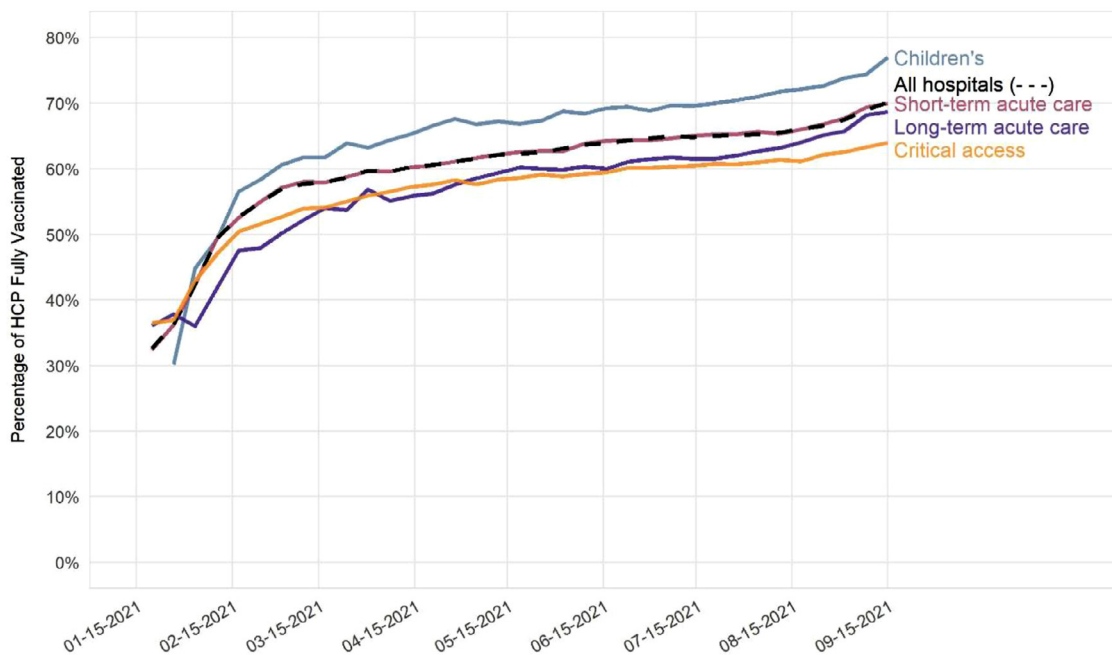
Among 5,085 facilities in the HHS Unified Hospital Data Surveillance System, 2,457 (48.3%) reported data on HCP vaccination coverage and total personnel on September 15, 2021; 2,086 (41.0%) facilities were included in the analysis after validation checks were applied. Included versus excluded facilities were more likely to be critical access hospitals (30.4% vs 24.2%, respectively,  $P < .001$ ), were more likely to be located in rural counties (20.1% vs 13.7%, respectively,  $P < .001$ ), and were more likely to be in the lowest quartile for facility size (28.0% vs 22.9%, respectively,  $P < .001$ ).

Aggregate COVID-19 vaccine coverage data were reported for 3,357,348 hospital-based HCP by the 2,086 included facilities on September 15, 2021. Reported coverage rose substantially from 36.1% (95% CI: 36.0%, 36.2%) in January 2021 to 60.2% (95% CI: 60.2%, 60.3%) in April 2021; since April 2021, the increase in coverage has slowed, reaching 66.7% (95% CI: 66.7%, 66.7%) as of August 25th, 2021, and 70.0% (95% CI: 70.0%, 70.1%) as of September 15, 2021 (Fig 1).

Highest vaccination coverage was observed among HCP in children's hospitals (77.0%; 95% CI: 76.8, 77.3) followed by HCP in short-term ACH (70.1%; 95% CI: 70.1, 70.2), long-term ACH (68.8%; 95% CI: 68.2, 69.3), and critical access hospitals (64.0%; 95% CI: 63.8, 64.3; [Fig 1]). Coverage was higher among HCP working in facilities located in metropolitan counties (71.0%; 95% CI: 70.9, 71.0), followed by HCP working in facilities located in rural counties (65.1%; 95% CI: 64.8, 65.3), and HCP working in non-metropolitan urban counties (63.3%; 95% CI: 63.1, 63.5).

In multivariable modelling, comparing with the referent group of short-term ACH HCP, the odds of a children's hospital HCP being fully vaccinated were higher (adjusted odds ratio [aOR] 2.43, 95% CI: 1.79, 3.30); the odds of a critical access hospital HCP being fully vaccinated were not significantly different (aOR 0.93, 95% CI: 0.82, 1.05); and the odds of a long-term ACH HCP being fully vaccinated were not significantly different (aOR 1.00, 95% CI: 0.83, 1.21) (Table 1).

The odds of an HCP being fully vaccinated were slightly higher if they worked in a hospital with lower (25th percentile) cumulative admissions of patients with COVID-19 versus higher (75th percentile;



**Fig 1.** Hospital-based healthcare personnel (HCP) COVID-19 vaccination coverage, HHS Unified Hospital Data Surveillance System, January 20, 2021–September 15, 2021, United States. Data from children's hospitals are included beginning January 27, 2021, as few facilities reported prior to this date. A small horizontal jitter was applied to points in this figure to reduce overlap of the short-term acute care and all hospitals lines.

**Table 1**  
Hospital-based healthcare personnel COVID-19 vaccination coverage multivariable mixed effects logistic regression model results, HHS Unified Hospital Data Surveillance System, September 15, 2021, United States (N = 3,357,348)

Characteristic	Median (IQR) <sup>a</sup>	No. of HCP	No. of HCP Fully Vaccinated <sup>b</sup>	Percent of HCP Fully Vaccinated	95% Confidence Interval		Adjusted Odds Ratio	95% Confidence Interval	
					LCL <sup>c</sup>	UCL <sup>c</sup>		LCL	UCL
Overall		3,357,348	2,351,136	70.0	70.0	70.1			
Hospital type <sup>d</sup>									
Children's hospital <sup>e</sup>		115,423	88,897	77.0	76.8	77.3	2.43	1.79	3.30
Critical access hospital <sup>f</sup>		162,664	104,152	64.0	63.8	64.3	0.93	0.82	1.05
Long-term acute care hospital <sup>g</sup>		31,349	21,554	68.8	68.2	69.3	1.00	0.83	1.21
Short-term acute care hospital <sup>h</sup>		3,047,912	2,136,533	70.1	70.1	70.2	Ref		
Number of inpatient beds <sup>i</sup>	45.9 (22.0, 163.0)						1.03 <sup>jk</sup>	0.89	1.04
Urbanicity <sup>kl</sup>									
Metropolitan		2,919,815	2,071,963	71.0	70.9	71.0	Ref		
Non-Metropolitan Urban		306,727	194,087	63.3	63.1	63.5	0.89	0.80	0.99
Rural		130,806	85,086	65.1	64.8	65.3	0.84	0.74	0.95
Cumulative admissions per 100 inpatient beds <sup>lm</sup>	214.8 (95.5, 356.8)						1.14 <sup>no</sup>	1.09	1.2
County cumulative cases per 100,000 population <sup>pp</sup>	12,983.8 (10,616.4, 15,105.7)						1.10 <sup>***</sup>	1.04	1.17
County COVID-19 vaccination coverage <sup>q</sup>	45.7 (37.0, 54.6)						0.68 <sup>†††</sup>	0.64	0.73

<sup>a</sup>IQR = interquartile range.

<sup>b</sup>Fully vaccinated defined as having received both doses of COVID-19 vaccines requiring 2 doses for vaccine series completion, or having received 1 dose of COVID-19 vaccine requiring only 1 dose for completion.

<sup>c</sup>LCL = lower confidence limit; UCL = upper confidence limit.

<sup>d</sup>Model was adjusted for state and urbanicity.

<sup>e</sup>Children's hospitals are hospitals with inpatients predominantly aged 18 or younger.

<sup>f</sup>Critical access hospitals are rural hospitals that have 25 or fewer acute care inpatient beds, are located more than 35 miles from another hospital, maintain an average length of stay of 96 hours or less for acute care patients, and provide 24/7 emergency care services. Facilities that meet these criteria are eligible to apply for critical access hospital designation through the Centers for Medicare and Medicaid Services (CMS), which provides certain benefits such as cost-based reimbursement for Medicare services.

<sup>g</sup>Long-term acute care hospitals are facilities that specialize in the treatment of patients with serious medical conditions that require care on an ongoing basis but no longer require intensive care or extensive diagnostic procedures.

<sup>h</sup>Short-term acute care hospitals are hospitals that provides inpatient medical care and other related services for surgery, acute medical conditions or injuries, usually for a short-term illness or condition.

<sup>i</sup>Number of inpatient beds is used to represent hospital size and is calculated as the 7-day average of the number of staffed inpatient beds reported for the most recent week of data. Model was adjusted for state, urbanicity, and hospital subtype.

<sup>j</sup>Continuous predictor was log transformed due to non-normality prior to running the regression model. The odds ratio is interpreted as the odds of an HCP being fully vaccinated if they work in a hospital with inpatient beds equivalent to the 25th percentile value (22.0) versus the 75th percentile value (163.0).

<sup>k</sup>Urbanicity was defined using the 2013 Rural-Urban Continuum Codes, which form a classification scheme that distinguishes metropolitan counties by the population size of their metro area, and nonmetropolitan counties by degree of urbanization and adjacency to a metro area<sup>4</sup>. HCP are classified based on the location of the hospital they work in. Model was adjusted for state.

<sup>l</sup>Defined as cumulative hospital-level admissions of patients with confirmed COVID-19 per 100 staffed inpatient beds from August 1, 2020 - September 15, 2021. The 7-day average of the number of staffed inpatient beds reported for the most recent week of data was used. Model was adjusted for urbanicity and hospital subtype.

<sup>m</sup>Continuous predictor was log transformed due to non-normality prior to running the regression model. The odds ratio is interpreted as the odds of an HCP being fully vaccinated if they work in a hospital with cumulative COVID-19 admissions per 100 beds equivalent to the 25th percentile value (95.5) versus the 75th percentile value (356.8).

<sup>n</sup>Defined as cumulative cases of COVID-19 per 100,000 population among residents of the county that the hospital is located in from January 1, 2020 - September 15, 2021. Data source is data.cdc.gov. Model was adjusted for state, urbanicity, and hospital subtype.

<sup>o</sup>Continuous predictor was log transformed due to non-normality prior to running the regression model. The odds ratio is interpreted as the odds of an HCP being fully vaccinated if the county of the hospital had cumulative COVID-19 cases per 100,000 population equivalent to the first 25th percentile value (10,616.4) versus the 75th percentile value (15,105.7).

<sup>p</sup>Defined as the percentage of the population of the county that the HCP's hospital is located in that is fully vaccinated for COVID-19 as of September 15, 2021. Data source is data.cdc.gov. Counties with 0% or 100% of residents fully vaccinated were excluded from the regression model due to suspected data quality issues. Model was adjusted for state, urbanicity, and hospital subtype.

<sup>q</sup>The odds ratio is interpreted as the odds of an HCP being fully vaccinated if the county of the hospital has COVID-19 vaccination coverage equivalent to the 25th percentile value (37.0%) versus the 75th percentile value (54.6%).

aOR 1.14; 95% CI: 1.09, 1.20). Similarly, we found a small increase in the odds of an HCP being fully vaccinated if the county of the hospital had lower (25th percentile) versus higher (75th percentile) cumulative cases of patients with COVID-19 (aOR 1.10; 95% CI: 1.04, 1.17). Finally, the odds of an HCP being fully vaccinated were lower if the county of the hospital had lower (25th percentile) versus higher (75th percentile) community COVID-19 vaccination coverage (aOR 0.68; 95% CI: 0.64, 0.73).

## DISCUSSION

Among the hospital-based HCP included in this analysis, COVID-19 vaccine coverage increased steadily between the time of vaccine introduction (December 2020) and April 2021, but the rate of uptake

has slowed, and a substantial proportion of HCP remain unvaccinated; as of September 15, 2021, among 3,357,348 HCP in 2,086 facilities included in this analysis, 70.0% were fully vaccinated.

Surveys conducted to understand factors driving vaccine hesitancy have identified concerns among HCP about COVID-19 vaccine efficacy, adverse effects, the speed of vaccine development, and lack of full FDA approval.<sup>5</sup> HCP who did not want to be vaccinated often reported low trust in regulatory authorities and the government; notably, trust in information received from medical professionals was higher, suggesting an important role of professional societies and medical organizations in enhancing vaccine uptake among HCP and combating misinformation that might impact uptake.<sup>5</sup>

HCP play a critical role in advising patients and communities and influencing vaccine decisions.<sup>6</sup> Several studies have found that

vaccinated HCP were more likely to recommend vaccination to patients, friends, and family, suggesting that broader uptake of the COVID-19 vaccine among HCP might lead to improved coverage in the general population.<sup>7</sup> HCP are also at increased risk for acquiring and transmitting COVID-19 in healthcare settings.<sup>8</sup> HCP have direct contact with patients including children in age groups that are not yet eligible for vaccination.<sup>8</sup> COVID-19 outbreaks have occurred in long-term care facilities in which unvaccinated staff members were the source of transmission to residents.<sup>1</sup>

To protect both patients and staff, COVID-19 vaccination mandates as a condition of employment for HCP have been recommended by many experts and professional organizations.<sup>9</sup> With the highly transmissible Delta variant causing COVID-19 cases and hospital admissions to surge in the summer months of 2021,<sup>10</sup> and the FDA fully approving one mRNA vaccine, a number of jurisdictions and hospital systems have issued mandates requiring HCP to be fully vaccinated against COVID-19, including California, New York, Rhode Island, Maine, Oregon, and the District of Columbia.<sup>11</sup> CMS is developing an Interim Final Rule with a comment period issued in October 2021 that will require COVID-19 vaccination for HCP in all Medicare and Medicaid-certified U.S. facilities.<sup>12</sup> In our study, we observed that coverage increased from 60% to 65% over 4 months (April to August 2021), but coverage increased another 5 percentage points (65% to 70%) from August to September 2021; this increased rate of uptake may be a response to increased COVID-19 rates due to the Delta variant or related to mandates implemented in some jurisdictions.

Mandates for HCP influenza vaccination have been associated with high influenza vaccination rates and a significant decrease in HCP absenteeism, healthcare-associated influenza among hospitalized patients, and patient mortality.<sup>13</sup> In 2019–2020, 81% of HCP received influenza vaccine, with higher coverage among HCP who were required by their employer to be vaccinated (94%) than those whose employer did not require vaccination (70%).<sup>8,14</sup>

In this analysis, higher COVID-19 vaccination coverage was observed in children's hospital-based HCP compared with other hospital types, even after controlling for the effects of urbanicity and state. This might be driven by possible stronger expectations around employee vaccination or greater emphasis placed on preventing transmission to patients in children's hospitals, as children aged <12 years remain ineligible for vaccination, or by other unidentified factors. The odds of HCP being fully vaccinated were lower for HCP who worked in counties with lower community vaccination rates, which may be an indication that vaccination rates among HCP might reflect behaviors of the larger communities of which HCP are members.

The findings in this report have several limitations. Facilities report HCP vaccination data voluntarily, and those included in this analysis represent approximately 41% of all facilities in the HHS Unified Hospital Data Surveillance System, potentially limiting the generalizability of the findings. In addition, some hospitals may be unaware of an employee's vaccination status if the employee did not receive the COVID-19 vaccine through the hospital system, potentially leading to an underestimate of vaccinated HCP. Facilities included in the analysis were also more likely to be critical access hospitals and from rural counties, both of which are associated with lower coverage, which also may have led to an underestimate compared with all hospital-based HCP nationwide.

## CONCLUSIONS

Among 3,357,348 hospital-based HCP included in this analysis, a substantial percentage (approximately 30%) remain unvaccinated. Additional efforts are needed to improve COVID-19 vaccine coverage among HCP, such as educational and promotional activities, communication efforts to address misinformation, and providing paid time off to receive the vaccine. The forthcoming CMS rule for vaccination in healthcare settings should substantially increase COVID-19 vaccine coverage among HCP.

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