

1 COVID-19 Vaccine Hesitancy Among Healthcare Workers in Four Healthcare Systems in
2 Atlanta

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2 Abstract

3 COVID-19 vaccine hesitancy among healthcare workers (HCW) undermines community vaccine
4 confidence. Predictors and reasons for HCW hesitancy in the Atlanta region were evaluated
5 using a survey between May and June 2021. Vaccine hesitancy was highest in younger and
6 less educated HCW. Interventions to address vaccine hesitancy in HCW are necessary.

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1 Introduction

2 Vaccines play a pivotal role in controlling the COVID-19 pandemic, but vaccine hesitancy
3 continues to undermine pandemic mitigation. In December 2020, the US Food and Drug
4 Administration authorized two COVID-19 vaccine products for emergency use, followed by a
5 third in February 2021. More than 1 year later, Georgia has one of the lowest vaccination rates
6 in the country¹.

7 Healthcare workers (HCW) play a crucial role in promoting immunization programs, fostering
8 vaccine acceptance in the community, and interrupting transmission in the healthcare setting.
9 Previous studies have identified varying HCW hesitancy across different racial/ethnic groups
10 and clinical roles.²⁻⁹ We surveyed HCW in four major healthcare systems in Atlanta, Georgia to
11 identify predictors of vaccine hesitancy and evaluate HCW attitudes and perceptions regarding
12 COVID-19 vaccines to inform efforts to increase vaccine confidence.

13

14 Methods

15 We conducted an anonymous cross-sectional survey (using Qualtrics ®) of HCW via email from
16 May to June 2021. Question items included demographics, role (clinical or non-clinical),
17 personal or family history of COVID-19 infection, and whether the HCW had personally cared for
18 patients with COVID-19. General attitudes and perceptions about COVID-19 vaccines and
19 reasons for not receiving the vaccine were collected using a five-point Likert scale for
20 agreement. We defined “vaccine hesitant” individuals as those who had neither received nor
21 planned to receive the COVID-19 vaccine at the time of the survey.

22 Vaccine hesitancy was dichotomized to vaccine hesitant and not vaccine hesitant. We
23 compared basic descriptive variables using chi-square and t-tests. We used a multivariate
24 logistic regression model controlling for age, sex, race, ethnicity, and education to estimate

1 adjusted measures of association, and performed frequency distribution of reasons for not
2 getting a COVID-19 vaccine among the vaccine hesitant. Statistical analyses were performed
3 using SAS 9.4.

4 This study protocol was deemed to be exempt from human subjects research review by the
5 Emory University Institutional Review Board.

6 **Results**

7 Approximately 30,000 HCW worked in the participating healthcare systems. 5,329 HCW
8 responded to the survey (response rate: 17.76%); 5,281 (99.10%) completed all questionnaire
9 sections. Of the 5,329 respondents, 551 (10.34%) were vaccine hesitant. HCW in this survey
10 were predominantly female (79.32%), White (46.26%), non-Hispanic (88.77%), and with
11 educational attainment above a bachelor's degree (41.20%); these percentages were similar to
12 the overall population of HCW sampled. About two-thirds of respondents (63.84%) provided
13 direct COVID-19 patient care.

14 Among the 551 (10.34%) vaccine hesitant respondents, a smaller proportion of clinical HCWs
15 were vaccine hesitant than non-clinical HCWs (9.82% vs. 11.26%). Among clinical healthcare
16 roles, paramedics/EMT (29.03%), nurses (13.46%), technologists (13.19%), and
17 medical/nursing assistants (15.20%) were more vaccine hesitant than other clinical healthcare
18 roles. Clinical HCWs who cared for COVID-19 patients were more vaccine hesitant than those
19 who did not (10.71% vs. 7.84%) (Table 1). Vaccine hesitancy was higher in those with a
20 previous diagnosis of COVID-19 (19.69%) than those without (8.78%).

21 In the adjusted multivariate analysis, individuals in the age group 18-35 years (OR=8.81, 95%
22 CI=3.81, 20.38) had the highest odds of being vaccine hesitant as compared to those 66 years
23 or older. Non-Hispanic HCW had increased odds (OR=2.79, 95% CI=1.60, 4.84) of vaccine
24 hesitancy compared to Hispanic HCW. Those with a bachelor's (OR=2.29, 95% CI=1.79, 2.92)

1 and less than bachelor's (OR= 2.96, 95% CI=2.28, 3.84) educational attainment were more
2 vaccine hesitant than those with more than Bachelor's degrees. Among clinical healthcare roles,
3 paramedics/EMTs (OR=12.89, 95% CI=5.44, 30.56), nurses (OR=6.46, 95% CI=3.23-12.90),
4 technologists (OR=5.75, 95% CI=2.72, 12.16), and medical/nursing assistants (OR=5.59, 95%
5 CI=2.47,12.64) were more vaccine hesitant than physicians. After adjustment, no significant
6 association was observed for female gender, Black race, and those taking care of COVID-19
7 patients (Table-02).

8 Among all HCWs (n=5329), 27% felt COVID-19 vaccines were developed too fast, 45% doubted
9 vaccines' effectiveness against new variants, and 32% were concerned about side effects; 40%
10 felt COVID-19 vaccines should be mandated for HCWs (Supplementary Figure 1). Among
11 vaccine hesitant HCWs (n=551), primary concerns were vaccine side effects (47.37%), wanting
12 to wait for more people to get vaccinated (28.68%), and limited knowledge about the vaccines
13 (20.69%) (supplementary figure 1).

14 Discussion

15 COVID-19 vaccine hesitancy remains a significant barrier to controlling the COVID-19
16 pandemic. Ten percent of HCW in our survey were COVID-19–vaccine hesitant. Vaccine
17 hesitancy was associated with younger age (≤ 35), lower educational attainment, and non-
18 Hispanic ethnicity. There was no significant difference between the White and Black individuals;
19 as previous studies conducted earlier in the pandemic observed significant differences, this may
20 reflect changing perspectives in the Black community over the course of the pandemic and
21 vaccine administration.^{9,10} Nurses made up 34% of all respondents; of whom 11% were vaccine
22 hesitant (Table 1). Overall, nurses were six times more likely than physicians to be vaccine
23 hesitant. HCW with prior COVID-19 infections were also highly vaccine hesitant (19.7%),
24 possibly reflecting the misconception that natural immunity adequately protects against
25 reinfection. Topmost concerns about COVID-19 vaccination included side effects, efficacy, and

1 safety concerns based on the speed in which vaccine development occurred; these are
2 consistent with other literature reflecting similar concerns in the community.¹¹ (Supplementary
3 Figure 2)

4 Interestingly, vaccine hesitant nurses in our survey were relatively evenly distributed across
5 different groups; this may reflect inherent sociocultural beliefs irrespective of clinical role, age,
6 race, ethnicity or educational level. In addition to nurses, we observed those who have direct
7 contact working with patients (technologists, paramedics/EMT and medical/nursing assistants)
8 were more vaccine hesitant. Nurses are large in number and influential in their positions and
9 interface with other HCW of all educational levels and ages. One recent study demonstrated
10 that the decision to vaccinate was highly influenced by what the healthcare workers' colleagues
11 and others close to them thought about the vaccine and least influenced by mass media
12 marketing.¹² Assumptions about nursing knowledge and level of vaccine confidence should not
13 be made given the myriad of external influences that may be confounding decision making.
14 Utilizing nurses' human connection skills, medical background as well as extensive interfacing
15 with other HCW across educational levels creates opportunity for promoting vaccine uptake
16 among HCW and the community. Leveraging their position in society and their large numbers is
17 an important piece of vaccine promotion and they should be directly involved with policy-making
18 and communication campaigns.

19 COVID-19 vaccine mandates may threaten the workforce and healthcare infrastructure as we
20 lose HCW who opt out of COVID-19 vaccines at a time when they are needed the most. In
21 some areas, vaccine mandates have been accepted with minimal loss of workforce, but in
22 others, especially in the nursing field, there has been loss of workforce leading to reliance on
23 temporary staffing at high pay rates.¹³ HCW are considered role models in their families and
24 communities.¹⁴ Increased efforts are needed to increase HCW trust and confidence in COVID-
25 19 vaccines, allowing them to be effective champions for wider dissemination in the community.

1 One major strength of this study is the large sample size, spanning four health systems,
2 representing diverse race, ethnicity, gender, and age groups. Limitations include potential
3 selection bias related to the low response rate (17.76%); vaccine hesitant HCW may have been
4 less likely to respond likely to maintain social desirability especially in the healthcare setting,
5 though the demographic similarity of the sample to the overall HCW population may indicate a
6 reduced likelihood of such bias. Our survey was completed in mid-2021, and may not reflect
7 current vaccine hesitancy rates especially after COVID-19 vaccine mandates began.
8 Regardless, this data remains relevant as new vaccines directed at emerging variants as well as
9 the need for boosters remain a significant controversy in the discussion of vaccine mandates for
10 HCW.

11 As vaccine mandates roll out across the country, vaccine hesitant HCW must choose between
12 their livelihoods and their beliefs. Strategies to increase vaccine uptake and combat
13 misinformation should be directed at younger age groups and those with lower education status,
14 especially those who are “on the fence,” who are more likely to be influenced than those who
15 are adamantly opposed.¹⁵ Appealing to trusted colleagues to assist with vaccine promotion in
16 these age groups could be an effective measure to decrease vaccine hesitancy. In addition,
17 community outreach to external community organizational leadership could also promote
18 vaccine uptake not only in the community but also the HCW who belong to these trusted
19 communities.

20 As new COVID-19 variants continue to emerge, vaccine clinical guidance is evolving (e.g.,
21 adding booster doses), and future pandemics will continue to occur. Further training of frontline
22 HCW, especially nurses, in techniques such as motivational interviewing or decision aids to
23 build confidence to counter misconceptions is urgently needed. Formal training in these
24 techniques should be integrated into healthcare organizations to promote trust and increase
25 vaccine uptake.

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1 Table 1: Sample characteristics of healthcare workers compared by COVID-19 vaccine status in four major health care systems of Greater Atlanta, May 2021
 2 (n=5329).

| Demographics* | Frequency (%) (n=5329) | COVID-19 Vaccination status, n (%) | | COVID-19 Vaccination status, n (%) | | Chi-square p-value |
|--------------------------------------|---------------------------|------------------------------------|-------------------------------------|------------------------------------|-------------------------------------|-----------------------|
| | | Vaccine hesitant (n=551) | Non-vaccine hesitant (n=4778) | Vaccine hesitant (n=551) | Non-vaccine hesitant (n=4778) | |
| Age group (in years) | | | | | | |
| 18–35 | 1282 (24.28) | 191 (14.90) | 1091 (85.10) | 191 (35.44) | 1091 (23.01) | <0.0001 |
| 36–45 | 1216 (23.03) | 133 (10.94) | 1083 (89.06) | 133 (24.68) | 1083 (22.84) | |
| 46–55 | 1333 (25.24) | 132 (9.90) | 1201 (90.10) | 132 (24.49) | 1201 (25.33) | |
| 56–65 | 1221 (23.12) | 77 (6.31) | 1144 (93.69) | 77 (14.29) | 1144 (24.12) | |
| 66 and above (Ref.) | 229 (4.34) | 6 (2.62) | 223 (97.38) | 6 (1.11) | 223 (4.70) | |
| Gender | | | | | | |
| Male (Ref.) | 975 (18.46) | 68 (6.97) | 907 (93.03) | 68 (12.62) | 907 (19.13) | <0.0001 |
| Female | 4189 (79.32) | 414 (9.88) | 3775 (90.12) | 414 (76.81) | 3775 (79.61) | |
| Other response ^a | 117 (2.22) | 57 (48.72) | 60 (51.28) | 57 (10.58) | 60 (1.27) | |
| Race | | | | | | |
| White (Ref.) | 2443 (46.26) | 216 (8.84) | 2227 (91.16) | 216 (40.07) | 2227 (46.96) | <0.0001 |
| Black | 2038 (38.59) | 232 (11.38) | 1806 (88.62) | 232 (43.04) | 1806 (38.09) | |
| Asian | 390 (7.38) | 8 (2.05) | 382 (97.95) | 8 (1.48) | 382 (8.06) | |
| Native American | 9 (0.17) | 1 (11.11) | 8 (88.89) | 1 (0.19) | 8 (0.17) | |
| Other response ^b | 401 (7.59) | 82 (20.45) | 319 (79.55) | 82 (15.21) | 319 (6.73) | |
| Ethnicity | | | | | | |
| Hispanic (Ref.) | 275 (5.21) | 16 (5.82) | 259 (94.18) | 16 (2.97) | 259 (5.46) | <0.0001 |
| Non-Hispanic | 4688 (88.77) | 431 (9.19) | 4257 (90.81) | 431 (79.96) | 4257 (89.77) | |
| Other response ^c | 318 (6.02) | 92 (28.93) | 226 (71.07) | 92 (17.07) | 226 (4.77) | |
| Education | | | | | | |
| More than Bachelor's (Ref.) | 2176 (41.20) | 124 (5.70) | 2052 (94.30) | 124 (23.01) | 2052 (43.27) | <0.0001 |
| Bachelor's degree | 1628 (30.83) | 200 (12.29) | 1428 (87.71) | 200 (37.11) | 1428 (30.11) | |
| Less than Bachelor's | 1279 (24.22) | 176 (13.76) | 1103 (86.24) | 176 (32.65) | 1103 (23.26) | |
| Other response ^d | 198 (3.75) | 39 (19.70) | 159 (80.30) | 39 (7.24) | 159 (3.35) | |
| Previous diagnosis of COVID** | | | | | | |
| No (Ref.) | 4523 (84.88) | 397 (8.78) | 4126 (91.22) | 397 (72.05) | 4126 (86.35) | <0.0001 |
| Yes | 711 (13.34) | 140 (19.69) | 571 (80.31) | 140 (25.41) | 571 (11.95) | |

| At least one family member's previous diagnosis of COVID*** | | | | | | |
|--|--------------|-------------|--------------|-------------|--------------|---------|
| No (Ref.) | 1966 (36.89) | 201 (10.22) | 1765 (89.78) | 201 (36.48) | 1735 (36.94) | |
| Yes | 3237 (60.74) | 324 (10.01) | 2913 (89.99) | 324 (58.80) | 2913 (60.97) | 0.8033 |
| Health care worker role | | | | | | |
| Clinical (Ref.) | 3402 (63.84) | 334 (9.82) | 3068 (90.18) | 334 (60.62) | 3068 (64.21) | 0.0946 |
| Non-clinical | 1927 (36.16) | 217 (11.26) | 1710 (88.74) | 217 (39.38) | 1710 (35.79) | |
| Clinical health care roles (n=3402) | | | | | | |
| Physician/Resident (Ref.) | 616 (18.11) | 12 (1.95) | 604 (98.05) | 12 (3.59) | 604 (19.69) | <0.0001 |
| Nurse | 1211 (35.60) | 163 (13.46) | 1048 (86.54) | 163 (48.80) | 1048 (34.16) | |
| Technologist | 326 (9.58) | 43 (13.19) | 283 (86.81) | 43 (12.87) | 283 (9.22) | |
| Advanced Practice Provider | 240 (7.05) | 13 (5.42) | 227 (94.58) | 13 (3.89) | 227 (7.40) | |
| Medical/Nursing Assistant | 204 (6.00) | 31 (15.20) | 173 (84.80) | 31 (9.28) | 173 (5.64) | |
| Pharmacist | 128 (3.76) | 4 (3.13) | 124 (96.88) | 4 (1.20) | 124 (4.04) | |
| Paramedic/EMT | 79 (2.32) | 23 (29.11) | 56 (70.89) | 23 (6.89) | 56 (1.83) | |
| Other response ^e | 598 (17.58) | 45 (7.53) | 553 (92.47) | 45 (13.47) | 553 (18.02) | |
| Took care of COVID patients (n=3402) | | | | | | |
| No (Ref.) | 1021 (30.00) | 80 (7.84) | 941 (92.16) | 80 (23.95) | 941 (30.67) | 0.0381 |
| Yes | 2194 (64.50) | 235 (10.71) | 1959 (89.29) | 235 (70.36) | 1959 (63.85) | |
| Not sure | 187 (5.50) | 19 (10.16) | 168 (89.84) | 19 (5.69) | 168 (5.48) | |

1 *Demographic data missing for 48 respondents.

2 **96 selected "not sure," which is not shown.

3 ***126 selected "not sure," which is not shown.

4 ^aOther responses included "non-binary" and "prefer not to answer." ^bOther responses included "multiracial" and not specified/"prefer not to answer." ^cOther responses included "prefer not to answer." ^dOther responses included "professional certificate" and "prefer not to answer."

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1 Table 2: Predictors of COVID-19 vaccine hesitancy among HCWs in four major health care systems of Greater
 2 Atlanta, May 2021 (n=5329)

| Predictors | Odds Ratio (95% Confidence Interval) | |
|---|--------------------------------------|---------------------|
| | Unadjusted estimates | Adjusted estimates* |
| Age group (years) | | |
| 18–35 | 6.51 (2.85–14.85) | 8.81 (3.81–20.38) |
| 36–45 | 4.56 (2.00–10.47) | 5.30 (2.28–12.31) |
| 46–55 | 4.09 (1.78–9.37) | 3.77 (1.63–8.76) |
| 56–65 | 2.50 (1.08–5.81) | 2.31 (0.98–5.41) |
| 66 and above | Ref. | Ref. |
| Gender | | |
| Male | Ref. | Ref. |
| Female | 1.46 (1.12–1.91) | 1.30 (0.99–1.71) |
| Other response ^a | 12.67 (8.17–19.64) | 6.62 (3.93–11.15) |
| Race | | |
| White | Ref. | Ref. |
| Black | 1.32 (1.09–1.61) | 1.18 (0.95–1.46) |
| Asian | 0.22 (0.11–0.44) | 0.17 (0.08–0.35) |
| Native American | 1.29 (0.16–10.35) | 1.94 (0.23–16.41) |
| Other response ^b | 2.65 (2.00–3.51) | 1.53 (1.09–2.16) |
| Ethnicity | | |
| Hispanic | Ref. | Ref. |
| Non-Hispanic | 1.64 (0.98–2.74) | 2.79 (1.60–4.84) |
| Other response ^c | 6.59 (3.76–11.54) | 1.53 (1.09–2.16) |
| Education | | |
| More than Bachelor's | Ref. | Ref. |
| Bachelor's degree | 2.32 (1.83–2.93) | 2.29 (1.79–2.92) |
| Less than Bachelor's | 2.64 (2.08–3.36) | 2.96 (2.28–3.84) |
| Other response ^d | 4.06 (2.74–6.02) | 2.07 (1.27–3.37) |
| Health care worker role | | |
| Clinical | Ref. | Ref. |
| Non-clinical | 1.17 (0.97–1.40) | 1.08 (0.89–1.32) |
| Previous diagnosis of COVID | | |
| No | Ref. | Ref. |
| Yes | 2.55 (2.06–3.15) | 2.36 (1.88–2.96) |
| At least one family member's previous diagnosis of COVID | | |
| No | Ref. | Ref. |
| Yes | 0.98 (0.81–1.18) | 0.99 (0.81–1.21) |
| Clinical health care roles** | | |
| Physician/Resident | Ref. | Ref. |
| Nurse | 7.83 (4.32–14.18) | 6.46 (3.23–12.90) |
| Technologist | 7.65 (3.97–14.72) | 5.75 (2.72–12.16) |
| Advanced Practice Provider | 2.88 (1.30–6.41) | 2.70 (1.17–6.24) |
| Medical/Nursing Assistant | 9.02 (4.53–17.93) | 5.59 (2.47–12.64) |

| | | |
|-------------------------------|--------------------|--------------------|
| Pharmacist | 1.62 (0.52–5.12) | 1.41 (0.42–4.70) |
| Paramedic/EMT | 20.67 (9.77–43.74) | 12.89 (5.44–30.56) |
| Other response ^e | 4.10 (2.14–7.82) | 3.10 (1.53–6.27) |
| <hr/> | | |
| Took care of COVID patients** | | |
| No | Ref. | Ref. |
| Yes | 1.41 (1.08–1.84) | 1.25 (0.94–1.66) |
| Not sure | 1.33 (0.79–2.25) | 1.04 (0.59–1.82) |

1 * Adjusted for age, sex, race, ethnicity, education. Excluded 48 samples due to missing demographic data.

2 **Among clinical health care workers (n=3402).

3 ^aOther responses included “non-binary” and “prefer not to answer.” ^bOther responses included “multiracial” and

4 not specified/“prefer not to answer.” ^cOther responses included “prefer not to answer.” ^dOther responses included

5 “professional certificate” and “prefer not to answer.”

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