COVID-19 vaccine controversy: A cross-sectional analysis of factors associated with COVID-19 vaccine acceptance amongst emergency department patients in New York City

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Abstract

Objective: Understanding variables associated with coronavirus disease 2019 (COVID-19) vaccine confidence and hesitancy may inform strategies to improve vaccine uptake in clinical settings such as the emergency department (ED). We aim to identify factors contributing to COVID-19 vaccine acceptance and to assess patient attitudes surrounding offering COVID-19 vaccines in the ED.

Methods: We conducted a survey of a convenience sample of patients and patient visitors over the age 18 years, who were native English or Spanish speakers. The survey was conducted from March through August 2021 at 3 EDs in New York City. The survey was administered via an electronic format, and participants provided verbal consent.

Results: Our sample size was 377. Individuals with post-graduate degrees viewed vaccines positively (Prevalence Ratio [PR], 1.63; 95% Confidence Interval [CI], 1.07–2.47). Of the various high-risk medical conditions associated with adverse COVID-19 infection outcomes, diabetes was the only condition associated with more positive views of vaccines (PR, 1.37; CI, 1.17–1.59). Of all participants, 71.21% stated that they believed offering a COVID-19 vaccine in the ED was a good idea. Of unvaccinated participants, 21.80% stated they would get vaccinated if it were offered to them in the ED.
Conclusion: EDs can serve as a safety net for vulnerable populations and can act as an access point for vaccination.

KEYWORDS
COVID-19, COVID-19 vaccine, vaccine, vaccine acceptance, vaccine attitudes, vaccine hesitancy

1 | INTRODUCTION

1.1 | Background

The severe acute respiratory syndrome coronavirus 2 virus (SARS-CoV-2) [coronavirus disease 2019 [COVID-19]] caused a global pandemic, affecting the health and lives of millions, undermining healthcare systems, closing schools, and disrupting travel. As of September 1, 2022, the World Health Organization (WHO) COVID-19 reports show over 600 million confirmed cases and over 6.5 million deaths worldwide, and in the United States, the Centers for Disease Control and Prevention (CDC) reports more than 94 million cases and over 1 million deaths.1,2 Measures of prevention, such as mandated social distancing, mask-wearing, business and school closures, travel restrictions, contact tracing, and quarantine helped reduce, but not stop, the spread of COVID-19 infection.3 Vaccines are a core prevention strategy for severe COVID-19 illness, hospitalization, and death. However, despite aggressive public health campaigns and widespread vaccine availability in the United States, hesitancy persists. According to the WHO, vaccine hesitancy refers to “a delay in acceptance or refusal of vaccination despite availability of vaccination services. Vaccine hesitancy is complex and context specific, varying across time, place, and vaccines.”4 The causes for vaccine hesitancy are multifactorial and poorly understood.

Several studies have assessed reasons for COVID-19 vaccine hesitancy. Factors identified as exacerbating vaccine hesitancy include a negative attitude toward vaccines in general, distrust in their safety and efficacy, distrust of healthcare professionals or public health information campaigns, displeasure with the worldwide and governmental response to COVID-19, and distrust of governmental authority in general.5–13 By contrast, multiple studies have noted vaccine confidence and increased uptake among patients with increased income security and education, among patients with a perception that COVID-19 represents a threat to self and community, and knowing someone who has suffered from COVID-19 infection.14–17 Disparities in vaccine uptake among different demographic groups have also been identified. Youth, gender, Black race, Hispanic ethnicity, influenza vaccination status, and lack of a regular source of medical care have been associated with greater vaccine hesitancy.5,18 Studies in the United Kingdom demonstrated that women are more likely to be vaccine-hesitant or vaccine-resistant than men, and individuals younger than age 65 are likely to be more hesitant as well.19 Studies in the United Kingdom also showed that ethnic minorities were more likely to be vaccine hesitant than individuals identifying as white.20

A recent emergency department (ED)-specific study conducted in 2 Pennsylvania EDs found vaccine hesitancy to be more common among younger patients and individuals identifying as Black.21

1.2 | Importance

Our study looks specifically at patients presenting to the ED during the pandemic following the widespread availability of vaccines in the United States but before city-wide mandates requiring vaccination for dining, recreational activities, or employment by the city and some businesses. Our New York City patient population in the ED is particularly important to investigate, being at the epicenter of the first wave of the pandemic in the United States. The Washington Heights population is predominantly Hispanic, inner city, and of lower socioeconomic status; Columbia University serves local patients from Manhattan, the Bronx, and New Jersey as well as those from outside our area seeking specialty care. Globally, the patient population in any ED is uniquely accessible to healthcare professionals for vaccination counseling. Understanding factors behind vaccine hesitancy in individuals presenting to the ED will help healthcare practitioners develop a strategy to discuss the COVID-19 vaccine with their patients, especially vulnerable populations.

1.3 | Goals of this investigation

Ultimately, the ED is a social safety net serving a wide range of patients, many from some of the most vulnerable situations. The ED offers a unique opportunity to help increase vaccine administration, given this clinical interaction may be one of the few points of contact with the healthcare system for many of our patients. Our objective is to understand vaccine hesitancy within EDs, as they are often the initial access point to healthcare. We intend to highlight the role EDs can serve in increasing vaccination uptake.

2 | METHODS

2.1 | Study design and setting

We conducted a cross-sectional survey of 402 patients and caregivers from March through August 2021 in the New York-Presbyterian Adult Emergency Department, Morgan Stanley Children's Hospital of New
York (CHONY) Emergency Department, and New York-Presbyterian Allen Hospital Emergency Department of Columbia University Medical Center (CUMC). These EDs predominantly serve neighborhoods of lower socio-economic status, which include Washington Heights, Harlem, and the Bronx.

### 2.2 Selection of participants

This was a convenience sample. Of 402 records, 377 participants answered our primary question on vaccine attitudes, making this an availability analysis. Of these 377, only 322 completed the entire survey. Patients ≥18 years of age voluntarily accessed the survey through a quick response (QR) code or link provided by physicians and medical students or from flyers posted throughout the adult emergency department waiting rooms. Two versions of the survey were available: one for adult English speakers and one for adult Spanish speakers. Inclusion criteria included any patient presenting to one of the 3 EDs or their visitor waiting with them. Exclusion criteria included individuals younger than age 18. Participants accessed and completed the survey on their personal electronic devices or on a research tablet provided by a member of the research team. Verbal consent was obtained prior to the start of the survey. This study was approved by the CUMC Institutional Review Board (IRB).

### 2.3 Measurements

The survey consisted of 30 multiple-choice and fill-in-the blank questions, which were mirrored to questions in similar studies on vaccine hesitancy. We created and included ED specific questions based on our own hypothesis. Our questions have not been tested or validated by an external metric. This report relays findings from our multiple-choice questions.

Using a multiple-choice scale, participants were asked about their overall attitude toward vaccines, whether they believed COVID-19 vaccines would be overall beneficial to their community, whether they personally knew anyone who had been very ill or died from COVID-19, and whether they knew anyone who had received a COVID-19 vaccine. Participants were later asked if they had received the COVID-19 vaccine. This survey elicited information about current medical problems and whether participants felt they were at risk of severe disease if they were to contract COVID-19. The participants were asked to select from where they received the majority of their vaccine information and to indicate the source; they trusted the most to provide accurate information regarding the vaccine. Participants indicated whether they felt offering a vaccine in the ED was a good idea and if they would receive the vaccine if it were offered to them in the ED.

Demographic data includes: age, gender, race, Hispanic or Latino origin, education level, and insurance status. Participants were also asked whether they were considered an essential worker, defined as “healthcare, first responder, food services, delivery services, etc.”

### 2.4 Analysis

We examined the distribution of vaccine attitudes in our sample. We categorized individuals as having favorable attitudes if they reported positive or very positive attitudes toward vaccines. All other individuals were considered to have negative or neutral attitudes toward vaccines. We then explored the demographic and clinical characteristics of the sample and explored whether these variables were associated with reporting favorable vaccine attitudes using unadjusted log-binomial regression models. We then constructed unadjusted log-binomial regression models estimating the probability of having received the COVID-19 vaccine as a function of attitudes and COVID-19 history, including whether they had previously tested positive for COVID-19, the severity of COVID-19 infection (among those who tested positive), risk of severe COVID-19 infection, knowing someone who has become very ill or died of COVID-19, and knowing anyone who has received the vaccine. Finally, we examined whether being exposed to different health information sources and which of those they considered to be trusted were associated with favorable attitudes toward vaccines. These analyses were conducted using an available case analysis given that missing data on the primary outcome, vaccine attitudes, was low (6.2%). All analyses were conducted in Stata, Version 17.

### 3 RESULTS

Individuals over age 18 years and willing to participate were eligible for the study. As demonstrated in Table 1, roughly half (48.48%) of participants were younger than 35 years and about 7% were over 65 years. Individuals over age 35 years were more likely to report positive attitudes toward vaccination relative to participants under the age of 24 years. Those 25–34 years did not have a statistically significant attitude toward vaccines relative to participants who were 18–24 years (prevalence ratio [PR], 1.78; 95% confidence interval [CI], 0.93–3.4). Attitudes toward vaccines were not significantly different based on gender. Most participants (79.18%) identified as non-white, with 57% identifying as Hispanic. Individuals identifying as Black/African American were less likely to report positive attitudes toward vaccines relative to participants who identified as White (PR, 0.74; CI, 0.6–0.9). Individuals with postgraduate degrees were
**TABLE 1**  Sociodemographic factors associated with vaccine hesitancy

| Variable                              | Negative or neutral attitudes (n = 128, 34.0%) | Positive attitudes (n = 249, 66.1%) | PR (95% CI) |
|---------------------------------------|-----------------------------------------------|-----------------------------------|-------------|
| Age, n (%), years                     |                                               |                                   |             |
| 18-24                                 | 33 (31.1)                                     | 28 (12.6)                         | REF         |
| 25-34                                 | 39 (36.8)                                     | 59 (26.6)                         | 1.31 (0.96, 1.8) |
| 35-44                                 | 19 (17.9)                                     | 39 (17.6)                         | 1.46 (1.06, 2.03) |
| 45-54                                 | 6 (5.7)                                       | 42 (18.9)                         | 1.91 (1.42, 2.55) |
| 55-64                                 | 7 (6.6)                                       | 30 (13.5)                         | 1.77 (1.29, 2.42) |
| >65                                   | 1 (0.9)                                       | 22 (9.9)                          | 2.08 (1.57, 2.77) |
| Prefer not to say                     | 1 (0.9)                                       | 2 (0.9)                           | 1.45 (0.62, 3.38) |

| Gender, n (%)                         |                                               |                                   |             |
| Women                                 | 64 (59.8)                                     | 139 (62.6)                        | REF         |
| Men                                   | 40 (37.4)                                     | 82 (36.9)                         | 0.98 (0.84, 1.15) |
| Prefer not to say                     | 3 (2.8)                                       | 1 (0.5)                           | 0.37 (0.07, 2) |

| Race, n (%)                           |                                               |                                   |             |
| White                                 | 12 (12.0)                                     | 54 (24.9)                         | REF         |
| American Indian or Alaska Native      | 0 (0.0)                                       | 3 (1.4)                           | REF         |
| Asian                                 | 0 (0.0)                                       | 3 (1.4)                           | REF         |
| Black or African American             | 39 (39.0)                                     | 59 (27.2)                         | 0.74 (0.6, 0.9) |
| Native Hawaiian or Other Pacific Islander | 2 (2.0)                                     | 1 (0.5)                           | 0.41 (0.08, 2.03) |
| Other                                 | 32 (32.0)                                     | 81 (37.4)                         | 0.88 (0.74, 1.03) |
| Prefer not to say                     | 15 (15.0)                                     | 16 (7.4)                          | 0.63 (0.44, 0.9) |

| Ethnicity, n (%)                      |                                               |                                   |             |
| No                                    | 34 (32.1)                                     | 81 (36.8)                         | REF         |
| Prefer not to say                     | 13 (12.3)                                     | 11 (5.0)                          | 0.65 (0.41, 1.02) |
| Yes                                   | 59 (55.7)                                     | 128 (58.2)                        | 0.97 (0.83, 1.13) |

| Education, n (%)                      |                                               |                                   |             |
| Less than a high school diploma       | 11 (10.5)                                     | 12 (5.6)                          | REF         |
| High school degree or equivalent      | 23 (21.9)                                     | 44 (20.6)                         | 1.26 (0.82, 1.93) |
| Some college                          | 30 (28.6)                                     | 60 (28.0)                         | 1.28 (0.84, 1.94) |
| Bachelor’s degree                     | 26 (24.8)                                     | 65 (30.4)                         | 1.37 (0.91, 2.07) |
| Postgraduate degree                   | 5 (4.8)                                       | 28 (13.1)                         | 1.63 (1.07, 2.47) |
| Other                                 | 3 (2.9)                                       | 1 (0.5)                           | 0.48 (0.08, 2.73) |
| Prefer not to say                     | 7 (6.7)                                       | 4 (1.9)                           | 0.70 (0.29, 1.67) |

| Insurance, n (%)                      |                                               |                                   |             |
| I pay for my own insurance            | 5 (4.8)                                       | 16 (7.4)                          | REF         |
| I receive insurance through my work   | 20 (19.1)                                     | 65 (30.0)                         | 1.07 (0.77, 1.41) |
| Medicaid                              | 48 (45.7)                                     | 76 (35.0)                         | 1.36 (0.21, 1.06) |
| Medicare                              | 10 (9.5)                                      | 35 (16.1)                         | 1.02 (0.77, 1.36) |
| Other                                 | 5 (4.8)                                       | 12 (5.5)                          | 0.93 (0.63, 1.37) |
| Prefer not to say                     | 14 (13.3)                                     | 6 (2.8)                           | 0.39 (0.19, 0.8) |
| Uninsured                             | 3 (2.9)                                       | 7 (3.2)                           | 0.92 (0.57, 1.47) |

| Essential worker, n (%)               |                                               |                                   |             |
| No                                    | 53 (50.0)                                     | 124 (56.6)                        | REF         |
| Prefer not to say                     | 5 (4.7)                                       | 2 (0.9)                           | 0.41 (0.13, 1.32) |
| Unsure                                | 5 (4.7)                                       | 3 (1.4)                           | 0.54 (0.22, 1.32) |
| Yes                                   | 43 (40.6)                                     | 90 (41.1)                         | 0.97 (0.83, 1.12) |

The bold values were used to signify the significant P values (P<0.05).
Abbreviations: COVID-19, Coronavirus- disease 2019; PR, prevalence ratio; CI, confidence interval; REF, reference group.
TABLE 2  History of infection and vaccination in relation to vaccine hesitancy

| Variable                                                      | Not received COVID-19 vaccine | Received COVID-19 vaccine | PR (95% CI) |
|---------------------------------------------------------------|------------------------------|--------------------------|-------------|
| Vaccine attitudes, n (%)                                      |                              |                          |             |
| Very negative                                                | 19 (14.1)                    | 1 (0.5)                  | REF         |
| Slightly negative                                            | 11 (8.2)                     | 5 (2.5)                  | 6.25 (0.81, 48.25) |
| Neutral                                                      | 58 (43.0)                    | 19 (9.4)                 | 4.94 (0.70, 34.68) |
| Positive                                                     | 28 (20.7)                    | 71 (35.2)                | 14.34 (2.11, 97.28) |
| Very positive                                                | 19 (14.1)                    | 106 (52.5)               | 16.96 (2.51, 114.73) |
| Positive vaccine attitudes, n (%)                            |                              |                          |             |
| Negative or neutral attitudes                                 | 88 (65.2)                    | 25 (12.4)                | REF         |
| Positive attitudes                                            | 47 (34.8)                    | 177 (87.6)               | 3.57 (2.51, 5.08) |
| Have you ever tested positive for COVID-19, n (%)             |                              |                          |             |
| No                                                           | 93 (68.9)                    | 141 (70.5)               | REF         |
| Unsure                                                       | 8 (5.9)                      | 6 (3.0)                  | 0.71 (0.39, 1.31) |
| Yes                                                          | 34 (25.2)                    | 53 (26.5)                | 1.01 (0.83, 1.23) |
| Among those who tested positive, how severe was your COVID-19 infection, n (%) | | | |
| Asymptomatic                                                  | 8 (23.5)                     | 9 (17.0)                 | REF         |
| Mild                                                         | 24 (70.6)                    | 37 (69.8)                | 1.15 (0.70, 1.87) |
| Moderate                                                     | 2 (5.9)                      | 6 (11.3)                 | 1.42 (0.78, 2.58) |
| Severe                                                       | 0 (0.0)                      | 1 (1.9)                  | REF         |
| Do you consider yourself high risk for having severe COVID-19 infection, n (%) | | | |
| No                                                           | 74 (55.2)                    | 121 (60.8)               | REF         |
| Unsure                                                       | 35 (26.1)                    | 29 (14.6)                | 0.73 (0.55, 0.98) |
| Yes                                                          | 25 (18.7)                    | 49 (24.6)                | 1.07 (0.88, 1.3) |
| Personally know someone who has been very ill or died of COVID, n (%) | | | |
| No                                                           | 30 (22.2)                    | 59 (29.2)                | REF         |
| Unsure                                                       | 7 (5.2)                      | 4 (2.0)                  | 0.55 (0.25, 1.22) |
| Yes                                                          | 98 (72.6)                    | 139 (68.8)               | 0.88 (0.74, 1.06) |
| Know anyone who has received the vaccine, n (%)               |                              |                          |             |
| No                                                           | 7 (5.2)                      | 2 (1.0)                  | REF         |
| Unsure                                                       | 1 (0.8)                      | 0 (0.0)                  | REF         |
| Yes                                                          | 126 (94.0)                   | 198 (99.0)               | 2.75 (0.81, 9.36) |

The bold values were used to signify the significant P values (P<0.05).
Abbreviations: COVID-19, coronavirus disease 2019; PR, prevalence ratio; CI, confidence interval; REF, reference group.

significantly more likely to report positive attitudes toward vaccines relative to individuals with less than a high school diploma (PR, 1.63; CI, 1.07–2.47).

Table 2 demonstrates that individuals who had favorable attitudes toward vaccines were more likely to have received a COVID-19 vaccine (PR, 3.57; CI, 2.51–5.08). Having previously had COVID-19 had no impact on whether people decided to be vaccinated (PR, 1.01; CI, 0.83–1.23). Individuals who were unsure of their risk of having a severe infection if they became infected with COVID-19 were less likely to have received a vaccine (PR, 0.73; CI, 0.55–0.98). Knowing someone who had been very ill from or died from COVID-19 did not impact participants’ decision to receive the vaccine (PR, 0.88; CI, 0.74–1.06). Knowing someone who had been vaccinated did not significantly improve participants’ likelihood of receiving the vaccine (PR, 2.75; CI, 0.81–9.36).

This survey also requested participant information about current medical problems and their perceived risk factors. Results (Table 3) illustrated that individuals who reported having diabetes were more likely to report positive attitudes toward vaccines (PR, 1.37; CI, 1.17–1.59). Other notable health conditions such as hypertension (PR = 1.18; CI = 1–1.39), heart problems (PR, 0.71; CI, 0.45–1.12), smoking status (PR, 0.68; CI, 0.42, 1.07) or lung disease (PR, 0.92; CI,
### TABLE 3  Pre-existing medical conditions and vaccine hesitancy

| Variable                                | Negative or neutral attitudes (n = 128, 34.0%) | Positive attitudes (n = 249, 66.1%) | PR (95% CI) |
|------------------------------------------|-----------------------------------------------|-------------------------------------|-------------|
| **Heart problems, n (%)**               |                                               |                                     |             |
| No                                       | 117 (91.4)                                     | 239 (96.0)                          | REF         |
| Yes                                      | 11 (8.6)                                       | 10 (4.0)                            | 0.71 (0.45, 1.12) |
| **Diabetes, n (%)**                      |                                               |                                     |             |
| No                                       | 124 (96.9)                                     | 221 (88.8)                          | REF         |
| Yes                                      | 4 (3.1)                                        | 28 (11.2)                           | 1.37 (1.17, 1.59) |
| **High blood pressure, n (%)**          |                                               |                                     |             |
| No                                       | 114 (89.1)                                     | 205 (82.3)                          | REF         |
| Yes                                      | 14 (10.9)                                      | 44 (17.7)                           | 1.18 (1.19) |
| **Lung problems/asthma, n (%)**         |                                               |                                     |             |
| No                                       | 106 (82.8)                                     | 214 (85.9)                          | REF         |
| Yes                                      | 22 (17.2)                                      | 35 (14.1)                           | 0.92 (0.74, 1.14) |
| **Cancer, n (%)**                        |                                               |                                     |             |
| No                                       | 126 (98.5)                                     | 244 (98.0)                          | REF         |
| Yes                                      | 2 (1.6)                                        | 5 (2.0)                             | 1.08 (0.67, 1.74) |
| **Kidney problems, n (%)**              |                                               |                                     |             |
| No                                       | 122 (95.3)                                     | 240 (96.4)                          | REF         |
| Yes                                      | 6 (4.7)                                        | 9 (3.6)                             | 0.91 (0.59, 1.38) |
| **Overweight/obese, n (%)**             |                                               |                                     |             |
| No                                       | 110 (85.9)                                     | 211 (84.7)                          | REF         |
| Yes                                      | 18 (14.1)                                      | 38 (15.3)                           | 1.03 (0.85, 1.26) |
| **Smoking, n (%)**                       |                                               |                                     |             |
| No                                       | 116 (90.6)                                     | 239 (96.0)                          | REF         |
| Yes                                      | 12 (9.4)                                       | 10 (4.0)                            | 0.68 (0.42, 1.07) |
| **Transplant, n (%)**                   |                                               |                                     |             |
| No                                       | 127 (99.2)                                     | 243 (97.6)                          | REF         |
| Yes                                      | 1 (0.8)                                        | 6 (2.4)                             | 1.31 (0.96, 1.78) |
| **Weak immune system under care of specialist, n (%)** | | | | |
| No                                       | 122 (95.3)                                     | 234 (94.0)                          | REF         |
| Yes                                      | 6 (4.7)                                        | 15 (6.0)                            | 1.09 (0.82, 1.44) |
| **Other medical problems, n (%)**       |                                               |                                     |             |
| No                                       | 119 (93.0)                                     | 217 (87.2)                          | REF         |
| Yes                                      | 9 (7.0)                                        | 32 (12.9)                           | 1.21 (1.01, 1.45) |

The bold values were used to signify the significant P values (P<0.05).

Abbreviations: PR, prevalence ratio; CI, confidence interval; REF, reference group.

0.74–1.14) did not have any statistically significant association with vaccination status.

Additionally, the participants were asked to select where they received most of their information regarding the vaccine and to indicate the source, they trusted the most to provide accurate information regarding the vaccine. As demonstrated in Table 4, results showed that individuals who received their health information from scientific journals had positive attitudes toward vaccines (PR, 1.29; CI, 1.12–1.49). Participants who reported their trusted source of information to be television (PR, 1.27; CI, 1.09–1.47) also were more likely to report positive attitudes toward vaccines. Notably, those who received their information from social media (PR, 0.96; CI, 0.83–1.12) or found social media to be their most trusted source for information (PR, 1.12; CI, 0.87–1.43) was not associated with attitudes toward vaccines.

When participants were asked whether they thought offering the vaccine in the ED would be a good idea, 71.21% of participants reported that they thought it was a good idea. Approximately half of the unvaccinated participants reported that they would not be willing to
| Variable | Negative or neutral attitudes (n = 128, 34.0%) | Positive attitudes (n = 249, 66.1%) | PR (95% CI) |
|----------|---------------------------------------------|-----------------------------------|-------------|
| Health information source: TV, n (%) | | | |
| No       | 65 (50.8)                                   | 140 (56.2)                        | REF         |
| Yes      | 63 (49.2)                                   | 109 (43.8)                        | 0.93 (0.8, 1.07) |
| Health information source: news articles, n (%) | | | |
| No       | 76 (59.4)                                   | 152 (61.0)                        | REF         |
| Yes      | 52 (40.6)                                   | 97 (39.0)                         | 0.98 (0.84, 1.13) |
| Health information source: social Media, n (%) | | | |
| No       | 75 (58.6)                                   | 153 (61.5)                        | REF         |
| Yes      | 53 (41.4)                                   | 96 (38.6)                         | 0.96 (0.83, 1.12) |
| Health information source: family/friends, n (%) | | | |
| No       | 89 (69.5)                                   | 178 (71.5)                        | REF         |
| Yes      | 39 (30.5)                                   | 71 (28.5)                         | 0.97 (0.82, 1.14) |
| Health information source: scientific journals, n (%) | | | |
| No       | 116 (90.6)                                  | 197 (79.1)                        | REF         |
| Yes      | 12 (9.4)                                    | 52 (20.9)                         | 1.29 (1.12, 1.49) |
| Health information source: doctor or other medical provider, n (%) | | | |
| No       | 89 (69.5)                                   | 176 (70.7)                        | REF         |
| Yes      | 39 (30.5)                                   | 73 (29.3)                         | 0.98 (0.84, 1.15) |
| Health information source: other source(s), n (%) | | | |
| No       | 81 (63.3)                                   | 161 (64.7)                        | REF         |
| Yes      | 47 (36.7)                                   | 88 (35.3)                         | 0.98 (0.84, 1.14) |
| Trusted information source: TV, n (%) | | | |
| No       | 116 (90.6)                                  | 200 (80.3)                        | REF         |
| Yes      | 12 (9.4)                                    | 49 (19.7)                         | 1.27 (1.09, 1.47) |
| Trusted information source: news articles, n (%) | | | |
| No       | 108 (84.4)                                  | 194 (77.9)                        | REF         |
| Yes      | 20 (15.6)                                   | 55 (22.1)                         | 1.14 (0.97, 1.34) |
| Trusted information source: social media, n (%) | | | |
| No       | 121 (94.5)                                  | 230 (92.4)                        | REF         |
| Yes      | 7 (5.5)                                     | 19 (7.6)                          | 1.12 (0.87, 1.43) |
| Trusted information source: family/friends, n (%) | | | |
| No       | 112 (87.5)                                  | 219 (88.0)                        | REF         |
| Yes      | 16 (12.5)                                   | 30 (12.1)                         | 0.99 (0.79, 1.23) |
| Trusted information source: scientific journals, n (%) | | | |
| No       | 89 (69.5)                                   | 179 (71.9)                        | REF         |
| Yes      | 39 (30.5)                                   | 70 (28.1)                         | 0.96 (0.82, 1.13) |
| Trusted information source: doctor or other medical provider, n (%) | | | |
| No       | 61 (47.7)                                   | 92 (37.0)                         | REF         |
| Yes      | 67 (52.3)                                   | 157 (63.1)                        | 1.17 (1, 1.36) |
| Trusted information source: other source(s), n (%) | | | |
| No       | 44 (34.4)                                   | 85 (34.1)                         | REF         |
| Yes      | 84 (65.6)                                   | 164 (65.9)                        | 1 (0.86, 1.17) |

The bold values were used to signify the significant P values (P<0.05). Abbreviations: PR, prevalence ratio; CI, confidence interval; REF, reference group.
receive the COVID-19 vaccine if it were offered to them (47.37%). The remaining unvaccinated participants were either unsure (30.83%) or would be willing to take the vaccine if it were offered to them (21.80%). Among those participants who said they were willing to get the vaccine if it were offered to them, most would be willing to take the vaccine if it were offered to them in the ED (67.86%). However, 14.29% and 17.86% of those would not be willing or reported being unsure whether they would take it in the ED, respectively.

4 | LIMITATIONS

This is a small sample size, and our ED demographics are unique, given our patient population is predominantly Hispanic, inner city, and of lower socioeconomic status. Given the socio-economic demographics of our neighborhood, it is notable that more than two-thirds of our participants had attended some college. This likely indicates a selection bias where mostly educated people or people who could read participated in our study. This disproportionate amount of college-educated respondents may also account for the large proportion who list scientific journals as their trusted source of information. Additional limitations include disproportional gender balance and a racial sample that is not indicative of the United States population at large.

For race, many respondents of Dominican descent may have reported “Other” or “Prefer not to say” because many do not see themselves as strictly white or black. Further, in this Spanish-speaking neighborhood, there was no race option listed as “Hispanic/Latinx.” Therefore, some Dominicans and Latin Americans identified themselves under the question addressing ethnicity while others just selected the race they most identified with. Ultimately, the patient population in general likely skewed the results.

The survey questions were developed by the study team based on our hypothesis and prior survey studies. There was no pilot testing, and the survey questions were not validated. It poses limitations, with an unvalidated survey, if the questionnaire were appropriately measuring these key underlying constructs of vaccine hesitancy or attitude toward vaccines.

Other limitations of the study included the QR code, which individuals with certain Android phones could not access. Individuals who were not technologically savvy also may have struggled with the survey. Because of the length of the study and the nature of the ED, only 322 participants completed the full questionnaire.

5 | DISCUSSION

To better understand vaccine hesitancy, our study captures a unique patient population—individuals seeking emergent medical care who are more likely to be experiencing an exacerbation of an underlying medical illness, who may be more vulnerable at baseline than the remainder of the population due to socio-economic factors, access to primary care or insurance status, and who are at risk of contracting hospital-acquired COVID-19 by being around other ill patients. Furthermore, given that this ED patient population is based in New York City (the epicenter during the onset of the pandemic), we find it surprising that knowing someone who has been severely ill or died is not associated with an increased uptake of the vaccine. This may explain lingering low vaccination rates in areas and communities that have been hit hardest by the pandemic. Patients are more likely to be vaccinated if someone they know received the vaccine, emphasizing the role of word of mouth.

The participant population in the ED may be more likely to be forthcoming about their medical concerns, especially if that is what brought them to the ED. We did not ask why the patients presented to the ED, therefore presentation for COVID concerns could have affected results. In addition, it is interesting to note that diabetes (and not lung disease, heart disease, hypertension, smoking status, or immune status) is the only medical concern associated with positive views toward vaccination.

Further, the trust participants place in television is not surprising given the media has been implicated widely for reinforcing attitudes toward vaccines. Although we did not find social media to have a statistically significant role, that may be an indicator of a divide within social media, with negative opinions and positive opinions canceling each other out. Given healthcare practitioners and medical students were administering the survey, a response bias could explain the significance for trust in healthcare practitioners.

Our study reinforces prior demographic data regarding who has received the vaccine. We expected to see individuals with a postgraduate degree to be more likely to have received the vaccine, though the lack of significance among individuals with a bachelor’s degree was unexpected. As other studies have documented, Black or African American individuals are less likely to have positive attitudes toward vaccines. Individuals without insurance may not have wanted to report their insurance status given they were in an ED. The lack of a difference within Gender may be attributed to the sample proportions, with women answering the survey at much higher rates. Unlike our study, previous studies show women to be more vaccine-hesitant. This was also an exploratory analysis reporting unadjusted models. Future, hypothesis-driven studies should account for potential confounders of associations to clarify the relationships that emerged in this study.

Overall, the study was able to assess for a multitude of factors correlating to vaccine hesitancy. Since this study, EDs nationwide began offering a COVID-19 vaccine making our study’s findings relevant to the impact of ED-initiated vaccination. Given 71.21% of participants believe offering COVID-19 vaccines in the ED is a good idea and that roughly half of the unvaccinated individuals are either unsure or willing to be vaccinated in the ED, we can conclude that offering vaccination in the ED would provide greater access and even potentially lead to higher vaccination rates in otherwise vaccine-hesitant individuals.

We hope future research will focus on the likelihood of individuals receiving the vaccine given their medical problems or their perceived risk of severe infection. We especially would like to see further studies among individuals who smoke. We also encourage research to further study vaccination rates among those who have known someone to be
severely ill or to have died from COVID-19, as it is surprising that this is not a motivating factor for vaccination.

We hope this research demonstrates the impact of offering vaccines in EDs. Vaccine hesitancy is a clear indicator of health disparities and health inequities both exemplified in New York City and across the United States. This survey identified specific populations who have neutral/negative attitudes toward the COVID-19 vaccine. We are advocating for better dissemination of information and vaccine promotion among hesitant groups, especially those already disproportionately affected by the pandemic and vulnerable populations that often access healthcare through the ED. This research can inform targeted interventions to certain information outlets, including television marketed to specific demographics and/or word-of-mouth campaigns in community centers. We hope it emphasizes the ED’s significance in increasing vaccination.

AUTHOR CONTRIBUTIONS
Tsion Firew and Anju Wagh conceived the idea, oversaw, and take final responsibility for the research. Christina P. Guzman developed the idea and designed the data collection instruments. Jamie Aron and Jennifer Egbebike drafted the initial manuscript. M. Claire Greene carried out the initial data analysis. Bianca R. Stefan translated the survey into Spanish. Bernard P. Chang oversaw the research and provided general support. All listed authors assisted in developing the survey, implementing the study, and reviewing and revising the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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