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COVID-19 and Influenza Vaccine Hesitancy among Adults Hospitalized in the United States, 2019 – 2022

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Abstract

Background: Understanding similarities and differences between hesitancy for influenza and COVID-19 vaccines could facilitate strategies to improve public receptivity towards vaccination.

Methods: We compared hesitancy for COVID-19 vaccines during the first 13 months of availability (January 2021-January 2022) with hesitancy for influenza vaccines in the 15 months prior to COVID-19 vaccine availability (October 2019-December 2020) among adults hospitalized with acute respiratory illness at 21 hospitals in the United States. We interviewed patients regarding vaccination status, willingness to be vaccinated, and perceptions of vaccine safety and efficacy. We used multivariate logistic regression to identify factors associated with vaccine hesitancy.

Results: Among 12,292 patients enrolled during the COVID-19 vaccine period, 5,485 (44.6%) were unvaccinated. Patient characteristics associated with not receiving the COVID-19 vaccine included younger age, female sex, higher BMI, lack of health insurance, absence of chronic comorbid medical conditions, no or rare influenza vaccination in prior years, higher CDC social vulnerability index (SVI), a measure of external stresses that may negatively impact health, living in the Midwest or southern US, lack of college or higher education, and not wearing a mask. Among 983 patients enrolled during the influenza vaccination period, 381(37.8%) were unvaccinated. Characteristics associated with not receiving the influenza vaccine included no or one chronic comorbid medical condition, no or rare influenza vaccination in prior years, being a current smoker, and higher SVI. Discussion with healthcare providers was a reason for vaccination for 27.7% (167) for influenza and 8.3% (564) for COVID-19 and to decline vaccination for 0.5% (2) for influenza and 2.2% (118) for COVID-19.

Conclusions: We found that higher SVI scores and lack of prior influenza vaccination were associated with hesitancy for both COVID-19 and influenza vaccines. There were regional variations in COVID-19 vaccine acceptance and discussions with HCPs significantly influenced acceptance for both vaccines.

Keywords

Influenza; COVID-19; SARS-CoV-2; vaccine hesitancy; vaccine acceptance

INTRODUCTION

Vaccination against viral pathogens can markedly improve public health [1, 2]. However, vaccine hesitancy, a delay or refusal of vaccination despite the availability of safe and effective vaccines, has recently increased[3–5] and has been particularly prevalent for COVID-19 vaccines [6–8].

COVID-19 vaccines became widely available in the United States (US) in early 2021 [9–14]. The vaccines are safe and highly effective in preventing COVID-19 associated severe disease[12, 14–20]. Despite widespread availability, approximately 18.6% of eligible persons in the US had not received a primary COVID-19 vaccine series, and 83% had not received the updated bivalent COVID-19 vaccine by May 2023 [5, 21]. Understanding why some people decline COVID-19 vaccination is crucial to increasing vaccination rates and maintaining a highly vaccinated population against respiratory viral illnesses, especially when serial vaccinations are necessary [22].

Well-described strategies to decrease hesitancy for seasonal influenza vaccination may inform approaches to overcome COVID-19 vaccine hesitancy, especially if risk factors for being unvaccinated and vaccine hesitancy for COVID-19 and influenza vaccines are similar[23]. These include community outreach programs and worksite interventions,[24] educating patients through various tailored methods,[25–27] training physicians to improve communication with patients,[25, 28] and expanding access to vaccine services.[29] To evaluate the similarities and differences in vaccine hesitancy between COVID-19 and influenza vaccines, we evaluated risk factors for being unvaccinated and patient perceptions related to these vaccines among US adults hospitalized with acute respiratory illnesses between 2019 and 2022.

METHODS

Design and Setting

As part of an in-hospital surveillance program within the Investigating Respiratory Viruses in the Acutely Ill (IVY) Network [30–32], we prospectively enrolled adults hospitalized with signs and symptoms of acute respiratory infection at 21 hospitals in 18 US states between October 10, 2019, and January 25, 2022. We chose hospitalized patients with respiratory syndromes as our sample population because they represent a high-risk group with significant exposure to healthcare systems, making them uniquely positioned to benefit from vaccination. This approach allowed for a controlled data collection process and access to detailed clinical information.

The US Centers for Disease Control and Prevention (CDC) funds the IVY Network surveillance program. The program was determined to be public health surveillance by all participating institutions and the CDC with a waiver of informed consent. We have

previously reported COVID-19 and influenza vaccine effectiveness using data from this program [30–32]. We also previously reported risk factors for being unvaccinated for influenza and patient perceptions of influenza vaccines [33]. The current study expands on prior work by evaluating risk factors for being unvaccinated for COVID-19 and patient perceptions of COVID-19 vaccines.

Population

Eligibility criteria included hospital admission with signs and or symptoms of an acute respiratory infection, such as acute cough, shortness of breath, or fever (full eligibility criteria, including modifications during the study, are detailed in Table S1). Enrollment included both cases, defined as patients with laboratory-confirmed influenza or SARS-CoV-2 infection, and controls, defined as patients with negative testing for influenza and, after March 2020, SARS-CoV-2. Patients were enrolled from October 10, 2019 - January 25, 2022, and divided into two periods based on the timing of widespread availability of COVID-19 vaccines beginning in January 2021: (1) Influenza vaccine assessment period (October 10, 2019 - December 31, 2020); and (2) COVID-19 vaccine assessment period (January 1, 2021 - January 25, 2022). The study population for this analysis included patients enrolled in the IVY surveillance program who completed self-reported interview questions about vaccine receipt and vaccine perceptions.

Data collection and classification

At the time patients were prospectively enrolled in the hospital, trained study personnel interviewed patients (or surrogate caretakers when the patient could not answer) regarding vaccination status and their perceptions of influenza vaccines (October 2019 - December 2020) or COVID-19 vaccines (January 2021 - January 2022) using standardized questions. For this analysis, unvaccinated status for COVID-19 was defined as no COVID-19 vaccine dose at any time, and unvaccinated status for influenza was defined as no influenza vaccine dose in the year prior to enrollment. Data on source verification of vaccine receipt collected from enrolled patients were not used in the current analysis due to its focus on patient- or surrogate-reported perceptions of vaccines, which relied on the patient's self-report of being vaccinated or unvaccinated.[30–32, 34]

Patients reported to have been vaccinated selected the primary reason they received a vaccine from prespecified answer options (Table S2). For patients who reported not being vaccinated, patients selected reasons for non-vaccination from two broad categories: (1) the patient desired to be vaccinated but had not been vaccinated yet, and (2) the patient did not desire to be vaccinated. Patients selected their primary reason for non-vaccination within each category from prespecified answer options (Table S3) or provided a free text answer. The proportions of unvaccinated patients who reported a logistical barrier to vaccine receipt and those who reported a personal choice to remain unvaccinated were tracked over time. Two investigators (AK & WBS) independently reviewed free text answers. They classified them into one of the prespecified choices if they fit the theme of one of the answer choices or classified it as “other” if it did not. In the case of a disagreement between the initial two evaluations, a third investigator (WHS) classified the response, and the final classification was based on the majority opinion.

Data on demographics and medical conditions were collected by structured electronic medical record (EMR) review using a data collection instrument shared across all sites. The CDC Social Vulnerability Index (SVI) was used to classify patient communities. The CDC SVI measures external stresses on a community that may negatively impact health.[35] Following standardized methods, the patient's home address was used to geo-code each patient to a specific community. Then, 16 US census variables were used to assign a Social Vulnerability Index score for that community. The SVI score ranges from 0 to 1, with higher scores indicating more stressors (greater vulnerability). For example, a community with a SVI score of 0.75 is more vulnerable than 75% of US communities.

Statistical analysis

The study population was stratified by date of hospital admission into two groups: (1) the influenza vaccine assessment period (dates of enrollment: October 10, 2019 - December 31, 2020) and (2) the COVID-19 vaccine assessment period (dates of enrollment: January 1, 2021 - January 25, 2022). Cases (positive for influenza or COVID-19) and controls (negative for influenza and COVID-19) were pooled for analysis. Within each period, patient characteristics were compared between unvaccinated and vaccinated individuals using the chi-square test for categorical variables and Wilcoxon tests for continuous variables.

Multivariable logistic regression models were constructed to assess for associations between patient characteristics and unvaccinated status. These characteristics were selected *a priori* based on expert opinion regarding characteristics that may have important associations with patients' vaccination status [8, 33, 36–38]. The following patient characteristics were evaluated: age, sex, race/ethnicity, body mass index, chronic medical conditions, health insurance, social vulnerability index, census tract region (Northeast, Midwest, West and South), tobacco smoking, and self/surrogate reported influenza vaccination frequency in the past. For COVID-19, unvaccinated status, education level, and masking practice in public places were also included as potential risk factors (Table S4 contains a detailed description of these variables).

The primary reason for being vaccinated or unvaccinated was reported with frequency counts and proportions and compared between the COVID-19 and influenza vaccine assessment periods. In addition, during the COVID-19 vaccine assessment period, the proportion of unvaccinated patients reporting a personal choice to remain unvaccinated vs. logistic limitations was reported by quarter (3-month blocks) with 95% confidence intervals calculated using the Wilson method [39].

RESULTS

A total of 16,272 adults hospitalized with an acute respiratory illness were prospectively enrolled. Self-reported influenza or COVID-19 vaccination status was unavailable for 2997(18.4%), resulting in an analytical population of 13,275 patients, including 12,292 (92.6%) patients in the COVID-19 vaccine assessment period (January 1, 2021 – January 25, 2022) and 983 (7.4%) patients in the influenza vaccine assessment period (October 10, 2019 – December 31, 2020) (Figure S1). Our analysis focused on understanding vaccine hesitancy

during this critical period, when initial responses to COVID-19 vaccines were forming, and offers valuable insights into the early drivers of vaccine acceptance.

Of 12,292 inpatients during the COVID-19 vaccine assessment period, 5637 (45.9%) tested positive for SARS-CoV-2, 6655 (54.1%) tested negative for SARS-CoV-2, 6807 (55.4%) reported receiving at least one COVID-19 vaccine, and 5485 (44.6%) reported being unvaccinated for COVID-19 (Table 1). The median age was 60 years (IQR 47–71), 5939 (48%) were female, 2549 (21%) were Black, and 2033 (17%) were Hispanic. In addition, 4421 (36%) had at least 3 chronic medical conditions.

Of 983 inpatients during the influenza vaccine assessment period, 335 (34.1%) tested positive for influenza, 648 (65.9%) tested negative for influenza, 602 (61.2%) reported receiving the influenza vaccine, and 381 (38.8%) reported being unvaccinated for influenza (Table 1). The median age was 59 years (IQR 45–70), 476 (48%) were female, 219 (22%) were Black, 100 (10%) were Hispanic, and 384 (39%) had at least 3 chronic medical conditions.

In multivariable regression, patient characteristics significantly associated with not receiving the COVID-19 vaccine after adjusting for other covariates included younger age, female sex, increasing BMI, lack of insurance, absence of chronic comorbid medical conditions, no or rare influenza vaccination in prior years, higher SVI, living in the Midwest or Southern US, lack of college or higher education and not wearing a mask (Figure 1a, Table S5). Patient characteristics significantly associated with not receiving influenza vaccination after adjusting for other covariates included a higher SVI, being a current smoker, no or rare influenza vaccination in prior years, and no or one chronic comorbid medical condition (Figure 1b, Table S6).

Patient-reported reasons for receiving vaccination (vaccine acceptance)

A higher proportion of respondents identified personal protection as the primary reason for receiving the COVID-19 vaccine, compared to the influenza vaccine (76.4% vs 66.5%, $p < 0.001$). The second most common reason for vaccination was a healthcare provider recommendation, however, this was less frequently reported as the primary motivation for COVID-19 vaccination than for influenza vaccination (8.3% vs 27.7%, $p < 0.001$) (Table 2). Only a small percentage of respondents identified vaccine advertisements (5.4%) or a work-related mandates as their main reason for choosing to receive the COVID-19 vaccine (1.3%).

Patient reported reasons for not receiving vaccination (vaccine hesitancy)

The primary reason for not getting vaccinated for both COVID-19 and influenza was planning to get vaccinated but having not done so yet (Table 3). The proportion was lower for COVID-19 compared to influenza (16.8% vs 30.7%, $p < 0.001$). The proportion of unvaccinated individuals avoiding vaccination due to the belief that the vaccines are dangerous was similar between COVID-19 and influenza (11.6% vs. 13.7%, $p = 0.27$). A lower proportion of participants believed that COVID-19 vaccination was not important for health compared to influenza vaccination (11.9% vs. 24.2%, $p < 0.001$). (Table 3). During the first 13 months of COVID-19 vaccine availability in the US, trends reflected an increasing

proportion of unvaccinated patients avoiding vaccination for personal reasons compared to logistic issues with getting to a vaccination site ($p < 0.001$, trend test, Figure 2). A small proportion of unvaccinated COVID-19 individuals reported not getting vaccinated based on advice from their healthcare provider compared to unvaccinated influenza individuals (2.2% vs. 0.5%, $p = 0.05$). A small proportion for both vaccines believed a medical condition or pregnancy had made them ineligible for the vaccine.

DISCUSSION

Bivalent COVID-19 vaccines against the ancestral, Omicron BA.4/BA.5 and XBB.1.5 variants, have been shown to be safe and effective [20, 40, 41]. The uptake of the bivalent COVID-19 vaccine remains low, and as of May 2023, 18.6% of eligible persons in the US had not received a primary COVID-19 vaccine series, and 83% had not received the updated (bivalent) COVID-19 vaccine.[5, 21] Multiple factors have led to vaccine hesitancy, such as vaccine fatigue, perceived immunity after infection, lack of patient education on eligibility, vaccine availability, and perceived safety of the vaccination [8, 37, 38, 42]. Understanding vaccine hesitancy for the primary COVID-19 vaccine series and comparisons with influenza may help design interventions to improve vaccine uptake for future pandemics.

In this prospective analysis from the IVY Network, we identified similarities in vaccine hesitancy between the primary COVID-19 vaccine and the influenza vaccine. COVID-19 vaccine hesitancy was associated with younger age, female sex, absence of comorbid chronic conditions, no or rare prior influenza vaccination, and social factors such as lack of insurance, high school or lower education, and higher social vulnerability. Similarly, influenza vaccine hesitancy was associated with having one or fewer comorbid chronic conditions, no or rare influenza vaccination in prior years, and higher social vulnerability.

However there were notable differences between the two vaccines. Age, sex, BMI, and insurance status were associated with being unvaccinated for the COVID-19 vaccine but did not reach statistical significance for being unvaccinated for the influenza vaccine. Smoking was associated with influenza vaccine hesitancy but not with COVID-19 hesitancy. There were regional variations in COVID-19 vaccine hesitancy with lower acceptance in the Midwest and Southern US, while there were no significant regional variations for influenza vaccine.

A significant finding of our analysis is that higher proportions of patients vaccinated for influenza “every or most years” were vaccinated for both influenza and COVID-19 (Figures 1a and b). While early in the pandemic, logistic limitations were a significant barrier to vaccination, personal choice became the dominant factor over time (Figure 2). A discussion with a healthcare provider was identified as a more common reason for accepting the influenza vaccine than the COVID-19 vaccine, and in a small minority of cases cited as a reason for declining the COVID-19 vaccine more often than the influenza vaccine.

In our study, healthcare provider recommendations significantly influenced vaccine uptake, particularly for the influenza vaccine. However, since respondents could identify only one primary reason for vaccination, the role of healthcare provider recommendations may

be understated. The higher proportion of individuals citing ‘personal protection’ as their primary reason for receiving the COVID-19 vaccine likely reflects an elevated perception of COVID-19-related risk rather than a diminished influence of healthcare providers. Additionally, while a small proportion of respondents reported that their healthcare provider advised against COVID-19 vaccination (2.2%), this finding may not be meaningful given the low numbers.

Our data have several implications for overcoming vaccine hesitancy. First, individuals frequently rely on healthcare providers as trusted and credible sources for vaccine information[3, 43]. In our study, healthcare provider discussion was the primary reason for 27% of respondents to accept the influenza vaccine and 8.3% of patients to accept the COVID-19 vaccine, and these differences in numbers were significant. Notably, healthcare providers advised a small proportion, 0.5%, of patients to decline the influenza vaccine and 2.2% to decline the COVID-19 vaccine, presumably due to providers’ concerns regarding the vaccine for those individuals. In addition, 6.1% of COVID-19 hesitant patients chose not to receive the vaccine due to worries about underlying medical conditions that their healthcare provider could have also addressed. Our data is similar to a study by Garza et al., which showed that trusting advice from a physician or healthcare organization increased the odds of receiving the COVID-19 vaccine[43]. Partnering with healthcare providers may significantly reduce vaccine hesitancy and improve acceptance for influenza and COVID-19. A factor which would be important in future pandemics.

Second, prior vaccination influences future behaviors.[43] In our cohort, a history of vaccination for influenza “every year or most years” was highly associated with both influenza and COVID-19 vaccination, suggesting the continued importance of influenza vaccination discussions. Our findings suggest that a history of influenza vaccination may influence future vaccine behaviors, including COVID-19 vaccination. Those vaccinated for influenza “every year or most years” were significantly more likely to receive both influenza and COVID-19 vaccines. This supports the notion that addressing influenza vaccine hesitancy may indirectly improve uptake of other vaccines, including the COVID-19 vaccine and any future pandemics. This is consistent with other studies demonstrating an association between influenza and COVID-19 hesitancy.[43, 44]

Third, in our sample, COVID-19 vaccine hesitancy was higher in younger individuals, females, those with lower educational attainment, and people living in areas with high social vulnerability. Increasing educational efforts in these high-risk groups may help address vaccine hesitancy, as seen in other studies [45].

Our data identified differences in COVID-19 vaccine acceptance and hesitancy based on insurance status and age, which has been noted in other studies [46–49]. A 2020 Medicare beneficiary survey showed that up to 40% of Medicare beneficiaries were hesitant about getting a COVID-19 vaccine, however, unlike our study population, the hesitancy was greater in racial/ethnic minorities [50].

Additionally as seen in other studies, socio-political factors like misinformation and trust in the scientific community may also contribute to hesitancy [7]. Approximately 11.6% of our

cohort did not receive the COVID-19 vaccine due to safety concerns, a figure that aligns with other studies. Vaccine hesitancy may be related to trust in the scientific community, with a higher level of trust being associated with higher vaccination rates.[51] Basagra et al. found racial differences between groups. In their sample, Asian and Caucasian groups had a greater trust in the government and scientific community than Native Americans and African Americans. In a survey of 1,068 stable adult ED patients without active COVID-19, 31.6% of ED patients reported vaccine hesitancy.[52] In a multivariate regression analysis, Black race (odds ratio [OR] 4.24, 95% confidence interval [CI], 2.62 – 6.85) and younger age (age 18–24 years OR 4.57, 95% CI, 2.66 – 7.86; age 25–35 years OR 5.71, 95% CI, 3.71 – 8.81) were independently associated with hesitancy, to a greater degree than the level of education (high school education or less OR 2.27, 95% CI, 1.23 – 4.19). In addition, hesitant patients were significantly less likely to trust governmental sources of vaccine information than non-hesitant patients (39.6% v. 78.9%, $p < 0.001$); a smaller difference was noted in the domain of trust toward friends and family (51.1% v. 61.0%, $p = 0.004$). Hesitant patients also cited vaccine safety concerns and a perception of insufficient supportive research.

In a survey of approximately 1000 adults in April 2020 for the COVID-19 vaccine, 57.6% of participants ($n = 571$) intended to be vaccinated, 31.6% ($n = 313$) were not sure, and 10.8% ($n = 107$) did not intend to be vaccinated.[53] Factors independently associated with vaccine hesitancy included younger age, African-American race, lower educational attainment, and not receiving the influenza vaccine in the prior year. In addition, other reasons for vaccine hesitancy included vaccine-specific concerns, a need for more information, antivaccine attitudes or beliefs, and a lack of trust.

Similar to our study, vaccine hesitancy in Canada was significantly associated with younger age (18–39 years), lower education, and non-liberal political leaning [54]. In this study, the vaccine hesitant were less likely to believe that a COVID-19 vaccine could end the pandemic or that the benefits of a COVID-19 vaccine outweighed the risks [54]. Like our cohort, individuals with vaccine hesitancy had a higher prevalence of being concerned about vaccine side effects, a lower prevalence of being influenced by peers or healthcare providers, and a lower prevalence of trust in government institutions. Similarly, in a survey of 1,000 people in Nevada, 30.4% exhibited vaccine hesitancy, which was higher in younger individuals and middle-aged females, African Americans, lower-income, and conservative individuals [55].

Our data are also consistent with our prior work, showing that amongst individuals hospitalized with severe acute respiratory illness from 2019–2020, 38.9% reported not receiving the influenza vaccine [56]. In the unvaccinated group, 51.1% reported not receiving the vaccine due to perceived ineffectiveness or risks of influenza vaccination. Like our current study, lack of medical insurance and, unlike our current data, Black or Hispanic race were associated with higher rates of vaccine hesitancy.

Our study had a few notable limitations. We used self-reported vaccination status, which may introduce reporting bias. However, self-reported vaccination status has been congruent with biological tests, suggesting that it can be a valid vaccination measure [57, 58]. We surveyed hospitalized patients who may not be fully representative of the general public, limiting the generalizability of our findings. We excluded subjects 67 subjects unwilling

to discuss reasons for their COVID-19 vaccine hesitancy. This may limit the diversity of perspectives captured. In addition, participant responses may have been affected by social desirability bias [37, 59]. In our survey participants could only select one primary reason for vaccination, which likely limits the accuracy of capturing the full range of motivations and likely underestimates the influence of healthcare providers. Our models adjust for various risk factors, but it is possible that other unmeasured factors influencing hesitancy were not included. Despite discordant sample size, both influenza and COVID-19 cohorts should have sufficient power to identify risk factors, though we focused on similarities and differences based on point estimates. Finally our data were collected during the early phase of the pandemic, a period characterized by high levels of public concern regarding COVID-19 and strong expectations surrounding the impact of vaccination. Since then, public opinions and vaccine behaviors have shifted significantly. This shift limits the direct applicability of our findings to the present, though our study provides valuable insights into the initial drivers of vaccine hesitancy.

CONCLUSION

Vaccine hesitancy remains a significant challenge in the US particularly among certain socioeconomic and demographic groups. Our analysis showed that individuals with a history of regular influenza vaccination were more likely to choose to be vaccinated for both influenza and COVID-19, and infrequent vaccination for influenza was associated with vaccine hesitancy for both influenza and COVID-19. Therefore, efforts to improve influenza vaccination may indirectly improve COVID-19 vaccination rates, including the new generation of COVID-19 vaccines. We observed regional variations in vaccine acceptance for COVID-19, vaccine hesitancy more prevalent among younger individuals, females, the uninsured, those with lower education levels and socially vulnerable populations. Targeted outreach and education efforts directed at may be crucial to improving vaccination rates. Finally, healthcare provider recommendations played an important role in patients decisions to accept or decline vaccination. Ensuring consistent, clear and proactive messaging from healthcare providers may be a key strategy in addressing vaccine hesitancy for both influenza and COVID-19.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Data availability

Data will be made available on request.

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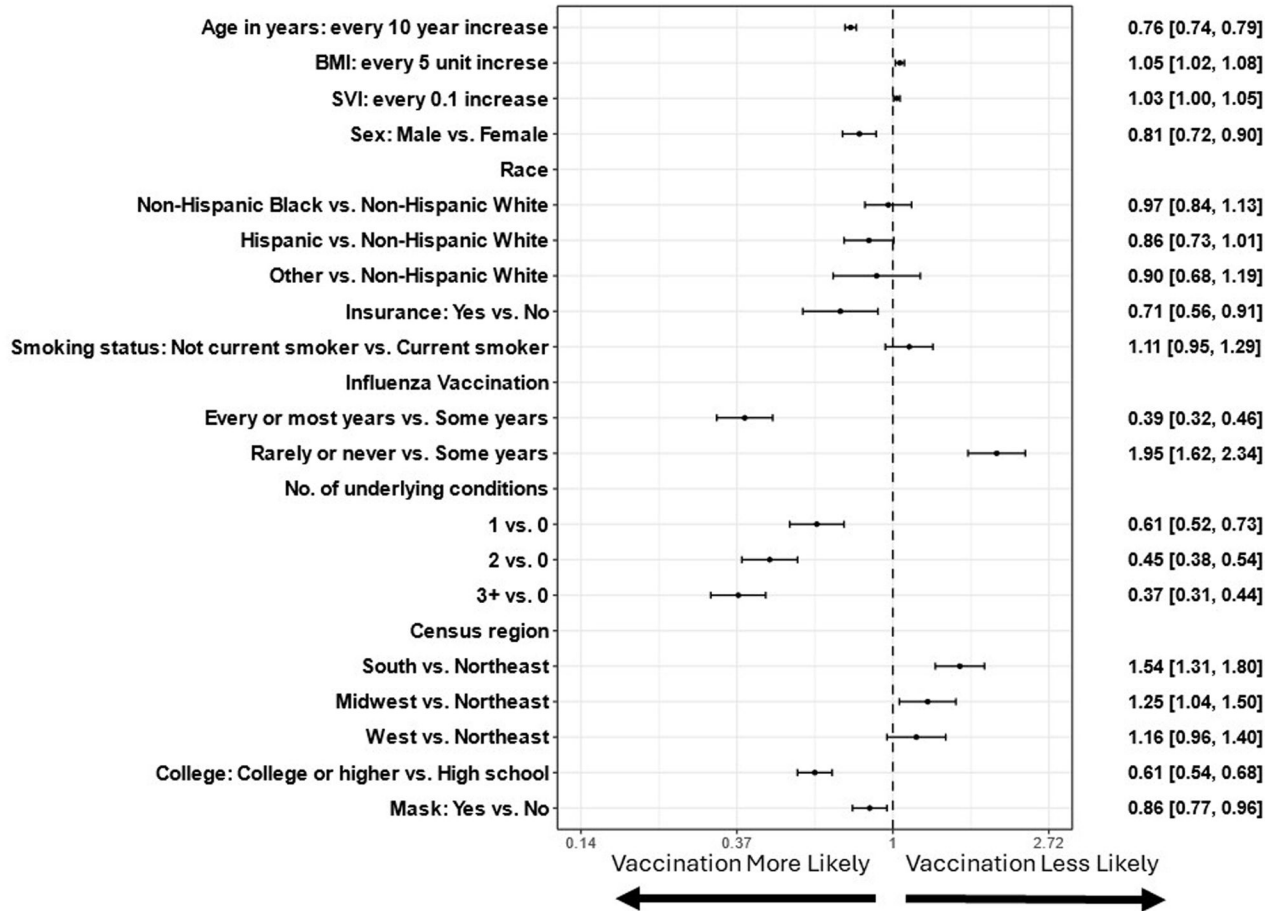
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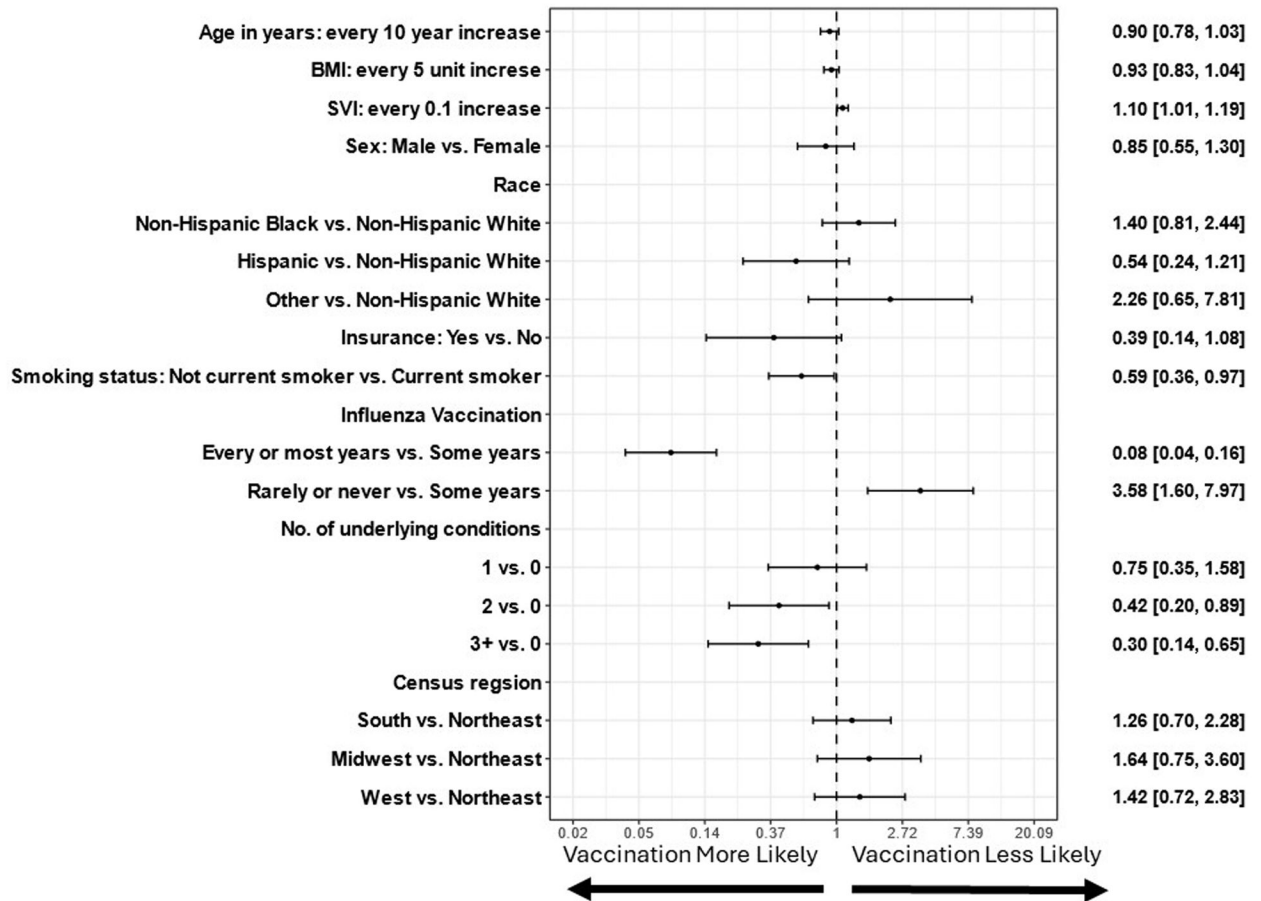
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Vaccine Hesitancy COVID - 19 January 2021 to January 2022



Vaccine Hesitancy for Influenza Vaccine October 2019 to December 2020

**Figure 1.**

Association of patient characteristics with being unvaccinated for (a) COVID-19 (patients enrolled January 1, 2021, to January 25, 2022) and (b) influenza (patients enrolled October 10, 2019, to December 31, 2020).

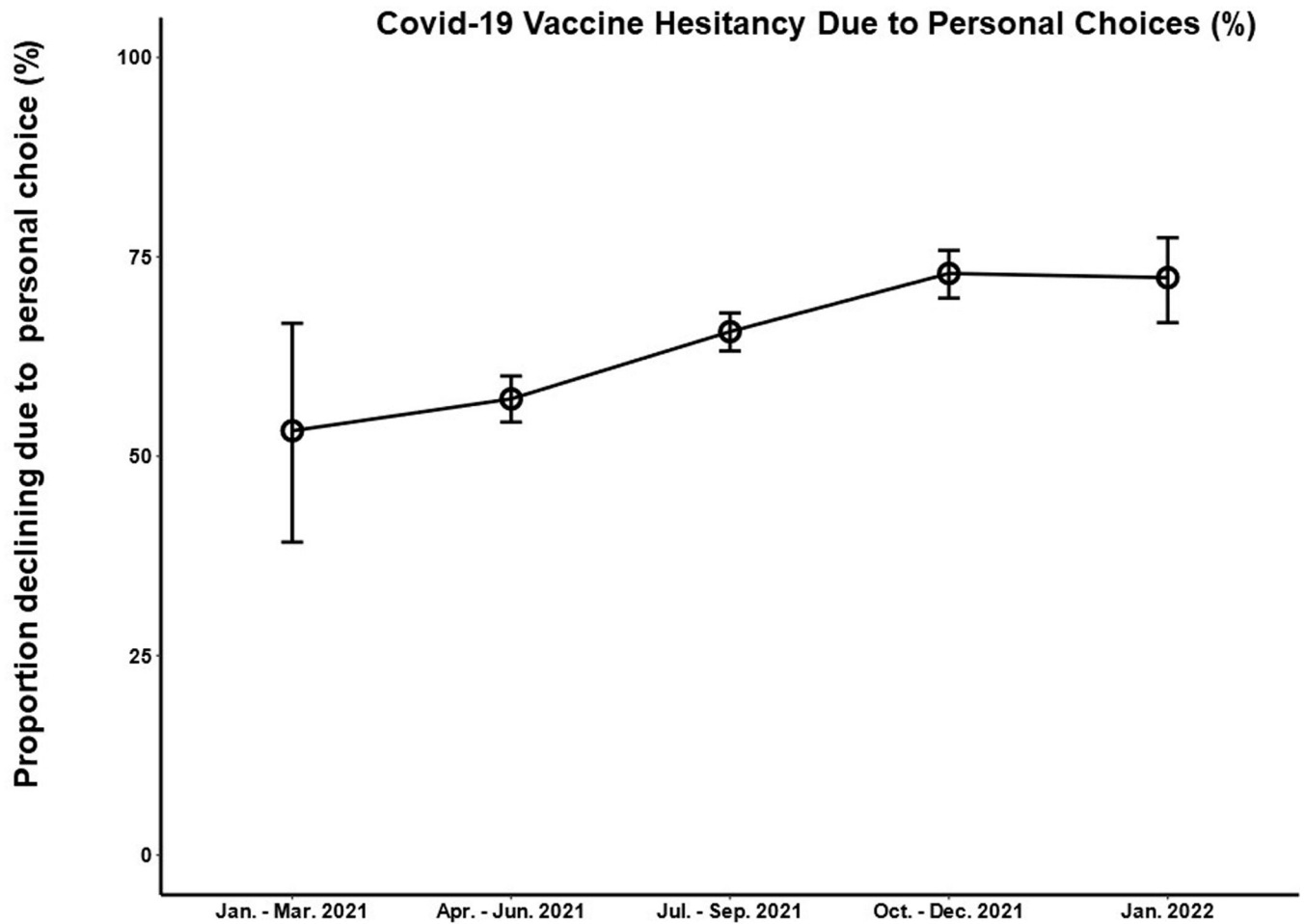


Figure 2.

The proportion of patients unvaccinated for COVID-19 who did not desire to be vaccinated by calendar time (quarter) over the first 13 months of COVID-19 availability in the United States. Over time, the proportion of unvaccinated patients who made a personal choice to actively avoid vaccination increased ($p < 0.001$, trend test) as compared to those who were not able to get vaccinated due to logistic limitations.

Table 1.

Characteristic of patients in the COVID-19 vaccine assessment period (January 1, 2021, to January 25, 2022) and the influenza vaccine assessment period (October 10, 2019, to December 31, 2020) by vaccination status.

		COVID-19 Vaccine Assessment Period (January 1, 2021 – January 25, 2022)		Influenza Vaccine Assessment Period (October 10, 2019 – December 31, 2020)	
		Unvaccinated for COVID-19 (n=5485)	Vaccinated for COVID-19 (n=6807)	Unvaccinated for influenza (n=381)	Vaccinated for influenza (n=602)
Age, median (IQR) [years]		54 (41, 65)	65 (54, 74)	53 (37, 63)	62 (51, 72)
Age Group, n (%)					
	18–49 years	40% (2203)	18% (1250)	45% (170)	24% (142)
	50–64	33% (1825)	31% (2103)	33% (124)	31% (184)
	65–75	17% (906)	27% (1860)	16% (61)	28% (166)
	≥75	10% (551)	23% (1592)	7% (26)	18% (110)
Sex, n (%)					
	Female	48% (2631)	49% (3308)	46% (175)	50% (301)
	Male	52% (2852)	51% (3496)	54% (206)	50% (300)
Race & ethnicity, n (%)					
	White, Non-Hispanic	52% (2856)	61% (4119)	57% (219)	65% (394)
	Black, Non-Hispanic	23% (1236)	19% (1313)	24% (93)	21% (126)
	Hispanic	19% (1038)	15% (995)	11% (41)	10% (59)
	Other race, Non-Hispanic	5% (258)	4% (299)	3% (12)	2% (10)
	Unknown	2% (97)	1% (81)	4% (16)	2% (13)
Medical insurance type, n (%)					
	Medicare	30% (1641)	49% (3345)	25% (94)	48% (291)
	Medicaid	18% (992)	11% (755)	23% (86)	13% (81)
	Private	34% (1855)	31% (2100)	30% (113)	28% (171)
	No medical insurance	10% (559)	3% (182)	13% (48)	2% (12)
	Other	8% (433)	6% (423)	10% (40)	8% (47)
Body mass index median (IQR) [kg/m ²]		30 (25, 37)	29 (24,34)	28 (23, 35)	29 (24, 36)
Comorbidities (chronic medical conditions), n (%)					
	0 –1	25% (1382)	9% (593)	25% (94)	6% (39)
	1 – 2	27% (1492)	19% (1309)	29% (109)	16% (99)
	2 –3	23% (1250)	27% (1845)	23% (89)	28% (169)
	3 +	25% (1361)	45% (3060)	23% (89)	49% (295)
Smoking history					
	Non-smoker	56% (3075)	51% (3466)	49% (187)	48% (288)
	Past smoker	23% (1281)	31% (2102)	23% (87)	36% (214)
	Current smoker	15% (816)	13% (859)	28% (105)	16% (94)
	Unknown	6% (313)	6% (380)	1% (2)	1% (6)

		COVID-19 Vaccine Assessment Period (January 1, 2021 – January 25, 2022)		Influenza Vaccine Assessment Period (October 10, 2019 – December 31, 2020)	
		Unvaccinated for COVID-19 (n=5485)	Vaccinated for COVID-19 (n=6807)	Unvaccinated for influenza (n=381)	Vaccinated for influenza (n=602)
≥ 1 hospital admission in prior year		36% (1940)	50% (3341)	44% (167)	59% (348)
Frequency of influenza vaccination, n (%)					
	Every or most years	33% (1807)	68% (4660)	25% (94)	92% (554)
	Some years	10% (537)	8% (536)	13% (51)	4% (22)
	Rarely or never	52% (2828)	18% (1230)	60% (230)	4% (25)
	Unknown	6% (313)	6% (381)	2% (6)	0% (1)
Education level					
	High School graduation or less	55% (2236)	44% (2519)	Not collected	Not collected
	College attendance or higher	45% (1848)	56% (3241)	Not collected	Not collected
Routine mask use while in public, n (%)		52% (2605)	60% (3984)	Not collected	Not collected
US Census region, n (%)					
	Northeast	16% (893)	20% (1350)	19% (72)	22% (131)
	South	47% (2551)	40% (2721)	44% (167)	47% (281)
	Midwest	17% (931)	19% (1324)	11% (42)	10% (63)
	West	20% (1110)	21% (1412)	26% (100)	21% (127)
Social Vulnerability Index, median (IQR)		0.65 (0.37, 0.89)	0.57 (0.30, 0.84)	0.67 (0.39, 0.88)	0.59 (0.34, 0.86)

Table 2.

The primary reason patients stated for receiving COVID-19 vaccination (January 1, 2021, to January 25, 2022) or influenza vaccination (October 10, 2019, to December 31, 2020) among those who reported receiving the vaccines.

Covid-19 Vaccine	n 6807	Influenza Vaccine	n 602	P value
Reason	Proportion (number)	Reason	Proportion (number)	
I believe the SARS-CoV-2 vaccine is important for my health	76.4% (5201)	I believe the influenza vaccine is important for my health	66.5% (400)	<0.001
My doctor suggested I get a SARS-CoV-2 vaccine	8.3% (564)	My doctor suggested I get the influenza vaccine	27.7% (167)	<0.001
I saw an advertisement for getting SARS-CoV-2 vaccines	5.4% (364)		N/A	
I believe getting a SARS-CoV-2 vaccine is important to keep others healthy	0.4% (29)	I believe getting the influenza vaccine is important to keep others healthy	2.5% (15)	<0.001
Family	0.8% (54)	Family	0.2 % (1)	0.141
Work/Other Mandated	1.3% (88)	Work/Other Mandated	2% (12)	0.214
Other	1% (67)	Other	0.5 % (3)	0.336
Medical Condition	0.3% (18)		N/A	
Politics	0.04% (3)		N/A	
Pregnancy	0.01% (1)		N/A	
No Answer/Unknown	6.1% (418)	No Answer/Unknown	0.7% (4)	<0.001

Table 3.

The primary reason patients stated for not receiving COVID-19 vaccination (January 1, 2021, to January 25, 2022) or influenza vaccination (October 10, 2019, to December 31, 2020) among those who reported not receiving the vaccines.

Covid-19 Vaccine	n 5485	Influenza Vaccine	n 381	P value
Reason	Proportion (number)	Reason	Proportion (number)	
I want to get a SARS-CoV-2 vaccine but it is not available to me yet	5.5% (299)		NA	
I want to get a SARS-CoV-2 vaccine and I think I can get one, but I have not gotten around to it	16.8% (920)	I meant to get the influenza vaccine but never got around to it	30.7% (117)	<0.001
I want to get a SARS-CoV-2 vaccine, but I could not get transportation to a place where vaccines are given	0.9% (47)		NA	
I want to get a SARS-CoV-2 vaccine but it costs too much money for me	0.1% (3)	The influenza vaccine costs too much money	1.6% (6)	<0.001
	NA	I was unable to get to a location that gives influenza vaccine	4.2% (16)	
Work/Other Mandated	0.06% (3)	Work/Other Mandated	0.26% (1)	0.626
Safety concerns	3.3% (163)		NA	
I do not want to get a SARS-CoV-2 vaccine because I don't think it is important for my health	11.9% (651)	I don't believe the influenza vaccine is important for my health	24.2% (92)	<0.001
I do not want to get a SARS-CoV-2 vaccine because I do not believe they work	5.3% (289)		NA	
I do not want to get a SARS-CoV-2 vaccine because I think they are dangerous	11.6% (637)	I think the influenza vaccine is dangerous for me	13.7% (52)	0.267
I do not want to get a SARS-CoV-2 vaccine because I have had COVID-19 and therefore don't believe a vaccine is important for me	2.6% (144)	I got the influenza vaccine in the past and still got the flu	9.5% (36)	<0.001
I did not know a SARS-CoV-2 vaccine was recommended for me	1.1% (58)	I didn't know I should get the influenza vaccine	3.9% (15)	<0.001
No Answer/Unknown	15% (820)	No Answer/Unknown	3.4% (13)	<0.001
Health Care Provider	2.2% (118)	Healthcare Provider	0.5% (2)	0.048
Family	0.3% (18)		NA	
Religious Reason	0.7% (37)	Religious Reason	NA	
Politics	0.6% (32)		NA	
Pregnancy	0.9% (50)	Pregnancy	0.3% (1)	0.301
Medical Condition	6.1% (335)	Medical Condition	4.5% (17)	0.232
Other	15.7% (859)	Other	3.4% (13)	<0.001
Total	5485	Total	381	