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Contents lists available at ScienceDirect

## Vaccine

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## COVID-19 vaccination intention and activation among health care system employees: A mixed methods study



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### ARTICLE INFO

#### Article history:

Received 27 September 2021

Received in revised form 5 July 2022

Accepted 7 July 2022

Available online 13 July 2022

#### Keywords:

COVID-19

Vaccine

Attitudes

Veterans health administration

Employee

Provider

Vaccine Hesitancy

### ABSTRACT

**Background:** Achieving high COVID-19 vaccination rates among employees is necessary to prevent outbreaks in health care settings. The goal of the study was to produce actionable and timely evidence about factors underlying the intention and decisions to obtain the COVID-19 vaccine by employees.

**Methods:** The study was conducted from December 2020 – May 2021 with employees from a VA health care system in Southeastern US. The study used a convergent mixed methods design comprising two main activities: a cross-sectional survey conducted prior to COVID-19 vaccine distribution, and semi-structured interviews conducted 4–6 months after vaccine distribution. Data were collected about participant characteristics, vaccination intention prior to distribution, vaccination decision post-distribution, determinants of vaccination intention and decision, activating factors, sources of information and intervention needs. Data from the survey and interviews were analyzed separately and integrated narratively in the discussion.

**Results:** Prior to vaccine distribution, 77% of employees wanted to be vaccinated. Post vaccine distribution, we identified 5 distinct decision-making groups: 1) vaccine believers who actively sought vaccination and included those sometimes described as “immunization advocates”, 2) go along to get along (GATGA) individuals who got vaccinated but did not actively seek it, 3) cautious acceptors who got the COVID-19 vaccine after some delay, 4) fence sitters who remained uncertain about getting vaccinated, and 5) vaccine refusers who actively rejected the COVID-19 vaccine. Participants identifying with Black or multiple races were more likely to express hesitancy in their vaccination intention.

**Conclusion:** The findings of our study highlight distinct decision-making profiles associated with COVID-19 vaccination among employees of a VA health care system, and provide tailored recommendations to reduce vaccine hesitancy in this population.

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### 1. Introduction

A central strategy in the response to the ongoing COVID-19 pandemic in the United States (US) is the achievement of high

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COVID-19 vaccination coverage. Benefits of COVID-19 vaccination include reduced probability of severe COVID-19 illness, hospitalizations, and deaths among individuals [1]. Yet, COVID-19 vaccination coverage gaps remain due to vaccine hesitancy, i.e., the decision of individuals to delay or refuse COVID-19 vaccines despite availability of vaccination services [2–6]. During the initial rollout of COVID-19 vaccines in the US, high risk populations were prioritized for vaccinations

due to limited supply [7,8]. Key among those high risk populations were individuals on the frontlines of COVID-19 response, including healthcare providers (HCPs) and other healthcare workers. Prioritizing HCPs and healthcare workers was considered beneficial not only to protect them from COVID-19, but also because prior studies suggest a strong link between HCP recommendation in favor of vaccines and vaccine acceptance among patients [9–11]. However, HCP's own experience with, and trust in vaccines, can impact the strength of their vaccine recommendation and their ability to address patients' vaccine hesitancy [2,6,12,13]. A narrative review focused in Western countries reported a vaccine hesitancy prevalence of 3–44% among HCPs across 5 studies [14]. In another review, Biswas et al. noted that, on average, 22.5% of healthcare workers worldwide were hesitant to be vaccinated against COVID-19 [13]. In prior studies, disparities in acceptance of COVID-19 and influenza vaccines have been documented by healthcare worker type and work setting suggesting the need to examine vaccine hesitancy among healthcare workers more broadly [2–4,13,15]. Identifying the nature and determinants of vaccine hesitancy among healthcare workers could help with the development of tailored intervention strategies to promote vaccinations in this population.

Determinants of vaccine hesitancy are typically multifaceted and reflect factors underlying vaccination decision-making such as contextual influences (e.g., religion, politics, geographic barriers), individual or group-level influences (e.g., risk perception, personal experiences with vaccination) and vaccine or vaccination-specific concerns (e.g., vaccine formulation, newness of vaccines) [6]. The current literature supports implementation of a tailored approach to reduce vaccine hesitancy, wherein individuals' specific questions or concerns about vaccines/vaccinations are addressed [15–17]. For instance, Bardenheier et al. [15] identified clusters of HCPs who varied by their influenza vaccination-related knowledge, attitudes, and beliefs and socio-demographic characteristics, supporting the need for tailored messaging for each HCP cluster. A similar approach is lacking for COVID-19 vaccination promotion and, in general, among healthcare workers.

As part of a collaboration between the Veterans Health Administration (VA) Quality Enhancement Research Initiative (QUERI) [18] and the VA National Center for Health Promotion and Disease Prevention [19], we conducted a rapid evaluation of COVID-19 vaccination intention among VA health care system employees. Our team, one of three enlisted by the QUERI to produce actionable and timely evidence about COVID-19 vaccine hesitancy among patients and employees across VA, focused specifically on factors underlying the intention and decisions of employees to obtain a COVID-19 vaccine using an in-depth case study [20–22]. Working with COVID-19 vaccine coordinators in one VA health care system, we sought answers to the following questions:

- Prior to COVID-19 vaccine distribution, what was the magnitude of COVID-19 vaccination intention among employees? What were key determinants of vaccination intention among employees?
- After vaccines became available, what determinants explained employees' decisions to receive the COVID-19 vaccine? Which determinants were activating factors, i.e., factors that nudged employees toward a decision to vaccinate or not?
- How do employees' qualitative reports about vaccine decisions compare/complement survey data about vaccination intention?

The detailed methods and findings of this case study are presented below.

## 2. Methods

### 2.1. Study setting and duration

The study was conducted from December 2020 – May 2021 with employees from a VA health care system in the southeastern US. COVID-19 vaccine distribution in this setting began in mid-December 2020. Unlike most other health care systems, this VA health care system made vaccines available to all employees independent of their risk status, from the beginning of the vaccine roll-out due to sufficient vaccine supply. The employee population at the VA health care system is demographically and occupationally diverse. As of May 2022, women comprise 66.2% of the employee population at the participating VA health care system. Distribution of racial and ethnic identities among employees is as follows: White (46.3%), Black (40.6%), Asian (9.5%), and Hispanic (1.5%). Occupational groups include various healthcare provider types (e.g., physicians, nurses, dentists, pharmacists), as well as employees in facility support, general administration, engineering and architecture, social science and psychology, and other services (e.g., accounting and budget, biological sciences, information and arts).

### 2.2. Study design

The study used a convergent mixed methods design [23,24] (Fig. 1) in which qualitative and quantitative data were collected and analyzed in parallel from the following sources prior to integration: (1) a cross-sectional survey with closed-ended (quantitative) and open-ended (qualitative) responses conducted prior to vaccine distribution, and (2) a semi-structured interview (qualitative data) conducted after vaccine distribution commenced. Survey and interview participants came from the employee population within a single VA health care system (see Data Collection for sampling details). The cross-sectional survey assessed COVID-19 vaccination intention among employees, with key determinants of vaccination intention identified via brief open-ended responses. Semi-structured interviews elicited in-depth information about determinants of vaccination decisions. For the convergent mixed methods component of the study, qualitative and quantitative data were integrated narratively in the discussion section of this manuscript [23,24].

### 2.3. Data collection

**Cross-sectional survey:** The cross-sectional survey was distributed by e-mail to all 3600 employees from the participating VA health care system to gauge interest in vaccination prior to the availability of the first vaccine shipment in December 2020. Data collection occurred from December 4, 2020 to January 9, 2021; however, participants were encouraged to complete the survey by December 18, prior to vaccine arrival, to facilitate planning for vaccine distribution. The survey response rate was approximately 85%. While identifying information was collected as part of the survey, this information was not available in the analytic dataset since our work was classified as non-research evaluation (see ethical approval). Closed-ended questions captured socio-demographic characteristics of respondents, employment characteristics (e.g., telework status, timing of work shift, engagement in COVID-19 positive patient care), brief clinical history (number of high risk conditions), as well as their intention to be vaccinated once a vaccine was available (response options: "I would like to receive the COVID-19 vaccine from the VA as soon as I am eligible", "I would NOT like to receive the vaccine at this time", or "I am undecided about receiving the vaccine at this time"). An open-

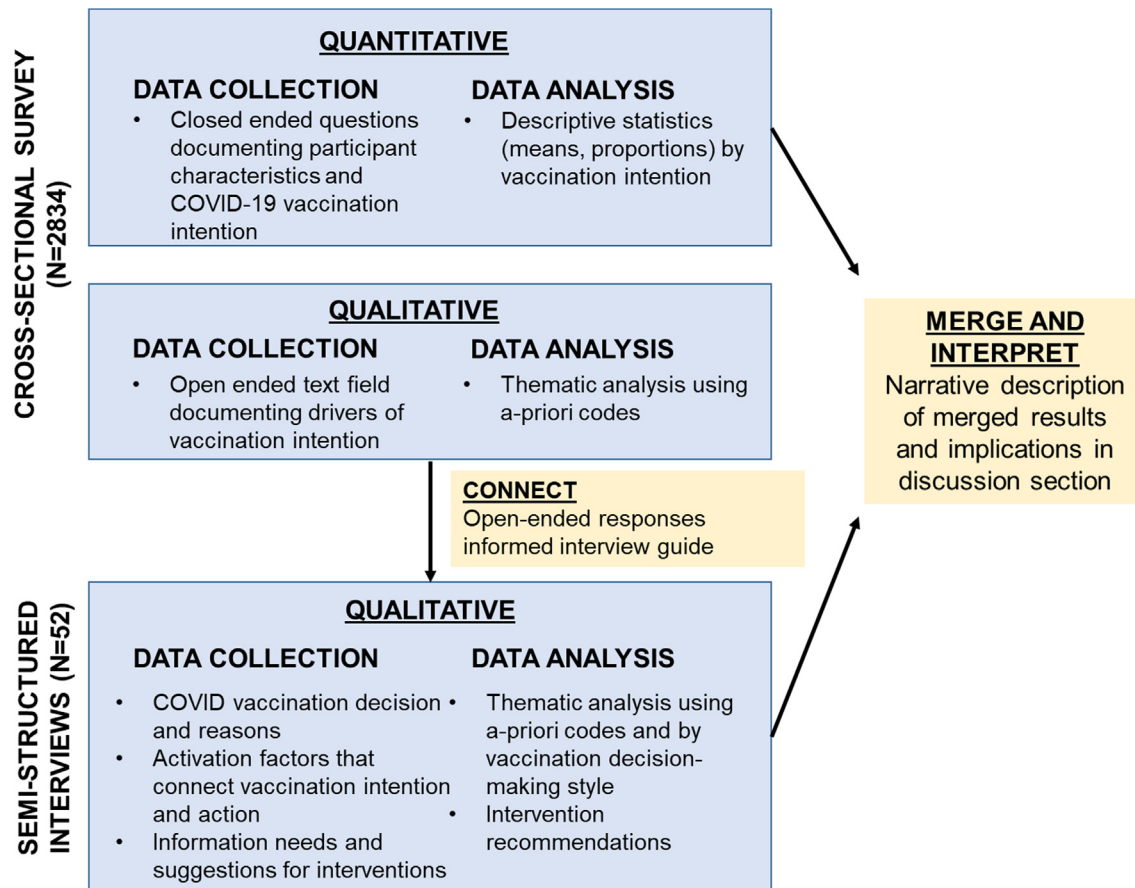


Fig. 1. Convergent mixed methods study design.

ended text field was included immediately after the vaccination intention question for respondents to explain their vaccination intention.

**Semi-structured interviews:** Employees from the same VA health care system were invited to participate in semi-structured qualitative interviews between March and May 2021 (i.e., approximately 4–6 months after COVID-19 vaccines were available to all employees, and at least 3 months post the closure of the survey). Since no identifying information was available from the survey, the participant sample was drawn independently from the broader employee population of the participating VA healthcare system. The recruitment strategy included purposeful sampling of vaccinated and unvaccinated employees, and vaccination status in this instance was self-reported. Employees were recruited through a healthcare system-wide email, an announcement on the Director's healthcare system-wide videoconference meeting, informal events with key staff groups, and snowball sampling. The interview guide (see Supplementary file 1) included questions about the employee's role at the health care system, the determinants of their vaccination decision, the sources they used for COVID-19 and vaccine-related information, their risk perception, and providers' experiences discussing vaccination concerns with patients. The guide also included questions about participants' socio-demographic and occupational characteristics as well as their COVID-19 vaccination status. Interviews were conducted virtually by a trained qualitative researcher and recorded with permission to facilitate transcription and data analysis. If the participant did not provide permission to record the interview, detailed notes were captured to use in the analysis.

#### 2.4. Data analysis

**Cross-sectional survey:** Responses to closed-ended survey questions were summarized using descriptive statistics and stratified by vaccination intention. Responses to open-ended questions were analyzed qualitatively using a similar approach to data from semi-structured interviews.

**Semi-structured interviews:** Data from the semi-structured interviews (and open-ended survey question) were analyzed using NVivo 12 software (QSR International). Two authors with expertise in qualitative data analysis independently applied a-priori codes to interview transcripts or detailed notes. During coding, they discussed the codes with a third author who has expertise on vaccine hesitancy and added clarifying language to the codebook to ensure consistency in coding and to minimize any potential overlap in themes (see Supplementary file 2 for codebook examples). The sources for the a-priori codes were as follows:

- World Health Organization's matrix of vaccine hesitancy determinants [6]. The matrix classifies vaccine hesitancy determinants into three categories (see Fig. 2): contextual influences, individual and group-level influences, and vaccine/vaccination-specific influences.
- Vaccination decision-making profiles (see Fig. 2) based on published literature [25,26]. These decision-making profiles ranked from least to most hesitant to get the COVID-19 vaccine are: 1) Vaccine believers who actively sought vaccination and included those sometimes described as "immunization advocates"; 2) go along to get along who got vaccinated but did not actively seek



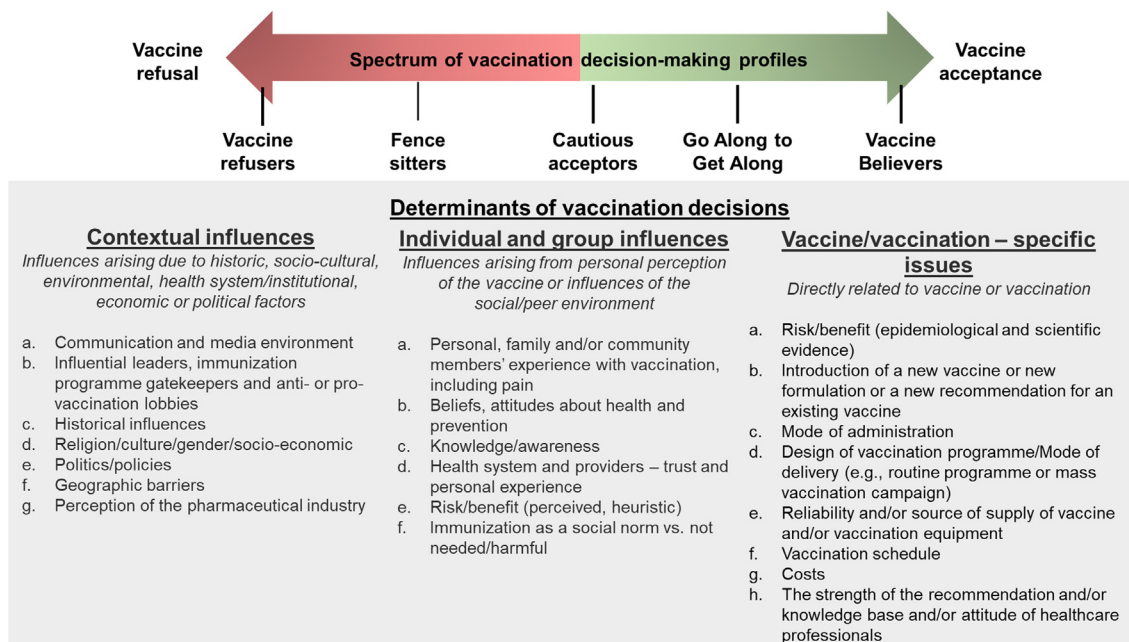


Fig. 2. Spectrum of vaccination decision-making profiles and determinants. Footnote: List of determinants is from MacDonald et al. (2015).

it; 3) cautious acceptors, who got the COVID-19 vaccine after some delay; 4) fence sitters, who were uncertain about whether to get vaccinated; and 5) vaccine refusers who actively rejected the COVID-19 vaccine.

- 5A's taxonomy of vaccine hesitancy (Access, Affordability, Awareness, Acceptance and Activation) [27]. A code for activation was used to capture events or factors that sparked people's vaccination intention to action.
- Semi-structured interview guide: A code about provider experience communicating with patients about the vaccine was used since that was of interest for this healthcare system employee population.

Data were organized using a matrix by vaccination intention or decision-making profiles (columns) and determinants of vaccination decisions, information sources, and provider experiences (rows). Thematic summaries were drafted to capture how determinants, activation factors, information sources, and provider experiences varied by vaccination intention or decision-making profiles.

### 2.5. Ethical approval

This study was conducted under the authority of the Quality Enhancement Research Initiative (QUERI) and was classified as a non-research evaluation [28].

## 3. Results

### 3.1. Quantitative survey

The final sample included 2834 unique survey respondents; 786 respondents included text responses via the open-ended field. Table 1 summarizes key characteristics of survey respondents including their COVID-19 vaccination intention, prior to vaccine distribution. A majority of the respondents (n = 2190, 77%) reported that they wanted to receive COVID-19 vaccination while 332 (12%) did not want it and 300 (11%) were undecided. Compared with employees who wanted the vaccine, those who did not want the vaccine or were undecided were more frequently:

- those who did not provide direct patient or COVID-positive patient care
- those who worked during the evening or night shift (vs. day or rotating shift)
- those who worked in outpatient settings (vs. inpatient or administrative settings)
- those who identified as Black or of multiple races, and
- those with a greater number of high-risk conditions

Supplementary Table 1 summarizes determinants of vaccination intention from participants' open-ended responses, classified using the WHO framework of vaccine hesitancy determinants. Those who wanted the vaccine commonly indicated in open-ended questions a *risk/benefit calculation based on their interactions with others* (i.e., risk of exposures to COVID-positive patients at work or risk of exposing vulnerable family members outside of work to COVID). Reasons for vaccine hesitancy included concerns about *newness of the vaccine* (e.g., rushed to the public, not enough studies or evidence, limited information about long-term or side effects) and *medical/health risks* (e.g., higher risk of bad outcome from allergies or vaccine side effects; lower risk of bad outcomes from COVID-19 because of young age). Undecided employees also indicated that they needed more information about the vaccine (e.g., about side effects from vaccine or safety of the vaccine).

### 3.2. Qualitative interviews

Supplementary Table 2 summarizes key characteristics of 52 employees who participated in semi-structured interviews about their vaccination decisions, after vaccine distribution had commenced. Most participants (94%) had received a COVID-19 vaccine at the time of the interview. During data analysis, a majority of the participants were classified as vaccine believers (60%), while the remaining were cautious acceptors (25%), go along to get along (GATGA, 12%), fence sitters (2%), and vaccine refusers (2%).

Table 2 summarizes the WHO determinants of vaccine hesitancy, negative or positive activators, and information needs by vaccination decision-making categories. For this analysis, we merged the cautious acceptor and fence sitter categories since both

**Table 1**  
Key characteristics of survey respondents (N = 2,834) stratified by their COVID-19 vaccination intention.

Characteristics	COVID-19 vaccination intention				
	Yes n (%)	No n (%)	Undecided n (%)	Missing n (%)	Total n (%)
<b>Age</b>					
18–49	1208 (55.2)	155 (46.7)	169 (56.3)	1 (8.33)	1533 (54.1)
50–64	775 (35.4)	83 (25.0)	101 (33.7)	7 (58.3)	966 (34.1)
65–74	126 (5.75)	2 (0.60)	15 (5.00)	1 (8.33)	144 (5.1)
75 or older	12 (0.55)	0 (0.00)	0 (0.00)	0 (0.00)	12 (0.4)
Missing	69 (3.15)	92 (27.7)	15 (5.00)	3 (25.0)	179 (6.3)
<b>Direct Patient Care</b>					
Yes	1508 (68.9)	172 (51.8)	167 (55.7)	8 (66.7)	1855 (65.5)
No	667 (30.5)	155 (46.7)	131 (43.7)	3 (25.0)	956 (33.7)
Missing	15 (0.68)	5 (1.51)	2 (0.67)	1 (8.33)	23 (0.8)
<b>COVID + Care</b>					
Yes	794 (36.3)	53 (16.0)	62 (20.7)	5 (41.7)	914 (32.3)
No	1360 (62.1)	271 (81.6)	231 (77.0)	5 (41.7)	1867 (65.9)
Missing	36 (1.64)	8 (2.41)	7 (2.33)	2 (16.7)	53 (1.9)
<b>Willingness to Travel to VA Health Care System</b>					
Yes	2089 (95.4)	57 (17.2)	195 (65.0)	8 (66.7)	2349 (82.9)
No	83 (3.79)	273 (82.2)	96 (32.0)	4 (33.3)	456 (16.1)
Missing	18 (0.82)	2 (0.60)	9 (3.00)	0 (0.00)	29 (1.0)
<b>Working Shift</b>					
Day (1st shift)	1801 (82.2)	205 (61.7)	247 (82.3)	10 (83.3)	2263 (79.9)
Evening (2nd shift)	82 (3.74)	12 (3.61)	15 (5.00)	1 (8.33)	110 (3.9)
Night (3rd shift)	106 (4.84)	15 (4.52)	21 (7.00)	0 (0.00)	142 (5.0)
Rotating	131 (5.98)	2 (0.60)	4 (1.33)	0 (0.00)	137 (4.8)
Missing	70 (3.20)	98 (29.5)	13 (4.33)	1 (8.33)	182 (6.4)
<b>Facility Location</b>					
Urban	2031 (92.7)	264 (79.5)	256 (85.3)	10 (83.3)	2561 (90.4)
Rural	150 (6.85)	66 (19.9)	44 (14.7)	0 (0.00)	260 (9.2)
Missing	9 (0.41)	2 (0.60)	0 (0.00)	2 (16.7)	13 (0.5)
<b>Facility Type</b>					
Inpatient	1728 (78.9)	207 (62.3)	203 (67.7)	7 (58.3)	2145 (75.7)
Outpatient	304 (13.9)	110 (33.1)	79 (26.3)	3 (25.0)	496 (17.5)
Administrative/Research	149 (6.80)	13 (3.92)	18 (6.00)	0 (0.00)	180 (6.4)
Missing	9 (0.41)	2 (0.60)	0 (0.00)	2 (16.7)	13 (0.5)
<b>Race/Ethnicity</b>					
Asian	289 (13.2)	7 (2.11)	19 (6.33)	2 (16.7)	317 (11.2)
Black	416 (19.0)	125 (37.7)	144 (48.0)	4 (33.3)	689 (24.3)
Native American	6 (0.27)	1 (0.30)	1 (0.33)	0 (0.00)	8 (0.3)
White	1268 (57.9)	65 (19.6)	104 (34.7)	4 (33.3)	1441 (50.8)
Multiple	140 (6.39)	47 (14.2)	28 (9.33)	2 (16.7)	217 (7.7)
Missing	14 (0.64)	82 (24.7)	3 (1.00)	0 (0.00)	99 (3.5)
Hispanic	57 (2.60)	5 (1.51)	1 (0.33)	0 (0.00)	63 (2.2)
<b>Telework</b>					
All the time	271 (12.4)	31 (9.34)	42 (14.0)	0 (0.00)	344 (12.1)
Some of the time	552 (25.2)	54 (16.3)	81 (27.0)	4 (33.3)	691 (24.4)
Rarely or never	1261 (57.6)	145 (43.7)	158 (52.7)	7 (58.3)	1571 (55.4)
Missing	106 (4.84)	102 (30.7)	19 (6.33)	1 (8.33)	228 (8.0)
<b>Number of High-Risk Conditions</b>					
0	1381 (63.1)	154 (46.4)	173 (57.7)	6 (50.0)	1714 (60.5)
1	512 (23.4)	49 (14.8)	68 (22.7)	1 (8.33)	630 (22.2)
2	173 (7.90)	22 (6.63)	28 (9.33)	2 (16.7)	225 (7.9)
3	60 (2.74)	9 (2.71)	9 (3.00)	1 (8.33)	79 (2.8)
Missing	64 (2.92)	98 (29.5)	22 (7.33)	2 (16.7)	186 (6.6)

of these groups considered vaccination as a possibility in contrast to refusers who actively opposed vaccination.

### 3.3. Vaccine believers

#### 3.3.1. Contextual influences

Vaccine believers weighed scientific information more heavily than individual opinions. They trusted and relied on scientific or peer-reviewed sources of information on COVID-19 and COVID-19 vaccines, such as the US Centers for Disease Control and Prevention (CDC), journal articles, local VA’s infectious disease and public health representatives, medical or research colleagues, and national figures (e.g., Dr. Anthony Fauci, a member of the U.S. Coronavirus Task Force). Vaccine believers who noted that their religious or cultural background had influenced their vaccination

decision described beliefs about the importance of caring for oneself and others (e.g., as an extension of the Christian concept of caring for others). A few vaccine believers assumed that COVID-19 vaccination would eventually become mandatory in the workplace, although this was not the primary motivator to get vaccinated and no mandates existed at the time of the study.

#### 3.3.2. Individual and group differences

Vaccine believers perceived a high risk of contracting COVID-19 and reported a strong desire to protect themselves, family, friends, and patients from the disease. For example, one respondent described vaccination as “the decision that was just right for our family,” noting risks of COVID-19 infection to their unvaccinated family members. Some described anticipated regret if they were to pass COVID-19 infection to someone else. Further, vaccine

**Table 2**  
Vaccine hesitancy determinants and activation factors by vaccination decision-making profile.

WHO determinants of vaccine hesitancy <sup>a</sup>	Vaccine believers	Go Along To Get Along	Cautious acceptors/fence sitters	Vaccine refusers
Contextual factors Influences arising due to historic, socio-cultural, environmental, health system/ institutional, economic or political factors	Trust science and weigh scientific/expert sources of information more than anecdotal or opinion-based information.	Trust science and seek information from their own sources (internet searches/people known to them [e.g., personal physicians, VA colleagues/ infectious disease experts])	Trust people closer to them (e.g., same as GATGA plus social circle, family members, social media) and observed others before deciding for themselves- waiting and watching.	Trust family and anecdotal evidence. High mistrust of science and medicine. Low reliance on scientific/expert sources of information.
Illustrative quotes	<p><i>"You know emotion and narrative matters, as well as data. For this kind of thing, I tend to be a little more on the data side."</i></p> <p><i>I'm a Christian and I think you know, being Christian is loving your neighbor. And in this pandemic... I think, you know, taking care of one another is helping stop the pandemic. And so how do we help stop the pandemic? By all of us getting vaccinated."</i></p>	<p><i>"I know we have the Table Talks [VA health care system-wide Director's calls with COVID experts] and whatnot like that. But I really, really get most of [my information] from the docs I work with."</i></p>	<p><i>"I also belong to a health care [state] COVID group on Facebook and that really helped me, too. I would just go and see people's responses and see how you know that I was kind of just monitoring how people did react to it."</i></p> <p><i>"My religion plays a big part because if you pray about it, trust God. You know, because it's just one of those things that we don't know what's happening inside, but we can't see it. We have to trust that when they're doing it, they're doing it right."</i></p>	[Not presented since n = 1]
Individual/group influences Influences arising from personal perception of the vaccine or influences of the social/peer environment	Perceive high risk to themselves, family and patients from COVID-19 and believe in benefit of vaccination	Strong desire to protect family members from COVID-19 infection	Strong desire to protect others though waiting to see how those close to them (e.g., coworkers, family members) respond first, in part with mistrust of system (a barrier to vaccine confidence)	Low perceived risk of disease for self and family members. Potential prior history of non-vaccination.
Illustrative quotes	<p><i>"I see my parents and they help with childcare and at that time you know they weren't eligible yet for vaccine. So, I was the person that was going to see people so I would have been the person to have gotten the virus. So, mostly for my family."</i></p> <p><i>"I would feel horrible if I hurt somebody I cared about, you know, like my best friend who does have higher risks or even just a stranger in the grocery store..."</i></p>	<p><i>"Well my daughter was working at home, my son-in-law worked at home. They were all home so I was the only one that was coming out of the house. So I just wanted to be safe, make sure they were safe."</i></p> <p><i>"So, the main reason for me to take the vaccine is so that that's the way I can... teach my patients that is safe to take 'cause if I don't know what to expect, how can I tell them?"</i></p> <p><i>"I decided to take it because I was in a position where had to encourage patients to take it, and it was more, I felt like a hypocrite encouraging patients to take the vaccine if I myself, I'm not going to take it. And then I was asked to be a vaccine champion as well. So I was going to be administering the vaccine, so I wasn't going to be giving it to other people and not taking it myself. Ethically, that wasn't right."</i></p>	<p><i>Well, my brother... he was really looking forward to his vaccination shot... He was really excited, 'Well, you know, I hope that I can get my shot because you know I'm borderline and my doctor said that I could get it now that I'm [age].'</i></p> <p><i>And... I was like, well, he's not scared and he's not having any fear or anxieties about it. Matter of fact, he's really excited. And so... he says, 'Look, let me tell you something. Either way, COVID is going to happen whether you have a shot or you don't have the shot. COVID is still active and so wouldn't you rather have some protection? You know, even if it's at this percentage or at this percentage... but you still get some type of protection,' he says, 'why not? What's holding you back?' And I got to thinking about it. I was like you're right..."</i></p> <p><i>"If you have this history of not being heard by the healthcare system, then why would I ever think that some new vaccine that's for experimental use authorization would ever be beneficial to me? Because even in my everyday interactions with the health care system, I'm not treated fairly."</i></p>	[Not presented since n = 1]

Table 2 (continued)

WHO determinants of vaccine hesitancy <sup>a</sup>	Vaccine believers	Go Along To Get Along	Cautious acceptors/fence sitters	Vaccine refusers
Vaccine/vaccination factors Directly related to vaccine or vaccination	Confident in vaccine efficacy and safety as well as vaccine development process	Some concern about speedy development of vaccine and vaccine safety, but outweighed by concerns about COVID-19 infection; mild preference for source of vaccine	Questions about vaccine safety/efficacy and quick development of vaccine; specific health questions (missing info to be able to make decisions); strong preference for source of vaccine	Low perceived need for vaccine. Low confidence in safety and effectiveness of vaccine.
Illustrative quotes	<p><i>"I have grown up and it's been a part of my life to having healthy appreciation for vaccines. And on the flip side, being a nurse, I've seen vaccine preventable illnesses so that's just where I come from."</i></p> <p><i>"I'd rather get something that's been tested with people in a lab, than some wild virus that was still really new."</i></p>	<p><i>"Well, actually, when we were, they were first talking about it. I said I wasn't gonna do it 'cause I felt like it came about too quickly. And I was worried that they were rushing it."</i></p>	<p><i>"So that my main concern really was the fact of just not having the research for pregnant women or, you know, like what it could do to the reproductive system. So that really was like one of the major holdups that I had. Honestly, what I just started talking to people more and more and you know our head attending some people who are just very educated and I know that they've done a little more research than I have. Then I started researching more and also there was a meeting, I think like the [Director's meeting] that we do every week with our Director and the questions that I really had happened to be answered that day."</i></p>	[Not presented since n = 1]
Activating factors	None needed (this group considers vaccination as a given).	This group is more likely to decide to get vaccinated in response to an external cue or motivating factor (e.g., easy access, taking care of routine health prevention, having to recommend the vaccine to patients, potential mandates related to travel/work)	Activated when their own specific health questions were answered, bought into perceived benefits and guidance, and able to make decision about risk/benefit tradeoff	Difficult to activate; may require building long-term trusted relationship with a vaccination messenger (e.g., primary care provider).
Illustrative quotes	[Participants in this group did not mention activating factors]	<p><i>"Initially I was hesitant and skeptical. . . And then when it became available so easily, I just followed through with it."</i></p> <p><i>". . . probably driven in large part because, I was on the presumption that at some point it will become mandatory."</i></p>	<p><i>"We could talk freely and without a worry about retaliation or repercussion."</i></p>	[Not presented since n = 1]

<sup>a</sup> See Fig. 2 for a detailed list of WHO determinants of vaccine hesitancy.

believers anticipated that vaccination would help them and others return to normalcy, such as by being able to visit again with family and friends.

Vaccine believers also expressed a strong belief in the benefit of vaccination broadly. Some reported that vaccination had been the norm for them since childhood and was reinforced by life experiences, such as being in the military or in healthcare. Others came to a belief in the importance of vaccination later in life, sometimes going against their early experiences and family beliefs. Several specifically expressed confidence in, and familiarity with, science, research, healthcare, and the medical industry, which set the stage for trust in the safety and efficacy of the COVID-19 vaccines. Although some vaccine believers reported being surrounded by friends and family who were pro-vaccination and others reported that friends and family were against it (or hesitant), they were all firm in their support of COVID-19 vaccination. Some vaccine believers simply expressed that others' opinions "did not have. . . any weight on my decision whatsoever" and others said that their decision to get the COVID vaccine was, in part, driven by a desire to influence hesitant family members to get vaccinated.

### 3.3.3. Vaccine- and vaccination-specific issues

Vaccine believers perceived that the benefits of preventing COVID-19 infection outweighed any risks from the vaccine. They described the risk of severe COVID-19 disease as unpredictable in comparison to the known risks of vaccination found in research trials. Additionally, vaccine believers expressed confidence in the development of the vaccines, with some pointing to the US Food and Drug Administration and CDC vaccination recommendations, as well as endorsements from Dr. Fauci and other experts. Although some vaccine believers had concerns initially about the speed of vaccine development and research, they were reassured after learning more about the process or reframing COVID-19 vaccination in terms of other vaccines they accept readily. Most vaccine believers expressed little or no preference for COVID-19 vaccines developed by a specific manufacturer. Those who did have a preference typically based it on how well-known and respected the manufacturer was, the origin of the vaccine (e.g., Western-country-developed versus from a developing country), and the reported efficacy rate.

Vaccine believers described the process of getting vaccinated at the VA as "seamless" and "smooth." Many said that the



convenience of getting vaccinated in their workplace was influential in their decision to get vaccinated, but many also added that they would have sought vaccination regardless of whether they had to drive to another clinic to get the vaccine.

### 3.3.4. Activation

Most vaccine believers decided to get the COVID-19 vaccine well before the first vaccine was approved for emergency use. They typically reported no or minimal decision-making, viewing vaccination as a given. Some vaccine believers reported that they waited until the vaccine was approved under the emergency use authorization before deciding to get vaccinated, but they reported trust in science and the process of vaccine safety testing and approval. Some vaccine believers participated in, or attempted to participate in, vaccine trials, had altruistic intentions, and a desire to serve as a role model for others.

## 3.4. Go along to get along (GATGA)

### 3.4.1. Contextual influences

Individuals in the GATGA group indicated trust in scientific experts and major news media outlets. Similar to vaccine believers, they turned to sources such as CDC, local and national experts, news outlets, and COVID-19 trackers for information about COVID-19 infections and COVID-19 vaccines. Unlike vaccine believers, GATGA did not seek information from journal articles or primary sources of vaccine trial information; instead, they did their own research on the subject through internet searches or by asking questions of people in their networks (e.g., personal physicians, colleagues at the VA with expertise in infectious disease). Overall, more of this group placed emphasis on COVID-19 information from people they judged to have more expertise than they did. A couple of GATGA participants reported that a possible future COVID-19 vaccination mandate by their employer was a major activating factor in their decision to get vaccinated.

### 3.4.2. Individual and group differences

Similar to vaccine believers, a key factor in GATGA participants' vaccination decision was a strong desire to protect family members from COVID-19 infection. Some GATGA participants were tasked with vaccinating patients or recommending COVID-19 vaccination to their patients, activities they reported heavily influenced their own vaccination decision. Like vaccine believers, GATGA generally reported that the experiences and opinions of family and friends regarding vaccination did not influence them.

### 3.4.3. Vaccine- and vaccination-specific issues

GATGA participants were concerned about the potential severity of COVID-19 disease; however, about half had initial concerns about the safety of the vaccines due to their speedy development. Unlike the vaccine believers, GATGA sometimes questioned, if only briefly, whether vaccination was the best course of action in light of potential safety concerns. GATGA's often needed additional "motivations" such as being able to protect family members, advise patients, engage in other preventive health activities, stop wearing a mask, and because they perceived there would be mandates. Ultimately, for some GATGA their concerns about COVID-19 infection outweighed their concerns about vaccination. Most GATGA had a mild preference for a particular vaccine manufacturer, but they did not describe these preferences as significant factors in their vaccination decision. Additionally, like the vaccine believers, they described the experience of obtaining the vaccine through the VA as smooth and seamless.

### 3.4.4. Activation

Unlike vaccine believers, GATGA participants got vaccinated in response to an external cue or motivating factor, rather than a long-standing belief in vaccination. These activating factors included the possibility of vaccine mandates in the future, engaging in other preventive health activities (e.g., mammogram), being in a patient care role that involves recommending vaccination, and a desire to eventually stop wearing a mask.

## 3.5. Cautious acceptors and fence sitters

### 3.5.1. Contextual influences

Cautious acceptors and fence sitters described a context of deeper trust in and reliance on the people around them, as opposed to official institutions, when compared with vaccine believers and GATGA. Many cautious acceptors and fence sitters described the same trusted sources for COVID-19 and vaccination information as vaccine believers and GATGA (e.g., CDC, news, local experts); however, these participants also relied on people in their social circle or family, internet searches, and social media.

Because many cautious acceptors and fence sitters had specific questions about vaccination, such as whether there were safety concerns for people with their specific health conditions, they not only sought others' experiences but also appreciated opportunities to ask questions of experts. For example, one participant valued having an open forum for questions and answers with VA health care system experts about vaccination: "we could talk freely and without a worry about retaliation or repercussion."

For some cautious acceptors and fence sitters, their religious or cultural context shaped their vaccination decision-making. These participants, some of whom had lingering concerns about vaccine safety, said they prayed to God for guidance about getting vaccinated. A few cautious acceptors reported that they ultimately decided to get vaccinated because of anticipated vaccine mandates for employment or travel.

### 3.5.2. Individual and group differences

Similar to vaccine believers and GATGA, many cautious acceptors and fence sitters were motivated to get vaccinated to protect others, including patients and family members. Unlike vaccine believers and GATGA, many cautious acceptors and fence sitters said that the experiences of others they know with vaccination and COVID-19 were influential in their decision-making. Some waited to see how others, such as coworkers or family members, responded to the vaccines before getting vaccinated themselves. Others saw first-hand how severe COVID-19 disease could be, in either family members or themselves. For some, an influential family member convinced them to get vaccinated. Some perceived shaming or pressure about vaccination from coworkers, friends, healthcare providers, and social media. Although most said this pressure did not influence them, one mentioned that the pressure "kind of kept [vaccination] in the back of my mind that maybe I ought to do it."

Distrust of the healthcare system due to modern and historic injustices contributed significantly to hesitation about getting vaccinated among several cautious acceptors who identified as African American or Black. Some pointed to the Tuskegee experiments [29] and a "history of people putting things in vaccines and giving it to Black people." Others cited personal experiences of unequal treatment in the healthcare system.

### 3.5.3. Vaccine- and vaccination-specific issues

Cautious acceptors and fence sitters often had diverse concerns and considerations regarding vaccine safety, effectiveness, and risk of COVID-19 disease. Unlike vaccine believers and GATGA, many had specific health issues or questions regarding the tradeoff

between the risk of vaccination and the risk of COVID-19 disease. For example, one cautious acceptor had recently undergone surgery, was taking medication, and was of childbearing age and expressed initial concern about adverse effects from vaccination. The fence sitter was yet to be vaccinated due to conflicting advice from different providers about whether or not they should get the vaccine.

Several cautious acceptors had concerns about the newness of the COVID-19 vaccines and their speed of development. Some reported asking coworkers or acquaintances with a research or medical background about vaccine development and mostly were reassured; however, one was told that “there’s no way [vaccine manufacturers] could have jumped through all the hoops in that short period of time.”

Nearly all cautious acceptors and fence sitters had preferences for vaccines produced by a particular manufacturer. Unlike vaccine believers and GATGA, many of these participants had strong preferences, noting that they would not accept any other vaccine. Like vaccine believers and GATGA, most cautious acceptors and fence sitters described a smooth process for getting vaccinated, and a few said that ease of access was key to their decision to get vaccinated.

#### 3.5.4. Activation

Activating factors for cautious acceptors were varied and matched to each individual’s needs. Cautious acceptors with specific questions, such as about the speed of vaccine development, experienced positive activation when their questions were answered. Other positive activators included anecdotal evidence, such as from friends or family, on vaccine efficacy and safety; learning that vaccination would enable travel; a desire to protect oneself and patients from COVID-19 infection; and learning of COVID-19 deaths within circles of close family members. Other factors enabled or co-activated cautious acceptors to get vaccinated. For example, one cautious acceptor mentioned dwindling vaccine supply as a positive co-activator, since they became “nervous” that the vaccine of their choice might not be available. Other enabling factors included the possibility of vaccine mandates or documentation requirements (e.g., passports) in the future, willingness of close family members to get the vaccine, availability of up-to-date information on weekly Director’s meetings, and short lines at the vaccination clinic. Of note, the fence sitter participant had not yet been activated to get vaccinated. As noted earlier, that individual received conflicting advice about vaccination from medical providers that served as a negative activator.

#### 3.6. Vaccine refuser

We were only able to identify one vaccine refuser among the interview participants. This person described a context of distrust of government involvement in vaccine development and official sources of COVID-19 information, such as the CDC, which “keep changing their mind so much.” The vaccine refuser also described personal and family experiences with COVID-19 exposure and infection that were treated successfully, fostering a belief that the risk of COVID-19 infection was low. Additionally, the vaccine refuser viewed COVID-19 vaccines as insufficiently tested for long-term adverse effects and only partially effective. This person had decided against vaccination early on, upon hearing news that the vaccines were under development.

#### 3.7. Provider experiences and needs

Of the six providers interviewed, most encountered patients who were largely interested in getting COVID-19 vaccination. Some providers noted that their patient populations had characteristics that made them more likely to accept vaccination. For exam-

ple, one provider who worked exclusively with transplant patients noted widespread interest in vaccination. Those providers who encountered vaccine-hesitant patients noted concerns about vaccine side effects, potential safety concerns related to their preexisting conditions, or steadfast refusal, such as due to ethical concerns about use of fetal cell lines in vaccine development. Providers described various approaches to engaging vaccine-hesitant patients with concerns about vaccine safety, such as by comparing the risks of COVID-19 infection with the known risks of vaccination; however, none of the providers reported attempting to discuss vaccination with patients who were very opposed. A couple of providers expressed a need for information or materials to aid in discussions about vaccination with patients, including “simple language material coming from trusted sources” such as community or faith groups and information about vaccine effects on a specific patient population.

## 4. Discussion

This study represents a systematic analysis of vaccination intention among employees of a VA healthcare system before and after roll out of the COVID-19 vaccines. While survey data revealed differences in vaccination intention by employee characteristics, interviews provided more information about determinants and activating factors leading to vaccination/non-vaccination decisions. A comprehensive and coordinated vaccination campaign in any health care system must include targeted outreach to vaccine hesitant employees, including but not limited, to healthcare providers. Another VA QUERI team characterized vaccine hesitancy across VA employees and Veteran patients according to five dimensions (deliberation, dissent, distrust, indifference, and skepticism) and identified overall facilitators to overcome hesitancy [20]. Findings of this case study complement that work by focusing more specifically on employees from one VA hospital system all exposed to the same operational initiative and, from within that context, categorizing vaccination decisions into distinct subgroups that lie along a spectrum that spans vaccine acceptance and vaccine refusal. Additionally, we triangulated qualitative descriptions of vaccine decisions with qualitative and quantitative data on intentions from that same employee population. By viewing COVID-19 vaccine hesitancy dynamically along a spectrum, we can identify targeted activation factors [27] that nudge health system employees towards vaccine acceptance. In addition to acting on determinants of vaccine hesitancy, future interventions may focus on increasing positive activators that nudge individuals toward vaccine acceptance and relatedly, reduce negative activators that nudge individuals away from vaccine acceptance. The study findings on decision-making profiles and activating factors may be leveraged to tailor existing evidence-based [30] interventions to promote COVID-19 vaccinations among health care system employees and potentially other populations (see Table 3 for examples of intervention tailoring).

Vaccine believers in our study needed little to no activation. Due to their high trust in science and reliance on evidence-based information, vaccine believers had confidence in vaccine safety and effectiveness. Hence, interventions for vaccine believers should continue providing evidence-based information and resources. Strategies that promote convenience of vaccinations, such as free, on-site vaccination clinics, may promote ease of uptake for this group, especially because those who wanted to get the vaccine when available were more likely to work in daytime or rotating shifts and in inpatient/administrative settings.

GATGA individuals were similar to vaccine believers in their trust in science and perceived risk but expressed slightly lower confidence in vaccine safety and effectiveness. Interviews indi-

**Table 3**  
Recommendations for targeted interventions based on vaccination decision-making profiles and activating factors among VA health care system employees.

Recommendations	Vaccine Believers	GATGA	Cautious acceptors / Fence sitters	Vaccine Refusers
<b>Community-wide education</b>				
Evidence-based information (e.g., information from national or state public health agencies, statements from professional societies, peer-reviewed publications)	X	X		
National or state expert testimonials	X	X		
Local expert testimonials		X	X	
Peer champion testimonials/vaccination experiences of peers (e.g., via vaccination selfies, social media posts)			X	X
Safe, non-judgmental venues for collating and addressing concerns (e.g., TableTalks, Q&A forum, information sessions, FAQ documents)		X	X	X
Manual outreach/individualized counseling			X	X
<b>Enhance access to vaccinations</b>				
On-site, free, actively promoted vaccinations	X	X	X	X
Access for night/shift workers	X	X	X	X
Co-offerings with other screening or health services	X	X	X	X
Prominent signage/high traffic locations	X	X	X	X
<b>Healthcare system interventions</b>				
Provider reminders	X	X	X	X
Standing orders	X	X	X	X
Provider training to address concerns and offer a strong recommendation in favor of vaccination		X	X	X
Provider assessment and feedback		X	X	X
Scheduling/appointment reminders	X	X	X	
<b>Incentives rewards</b>				
Gift cards, food vouchers or lottery prizes		X	X	
Stickers, bracelets, or observable gifts for vaccinated individuals		X	X	
Paid time off to get vaccinated		X	X	
<b>Vaccine mandates</b>				
		X	X	X

cated that GATGA individuals often reported being activated in response to external cues (e.g., being in roles where they had to make vaccine recommendations to others, engaging in other preventive services). However, survey data indicated that hesitant employees tended to work in outpatient settings or during the evening or night shift which could have fewer opportunities for external cues compared to the in-patient hospital setting. As such, interventions for GATGA may continue providing evidence-based information and resources, but also need to incorporate cues for action (e.g., scheduling reminders, monetary incentives, collocation of vaccination clinic in high traffic areas to increase visibility) during all shifts and in outpatient settings.

Unlike vaccine believers and GATGA, cautious acceptors and fence sitters were more likely to rely on trusted sources within their individual or social networks and expressed lower confidence in vaccine safety and effectiveness. This concern about safety among hesitant employees also appeared in the pre-rollout survey along with expressed need for more information. These groups align with Elwy’s et al.’s (2021) dimensions of “vaccine deliberation” and “vaccine skepticism” from their study of COVID-19 vaccine hesitancy among VA employees and patients [20]. Interventions for cautious acceptors and fence sitters may leverage local experts and resources (e.g., peer champions), and provide safe and non-judgmental venues where their specific concerns may be addressed. A strong provider recommendation may be beneficial for this group since many expressed concerns related to vaccine safety and pre-existing co-morbidities. Employees with a greater number of co-morbidities were also more likely to have expressed hesitancy in their intention to obtain vaccine prior to rollout, and some of this hesitation may be linked to the strength of vaccine recommendation from their providers.

Our findings reveal differences in socio-demographic characteristics associated with COVID-19 vaccination. Participants identifying with Black or multiple races were more likely to be described as GATGA, fence sitters, or cautious acceptors, compared to their White counterparts in our study. These findings agree with other data on demographic characteristics associated with COVID-19 vaccinations [31–38]. Other surveys among US adults in 2021

found that individuals identifying as Black had lower rates of acceptance of vaccination as well as COVID-19 vaccine trial participation, and that this was partially mediated by medical mistrust [35,39].

Vaccine refusers are difficult to activate since they have low trust in science and low confidence in vaccine safety or effectiveness. The one vaccine refuser in our study expressed low perceived susceptibility to COVID-19 and relied heavily on personal experiences rather than public health data. Employees in this end of the vaccine hesitancy spectrum may include not only the indifferent but also dissenters, i.e., those who actively reject vaccines [20]. Interventions for vaccine refusers may require long-term engagement with their primary healthcare provider or stringent measures such as vaccine mandates.

Since the time the study ended, the VA has mandated COVID-19 vaccination as a condition of employment for all employees within a broader mandate for all federal employees in the US [40]. Prior studies suggest that mandates can successfully increase vaccination rates among health care workers [8,41,42]. However, the ability of individuals to opt out of vaccinations through use of non-medical exemptions remains a threat to vaccination coverage. Rising rates of non-medical exemptions have been documented in the childhood vaccination literature [43,44]. Personalized outreach to fence sitters and refusers to address specific concerns may be needed in the future to reduce opting-out via exemptions. To increase the likelihood of the mandate’s success, vaccine hesitancy determinants should be addressed and additional interventions (such as those listed in Table 3) may be implemented to promote vaccine acceptance.

The strengths of this study include the use of a convergent mixed methods design and use of a-priori codes derived from widely used frameworks of vaccine hesitancy determinants, i.e., the WHO matrix of vaccine hesitancy determinants, and the 5As taxonomy of vaccine hesitancy. The study is unique in providing an assessment of vaccination decision-making and related determinants before and after COVID-19 vaccine roll out. In addition, the study sample reflects diverse demographic and occupational groups represented in healthcare systems including staff in non-

clinical positions. Although we did not identify differences in determinants or activating factors by occupational groups (data not shown), a major contribution of this study is in advancing the understanding of the healthcare employee clusters of COVID-19 vaccination decision-making and the use of this information for tailoring interventions to reduce vaccine hesitancy.

Study limitations include use of independent samples for the quantitative and qualitative portions of the study as this limits our ability to understand within-person change in vaccination decision-making over time. While only a small number of vaccine refusers and fence sitters participated in semi-structured interviews, the lower participation rates may be reflective of the potential stigma associated with non-vaccination in a healthcare setting. Since participants were recruited from a single VA healthcare system, study findings may not be generalizable to VA healthcare systems in other parts of the US. However, there is a strong overlap of socio-demographic characteristics in our findings and other national polls that were conducted at the time of the study [31–34].

## 5. Conclusion

This study identified distinct decision-making profiles associated with COVID-19 vaccination among employees of a VA health care system as well as tailored recommendations to reduce vaccine hesitancy in this population. The methodology and coding framework used in this study can serve as a model for other VA and non-VA healthcare systems seeking to study vaccine hesitancy among employees.

### CRedit authorship contribution statement

**Lavanya Vasudevan:** Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Visualization. **Rebecca Bruening:** Methodology, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, Visualization. **Anna Hung:** Writing – original draft, Writing – review & editing, Visualization. **Sandra Woolson:** Software, Data curation, Formal analysis, Visualization, Writing – review & editing. **Adrian Brown:** Project administration. **Susan N. Hastings:** Conceptualization, Writing – review & editing, Supervision, Funding acquisition. **Tammy Linton:** Project administration. **Genevieve Embree:** Conceptualization, Resources, Data curation, Writing – review & editing. **Christopher J. Hostler:** Conceptualization, Resources, Data curation, Writing – review & editing. **Elizabeth Mahanna:** Project administration. **Nwora Lance Okeke:** Conceptualization, Writing – review & editing. **Hayden Bosworth:** Conceptualization, Writing – review & editing, Supervision, Funding acquisition. **Nina R. Sperber:** Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Visualization, Supervision, Funding acquisition.

### Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: HBB reports receiving research funds from Sanofi, Otsuka, Novo Nordisk, Improved Patient Outcomes, Boehringer Ingelheim, and Bbetter Therapeutics, as well as consulting funds from Sanofi, Otsuka, Abbott, Novartis, WEBMD, YiDYA, Imatar, Walmart, and Proteus Digital Health in the last three years. AH reports research funds from PhRMA in the past three years. LV has family members who receive compensation from Pfizer for their participation in the COVID-19 vaccine trial. LV does not receive any direct salary or research support from Pfizer. All other authors have no relevant conflicts to declare.

## Acknowledgement

The authors are grateful to the participants for their time and contributions to this study.

## Funding

This work was supported by the Quality Enhancement Research Initiative (QUERI) Award # QUE 16-170 from the United States (U. S.) Department of Veterans Affairs and the Durham Center of Innovation to Accelerate Discovery and Practice Transformation (ADAPT), (CIN 13-410) at the Durham VA Health Care System and HSR&D grants #08-027 (to HBB). The content is solely the responsibility of the authors and does not necessarily reflect the position or policy of Duke University, the U.S. Department of Veterans Affairs, or the U.S. government. Funding provided by the U.S. Department of Veterans Affairs (VA) Office of Rural Health. LV receives funding from the National Center for Advancing Translational Sciences of the National Institutes of Health under Award Number KL2TR002554. AH receives funding from Career Development Award Number IK2 HX003359 from the U.S. Department of Veterans Affairs HSR&D Service. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

## Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.vaccine.2022.07.010>.

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