Healthcare workers’ attitudes on mandates, incentives, and strategies to improve COVID-19 vaccine uptake: A mixed methods study

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ABSTRACT
Healthcare workers are a trusted health information source and are uniquely positioned to reduce the burden of the COVID-19 pandemic. The purpose of this sequential exploratory mixed methods study was to understand attitudes of healthcare workers working in Massachusetts during the COVID-19 pandemic regarding strategies to improve COVID-19 vaccine utilization, including vaccine mandates and incentives. Fifty-two individuals completed one-on-one interviews between April 22nd and September 7th, 2021. The survey was developed based on findings from the interviews; 209 individuals completed the online survey between February 17th and March 23rd, 2022. Both the interview and survey asked about attitudes toward COVID-19 vaccine and booster mandates, incentives, and strategies to improve vaccination rates. Most participants were female (79%-interview, 81%-survey), Caucasian (56%, 73%), and worked as physicians (37%, 34%) or nurses (10%, 18%). Overall, nuanced attitudes regarding vaccine and booster mandates were expressed; many supported mandates to protect their patients’ health, others emphasized personal autonomy, while some were against mandates if job termination was the consequence of declining vaccines. Similarly, views regarding vaccine incentives differed; some considered incentives helpful, yet many viewed them as coercive. Strategies believed to be most effective to encourage vaccination included improving accessibility to vaccination sites, addressing misinformation, discussing vaccine safety, tailored community outreach via trusted messengers, and one-on-one conversations between patients and healthcare workers. Healthcare workers’ experiences with strategies to improve utilization of COVID-19 vaccines and boosters have implications for public health policies. Generally, efforts to improve access and education were viewed more favorably than incentives and mandates.

Introduction
In the United States, approximately 72% of eligible individuals aged 5 years and older are fully vaccinated against Coronavirus Disease 2019 (COVID-19) and about 49% have received at least one booster, as of September 26th, 2022. Although COVID-19 vaccines have been shown to significantly reduce the risk of severe COVID-19-related illness and death, vaccine and booster rates have remained sub-optimal. Furthermore, as the SARS-CoV-2 pandemic continues, COVID-19 boosters appear to be needed at regular intervals to decrease the risk of severe disease, hospitalization, and/or death. Therefore, the need to better understand potential strategies to improve COVID-19 vaccine and booster uptake is paramount.

Vaccine requirements or mandates in various settings, including schools, workplaces and for travel, have long been successful in increasing vaccine uptake to protect against different vaccine-preventable diseases. Importantly, influenza vaccine mandates in healthcare systems resulted in increased vaccination uptake. However, additional research on COVID-19 vaccine mandates is warranted given heavy politicization of the issue in the United States. In addition, understanding healthcare worker attitudes regarding other strategies to increase vaccination rates is important as multiple strategies may be needed to achieve optimal coverage. Further, evidence regarding how healthcare workers perceive the effectiveness of additional strategies to promote COVID-19 vaccination is limited. Vaccine incentive or reward programs were implemented during the COVID-19 pandemic with varying success. Other strategies included one-on-one conversations with patients, efforts to publicly combat misinformation,
and efforts to increase access to vaccines.\textsuperscript{17–20} Healthcare workers play critical roles in vaccine provision and acceptance for the general public. Understanding their perceptions toward different vaccination strategies may help inform future programs. We performed a sequential exploratory mixed methods study among workers representing various positions in healthcare in Massachusetts to explore how attitudes regarding mandates, incentives, and other strategies to improve COVID-19 vaccination rates evolved over time.

**Methods**

A sequential exploratory mixed-methods study using qualitative interviews followed by a cross-sectional online survey of healthcare workers in Massachusetts was conducted. Eligible participants were English-speaking, at least 18 years old, and worked in healthcare during the COVID-19 pandemic. Figure 1 outlines the timeline of COVID-19 in Massachusetts as well as research study events. Interviews were performed between April and September of 2021, and the survey was developed based on interview findings and distributed in February of 2022. The interviews were held soon after COVID-19 vaccines became available. Shortly thereafter, COVID-19 vaccines were mandated for healthcare workers, often with the consequence of job termination for non-vaccination. In addition, waning vaccine effectiveness during the Delta wave led to a recommendation for COVID-19 boosters, which later became mandatory as well. In December, 2021 and January, 2022 the Omicron wave resulted in the highest rates of COVID-19 in Massachusetts compared to any time prior, including more breakthrough infections among vaccinated persons.

**Interview guide development**

A semi-structured interview guide was developed and included vaccination topics using constructs of the Consolidated Framework for Implementation Research (CFIR) model. CFIR consists of 39 constructs across the following five domains: intervention characteristics, outer setting, inner setting, characteristics of the individual and implementation process.\textsuperscript{21} Participants were asked about their attitudes toward mandates and incentives for COVID-19 vaccination, both for healthcare workers and the general public. Specific questions pertaining to mandates included: “How would you feel about mandatory vaccination for healthcare workers?” and “How do you feel about mandatory vaccination in other settings?” Questions pertaining to mandates and incentives were captured under the organizational policies construct within the inner setting domain and under the outer setting domain within the external policies and incentives construct. Participants also shared their views regarding other potential strategies to improve COVID-19 vaccination and booster rates. Strategies discussed included education efforts, messaging and dissemination of data and information, and improving public trust. Demographic information collected included age, sex/gender, race/ethnicity, country of origin, time in the United States for those born elsewhere, number of people in household, religion, healthcare role and specialty, healthcare setting, and geographical work location. The interview also included questions about healthcare workers’ perceptions of facilitators and barriers to accepting COVID-19 vaccines for themselves and their patients (detailed in a forthcoming manuscript). See supplement for full interview guide.

**Interview participant recruitment and data collection**

A Community Stakeholder Advisory Board was formed in April, 2021 as part of this research study. The purpose of the Board was to inform the research and to allow dissemination of results in real time to stakeholders. The Advisory Board included 26 individuals from healthcare areas including emergency, family medicine, obstetrics/gynecology, pediatrics, as well as ancillary services (public safety, environmental services, interpreter services etc.) to ensure representation of attitudes and views across all those who work in healthcare. Interview participants were recruited from the Advisory Board and their networks. In total, 72 individuals were contacted, 4 declined, 16 did not respond or were interested but unable to participate, and 52 individuals participated (72%) in one-on-one qualitative interviews. Participants provided verbal informed consent, and interviews were conducted with a trained qualitative researcher. Interviews were approximately 1 hour in length, ranging from 30 to 80 minutes, were digitally audio-recorded. Interviewees were asked open-ended questions with follow-up probes. Interviews took place between April 22nd and September 7th, 2021 (Figure 1).

**Interview data analysis**

Interviews were transcribed verbatim by study team members and reviewed for accuracy. Transcripts were imported into

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**Figure 1.** Timeline of COVID-19 in Massachusetts and research study events.
NVIVO (version 12 March 2020) for coding and analysis, using content analysis. Transcripts were coded in an iterative process and themes were developed based on responses. Inductive and deductive coding were used to establish a codebook based on the Consolidated Framework for Implementation Research model. At least two study team members independently coded each transcript. Consistency in code application and resolution of discrepancies occurred in weekly meetings.

Survey development

The survey was developed based on findings from qualitative interviews and feedback from members of the Advisory Board. The survey included questions asking about views on COVID-19 vaccine and booster mandates for healthcare workers, opinions regarding vaccine incentives, and perceptions regarding other potential strategies for improving COVID-19 vaccine uptake for the general public. At the time of survey distribution, vaccine mandates for healthcare workers were in place. Vaccine mandates for healthcare workers were federal requirements from the United States Centers for Medicare and Medicaid Services (CMS) stating that all Medicare- and Medicaid-certified healthcare facilities were required to have all staff vaccinated with the only option for non-vaccination being employee termination. As nearly all facilities in the United States utilize Medicare and Medicaid, this mandate applied to essentially all healthcare workers. In the survey, participants were asked: “For healthcare settings, how do you feel about COVID-19 vaccine mandates for the primary series (defined as 2 Pfizer or Moderna shots or 1 J&J shot)?” Participants had the option to respond that they fully supported mandates, did not support mandates under any circumstances, or supported them if the alternative option was masking/testing but not if the consequence of non-vaccination was job termination. We asked a similar question about booster mandates, defined as required to keep vaccine doses up to date per national guidelines, with the same response options. The survey also included questions on the mental health impact of the COVID-19 pandemic and burnout in healthcare workers (detailed in a forthcoming manuscript). Demographic information was also collected, as described for the interviews. (See supplement for full survey). The survey was built using REDCap, a secure web-based application used to collect and manage research data. The survey was pilot tested by 8 healthcare workers and revised before dissemination.

Survey participant recruitment and data collection

The survey was distributed using the snowball sampling method, where Advisory Board members and the study team shared the survey link with potential participants from their networks. Individuals who participated in the study were asked to refer potential participants from their networks of healthcare workers in Massachusetts. Surveys were completed between February 17th and March 23rd, 2022 (Figure 1).

Survey data analysis

Anonymous data were exported from REDCap. Descriptive statistics were summarized and presented in tables. Categorical variables were collapsed. Statistical analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC, USA).

The institutional review board at Boston University Medical Campus and Boston Medical Center approved these studies. Interview and survey respondents were compensated for their participation.

Results

Characteristics of interview participants

The sociodemographic characteristics of the study sample, stratified by participation in either the qualitative interviews or the survey, are illustrated in Table 1. Fifty-two individuals participated in one-on-one qualitative interviews. Participants’ ages ranged from 22 to 74 years, most reported their gender as female (n = 41, 79%), and their race/ethnicity as Caucasian (n = 29, 56%). The majority were physicians (n = 19, 37%) or nurse practitioners/midwives (n = 8, 15%) and worked in hospitals (n = 24, 46%) or outpatient clinics (n = 17, 33%). Areas of healthcare included obstetrics/gynecology (n = 11, 21%), emergency (n = 9, 17%), ICU/critical care (n = 4, 8%), and several other areas (n = 14, 27%).

Characteristics of survey respondents

The survey was completed by 211 participants; responses from two individuals who no longer worked in healthcare were excluded from analyses. Of the 209 participants included in the final analysis, most were between 18 and 35 years of age (n = 58, 28%), reported their gender as female (n = 170, 81%), and their race/ethnicity as Caucasian (n = 152, 73%). The majority were physicians (n = 71, 34%) or nurses (n = 38, 18%) and worked in hospitals (n = 129, 62%) or outpatient clinics (n = 47, 23%). Most participants worked in areas of healthcare including pediatrics (n = 67, 32%), emergency (n = 27, 13%), and obstetrics/gynecology (n = 23, 11%), and several other areas (Table 1).

Qualitative themes related to COVID-19 vaccine mandates, incentives, and other strategies to improve vaccination uptake

Participants expressed nuanced views regarding vaccine and booster mandates for healthcare workers; many supported mandates to protect the health of patients, others emphasized the importance of personal autonomy, while some were against mandates when the consequence of declining vaccines was job termination. Similarly, attitudes toward vaccine incentives differed among healthcare workers; some considered incentives helpful, yet many believed them to be coercive. Strategies regarded as the most effective to encourage COVID-19 vaccination included efforts to improve access to vaccines and education.

Mandates for COVID-19 vaccination

Interview findings

During the interviews, which took place prior to the implementation of COVID-19 vaccine mandates for healthcare
Table 1. Demographics of interview and survey participants.

| Demographic Category | Interviews (N=52) | Survey (N=209) |
|----------------------|------------------|----------------|
|                      | n (%)            | n (%)          |

### Age (years)
- 18–35: 12 (23)
- 36–45: 11 (21)
- 46–55: 19 (37)
- ≥56: 10 (19)

### Gender
- Female: 41 (79)
- Male: 11 (21)
- Transgender/non-binary: 0

### Race/Ethnicity
- Asian: 3 (6)
- Black/African-American/Haitian: 9 (17)
- Caucasian: 29 (56)
- Mixed race: 3 (6)
- Prefer not to say: 8 (15)

### Hispanic
- Yes: 11 (21)
- No: 29 (56)
- Prefer not to say: 12 (23)

### Country of birth
- United States: 36 (69)
- Outside United States: 16 (31)

### Household number
- 1: 5 (10)
- 2: 9 (17)
- 3-7: 38 (73)

### Religion
- None: 14 (27)
- Christianity: 35 (67)
- Other: 3 (6)

### Healthcare worker role
- Advanced Practice Provider (NP, CNM, PA): 8 (15)
- Emergency Medical Technician/Paramedic: 6 (11)
- Medical or Patient Care Assistant: 2 (4)
- Nurse (RN, LPN): 5 (10)
- Physician: 19 (37)
- Social worker/Mental health specialist: 1 (2)
- Other: 11 (21)

### Healthcare setting
- Ambulance: 6 (11)
- Hospital: 24 (46)
- Outpatient clinic: 17 (33)
- Other: 5 (10)

### Area of healthcare
- Emergency: 9 (17)
- Family medicine: 6 (11)
- ICU/critical care: 4 (8)
- Internal medicine: 3 (6)
- Obstetrics/gynecology: 11 (21)
- Pediatrics: 5 (10)
- Other: 14 (27)

### Work location
- Cape and Islands/South Shore: 7 (14)
- Central MA/Western MA: 2 (4)
- Greater Boston metropolitan area/North Shore: 43 (82)

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1. Age: Interviews: 18–25 years (n = 4), 26–35 years (n = 8), 36–55 years (n = 8), ≥56 years (n = 2). Survey: 18–25 years (n = 5), 26–35 years (n = 81), 36–55 years (n = 81), ≥56 years (n = 21), ≥66 years (n = 2).
2. Other religion: Interviews: Judaism (n = 2), Community health worker/Wellness advocate (n = 2), Director of Interpreter Services (n = 1), Environmental Services (n = 1), Patient Navigator (n = 1), Public Safety Officer (n = 1), Laboratory director/Research scientist (n = 1), Respiratory Therapist (n = 1), Survey: Dietician (n = 2), Laboratory director/Research scientist (n = 1), Lactation Consultant (n = 1), Pharmacist/Pharmacy technician/Pharmacy liaison (n = 1), Physical/Occupational therapist (n = 1), Program manager/Administrator (n = 1), Imaging technician (n = 1), Not specified (n = 4).
3. Other healthcare worker role: Interviews: Clinical Support Specialist (n = 1), Community health worker/Wellness advocate (n = 2), Director of Interpreter Services (n = 1), Environmental Services (n = 1), Patient Navigator (n = 1), Public Safety Officer (n = 1), Laboratory director/Research scientist (n = 1), Respiratory Therapist (n = 1), Survey: Dietician (n = 2), Laboratory director/Research scientist (n = 1), Lactation Consultant (n = 1), Pharmacist/Pharmacy technician/Pharmacy liaison (n = 1), Physical/Occupational therapist (n = 1), Program manager/Administrator (n = 1), Imaging technician (n = 1), Not specified (n = 7).
4. Other healthcare setting: Interviews: Academic (n = 2), Community (n = 1), Homecare agency (n = 1), Remote (n = 1), Survey: Academic (n = 1), Dental setting (n = 1), Health Department (n = 2), Nursing home/Assisted living facility (n = 2), Remote (n = 2), School health center (n = 2), Multiple (n = 3), Not specified (n = 4).
5. Other area of healthcare: Interviews: Ambulatory (1), Nursing home/Assisted living facility/Elder care (n = 1), Research (1), Orthopedic Surgical Practice (1), Primary Care (1), Psychiatry (1), Public Health (1), Renal Medicine (1), Social Work (1), Not specified (n = 1), Survey: Administration (n = 2), Anesthesiology (n = 2), Emergency Services (n = 1), Neurology (n = 1), Obstetrics/Gynecology (n = 1), Pediatrics (n = 1), Physical/Occupational therapy (n = 1), Public health (n = 1), Multiple (n = 1), Not specified (n = 2).
6. Work location: Interviews: Cape and Islands (n = 1), Central MA (n = 1), South Shore (n = 6), Western MA (n = 1), Greater Boston metropolitan area (n = 42), North Shore (n = 1), Survey: Cape and Islands (n = 4), South Shore (n = 29), Central MA (n = 11), Western MA (n = 6), Greater Boston metropolitan area (n = 151), North Shore (n = 8).

MA = Massachusetts.
workers, many interviewees supported vaccine mandates, while some opposed mandates or expressed nuanced views (Figure 1 and Table 2). Some participants believed that mandatory COVID-19 vaccination in healthcare settings was important to protect patients’ health: “... healthcare workers have already been mandated to get flu shots so COVID-19 vaccines should not be any different, and healthcare workers are responsible not only for their own health but for the health of patients that they’re taking care of.” (P06-Internal Medicine MD) However, others expressed that vaccination mandates should be limited to healthcare settings, with some stating that the requirement to be vaccinated should be different for healthcare workers and the general public. While all participants understood the potential public health importance of vaccines, some spoke of the importance of respecting an individual’s personal autonomy: “This is cultural for me. I was trying to unpack this, and I think why I am so against [mandates is] because my parents came to this country for free choice ... the hit we take in this country for independence and in the more spirit of individuality, will be that more people will suffer on a population health basis.” (P19-Pediatrics MD)

Survey findings
The surveys were completed when COVID-19 vaccine mandates in healthcare settings had been in place for several months, often with the consequence of noncompliance being job termination (Figure 1). Almost two thirds of respondents supported COVID-19 vaccine mandates (n = 131, 62.7%) and over half supported booster requirements (n = 118, 56.5%) in healthcare settings. However, about one third of respondents supported vaccine (n = 61, 29%) and booster (n = 66, 32%) mandates in healthcare settings only if the alternative were masking/testing rather than job termination (Table 3).

In an open-ended survey question, respondents were asked to further share their thoughts regarding vaccine mandates for healthcare workers. Similar to interview responses, several mentioned that vaccination against COVID-19 was important to protect those around them: “I feel it is the right thing to do to protect others and everyone has responsibility to protect the community ...” (33-Internal Medicine MD) Some expressed that vaccination should be a personal choice: “I believe people should have personal autonomy over their own body. We re-used N95s and subpar gowns, we risked everything to take care of patients. But we are not afforded the right to decide what is right for our own bodies.” (199-ICU Nurse). Others were against vaccine mandates when the consequence was job termination: “Leveraging people’s jobs in order to get them to get a booster isn’t the way to do this. You are just creating a staffing shortage that could be avoided.” (205-ICU Nurse)

| Table 2. Key themes and example quotes from interviews and surveys. |
| --- | --- |
| Key theme | Illustrative quotes |
| **COVID-19 vaccine mandates** | “... on one hand, I feel like it should be mandatory ... but also too, I feel like people should have the freedom to decide on their own, you know.” (P10-EMT, interview) |
|  | Vaccine requirements are not new in healthcare. We can’t work at the hospital without an MMR or a flu shot each year. The way this has been politicized is disgusting.” (123-Pediatric MD, survey) |
|  | “Vaccines save lives and are proven effective. They have been mandated to attend public schools and colleges for years. This seems like an arbitrary vaccine to fight and the biggest issue I have is that unlike choosing not to wear a seatbelt, choosing not to vaccinate can hurt others who don’t have the option to get vaccinated. Putting others at risk unnecessarily should not be allowed in a healthcare setting. We have to get PPD testing and flu shots too. This is not different.” (156-Dietician, survey) |
|  | “We must all work together to end this. It isn’t about the individual, it’s the ‘collective we.’ (53- Advanced Practice Provider, survey) |
|  | “Vaccination mandates are ruining healthcare. We have body autonomy over everything else in regards to our health, but coercing people to get vaccinated is unethical, unconstitutional and deplorable.” (205-ICU Nurse, survey) |
|  | “I am fully vaccinated but I resent the mandate on boosters – especially termination for noncompliance.” (125- Imaging technician, survey) |
| **COVID-19 vaccine incentives** | “Your job is to take care of people you don’t, you shouldn’t need an incentive for that.” (P12-Family Medicine MD, interview) |
|  | “We shouldn’t be incentivized to do the right thing, I think that sends the wrong message.” (P01-OBGYN MD, interview) |
|  | “Incentives can be effective but also people to become suspicious of the vaccines.” (52-ICU Advanced Practice Provider, survey) |
| **Strategies to improve COVID-19 vaccination rates** | “I think public health messaging um that’s, you know, sort of culturally and linguistically competent ... I think that’s a really important one.”(P04-Midwife, interview) |
| Healthcare workers cited areas for improvement with the COVID-19 vaccine rollout. | “... I am discussing [vaccines] because I care about them and their family. That I did it for my community and patients.” (173-Pediatrics Nurse, survey) |
|  | “I think each person who’s declining has, unfortunately, a unique reason why. And that’s where the one-on-one conversation with a trusted source and whether that trusted source is someone that you’ve known for a long time, whether it’s someone that’s like you, whether it’s someone who has a familiar background to you, culturally ...” (P07-Family Medicine MD, interview) |
|  | “Provide information on safety of mRNA vaccines, importance of preventing infection in vulnerable populations including pregnant patient.” (206-Pharmacist, survey) |
|  | “… just to be transparent because I think one of the reasons people don’t trust it is because people aren’t being clear about the potential side effects. And if you’re just upfront with people about it and they know what they’re getting themselves into then they feel more comfortable with it.” (P16-Social worker/Mental health specialist, interview) |
|  | “Bring vaccines to the people. Don’t make them come to you.” (151-Researcher, survey) |
|  | “[EMTs should be prioritized for vaccination because] there is no six feet social distancing in the back of an ambulance and even with all our PPE, we still have first responders becoming sick (R01-EMT, interview)” |
When participants were asked to rate the perceived effectiveness of other potential strategies to improve COVID-19 vaccination, 57% (n = 120) of respondents considered general public mandates for the primary vaccine series as ‘effective/very effective,’ while 22% (n = 46) believed they were ‘not effective.’ Results were similar regarding mandates for booster doses for the general public: 58% (n = 121) considered them as ‘effective/very effective’ while 23% (n = 49) considered them ‘not effective’ (Table 4).

### Incentives to promote COVID-19 vaccination

#### Interview findings

Participants expressed differing views related to incentives for COVID-19 vaccination, as shown in Table 2. Most interviewees opposed incentives or considered them as ineffective, while the rest supported incentives or expressed nuanced views regarding the use of incentives to encourage vaccination. Some mentioned that providing vaccine incentives to patients, particularly money, may further erode public trust as patients may be suspicious about the motivation for payment. Incentivizing patients to increase vaccination rates was considered coercive by some: “I have always felt funny about incentives for healthcare things because I feel like it’s a little bit unethical.” (R09-Midwife) One participant presented incentives as a means to overcome barriers to vaccination at inconvenient locations: “I think given that the distribution has been so inequitable, incentives in the way that support how difficult it may be for someone to get to a site . . . I think, like here’s a meal, or have a subway card, like that kind of stuff makes sense to me.” (P18-OBGYN MD) Others thought that the type of incentives should be tailored to particular needs of individuals: “In general, incentives are not all that great, but maybe it could be an incentive like an extra day of vacation or something that healthcare workers really want . . . it can’t just be money, because money is, surprisingly, not a very good incentive for people.” (P11-Internal Medicine MD)

#### Survey findings

Overall, survey participants viewed incentives for promoting vaccination to the general public more favorably than interview participants, with 68% (n = 143) of participants rating incentives as ‘effective/very effective’ and 12% (n = 25) of participants considering them as ‘not effective.’ Views were similar regarding incentives for booster doses of COVID-19 vaccines, with 67% (n = 141) of participants rating them as ‘effective/very effective.’

### Table 3. Attitudes toward COVID-19 vaccine and booster mandates and masking policies.

| Mandate Item                                                                  | n   | %   |
|-------------------------------------------------------------------------------|-----|-----|
| COVID-19 vaccine mandates in healthcare settings (n = 209)                    |     |     |
| I fully support them                                                          | 131 | 62.7|
| I support them if the option for non-vaccination is masking/testing, but do not support them if the consequence of non-vaccination is job termination | 61  | 29.2|
| I do not support them under any circumstances                                 | 14  | 6.7 |
| Other                                                                        | 3   | 1.4 |
| COVID-19 booster mandates in healthcare settings (n = 209)                    |     |     |
| I fully support them                                                          | 118 | 56.5|
| I support them if the option for non-vaccination is masking/testing, but do not support them if the consequence of non-vaccination is job termination | 66  | 31.5|
| I do not support them under any circumstances                                 | 21  | 10.1|
| Other                                                                        | 4   | 1.9 |
| Staff shortages due COVID-19 vaccine mandates                                 |     |     |
| Yes                                                                          | 84  | 40.2|
| No                                                                           | 59  | 28.2|
| Not sure                                                                     | 66  | 31.6|

### Table 4. Effectiveness of strategies to improve COVID-19 vaccination and booster uptake (n = 209).

| Strategy                                                                 | Effective/Very effective | Somewhat effective | Not effective |
|--------------------------------------------------------------------------|--------------------------|--------------------|---------------|
| COVID-19 vaccination                                                     |                          |                    |               |
| Addressing misinformation                                               | 15 (7.2)                 | 29 (13.9)          | 165 (78.9)    |
| Tailored community outreach in areas with lower vaccination rates        | 15 (7.2)                 | 34 (16.3)          | 160 (76.6)    |
| Discussing vaccine safety                                               | 15 (7.2)                 | 40 (19.1)          | 154 (73.7)    |
| Incentives                                                              | 25 (12.0)                | 41 (19.6)          | 143 (68.4)    |
| One-on-one conversations with medical providers                         | 15 (7.2)                 | 53 (25.4)          | 141 (67.5)    |
| Mandates                                                                | 46 (22.0)                | 43 (20.6)          | 120 (57.4)    |
| Increasing access to vaccinations                                       | 33 (15.8)                | 60 (28.7)          | 116 (55.5)    |
| Increasing awareness of vaccine benefits                                | 30 (14.4)                | 70 (33.5)          | 109 (52.2)    |
| Public service announcements                                            | 47 (22.5)                | 88 (42.1)          | 74 (35.4)     |
| COVID-19 booster                                                        |                          |                    |               |
| Addressing misinformation¹                                               | 19 (9.1)                 | 36 (17.3)          | 153 (73.6)    |
| Tailored community outreach in areas with lower vaccination rates¹       | 17 (8.2)                 | 41 (19.7)          | 150 (72.1)    |
| One-on-one conversations with medical providers¹                         | 18 (8.6)                 | 41 (19.6)          | 150 (71.8)    |
| Increasing awareness of the need/eligibility for boosters               | 18 (8.6)                 | 43 (20.6)          | 148 (70.8)    |
| Increasing access to boosters                                           | 24 (11.5)                | 43 (20.6)          | 142 (67.9)    |
| Incentives                                                              | 28 (13.4)                | 40 (19.1)          | 141 (67.5)    |
| Mandates                                                                | 49 (23.4)                | 39 (18.7)          | 121 (57.9)    |
| Public service announcements                                            | 38 (18.2)                | 75 (35.9)          | 96 (45.9)     |

¹n=208.
Strategies to improve COVID-19 vaccination rates

Interview findings
Participants were asked to express their views regarding how strategies, other than vaccine mandates and incentives, could improve COVID-19 vaccination rates among patients and the general public. When discussing the initial vaccine rollout, some referred to the limitation of online vaccination scheduling as a key barrier to accessing COVID-19 vaccines and believed that accessible walk-in facilities would better support vaccination rates for many communities. Others expressed location as a principal barrier to COVID-19 vaccination, where mass vaccination sites were often difficult to access and located outside of communities experiencing high COVID-19 burden. Many suggested that vaccination sites should be established within neighborhoods without requiring the use of appointments and transportation: “I think that chief barrier is that it should not be necessary to interact with a computer screen in order to schedule a COVID vaccination. You should be able to walk into a site and get your vaccine the moment you access that site, and that site should be in your neighborhood.” (P11-Internal Medicine MD)

Perceptions regarding misinformation concerning the COVID-19 vaccine was identified as a significant driver of vaccine hesitancy among patients. Providing accurate information through tailored community outreach via trusted messengers was mentioned as a preferred approach to tackle such hesitancy: “... making sure people feel they have all the information that they need, that they have people that they trust deliver that information. (P04-Midwife)” Possible trusted messengers included healthcare workers or influential members of the community such as religious leaders. Participants felt that addressing individual and community specific concerns should be through one-on-one conversations or through wider transparent messaging with a focus on community values: “... you have to identify the different cohorts that have, you know, significant commonality, and a significant amount of reticence or resistance to it, and then you need to find people within those cohorts who are trusted to disseminate information...” (P05-ICU MD)

Survey findings
Strategies for communication with patients. Among respondents who reported they discussed or recommended COVID-19 vaccines to patients, family, and others (n = 188/209, 90%), when asked if they had found an effective strategy to encourage COVID-19 vaccine uptake by others, the majority (n = 90, 47.9%) responded they were 'not sure, sometimes my patients and others vaccinate, but I’m not sure what I am doing differently to make this happen'. While 28% (n = 53) reported 'No, I'm rarely able to change their mind,' 24% (n = 45) reported positively 'Yes, I am able to get many people who were initially reluctant to accept vaccination.'

In an open-ended survey question, healthcare workers were asked to explain successful approaches to encourage others to accept COVID-19 vaccines and boosters. The importance of communication and sharing personal stories was stated by respondents. Some discussed the development of the vaccine as well as the risk of not receiving the vaccine with others: “Explaining to them that the same process/protocol for creating vaccines was used for the COVID vaccines and if they have received vaccines in the past, there is no difference this time around. I also explain that the alternative, getting COVID, would be a more dire situation if they remain unvaccinated.” (170-OBGYN Nurse) Similar to interview findings, some respondents believed that trust in healthcare workers was significant in the decision-making process of others to get vaccinated: "Family and friends that didn’t want to take it changed their minds because they knew I would do the research and get it if [the vaccines] were safe.” (88-EMT)

Vaccination among pregnant individuals was also discussed: “Working in OB/GYN, mostly pregnant women were reluctant with not knowing fetal impacts. While not often able to get a yes during pregnancy, most felt amenable to it post-partum after gentle discussions.” (187-OBGYN Patient navigator) Some respondents stated they discuss the safety of the vaccine during pregnancy and the potential risks of COVID-19 during pregnancy with their patients, as well as sharing personal experiences related to receiving the COVID-19 vaccine and booster during their pregnancy: “Many people cite pregnancy as a reason to wait, but I am in fact pregnant and was boosted during this pregnancy. I talk about 1) my experience and decision to do so, and 2) the severity of sickness we see in non-vaccinated pregnant people. I share stories and make it personal.” (78-OBGYN Advanced Practice Provider)

Strategies for improving vaccination rates in the general public. Table 4 describes how effective survey participants considered various strategies to improve acceptance of the primary COVID-19 vaccine series. Addressing misinformation (n = 165, 78.9%), tailored community outreach in areas with lower vaccination rates (n = 160, 76.6%), and discussing vaccine safety (n = 154, 73.7%) were most commonly perceived to be 'effective/very effective.' Similarly, when asked about strategies to improve booster uptake, the strategies most often considered as 'effective/very effective' were addressing misinformation (n = 153, 73.6%), tailored community outreach (n = 150, 72.1%), and one-on-one conversations with medical providers (n = 150, 71.8%). One respondent mentioned the importance of: "Information and targeted advocacy from people that look like and have the cultural awareness of those they are trying to get to consider the vaccination.” (157-Social worker/Mental health specialist) Public service announcements were considered relatively ineffective strategies to increase vaccine uptake and booster uptake (Table 4).

Discussion
COVID-19 vaccine uptake in the United States remains sub-optimal and strategic efforts to increase vaccination and booster rates are needed to curb rates of severe illness, hospitalization, and death. The aim of this sequential exploratory mixed methods study was to explore views toward COVID-19 mandates, vaccine incentive programs, and to gain a better understanding of experiences and attitudes.
regarding other potential strategies to improve COVID-19 vaccination and booster rates from a sample of healthcare personnel working in Massachusetts during the COVID-19 pandemic. A key strength of this study is that the interviews and surveys were completed over different time periods when COVID-19 policies and guidelines were shifting, allowing us to assess the evolution of attitudes and perceptions about potential strategies over time. Interestingly, similar results were observed in 2021, immediately after vaccine rollout, and in 2022, after two additional COVID-19 surges and emergence of data indicating the need for boosters to maintain vaccine effectiveness. Additional research from this study population found that vaccine mandates for work or school were common reasons for vaccination among those who initially declined. However, in this study we found limited support for broad implementation of COVID-19 vaccine mandates as a way to improve vaccination rates. Generally, incentive programs were also believed to have limited impacts. Overall, we found that participants favored strategies that educated the public and partnered with communities and used personal experiences to educate the public.

Vaccine mandates have long been implemented to increase vaccine uptake, including increasing uptake of COVID-19 vaccines. However, with the emergence of SARS-CoV-2 and the introduction of COVID-19 mandates, attitudes have become increasingly divisive, with varying levels of support for healthcare worker mandates in the United States as well and other settings worldwide. The majority of healthcare workers in our study support for mandates in healthcare settings, which differs from the UK, where, although population-level vaccine uptake is greater than in the United States, only 1 in 6 healthcare workers supported mandates for healthcare workers. COVID-19 vaccines reduce the risk of severe disease and hospitalizations, and thus vaccine mandates in healthcare settings were established to minimize the risk of COVID-19 for healthcare workers given their increased exposure as well as to alleviate the overall burden on healthcare systems from worker absences. While influenza and other vaccine mandates have been widely implemented across healthcare systems, repercussions did not include job termination, as they frequently have, for COVID-19 vaccines. Early on, it was believed that vaccination would significantly decrease transmission, thus healthcare worker vaccine mandates were thought to be crucial for protecting patients. While many interviewees and survey respondents believed vaccine mandates were important to protect the health of patients and those working in healthcare settings, as found in other research, the principle of personal autonomy was also believed to be a strongly influencing factor. Further, a large proportion of survey respondents endorsed COVID-19 vaccine and booster mandates in healthcare settings only when the alternative is not job termination. A qualitative study conducted among healthcare workers in Western Australia reported similar nuanced findings regarding vaccine mandates, in particular related to job termination. In the United States, Texas has banned healthcare worker mandates, however the state still has difficulty obtaining enough nurses to cover their patients. Another study using data from the California Health Interview Survey evaluating COVID-19 vaccine hesitancy observed that initiatives such as mandates may not support vaccine uptake, citing that community level outreach should be prioritized, a finding echoed by a further study finding that public health efforts to improve access to vaccines should be prioritized over mandates. Similar to our findings, a survey study evaluating attitudes of healthcare workers in the UK reported that a large proportion of the sample favored education and building public trust over vaccine mandates.

Research on the use of incentives to improve vaccination uptake suggests that guaranteed and direct incentives that are valued by the recipient may be useful, whereas large and uncertain financial rewards including lotteries are not effective. Results from this study indicate similar opinions concerning incentives for COVID-19 vaccination. Many participants believed that incentives for vaccination may undermine public trust in vaccines and may be considered as coercive. Of note, the use of incentives to meet specific needs of individuals to access vaccination, such as transportation vouchers to vaccination sites, was encouraged. Findings from other research highlight that the use of targeted incentives would be effective in addressing COVID-19 vaccine uptake. Some participants viewed incentivizing booster shots as effective given that these individuals were more accepting of COVID-19 vaccines.

Participants expressed more support for strategies other than incentives or mandates to support vaccine utilization. Improving accessibility of vaccination sites was considered an important approach to support vaccination efforts. Walk-in, convenient, community vaccination sites were supported over requiring online appointments and using mass vaccination sites without easy access to public transportation. As underscored in the literature, participants suggested that communities that experience a heavy burden of COVID-19 illness should receive equitable access to vaccination.

Tailored outreach by trusted community members such as healthcare workers or religious leaders was also perceived to be a crucial strategy to improve vaccine uptake. Key aspects of communication that were supported included one-on-one conversations as well as transparent messaging to address specific community values. Communicating specific information was considered a successful approach by some participants such as discussing vaccine development, vaccine safety, and comparing risks associated with non-vaccination and COVID-19. Research shows that a lack of transparency and vague messaging can diminish confidence and trust and that messaging tailored to address concerns of specific groups is impactful in promoting behavior change.

The importance of open and transparent communication specifically with pregnant people regarding COVID-19 vaccination was a key theme in this study. Similar to findings from other studies, discussion of vaccine safety during pregnancy and potential risks during pregnancy with a healthcare professional were believed to be essential. The trend of seeking transparency and trustworthiness regarding pregnancy safety was apparent in social media themes during the early phase of the COVID-19 pandemic. This is perhaps no surprise given the torrent of information shared in the lay media simultaneous to the evolution of clinical recommendations, as well as early directives to obstetrician-gynecologists advising caution given the lack of data on pregnancies during clinical trials. As more data on vaccine safety and effectiveness in pregnancy to support
vaccine recommendations develops, COVID-19 vaccination rates may improve, similar to improvements seen following protocolized recommendations for maternal vaccinations in the past.\textsuperscript{50}

This study has several important limitations to consider. First, findings reported in this study from both the qualitative interviews and survey were obtained from a small sample of healthcare workers. A report from the Center for Economic Policy and Research (CEPR) highlighted that frontline healthcare workers in MA were 75.6\% female and 68.4\% white which is similar to our study where healthcare workers were predominantly white women. However, the CEPR report did not indicate the different healthcare worker roles and we know that there are gender and racial differences across healthcare worker type.\textsuperscript{51,52}

While our study includes healthcare workers from a wide range of roles not all healthcare worker roles or specialty settings are represented in this current study. Further, this study sampled healthcare personnel working in Massachusetts, therefore, results may not be generalizable to all areas or settings of healthcare or other geographic areas. It is also important to note that qualitative findings are not generalizable to a wider audience as they represent the experience of the sample. Policies regarding COVID-19 public health measures and vaccine mandates changed over the course of this study. In addition, given the design of this study, data collected may not accurately reflect changing views toward the COVID-19 pandemic. Lastly, as the majority of healthcare workers are white, additional studies focusing on communities of color are needed.

Findings from this research have important implications in understanding healthcare workers’ perceptions toward COVID-19 vaccination and future potential public health crises. Overall, strategies favoring education and trusted, community-based communication were viewed most favorably by healthcare workers. As the SARS-CoV-2 crisis continues, additional doses of vaccines will likely be recommended for the foreseeable future.\textsuperscript{4} Therefore, further research to identify and implement the best strategies from a diverse population to support ongoing updates to vaccine recommendations are needed.

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