Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Primary care professionals’ support for Covid-19 vaccination mandates: Findings from a US national survey

Brigid K. Grabert, Melissa B. Gilkey, Qian Huang, Wei Yi Kong, Peyton Thompson, Noel T. Brewer

PII: S2211-3355(22)00156-5
DOI: https://doi.org/10.1016/j.pmedr.2022.101849
Reference: PMEDR 101849

To appear in: Preventive Medicine Reports

Received Date: 27 September 2021
Revised Date: 26 May 2022
Accepted Date: 28 May 2022

Please cite this article as: B.K. Grabert, M.B. Gilkey, Q. Huang, W. Yi Kong, P. Thompson, N.T. Brewer, Primary care professionals’ support for Covid-19 vaccination mandates: Findings from a US national survey, Preventive Medicine Reports (2022), doi: https://doi.org/10.1016/j.pmedr.2022.101849

This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2022 Published by Elsevier Inc.
Primary care professionals’ support for Covid-19 vaccination mandates:
Findings from a US national survey

Brigid K. Grabert, PhD, JD, MPH1,2; Melissa B. Gilkey, PhD1,2; Qian Huang, PhD, MPA2; Wei Yi Kong, MA2; Peyton Thompson, MD, MSCR3; Noel T. Brewer, PhD1,2

1Lineberger Comprehensive Cancer Center, University of North Carolina at Chapel Hill, NC, USA
2Gillings School of Global Public Health, Department of Health Behavior, University of North Carolina at Chapel Hill, NC, USA
3Department of Pediatrics, Division of Infectious Diseases, University of North Carolina, Chapel Hill, NC, USA

Corresponding Author
Brigid K. Grabert, PhD, JD, MPH
bgrabert@live.unc.edu
170 Rosenau Hall, CB#7400
Chapel Hill, NC 27599

Word count:
Manuscript: 3189 words
Abstract: 177 words
ABSTRACT

Healthcare organizations have been early adopters of Covid-19 vaccine mandates as a strategy to end the pandemic. We sought to evaluate support for such mandates among pediatric primary care professionals (PCPs) in the United States. In February-March 2021, we conducted a national online survey of 1,047 PCPs (71% physicians). We used multivariable logistic regression to assess correlates of PCPs’ support for Covid-19 vaccine mandates for health care workers. Most PCPs supported Covid-19 vaccine mandates for health care workers (83%). PCPs were more likely to support mandates if they perceived health care workers to be at highest risk of getting Covid-19 compared to other worker types (8 percentage points, \( p<0.01 \)). PCPs were also more likely to support mandates if their clinic recommended or required vaccination (11 percentage points and 20 percentage points respectively, both \( p<0.01 \)). However, PCPs were less likely to support mandates if their clinic offered incentives to vaccinate (10 percentage points, \( p<0.05 \)). Clinic recommendations and requirements for Covid-19 vaccination may increase support for mandates. Incentives may decrease support, perhaps by creating the perception that viable alternatives to mandates exist.

Keywords

Vaccine mandate, Covid-19, primary care, incentive
INTRODUCTION

The Covid-19 pandemic has resulted in over 1 million deaths in the United States (US) and over 6 million deaths worldwide as of May 2022, according to the World Health Organization and the Centers for Disease Control and Prevention.1,2 After initially declining during the first several months of 2021, Covid-19 morbidity and mortality began to climb again sharply with the spread of the new, more transmissible Delta variant2,3 and then again in winter of 2021-22 with the Omicron variant.4,5 By spring 2022, about 65% of the total US population was fully vaccinated against Covid-19.6 However, many Americans have been hesitant to be vaccinated, including a substantial minority of health care workers.7–11 Vaccine hesitancy among primary care professionals (PCPs) is especially discouraging, as PCPs play a vital role in encouraging Covid-19 vaccination and ending the pandemic; trust in a physician is associated with high patient vaccine confidence, and physicians’ recommendations are associated with a higher likelihood to be vaccinated.12–14

Employers have used several strategies to combat vaccine hesitancy. Some employers have mandated vaccination for their employees, especially in the healthcare field, and evidence indicates that employer vaccine mandates may be more acceptable than population-wide mandates.15,16 Other employers, choosing a potentially less contentious or restrictive approach to overcome hesitancy, have recommended vaccination for workers without mandating it or have provided incentives for vaccination, including paid time off or lottery-style prize drawings.8,17–20

The US Equal Employment Opportunity Commission has issued guidance that employer-based vaccination mandates are legal,21 and mandates have received support in recent months from courts and health professional associations, especially after the vaccines received full regulatory approval.22–25 In June 2021, for example, a federal district court judge dismissed a case challenging Houston Methodist Hospital’s requirement that all employees be vaccinated, stating that an employee would “simply need to work somewhere else” if they chose not to be vaccinated.22 In late July 2021, the American Medical Association and the American Nurses Association, along with more than 50 other medical organizations, issued a statement calling for mandatory Covid-19 vaccination for health care workers,24 and in January 2022, the US Supreme Court allowed a rule issued by the Centers for Medicare and Medicaid (CMS) and the Department of Health and Human Services (DHS) mandating Covid-19 vaccination for all health
care providers that participate in Medicare or Medicaid programs.\textsuperscript{25,26} Though not without some ethical and political controversy,\textsuperscript{27–31} vaccine mandates for health care workers are now commonplace and their use will likely increase as the deadline for compliance with the CMS rule arrives for all states this spring.\textsuperscript{25}

Vaccine mandates for health care workers are a promising strategy to encourage vaccination and to overcome vaccine hesitancy, but only to the extent that health care workers accept them. While previous research has assessed Covid-19 vaccine hesitancy among PCPs, little is known about their support for mandates. To better understand the perspective of these important stakeholders, we surveyed 1,047 PCPs about their support for mandates and their perceived risk of getting and transmitting Covid-19 at work. We then sought to identify correlates of support for Covid-19 vaccine mandates specifically for health care workers, including whether PCPs’ clinics’ policies of incentives, recommendations, or mandates are associated with PCPs’ support for vaccine mandates. This study seeks to understand the acceptability of vaccine mandates for health care workers and to identify contexts in which mandates may have more support.

\textbf{METHODS}

\textbf{Participants and procedures}

Participants were US PCPs who were members of a standing national panel maintained by a survey research company. Our study was part of a larger survey about adolescent vaccines during the pandemic, to which we added items about Covid-19 vaccination. PCPs were eligible for the survey if they: 1) were US primary care physicians or other PCPs (i.e., nurse practitioners, physician assistants, and nurses); and 2) provided vaccines to adolescents ages 11-17. Upon recruitment, physicians provided licensure information to verify their identities. Residents of Vermont were excluded from the panel in compliance with state policies governing PCPs.

In February and March 2021, the survey company emailed invitations to panel members and up to two reminder emails. We received completed surveys from 1,055 panel members, yielding a response rate of 61\% among physicians and 41\% among non-physicians (calculated
using AAPOR Response Rate 4). We excluded eight PCPs who indicated that they saw no adolescent patients in a typical week, resulting in a final sample size of 1,047 PCPs. All PCPs provided informed consent to participate in the study. Depending on local market rates, PCPs received from $15 to $80 for their participation. The University of North Carolina Institutional Review Board approved the study protocol.

**Measures**

The vaccine mandate survey items began with an introductory statement: “Assume that [Covid-19] vaccines have received routine FDA approval, are free, and can be easily obtained by most people.” A closed-ended item assessed support for Covid-19 vaccine mandates by essential worker type: “Which of these workers should be required to get a Covid-19 vaccine? (Check all that apply.)” Response options were health care workers, first responders, nursing home workers, daycare workers, K-12 teachers, restaurant workers, and “none of these.” Two subsequent items assessed Covid-19 risk perceptions by asking respondents to select which group of workers was at highest risk of getting and which group was at highest risk of transmitting Covid-19 at work, using the same pre-specified lists of six worker types. We asked whether PCPs’ clinics or systems required them to get the Covid-19 vaccine, if their clinic recommended they get the Covid-19 vaccine, or if their clinic did not have a Covid-19 vaccine policy. Lastly, we asked if PCPs were offered any incentive for getting a Covid-19 vaccine. Seven close-ended options included: paid time off; a gift card; a cash or bonus payment; a small nonmonetary gift; public recognition; something else; or nothing; we combined responses into a single binary measure of any incentive.

We assessed PCPs’ demographic and professional characteristics, including training (physician or other PCP), number of years in practice, if they had been vaccinated against Covid-19 (receipt of at least one dose), gender identity, and race. Additionally, the survey assessed characteristics of clinics where PCPs worked, including rurality of the area that clinic served; US census region of the clinic; practice type (group, hospital/academic institution, solo, other); whether their clinic was part of a system or network; and the extent of financial strain the clinic experienced due to the Covid-19 pandemic (Table 1). The full survey instrument is available online at https://noelbrewer.web.unc.edu/wp-content/uploads/sites/16987/2021/09/UNC-Physician-Survey-2021-2.pdf.

**Statistical analysis**
We calculated PCPs’ perception of the risk of getting and transmitting Covid-19 at work by worker type and assessed the association of perceived risks of getting and transmitting Covid-19 at work with support for vaccine mandates by worker type using Pearson’s Chi-square and Fisher’s Exact tests. As health care workers were perceived to be most at risk for getting Covid-19 and the majority of respondents supported vaccine mandates for health care workers, we next conducted regression analyses to identify correlates of PCPs’ support for Covid-19 vaccine mandates for health care workers (yes vs. no). We first used bivariate logistic regression to identify correlates of support for Covid-19 vaccine mandates, using demographic and Covid-19 vaccine-related survey items. We included a variable for the perceived risk of health care workers getting Covid-19 at work, defined as a binary variable. We then used a multivariable logit model to estimate the average marginal effects of correlates of support for Covid-19 vaccine mandates. Marginal effects yield predicted probabilities, interpreted in our model as comparative likelihood of vaccine mandate support for health care workers measured in percentage points. We identified covariates to include in the final multivariable logit model based on significance in the bivariate logistic regression results, examination of pairwise correlations to avoid collinearity, testing of interaction terms, and results of model fit testing. We excluded perceived risk of transmission of Covid-19 at work because of high correlation with the risk of getting Covid-19 at work measure. We ran all models using robust Delta-method standard errors and reported average marginal effects. We conducted all statistical analyses using STATA 16.1 (College Station, Texas, USA).

RESULTS

Our sample of PCPs included 747 physicians (71%) and 300 nurses and advanced practice providers (29%). PCPs identified as white (68%), Asian (16%), Black (4%), and other races (11%, including 8% who indicated “prefer not to say”). Half of the sample practiced in suburban areas (50%), while about one-third practiced in urban (35%), and 15% practiced in rural areas. Most PCPs practiced in group practice settings (54%) and as part of a system or network (56%). Nearly 20% of PCPs responded that their clinic had experienced “a lot” of financial strain from the Covid-19 pandemic. At the time of our study, few PCPs (7%) said that their clinics required them to receive a Covid-19 vaccine, but 79% said that their clinic
recommended it. Only 9% of PCPs reported that their clinic offered an incentive for getting Covid-19 vaccine (Table 1). The most common incentive was paid time off (3%). Other incentives included public recognition (2%), a cash bonus or payment (1%), a small nonmonetary gift (1%), a gift card (1%), or something else (1%) (not shown). The majority (87%) of our sample had received at least one dose of any Covid-19 vaccine (Table 1).

Support for vaccine mandates and perceived Covid-19 risk

Support for Covid-19 vaccine mandates was highest for health care and nursing home workers (both 83%). Support for mandates was also high for first responders (81%), teachers and daycare workers (71%), and restaurant workers (58%) (Figure 1). About 13% of PCPs did not support mandates for any of the listed worker types.

Most respondents (60%) identified health care workers as being at highest risk of getting Covid-19 at work. Less commonly identified as being at highest infection risk were first responders (16%), followed by nursing home workers (13%), teachers (K-12, 4%), restaurant workers (4%), and daycare workers (2%). The groups with the highest perceived risk of transmitting Covid-19 at work were nursing home workers (37%) and health care workers (26%). Other groups with the highest perceived risk of transmitting Covid-19 were restaurant workers (17%), teachers (7%), daycare workers (6%), and first responders (5%). Higher perceived risk of getting and transmitting Covid-19 at work was associated with higher support for vaccine mandates (both \( p < 0.01 \), Appendix Table A1).

Correlates of support for Covid-19 vaccine mandates for health care workers

PCPs practicing in clinics that recommended the Covid-19 vaccine were more likely to support vaccine mandates; the marginal effect of 0.197 indicates that those PCPs were 19.7 percentage points \( (p<0.000) \) more likely to support mandates compared to PCPs practicing in clinics that did not recommend or require the vaccine. PCPs practicing in clinics that required the Covid-19 vaccine were also more likely to support mandates (11.2 percentage points, \( p=0.003 \)) compared to PCPs practicing in clinics that did not recommend or require the vaccine. However, PCPs practicing in clinics that offered an incentive for the Covid-19 vaccines were less likely to support vaccine mandates (10.0 percentage points, \( p=0.028 \)), compared to PCPs practicing in clinics that did not offer vaccine incentives (Table 2).
PCPs who perceived health care workers to be at highest risk of getting Covid-19 at work were more likely to support vaccine mandates compared to PCPs who thought other professions were at highest risk (7.8 percentage points, \(p=0.001\)). Physicians were 6.5 percentage points more likely (\(p=0.012\)) to support vaccine mandates for health care workers compared to other PCPs. Compared to PCPs with fewer than 10 years of practice, PCPs with 20 or more years in practice were more likely to support vaccine mandates (8.6 percentage points, \(p=0.004\)), though there was no difference between PCPs with 10-19 years of practice and PCPs with fewer than 10 years of practice. PCPs who identified as Asian were more likely to support mandates than PCPs who identified as white (7.4 percentage points, \(p=0.007\)). Compared to practicing in an urban area, PCPs practicing in suburban and rural areas were less likely to support vaccine mandates (5.4 percentage points, \(p=0.022\), and 12.4 percentage points, \(p=0.001\), respectively). Compared to PCPs practicing in the Northeast, PCPs practicing in all other regions were less likely to support vaccine mandates. The difference was most notable among PCPs in the South, where PCPs were 8.5 percentage points (\(p=0.003\)) less likely to support vaccine mandates than those in the Northeast (Table 2).

In bivariate analyses, we found that practice type, network affiliation, and financial strain were not associated with support for vaccine mandates and thus were not included in our multivariable model. Although gender was a statistically significant predictor in the bivariate analyses, we excluded it from the multivariable logit model because of strong correlation with the training measure and model fit testing (Table 2).

**DISCUSSION**

In a survey of over 1,000 US PCPs, the overwhelming majority supported Covid-19 vaccine mandates for health care workers. We found that perceived risk of getting Covid-19 at work was associated with support for vaccine mandates across essential worker types, and PCPs perceived health care to be most at risk of getting Covid-19 at work. We found that clinic recommendations for Covid-19 vaccination and existing mandates were positively associated with support for mandates, but incentives were negatively associated with support for mandates. Other covariates, including rurality, years of practice, and physician training, were also associated with support for vaccine mandates for health care workers.
We found that PCPs perceived themselves at high risk and were willing to support a policy of Covid-19 vaccine mandates for all health care workers, not just individual vaccine uptake. Prior research has found a positive association between perceived risk of disease and vaccine uptake.\textsuperscript{34,35} This study extends that literature, finding that PCPs who perceived themselves to be at high risk of Covid-19 are also more likely to support a vaccine mandate policy for health care workers. Research has found similar provider support for influenza vaccine mandate policies for health care workers.\textsuperscript{36}

PCPs working in clinics that already mandated or recommended vaccination were more likely to support vaccine mandates, indicating that exposure to a policy\textsuperscript{37} may also lead to greater support for a policy. In one recent study, exposure to a policy led to an increase in perceived effectiveness, which in turn was associated with greater support for that policy.\textsuperscript{37} Other research has described a positive association between perceived effectiveness of a policy and policy support.\textsuperscript{38} PCPs working in clinics with vaccine mandates are exposed to mandates, may perceive that mandates are effective, and, as we found, are more likely to support vaccine mandate policies as compared to PCPs in clinics not requiring vaccination. Perceived effectiveness may also explain our inverse finding about vaccine incentive policies: working in a clinic that offered vaccine incentives was associated with lower support for vaccine mandates for health care workers. If incentives are perceived to be effective, PCPs may not believe that mandates are necessary to encourage vaccination and may thus prefer a less restrictive policy. A preference for a less intrusive alternative to mandates, or for the proverbial carrot to the stick, makes sense, especially if less intrusive policies are perceived to be effective.\textsuperscript{38–40} Employers planning to mandate vaccinations may want to emphasize the effectiveness of mandates in efforts to increase employee support. Incentive policies to encourage Covid-19 vaccination are widely popular among employers and governments who may not be willing to impose mandates,\textsuperscript{8,17,18} and research has demonstrated that incentives are effective in promoting vaccination.\textsuperscript{41,42} However, less restrictive clinic policies that fall short of a mandate, such as incentives and recommendations, may not be as effective at quickly achieving high vaccination coverage.\textsuperscript{43–45} And in the health care context, high vaccination coverage is critical to protect health care workers and their patients, and to preserve the health care workforce needed during a pandemic.
Several other clinic-level and individual-level characteristics were associated with support for vaccine mandates for health care workers. Our finding that physicians were more likely to support vaccine mandates than other PCPs is consistent with previous research noting that nurses were more hesitant than physicians about getting the Covid-19 vaccine. Similarly, our findings related to rurality and region mirror trends of Covid-19 vaccine hesitancy across the US. Employers in regions where PCPs are less likely to support mandates, for example, in rural communities or in the South, may choose incentives to encourage vaccinations rather than mandates to limit opposition or to avoid anti-vaccine sentiment. Multifaceted vaccination campaigns, using vaccine incentives combined with recommendations and education, have been shown to increase coverage of the influenza vaccine in the health care context, but these campaigns did not reach the same coverage levels as vaccine mandates.

Strengths of this work include a nationwide sample of PCPs, which offers insight into support for vaccine mandates from health care workers themselves. However, our sample was limited to PCPs providing care to adolescents, as this research was part of a larger survey assessing routine adolescent vaccinations in the Covid-19 pandemic; support for mandates may vary across different provider specialties. Although the survey had a high response rate, we do not have information about non-respondents, and acknowledge that PCPs who did not respond may have been more or less supportive of vaccine mandates than those who did respond. It is also possible that PCPs opposed to vaccination may have been fired or quit their jobs and may not be included in the sample, but this is unlikely as mandates were not often being enforced at the time of this survey in March 2021. And while we believe that the introductory statement included in the survey was sufficient to encourage respondents to incorporate assumptions about FDA approval and availability of vaccines, we did not test these assumptions as separate survey items, and are unable to comment specifically on the impact of FDA approval and vaccine availability on support for vaccine mandates. We note that the survey was completed in early spring of 2021; by spring of 2022, vaccine mandates for health care workers have become increasingly common, potentially further strengthening support among PCPs. Additionally, our survey addressed some but likely not all relevant variables associated with PCPs’ views on Covid-19 vaccine mandates for health care workers. Because of this limitation and the cross-sectional study design, we frame our findings as associations rather than causal effects.
CONCLUSIONS

This research presents important findings about PCPs’ perspectives on Covid-19 vaccine mandates as well as individual and clinical characteristics that influence their support for mandates – an increasingly used policy in the health care field. We found that PCPs generally supported Covid-19 vaccine mandates for health care workers and that perceived risk of getting Covid-19 at work is associated with support for vaccine mandates. Working in a clinic that already mandated vaccination may elicit higher support for mandates, but working in a clinic that incentivizes vaccines may lower support for vaccine mandates and make mandates seem less necessary; future study should investigate potential unintended consequences of vaccine incentives. Vaccine mandates for health care workers in the US will likely become more prevalent and expand beyond employers that participate in federal programs, and exposure to mandates through clinic policies may increase support for their use.
Acknowledgements and funding
This project was supported by a Gillings Innovation Laboratory award from the UNC Gillings School of Global Public Health and the Lineberger Comprehensive Cancer Center through Tier 1 Innovation Award made possible by the University Cancer Research Fund. Brigid Grabert’s time was supported by the Cancer Control Education Program at UNC Lineberger Comprehensive Cancer Center (T32CA057726). Peyton Thompson was supported by grants from the National Institute of Health (NIAID K08AI148607) and the ASTMH/Burroughs-Wellcome Fund. Funders played no role in study design; the collection, analysis, and interpretation of data; the writing of the report; or the decision to submit the manuscript for publication.

Potential conflicts of interest
Noel Brewer has served as a paid advisor for CDC, WHO, and Merck. Peyton Thompson has received research support from Gilead Sciences and Abbott Laboratories. The remaining authors declared to no conflicts of interest.
REFERENCES

1. World Health Organization. WHO Coronavirus (COVID-19) Dashboard. https://covid19.who.int/. Published 2022. Accessed May 26, 2022.

2. U.S. Centers for Disease Control and Prevention. COVID Data Tracker. https://covid.cdc.gov/covid-data-tracker/#datatracker-home. Published 2021. Accessed May 26, 2022.

3. Engber D. Vaccination in America Might Have Only One Tragic Path Forward. Atl. July 2021. https://www.theatlantic.com/health/archive/2021/07/america-covid-19-vaccine-decline/619474/. Accessed July 26, 2021.

4. U.S. Centers for Disease Control and Prevention. CDC COVID Data Tracker: Variant Proportions. https://covid.cdc.gov/covid-data-tracker/#variant-proportions. Published 2021. Accessed July 26, 2021.

5. Hassan A. The pandemic’s official global toll surpasses 6 million known virus deaths. The New York Times. https://www.nytimes.com/2022/03/07/world/six-million-covid-deaths.html. Published March 7, 2022.

6. U.S. Centers for Disease Control and Prevention. COVID-19 Vaccinations in the United States. COVID Data Tracker. https://covid.cdc.gov/covid-data-tracker/#vaccinations_vacc-people-onedose-pop-5yr. Published 2022. Accessed November 3, 2022.

7. King WC, Rubinstein M, Reinhart A, Mejia RJ. COVID-19 vaccine hesitancy January-March 2021 among 18-64 year old US adults by employment and occupation. (preprint). 2021. doi:https://doi.org/10.1101/2021.04.20.21255821

8. Hamel L, Lopes L, Kearney A, Sparks G, Stokes M, Brodie M. KFF COVID-19 Vaccine Monitor: June 2021.; 2021. https://www.kff.org/coronavirus-covid-19/poll-finding/kff-covid-19-vaccine-monitor-june-2021/?utm_campaign=KFF-2021-polling-surveys&utm_medium=email&_hsml=137278754&_hsmc=p2ANq tz-8YJxBSqkceh7adFXsHKWSh9ToNingJAnAvthsabmtz5gzeGmtyVIE7AHx-emgSJ8z0ZD89ut. Accessed July 27, 2021.

9. Biswas N, Mustapha T, Khubchandani J, Price JH. The Nature and Extent of COVID-19 Vaccination Hesitancy in Healthcare Workers. J Community Health. 2021. doi:10.1007/s10900-021-00984-3

10. Roy B, Kumar V, Venkatesh A. Health Care Workers’ Reluctance to Take the Covid-19 Vaccine: A Consumer-Marketing Approach to Identifying and Overcoming Hesitancy. NEJM Catal. 2020. doi:10.1056/CAT.20.0676

11. Gadoth A, Halbrook M, Martin-Blais R, et al. Cross-sectional Assessment of COVID-19 Vaccine Acceptance Among Health Care Workers in Los Angeles. Ann Intern Med. 2021;174(6):882-885. doi:10.7326/M20-7580

12. Szilagyi PG, Thomas K, Shah MD, et al. The role of trust in the likelihood of receiving a COVID-19 vaccine: Results from a national survey. Prev Med (Baltim).
Weintraub RL, Subramanian L, Karlage A, Ahmad I, Rosenberg J. COVID-19 Vaccine to Vaccination: Why Leaders Must Invest in Delivery Strategies Now. *Health Aff.* 2021;40(1):33-41. doi:https://doi.org/10.1377/hlthaff.2020.01523

Kirzinger A, Sparks G, Brodie M. KFF COVID-19 Vaccine Monitor: In Their Own Words, Six Months Later. *KFF COVID-19 Vaccine Monit.* 2021;July. https://www.kff.org/ coronavirus-covid-19/poll-finding/kff-covid-19-vaccine-monitor-in-their-own-words-six-months-later/?utm_campaign=KFF-2021-polling-surveys&utm_medium=email&utm_smi=2&utm_hsmc=p2ANqtz-8scN9wbsrWv-Y18QA0SVjrwEWGDQPl0vS0hPNSNkpfdaQ1keWTFMG556s.

Largent EA, Persad G, Sangenito S, Glickman A, Boyle C, Emanuel EJ. US Public Attitudes Toward COVID-19 Vaccine Mandates. *JAMA Netw Open.* 2020;3(12):e2033324. doi:10.1001/jamanetworkopen.2020.33324

Lee JT, Hu ; S Sean, Zhou ; Tianyi, et al. Employer Requirements and COVID-19 Vaccination and Attitudes among Healthcare Personnel in the U.S.: Findings from National Immunization Survey Adult COVID Module, August - September 2021. *medRxiv.* 2022;Preprint. doi:10.1101/2022.03.14.22271847

Roy B, LeBlanc M. COVID-19 Vaccine Incentives. 2021. https://www.nga.org/center/publications/covid-19-vaccine-incentives/.

Coleman J. Cities, states experiment with incentives for vaccinations. *The Hill.* https://thehill.com/policy/healthcare/551246-cities-states-experiment-with-incentives-for-vaccinations?rl=1. Published May 1, 2021. Accessed July 27, 2021.

Mervosh S. Will Ohio’s Vaccine Lottery Actually Increase Vaccinations? *The New York Times.* https://www.nytimes.com/2021/05/26/us/coronavirus-ohio-lottery-vax-a-million.html. Published May 26, 2021. Accessed July 26, 2021.

Abelson R. More Hospitals Impose Vaccine Mandates for Employees. *The New York Times.* https://www.nytimes.com/2021/07/21/health/covid-vaccine-hospitals.html?utm_medium=email&utm_source=rasa_io&PostID=34246764&MessageRunDetailID=5882768629. Published July 26, 2021. Accessed July 26, 2021.

U.S. Equal Employment Opportunity Commission. What You Should Know About COVID-19 and the ADA, the Rehabilitation Act, and Other EEO Laws. https://www.eeoc.gov/wysk/what-you-should-know-about-covid-19-and-ada-rehabilitation-act-and-other-eeo-laws. Published 2021.

Southern District of Texas. *Jennifer Bridges, et Al. v. Houston Methodist Hospital, et Al.* 21, 1774 (2021). https://docs.justia.com/cases/federal/district-courts/texas/txsdcce/4:2021cv01774/1830373/18.

Liptak A. Supreme Court Won’t Block Indiana University’s Vaccine Mandate. *The New York Times.* https://www.nytimes.com/2021/08/12/us/supreme-court-indiana-university-covid-vaccine-mandate.html?campaign_id=9&em=edit_n_20210813&instance_id=37837&nl=the-
morning&regi_id=65945867&segment_id=66145&te=1&user_id=8b13914974d3c0c20b5
9d020547a2f89. Published August 12, 2021. Accessed August 18, 2021.

24. Anthes E. Medical Groups Call for Vaccine Requirements for Health Care Workers. The
New York Times. https://www.nytimes.com/2021/07/26/health/health-care-workers-vaccine-
requirement.html?campaign_id=60&emc=edit_na_20210726&instance_id=0&nl=breaking-
news&ref=headline&regi_id=65945867&segment_id=64452&user_id=8b13914974d3c0c20b59d020547a2f89. Published July 26, 2021. Accessed July 27, 2021.

25. Parasidis E. COVID-19 Vaccine Mandates At The Supreme Court: Scope And Limits Of
Federal Authority. Heal Aff Forefr. 2022;March. doi:DOI:10.1377/forefront.20220303.102051

26. Musumeci M. Explaining the New COVID-19 Vaccination Requirement for Health Care
Provider Staff. Kaiser Family Foundation. https://www.kff.org/coronavirus-covid-19/issue-brief/explaining-the-new-covid-19-vaccination-requirement-for-health-care-provider-staff/. Published 2021. Accessed November 3, 2022.

27. Gostin LO. Law, Ethics, and Public Health in the Vaccination Debates: Politics of the
Measles Outbreak. JAMA. 2015;313(11):1099-1100. doi:10.1001/JAMA.2015.1518

28. Gostin LO, Salmon DA, Larson HJ. Mandating COVID-19 Vaccines. JAMA.
2021;325(6):532-533. doi:10.1001/JAMA.2020.26553

29. Galanakis E, Jansen A, Lopalco PL, Giesecke J. Ethics of mandatory vaccination for
healthcare workers. Eurosurveillance. 2013;18(45):20627. doi:10.2807/1560-7917.ESS2013.18.45.20627

30. Omer SB, Betsch C, Leask J. Mandate vaccination with care. Nature.
2019;571(7766):469-472. doi:10.1038/d41586-019-02232-0

31. US Senate 117th Congress. Senate Joint Resolution 32: A joint resolution providing for
congressional disapproval under chapter 8 of title 5, United States Code, of the rule
submitted by the Centers for Medicare & Medicaid Services relating to "Medicare and
Medicaid Programs; Omnib. 2022. https://www.congress.gov/bill/117th-congress/senate-
joint-resolution/32.

32. American Association of Public Opinion Research -- AAPOR. AAPOR Response Rate
Calculator 4.1. https://www.aapor.org/Education-Resources/For-Researchers/Poll-Survey-
FAQ/Response-Rates-An-Overview.aspx. Published 2002. Accesssed June 22, 2021.

33. Cheloff AZ, Jarvie E, Tabaac AR, Katz-Wise SL, Fygetakis LM, Keuroghlian A. Sexual
Orientation, Gender Identity, and Sex Development: Recommendations for Data
Collection and Use in Clinical, Research, and Administrative Settings.
https://dicp.hms.harvard.edu/sites/default/files/sites/default/files/%0AMFDP_files/PDF/D
CP-Programs/LGBT/SOGI Data Collection.pdf.

34. Brewer NT, Weinstein ND, Cuite CL, Herrington JE. Risk Perceptions and Their Relation
to Risk Behavior. Ann Behav Med. 2004;27(2):125-130.
35. O’Connor RE, Bard RJ, Fisher A. Risk Perceptions, General Environmental Beliefs, and Willingness to Address Climate Change. *Risk Anal.* 1999;19(3):461-471. doi:10.1111/J.1539-6924.1999.TB00421.X

36. deSante JE, Caplan A, Shofer F, Behrman AJ. Physician attitudes towards influenza immunization and vaccine mandates. *Vaccine.* 2010;28(13):2517-2521. doi:10.1016/J.VACCINE.2010.01.042

37. Hall MG, Marteau TM, Sunstein CR, et al. Public support for pictorial warnings on cigarette packs: an experimental study of US smokerse. *J Behav Med.* 2018;41:398-405. doi:https://doi.org/10.1007/s10865-018-9910-2

38. Sunstein CR. PEOPLE PREFER SYSTEM 2 NUDGES (KIND OF). *Duke Law J.* 2016;66:121. https://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=3860&context=dlj.

39. Diepeveen S, Ling T, Suhrcke M, Roland M, Marteau TM. Public acceptability of government intervention to change health-related behaviours: a systematic review and narrative synthesis. *BMC Public Heal 2013 131.* 2013;13(1):1-11. doi:10.1186/1471-2458-13-756

40. Evers C, Marchiori DR, Junghans AF, Cremers J, De Ridder DTD. Citizen approval of nudging interventions promoting healthy eating: the role of intrusiveness and trustworthiness. *BMC Public Health.* 2018;18(1). doi:10.1186/S12889-018-6097-Y

41. Community Preventive Services Task Force. CPSTF Findings for Increasing Vaccination. The Guide to Community Preventive Services. https://www.thecommunityguide.org/content/task-force-findings-increasing-vaccination. Published 2019. Accessed August 4, 2021.

42. Brewer NT, Chapman GB, Rothman AJ, Leask J, Kempe A. Increasing Vaccination: Putting Psychological Science Into Action. *Psychol Sci Public Interes.* 2017;18(3):149-207. doi:https://doi-org.libproxy.lib.unc.edu/10.1177/1529100618760521

43. Lawler EC. Effectiveness of vaccination recommendations versus mandates: Evidence from the hepatitis A vaccine. *J Health Econ.* 2017;52:45-62. doi:10.1016/J.JHEALECO.2017.01.002

44. Volpp KG, Cunnuscio CC. Incentives for Immunity — Strategies for Increasing Covid-19 Vaccine Uptake. https://doi.org/101056/NEJMp2107719. 2021;385(1):e1. doi:10.1056/NEJMP2107719

45. Schumacher S, Salmanton-Garcia J, Cornely OA, Mellinghoff SC. Increasing influenza vaccination coverage in healthcare workers: a review on campaign strategies and their effect. *Infection.* 2021;49(3):387-399. doi:10.1007/S15010-020-01555-9
Table 1: Primary care professional (PCP) sample characteristics (n=1,047)

| Respondent characteristic | n   | (%) |
|----------------------------|-----|-----|
| Training                   |     |     |
| Physician                  | 747 | (71)|
| Other PCP<sup>a</sup>      | 300 | (29)|
| Years in practice          |     |     |
| 0-9                        | 252 | (24)|
| 10-19                      | 395 | (38)|
| ≥20                        | 400 | (38)|
| Gender                     |     |     |
| Woman                      | 515 | (49)|
| Man                        | 492 | (47)|
| Other<sup>b</sup>          | 40  | (4)|
| Race/Ethnicity             |     |     |
| White                      | 717 | (68)|
| Asian                      | 170 | (16)|
| Black                      | 41  | (4)|
| Other                      | 119 | (11)|
| Vaccination behavior       |     |     |
| At least 1 dose            | 908 | (87)|
| No doses                   | 139 | (13)|
| Clinic characteristic      |     |     |
| Rurality                   |     |     |
| Suburban                   | 525 | (50)|
| Urban                      | 363 | (35)|
| Rural                      | 159 | (15)|
| Region                     |     |     |
| South                      | 333 | (32)|
| Northeast                  | 265 | (25)|
| Midwest                    | 247 | (24)|
| West                       | 202 | (19)|
| Practice type              |     |     |
| Group                      | 569 | (54)|
| Hospital/academic institution | 254 | (24)|
| Solo                       | 127 | (12)|
| Other<sup>c</sup>          | 97  | (9)|
| Part of healthcare system/network |   |     |
| No                         | 457 | (44)|
| Yes                        | 590 | (56)|
| Financial strain from Covid-19 pandemic |       |     |
| None or a little           | 360 | (34)|
| Moderate                   | 489 | (47)|
| A lot                      | 198 | (19)|
| Clinic Covid-19 vaccination policy |       |     |
| None                       | 149 | (14)|
| Clinic recommended Covid-19 vaccination for PCPs | 823 | (79)|
| Clinic required Covid-19 vaccination for PCPs | 75  | (7)|
| Clinic offered PCP an incentive for getting a Covid-19 vaccine |   |     |
| No                         | 949 | (91)|
| Yes | 98   | (9) |
|-----|------|-----|

|   | a | b | c |
|---|---|---|---|
| 1 | \textsuperscript{a} Includes nurses, nurse practitioners and physician assistants | \textsuperscript{b} Includes neither woman nor man, prefer to self-describe, and prefer not to say | \textsuperscript{c} Includes Federally Qualified Health Centers, and state, local, community, public health, and non-profit clinics |
Figure 1: Support of Covid-19 vaccine mandates for workers and perceived risk of their getting and transmitting the disease

Workers perceived to be most at risk for\(^a\):

- **Getting Covid-19**
  - Restaurant: 4%
  - Daycare: 2%
  - Teacher: 4%
  - First responder: 16%
  - Nursing home: 13%
  - Healthcare: 37%

- **Transmitting Covid-19**
  - Restaurant: 17%
  - Daycare: 6%
  - Teacher: 7%
  - First responder: 5%
  - Nursing home: 37%
  - Healthcare: 26%

Percentages do not add to 100% due to respondents selecting “none of these” for getting Covid-19 (\(n=14, 1.34\%\)) and transmitting Covid-19 (\(n=26, 2.48\%\)), not shown.
# Table 2: Correlates of support for Covid-19 vaccine mandates for health care workers

| Clinic vaccine policy                          | No. of PCPs\(^a\) who supported Covid-19 vaccine mandates/total in category | (%)  | Marginal effect  | (Std. error) | Adjusted marginal effect | (Std. error) |
|-----------------------------------------------|---------------------------------------------------------------------------|------|------------------|--------------|--------------------------|--------------|
| None                                          | 108/149                                                                   | (72) | referent         |              | referent                 |              |
| Clinic recommended the Covid-19 vaccine       | 693/823                                                                   | (84) | 0.117\(^*\)     | (0.039)      | 0.112\(^*\)              | (0.037)      |
| Clinic required the Covid-19 vaccine          | 70/75                                                                     | (93) | 0.209\(^*\)     | (0.047)      | 0.197\(^*\)              | (0.046)      |
| Clinic offered incentive for the Covid-19 vaccine | No   | 798/949                                                                   | (84) | referent         |              | referent                 |              |
|                                               | Yes                         | 73/98                                                                     | (74) | -0.096\(^*\)    | (0.046)      | -0.100\(^*\)             | (0.045)      |
| Type of worker perceived at highest risk of getting Covid-19 \(^b\) | No | referent         |              | referent                 |              |
| Other                                         | 323/416                                                                   | (78) | referent         |              | referent                 |              |
| Health care workers                           | 548/631                                                                   | (87) | 0.092\(^*\)     | (0.024)      | 0.078\(^*\)              | (0.023)      |
| Training                                      | Other PCP\(^c\)                                                          | 230/300       | (77) | referent         |              | referent                 |              |
|                                               | Physician                   | 641/747                                                                   | (86) | -0.091\(^*\)    | (0.028)      | 0.065\(^*\)              | (0.026)      |
| Years of practice                             | 0-9                         | 205/252                                                                   | (81) | referent         |              | referent                 |              |
|                                               | 11-19                       | 314/395                                                                   | (79) | -0.019          | (0.032)      | 0.006                    | (0.032)      |
|                                               | ≥20                         | 352/400                                                                   | (88) | 0.067\(^*\)     | (0.029)      | 0.086\(^*\)              | (0.030)      |
| Gender                                        | Woman                       | 421/515                                                                   | (82) | referent         |              | --                       | --           |
|                                               | Man                         | 426/492                                                                   | (86) | 0.048\(^*\)     | (0.023)      | --                       | --           |

\(^a\) PCP = primary care provider

\(^b\) Other workers include nursing and non-nursing health care workers

\(^c\) Other PCP includes nurse practitioners and nurse midwives
|                          |       |       |                  |                  |                |                |
|--------------------------|-------|-------|------------------|------------------|----------------|----------------|
| Other                    | 24/40 | (60)  | -0.217**         | (0.079)          | --             | --             |
| Race/Ethnicity           |       |       |                  |                  |                |                |
| White                    | 596/717 | (83)  | referent         | referent         | referent       | referent       |
| Black                    | 33/41  | (80)  | -0.026           | (0.063)          | -0.040*        | (0.070)        |
| Asian                    | 155/170 | (91)  | 0.081**          | (0.026)          | 0.074**        | (0.027)        |
| Other                    | 87/119 | (73)  | -0.100*          | (0.043)          | -0.101*        | (0.042)        |
| Rurality                 |       |       |                  |                  |                |                |
| Urban                    | 319/363 | (88)  | referent         | referent         | referent       | referent       |
| Suburban                 | 435/525 | (83)  | -0.050*          | (0.024)          | -0.054*        | (0.024)        |
| Rural                    | 117/159 | (74)  | -0.143**         | (0.039)          | -0.124**       | (0.037)        |
| Region                   |       |       |                  |                  |                |                |
| Northeast                | 238/265 | (90)  | referent         | referent         | referent       | referent       |
| Midwest                  | 201/247 | (81)  | -0.084**         | (0.031)          | -0.076*        | (0.030)        |
| South                    | 264/333 | (79)  | -0.105**         | (0.029)          | -0.085*        | (0.029)        |
| West                     | 168/202 | (83)  | -0.066*          | (0.032)          | -0.065*        | (0.033)        |
| Practice type            |       |       |                  |                  |                |                |
| Solo                     | 105/127 | (83)  | referent         | --               | --             | --             |
| Group                    | 470/569 | (83)  | -0.001           | (0.037)          | --             | --             |
| Hospital/academic institution | 211/254 | (83)  | 0.004            | (0.041)          | --             | --             |
| Other                    | 85/97  | (88)  | 0.050            | (0.047)          | --             | --             |
| Part of healthcare system or network |       |       |                  |                  |                |                |
| No                       | 384/457 | (84)  | referent         | --               | --             | --             |
| Yes                      | 487/590 | (83)  | -0.015           | (0.023)          | --             | --             |
| Financial strain from Covid-19 pandemic |       |       |                  |                  |                |                |
| None or a little         | 293/360 | (81)  | referent         | --               | --             | --             |
| Moderate                 | 406/489 | (83)  | 0.016            | (0.027)          | --             | --             |
| A lot                    | 172/198 | (87)  | 0.055            | (0.032)          | --             | --             |

**Note:** Marginal effect and adjusted marginal effects are average marginal effects. Std. errors = robust Delta-method standard errors. Dashes (--) indicate the variable was not included in the multivariable model.

*p*<0.05; **p**<0.01; see text for actual p-values.
• PCPs largely support Covid-19 vaccine mandates for healthcare workers.
• Among PCPs, clinic vaccine incentives may decrease support for mandates.
• Clinic vaccine recommendations or requirements may increase support for mandates.