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Filip Viskupič Ph.D. , David L. Wiltse Ph.D.

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Drivers of COVID-19 Booster Uptake among Nurses

Filip Viskupič, Ph.D. (corresponding author)

Assistant Professor of Political Science and Research Associate in The SDSU Poll

School of American and Global Studies

South Dakota State University

David L. Wiltse, Ph.D.

Associate Professor of Political Science and Director of The SDSU Poll

School of American and Global Studies

South Dakota State University

Corresponding author address:

Filip Viskupič, Ph.D.

219 West Hall

South Dakota State University

Brookings, SD 57006

+1 605-688-5101

Filip.viskupic@sdstate.edu

Declarations

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Consent to participate: All participants consented to participate in our study.

Background: Nurses are at the forefront of efforts to contain COVID-19 and are thus at greater risk of infection from the virus than the general population. Unlike the initial vaccination, booster vaccinations are not always required and some nurses have not received a booster shot. We investigate the predictors of booster uptake among nurses.

Methods: We developed an original survey to study booster uptake among nurses. Using contact information from the South Dakota Board of Nursing, we contacted nurses in South Dakota in June and July of 2022. We conducted a multivariate logistic regression to analyze the data.

Results: 1,084 nurses participated in our study. We found booster uptake among nurses was associated with their partisan self-identification (OR 0.40, 95% CI 0.31-0.52), age (OR 1.04, 95% CI 1.02-1.05), flu vaccination last season (OR 5.61, 95% CI 2.6-12.1), and positive COVID-19 test in last 12 months (OR 0.51, 95% CI 0.35-0.74).

Discussion/Conclusions: Our results show that COVID-19 booster uptake has been politicized even among nurses. As public health officials continue devising interventions to increase booster uptake among healthcare workers, they should be mindful that they would be viewed through the partisan lens.

Keywords: COVID-19, booster uptake, nurses, survey

Highlights

- COVID-19 booster uptake is a challenge among nurses
- Partisan self-identification is associated with booster uptake among nurses
- Targeted interventions are needed to increase booster uptake among nurses

Journal Pre-proof

Background

More than two years have passed since the World Health Organization declared the outbreak of COVID-19 a pandemic. Ever since then, nurses together with other healthcare workers (HCWs), have been on the frontline of efforts to curb the spread of the virus. The pandemic has taken a dangerous toll on nurses' physical and mental health (Joo & Liu, 2021). Given that they interact with and care for those infected with the virus, nurses are at greater risk of exposure and infection from COVID-19 (Nguyen et al., 2020). As of November 2022, the overall number of healthcare personnel deaths in the United States since the start of the pandemic was 2,400 (CDC, 2022). Evidence also exists that nurses experienced heightened stress and job burnout during the pandemic (Galanis et al., 2021; Murat et al., 2021). In particular, female HCWs have been at risk for stress, burnout, and depression (Sriharan et al., 2020). Overall, the coronavirus pandemic imposed a tremendous burden on nurses.

Governments have introduced several measures to protect HCWs from the virus. When COVID-19 vaccines were first available, nurses and other HCWs were one of the first groups to gain access. In August 2021, The Biden administration announced a COVID-19 vaccine mandate for all healthcare workers. In South Dakota, Avera Health, Sanford Health, and Memorial Health – the state's largest healthcare providers – announced vaccine mandates for their employees. As vaccines offer protection only for a limited time, HCWs received priority access to booster doses of COVID-19 vaccines. While the research on their effectiveness is ongoing, several studies reported that boosters reduce the rate of disease as well as severe illness (Bar-On et al., 2021; Miyauchi et al., 2022; Skrzat-Klapaczyńska et al., 2022).

Nevertheless, despite their wide availability and evidence of high effectiveness, booster uptake has been a challenge not only among the general public (Agaku et al., 2022; Galanis et al., 2022), but also among HCWs (Frey et al., 2022; Koh et al., 2022; Rehman et al., 2022). A low booster uptake among nurses could threaten the health of both HCWs and their patients, many of whom are at high risk from COVID-19. Evidence exists that medical centers with vaccinated HCWs reported fewer breakthrough infections (Waldman et al., 2021), as well as fewer hospital admissions and COVID-19-related deaths (Cabezas et al., 2021).

Lower COVID-19 booster uptake among nurses might have additional negative downstream consequences in society. Nurses serve as trusted health advisors and play an important role in guiding patients on a variety of health decisions, including vaccine uptake for themselves and their children (Moss et al., 2016; Wiley et al., 2013), particularly during the coronavirus pandemic (Katzman & Katzman, 2021). Overall, lower booster uptake among nurses could affect booster vaccination decisions of the general population and lead to lower overall booster uptake in society.

Our study investigates the predictors of booster uptake among nurses, and contributes to the existing scholarship in two ways. First, the majority of studies that examined attitudes toward COVID-19 boosters were based on surveys of the general population (Lai et al., 2021; Lounis et al., 2022; Yoshida et al., 2022). Moreover, these studies were conducted before booster doses were available to the general population and therefore could only capture attitudes toward a hypothetical booster vaccine.

Attitudes of HCWs toward boosters have been understudied. Preliminary findings suggest that older HCWs, male HCWs, and HCWs with higher education were more willing to receive a booster (Klugar et al., 2021; Pal et al., 2022; Vellappally et al., 2022). However, the

samples included multiple types of HCWs and none were based on a survey of nurses. Moreover, these studies examined intentions of receiving a booster, not actual booster uptake. Our study adds to the scholarship by examining the predictors of booster uptake among nurses.

Second, we examine the relationship between partisan self-identification and booster uptake among nurses. Vaccination has always been a sensitive issue in society. However, during the coronavirus pandemic, vaccination has become politicized to an unprecedented degree (Sharfstein et al., 2021). Vaccination has moved from being primarily a health decision, to what is largely a political decision. In the United States, a gap exists between self-identified Republicans and Democrats, with the former being less likely to adhere to mitigation guidelines and receive vaccination (Gollust, 2021; Viskupic et al., 2022). However, scholars studying booster attitudes among HCWs typically do not typically account for partisan self-identification (Frey et al., 2022; Pal et al., 2021; Vellappally et al., 2022). We include partisan self-identification in our study to examine its impact on booster uptake among nurses.

Methods

Data

Our data comes from a survey of nurses in South Dakota, United States. We purchased the membership file with the contact information of all 23,854 Registered Nurses, Certified Nurse Practitioners, and Licensed Practical Nurses from the South Dakota Board of Nursing. We extracted 20,980 valid email addresses and emailed each nurse an invitation to complete an online survey that was administered on the *Questionpro* survey platform. The survey software was configured to not allow duplicate responses. The survey was open from 24 June to 9 July 2022. In sum, we received 1,084 responses, yielding a response rate of 5.3%. Participants did not

receive compensation for completing the survey. The survey was fielded by the authors and received approval from the IRB at [University name and IRB approval number redacted for peer review].

Measures

The outcome measure was whether or not participants received a COVID-19 booster vaccination (0= “Received one dose of Johnson & Johnson OR two doses of Pfizer or Moderna” 1= “Received a booster shot”). This measure was developed from a survey question asking about COVID-19 vaccination status (1= “Not vaccinated”, 2= “Received first dose of Pfizer or Moderna”, 3= “Received one dose of Johnson & Johnson OR two doses of Pfizer or Moderna”, 4= “Received a booster shot”). As the dependent variable was booster uptake, we kept only those participants who were eligible for a booster, and those who did not receive a vaccination or received one dose of Pfizer or Moderna were excluded from analysis.

Additionally, we asked respondents about age (in years), gender (0= male, 1= female), evangelical Christian identity (1= evangelical, 0 = non-evangelical), influenza vaccination status (0= no, 1= yes), and having a positive COVID-19 test in the last year (0= no, 1= yes). Proportion of time in direct patient care (1= 0% 2=1-25% 3=26-50% 4=51-75% to 5=76-100%), and partisan self-identification (1=Democrat, 2=independent, 3=Republican) were treated as ordinal variables. Though partisan self-identification can be treated as a multinomial variable, it is generally treated as an ordinal variable in American political science and psychology research since respondents identifying as “independent” place themselves between the two major parties (Motta, 2021; Peng, 2022; Viskupic & Wiltse, 2022).

Nursing credential was obtained from the membership file from the South Dakota Board of Nursing—RN (0= no, 1=yes), LPN (0= no, 1=yes), and CNP (0= no, 1=yes). It was treated as

a multinomial variable with indicators for LPNs and CNPs, with RNs as the excluded reference category. We provide the full text of all questions in the appendix. The survey also included an attention check question, which 99.2% of participants answered correctly.

Analysis

We first presented descriptive statistics **and compared our sample to the population of South Dakota nurses**. We then estimated bivariate associations between booster uptake and all independent variables using logistic regressions. To control for the effects of other independent variables, we then presented the results of a multivariate logistic regression with the predictor variables that were associated with booster uptake in bivariate analysis. Odds ratios were estimated and presented with 95% confidence intervals. Missing data was handled by case-wise deletion in our modeling. We conducted all statistical analyses using Stata 17 (StataCorp, 2021).

Results

We received 1,084 responses, including 980 completed responses. The average age of participants was 49 years; 91% identified as female and 9% male (all respondents identified as male or female). Regarding credentials, 82% were RNs, 9% LPNs, and 9% CNPs. Of our respondents, 89% were employed in nursing either full-time, part-time, or on a per diem basis, and 11% indicated that they were retired; 86% work in South Dakota and 14% worked in another state. Concerning COVID-19 vaccination status, 63% received a booster shot, 23% were fully vaccinated, 2% received one dose, and 11% were unvaccinated. We reported the full descriptive statistics of each variable used in Table 1.

Table 1: Descriptive Statistics

	Frequency	Percent		
Vaccination Status				
Not Vaccinated	111	11.19		
Partially Vaccinated	23	2.23		
Fully Vaccinated	231	23.29		
Fully Vaccinated and Boosted	627	63.21		
Gender				
Female	969	91.24		
Male	93	8.76		
Percent of Time with Patients				
0%	110	12.70		
1-25%	100	11.55		
26-50%	62	7.16		
51-75%	124	14.32		
76-100%	470	54.27		
COVID in last 12 Months				
No	653	66.09		
Yes	335	33.91		
Flu Shot in 2021-2022 Season				
No	114	11.63		
Yes	866	88.37		
Evangelical Identity				
No	626	60.54		
Yes	408	39.46		
Partisan Self-Identification				
Democrat	239	24.09		
Independent	311	31.35		
Republican	442	44.56		
Nursing Credential				
Licensed Practical Nurse	101	9.32		
Registered Nurse	885	81.64		
Nurse Practitioner	98	9.04		
	Mean	SD	Min.	Max.
Age	46.12	14.10	18	79

Table 2 compares our sample with population benchmarks reported by the South Dakota Board of Nursing. The table shows that our sample approximates the demographic characteristics of South Dakota nurses. More specifically, our sample closely resembles the age, ethnicity, and gender of South Dakota nurses. We can see small deviations between our sample and population benchmarks for work in South Dakota, work in nursing, and work full-time in nursing variables. Critically, these deviations are only present in our smaller samples of LPNs (n=101) and CNPs (n=98), and not in the larger sample of RNs (n=885). Notwithstanding the small limitations, our sample enables us to study COVID-19 booster uptake among nurses.

Table 2: Comparison of Nurse Sample to South Dakota Benchmarks

Variable	Registered Nurses		Licensed Practical Nurses		Nurse Practitioners	
	Nurse Survey (n= 885)	SD Benchmark (n= 18,693)	Nurse Survey (n=101)	SD Benchmark (n= 2,591)	Nurse Survey (n= 98)	SD Benchmark (n= 1,414)
Mean Age	49.4	44.6	48.5	43.7	47.4	44.4
White	97.6%	92.2%	91.1%	89.7%	94.9%	93.0%
Female	90.9%	91.3%	96.9%	95.3%	93.0%	88.5%
Work in SD	86.1%	67.0%	93.2%	82.3%	80.9%	78.6%
Work in nursing	83.6%	83.9%	82.6%	89.9%	83.1%	97.7%
Work full-time in nursing	66.3%	67.6%	65.2%	72.8%	66.3%	85.9%
Master's degree	--	--	--	--	81.3%	79.4%

Note: The table compares demographic characteristics of our sample of South Dakota nurses with state population benchmarks for nurses. State benchmarks were obtained from South Dakota Board of Nursing publicly available workforce data from 2020 (South Dakota Board of Nursing, 2021).

The results of our binary logistic regressions are presented in Table 3. With an odds ratio of 0.303 ($p < 0.001$), partisan self-identification was strongly associated with booster uptake. The percentage change in the odds of booster uptake was -60.7% for each unit of change (i.e. Democrat to independent, or independent to Republican). Age was also strongly associated with booster uptake ($p < 0.001$). With each additional year of age, the odds of booster uptake increased by 4.2%. Education was also significant in a bivariate test with an odds ratio of 1.195 and p-value of 0.035. Amongst the other variables, percent of time spent in patient care, having tested positive for COVID-19 in the last 12 months, and Evangelical identity were negatively associated with booster uptake at statistically significant levels; while receiving a flu shot was statistically significant in the positive direction. Gender and nursing credential were not significant.

Table 3: Bivariate Logistic Regression Results on Booster Uptake

	Odds ratio	P-value	[95% conf.	interval]	Pseudo r-sq
Partisan Self-Identification	0.393	0.000	0.314	0.491	0.0811
Age	1.042	0.000	1.030	1.054	0.0539
Female	1.080	0.774	0.636	1.835	0.0001
Percent of Time with Patients	0.869	0.014	0.777	0.971	0.0071
COVID in last 12 Months	0.431	0.000	0.314	0.590	0.0275
Flu Shot last Season	4.679	0.000	2.567	8.530	0.0262
Evangelical	0.623	0.003	0.457	0.851	0.0089
Nurse Practitioner	1.137	0.634	0.670	1.930	0.0002
Licensed Practical Nurse	0.624	0.068	0.376	1.036	0.0332

The results of multivariate logistic regression are presented in Table 4. The estimates showed statistically significant relationships between partisan self-identification and age. The odds ratios changed very little, partisan self-identification was 0.399 and age was 1.038.

Amongst the other independent variables, testing positive for COVID-19 and flu vaccination status were statistically significant, and generally mirrored the results in the bivariate analysis. Evangelical identity and percentage of time spent with patients were not independent predictors of booster uptake in the multivariable regression.

Table 4: Multivariate Logistic Regression Results of Booster Uptake

	Odds ratio	P-value	[95% conf.	interval]
Partisan Self-Identification	0.396	0.000	0.306	0.514
Age	1.040	0.000	1.024	1.055
Percent of Time with Patients	0.934	0.316	0.818	1.067
COVID in last 12 Months	0.487	0.000	0.336	0.706
Flu Shot last Season	5.843	0.000	2.707	12.611
Evangelical	0.821	0.304	0.564	1.195
Constant	1.297	0.699	0.347	4.855
Pseudo r-square	0.164			
Number of cases	713			

Discussion

Implications for research

In this study, we examined booster behavior among fully-vaccinated nurses. With vaccine mandates in place for nurses, the primary division is between those who have received a booster and those who have not. Overall, we found that the factors that are associated with vaccine uptake in the general population are very similar to the factors associated with booster uptake among nurses.

Results of both bivariate and multivariate analyses showed that nurses who identify as Republicans are far less likely to receive a booster compared to those identifying with the

Democratic Party and independents. Since the start of the pandemic, scholars showed the politicized nature of individual responses (Kerr et al., 2021; Viskupic et al., 2022), such as compliance with stay-at-home orders or vaccination. The reluctance of Republicans toward COVID-19 vaccination could be due to a combination of fundamental psychological motivations that underpin political attitudes and messaging from political and media elites (Graham et al., 2009). Our findings indicate that nurses are also susceptible to these biases, which is in line with previous scholarship that showed Republicans (Batra et al., 2022), and Republican HCWs having lower booster uptake (Peterson et al., 2022; Toth-Manikowski et al., 2022).

We also found that older nurses are more likely to have received a booster vaccination. The findings regarding age and COVID-19 vaccination status have been mixed and two plausible explanations exist. On the one hand, scholars reported that older adults (Viskupic et al., 2022), older HCWs (Klugar et al., 2021), and older nurses (Grafova et al., 2022) are more likely to be vaccinated. Older adults are at greater risk from COVID-19 and therefore are more likely to be vaccinated than younger adults. On the other hand, scholars found that younger HCWs are more likely to receive a COVID-19 vaccination (Toth-Manikowski et al., 2022; Shekhar et al., 2021). Younger adults tend to be more politically liberal, which might explain a higher vaccination rate compared to older adults who tend to lean toward political conservatism. While this study cannot provide a definitive answer, our results support the former explanation.

Previous studies showed that female nurses were more vaccine-hesitant than male nurses (Browne et al., 2021; Grafova et al., 2022; Khubchandani et al., 2022). We did not find a statistically significant difference in booster uptake between male and female nurses in our sample. The difference might be due to the inclusion of partisan self-identification, which is a strong predictor of booster uptake in our study.

We did not find a relationship between time spent in direct patient care and booster vaccine uptake. Findings in existing literature are mixed. Some studies reported a link between direct patient care and COVID-19 vaccination among HCWs (Green-McKenzie et al., 2021; Ledda et al., 2021), while others found no correlation (Parente et al., 2021). It is plausible that nurses interacting with patients are at greater risk of infection and more likely to receive a booster vaccination. On the other hand, risk perception can often be subjective, and nurses who believe they are not at risk from infection are less likely to seek additional vaccinations.

Finally, we reported that those nurses who received a flu shot in the previous flu vaccination season are more likely to receive a booster. This finding is in line with existing studies that show a positive effect of previous vaccination history on COVID-19 vaccination intentions among HCWs (Do et al., 2021; Kozak & Nienhaus, 2021) and among nurses (Trabucco Aurilio et al., 2020).

Implications for practice

The findings of our study should be of interest to public health officials and organizations. The presence of lower booster uptake among nurses and other HCWs might affect the ability to provide health care safely and effectively. Public health officials and administrators have sought to increase booster uptake among HCWs. The politicization of the pandemic, which is reflected in the differences in booster uptake among nurses identifying as Republican and Democrats, presents an added challenge for public health officials and administrators. Previously, public health officials and administrators might have assumed that such interventions would be assessed on their medical or public health merits. However, it is clear that most COVID-19-related policy interventions are viewed through a partisan lens. In many respects, booster uptake is as much of a political decision as it is a health decision. Research suggests that

even the interventions to mitigate the threat of COVID-19 to public health might not be able to overcome the political polarization currently existing in our society (Dimant et al., 2022; Gelfand et al., 2022).

Public health and social science experts have proposed a variety of creative interventions to bolster booster uptake (Bohm et al., 2022), but public health officials must also be mindful of the potential political ramifications. For example, while making booster uptake mandatory would likely increase uptake among nurses and other HCWs, administrators need to be mindful of the potential costs and negative repercussions such a policy would have due to the politicization of the pandemic. Overall, the results of our study show that the politicization of vaccination introduces another dimension that public health officials and administrators need to consider.

Limitations

Our results are based on a probability sample of nurses who are registered with the South Dakota Board of Nursing. We included RNs, LPNs, and CNPs, which are the three largest groups, but we did not include registered nurse anesthetists and licensed clinical nurse specialists. Therefore, the results could differ from a broader sample of all nursing credentials. Nevertheless, we do not see how this could bias the overall findings, given that our results revealed very few distinctions between the different types of credentials. Due to our sampling method, we were not able to contact those nurses who work in South Dakota but are registered elsewhere. Moreover, the invitation letter was sent via email and we were, therefore, unable to contact 10% of nurses who did not provide their email addresses to the Board of Nursing.

Additionally, we collected the data in June and July of 2022 when COVID-19 cases were relatively low in South Dakota, thus the perceived risks of COVID-19 may have suppressed recent booster uptake. The data also comes from one state, which is more rural, white, socially

and politically conservative, as well as having lower vaccination rates compared to the national average, which might limit the generalizability of our findings. While our results are consistent with the existing scholarship, the results could differ from a nationally representative sample. Yet, this propensity might make South Dakota a good “least likely” case to study booster uptake.

Finally, as with most studies exploring attitudes toward COVID-19 vaccines, our data is based on participants’ self-reports. Due to concerns about social desirability bias, some unvaccinated participants might have reported that they received a COVID-19 vaccination. Nevertheless, we do not expect this issue to affect our study. South Dakota has a COVID-19 vaccination rate that is lower than the national average, and being unvaccinated carries less of a social stigma compared to other states; in fact, over 11% of our participants indicated being unvaccinated, which indicates strong vaccine hesitancy amongst South Dakota nurses despite the national mandate.

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