# COVID-19 vaccine hesitancy and intent in California registered nurses

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ABSTRACT

Despite a national vaccination effort prioritizing frontline healthcare workers, COVID-19 vaccination rates among nurses have been lower than necessary to protect workforce and patient health. Historically, nurses have been more vaccine hesitant than other healthcare workers. To assess the vaccine attitudes and COVID-19 vaccine intent of California's registered nurses, we conducted a statewide cross-sectional survey among 603 licensed RNs working in direct patient care. Of 167 respondents (27.7%), 111 met inclusion criteria. Their mean score of 3.01 on a 6-point rating scale on the Vaccine Attitudes Examination scale measuring general vaccine hesitancy was comparable to previous findings among U. S. West Coast adults. Greater vaccine hesitancy was significantly associated with lower COVID-19 vaccine intent, after controlling for relevant confounders. Since nurses make up the largest portion of the healthcare workforce, it is crucial to specifically address this group's vaccine hesitancy.
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## Introduction

With the United States (U.S.) Food and Drug Administration emergency use authorization of two COVID-19 vaccines in December 2020, a national effort to vaccinate frontline healthcare workers (HCWs) was initiated. COVID-19 vaccine acceptance by all HCWs is important but may not be adequate among those who are hesitant about vaccination in general. The World Health Organization identifies "delay in acceptance or refusal of vaccines despite availability" (vaccine hesitancy) as an urgent global health threat [1]. Nurses have been found to be more vaccine hesitant than other HCWs [2]. It is imperative that public health messaging supporting COVID-19 vaccination effectively reaches vaccine-hesitant nurses. Nurses are the largest portion of the healthcare workforce [3] and are the HCWs most likely to be infected with COVID-19 [4]. Without adequate COVID-19 vaccination rates among nurses, maintaining a healthy workforce during the pandemic is difficult, affecting health systems' ability to adequately staff for safe patient care.

Nurses' personal vaccine attitudes may affect their willingness to vaccinate others in their professional role. This association has been observed with seasonal influenza vaccination, which is optional, unlike other immunizations that are required for employment in healthcare settings. When given the option to vaccinate against influenza, HCWs' vaccination rates have historically been low [5]. This is significant from a patient care perspective as HCWs who report intended flu vaccine uptake are more likely to support hospital flu vaccination programs [6] and recommend flu vaccination to patients [7]. Emerging anecdotal evidence suggests a similar phenomenon where nurses' COVID-19 vaccine hesitancy may lead to a reluctance to vaccinate others. For example, in a Kansas county health department, all 4 nurses reportedly refused to administer the COVID-19 vaccine due to safety concerns [8]. Effective health communication targeting vaccine-hesitant nurses may therefore increase COVID-19 vaccination rates and have an important downstream effect for population level immunity.

A fuller understanding of the factors shaping nurses' vaccine hesitancy and intent at multiple levels is likely to be instrumental in developing adequately tailored public health interventions to build vaccine confidence and increase vaccine uptake among this critical population of HCWs. Latkin et al. [9] recently applied a socio-ecological framework [10] to describe trust in the context of COVID-19 vaccines. Likewise, it may be useful to situate nurses' trust, safety concerns, and other individual-level attitudes about vaccines within a broader interpersonal, organizational, cultural, and structural context.

Examining the extent and pattern of COVID-19 vaccine hesitancy in registered nurses (RNs) will inform efforts to improve vaccine uptake to levels that will maintain adequate staffing at health facilities and expedite herd immunity. This information may also help shape future health system policies regarding staff COVID-19 vaccination incentives or requirements. Thus, we conducted a survey of California RNs from August 14, 2020 through December

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2, 2020 to describe vaccine-hesitant attitudes among this population and examine the associations between general vaccine hesitancy and COVID-19 vaccine intent.

## Methods

### Study participants

We used publicly available mailing information from the California Board of Registered Nursing to identify a random sample of RNs stratified by county. The number of RNs per county randomly selected to be included in the study reflected the proportion of the county's RNs compared to the total number of California RNs. Inactive, delinquent, and temporary licenses and out-of-state addresses were removed. Recommended mail survey procedures were followed using five points of contact: an initial postcard invitation, a mailed questionnaire, and three reminder mailings including one replacement questionnaire [11]. Completed surveys were returned by mail or online. A total of 603 invitations to participate in a cross-sectional survey were sent over three waves in August and September 2020. Inclusion criteria were that the RNs be currently licensed and working in California in direct patient care.

### Survey measures

#### Vaccine hesitancy

The Vaccine Attitudes Examination (VAX) scale is a 12-item self-administered survey that measures vaccine hesitancy on a scale of 1 to 6, with higher scores indicating greater vaccine hesitancy [12]. It was developed as a measure of general vaccine hesitancy, in contrast to previous instruments that focus on either a particular disease or parental attitudes toward children's vaccination. The VAX scale was rigorously developed and validated in a sample of 409 U.S. West Coast adults, and the final 12-item scale demonstrated high test–retest reliability in a separate group of 92 West Coast adults. The internal consistency ($\alpha$ = 0.92) and construct validity of the VAX scale has been replicated in a sample of 243 British adults [13]. However, the VAX scale has not previously been used in HCWs or nurses specifically. To adapt the VAX scale to evaluate general vaccine attitudes and trust in new vaccines among RNs, the VAX scale was expanded to a 15-item survey (eVAX). The additional 3 items were modeled on the original VAX scale items with content drawn from prior research with HCWs and nurses [14]. All eVAX items were scored on a 6-point Likert-style scale from strongly agree to strongly disagree, with higher scores indicating greater vaccine hesitancy [12].

#### Vaccine intent

Vaccine intent was assessed using 2 items that were developed in conjunction with the original VAX scale. During the original VAX scale's development, construct validity was assessed using 2 items that asked about participants' intent to be vaccinated against hypothetical local outbreaks of bird flu and ebola [12]. Vaccine intent was assessed using a 6-point Likert-style scale from very unlikely to very likely [12]. In this study, we replaced the bird flu item with a parallel COVID-19 item [Imagine that there is a surge of COVID-19 (novel coronavirus) cases in your area and a vaccine is available to protect against it. How likely is it that you would get vaccinated?]. Ratings from slightly likely to very likely were categorized as endorsed.

#### Sample characteristics

The survey also included items assessing respondent demographics, COVID-19-related attitudes and experiences, risk factors for more severe COVID-19 disease, years worked as an RN, and workplace location.

### Data analysis

Descriptive statistics were computed for sample characteristics and to quantify average levels of vaccine hesitancy and intent. Univariate associations between individual vaccine hesitancy items and vaccine intent were computed using Pearson correlations to identify attitudes among nurses that were particularly associated with COVID-19 vaccine intent. A Bonferroni correction was applied to adjust for multiple comparisons. Finally, multiple linear regression was performed to describe the association between vaccine hesitancy and COVID-19 vaccine intent, controlling for potential confounders. Data were analyzed using SPSS, version 27 (IBM, Armonk, NY, USA).

## Results

We received 167 responses (27.7%) with 111 respondents meeting inclusion criteria. Respondents were excluded for not currently being licensed in California (n = 3), not working in California (n = 17), not working in direct patient care (n = 35), and not completing substantial portions of the survey (n = 1).

Study sample characteristics are shown in Table 1. Respondents were primarily female (83.8%). Half of respondents (50.0%) identified as White, a quarter (24.1%) identified as Asian, 12.9% identified as Latinx, and 5.2% identified as Black. With respect to conditions placing respondents at higher risk for severe COVID-19, thirty-three (30.6%) reported having chronic health conditions, and 1 respondent was currently pregnant at the time of the survey. Twenty-nine respondents (26.1%) were 60 years old or older. Thirty-seven respondents (33.3%) indicated an adult age 65 years or older lived in their household, and thirty-nine respondents (35.5%) reported a child under age 18 lived in their household. Most respondents had more than 5 years of work experience as an RN (82.0%), and half (54.1%) described the location of their primary place of employment as urban. Half of respondents (48.7%) were bachelor's-prepared RNs.

The mean 12-item VAX score for California RNs was 3.01 (n = 109; SD = 1.11; $\alpha$ = 0.91), and the mean 15-item eVAX score was 2.98 (n = 108; SD 1.11; $\alpha$ = 0.93). The mean COVID-19 vaccine intent rating was 4.24 (n = 111; SD 1.85) with thirty-three respondents (29.7%) endorsing unlikely intent. The mean ebola vaccine intent score was 4.59 (n = 111; SD 1.61) with twenty-two respondents (19.8%) endorsing unlikely intent.

Mean vaccine hesitancy scores were moderately negatively correlated with ebola vaccine intent during a hypothetical local outbreak (VAX $r$ = −0.39, $P$ <.0001; eVAX $r$ = −0.41, $P$ <.0001). As shown in Table 2, mean vaccine hesitancy scores were strongly negatively correlated with COVID-19 vaccine intent during a hypothetical local surge (VAX $r$ = −0.64, $P$ <.0001; eVAX $r$ = −0.67, $P$ <.0001). After adjusting the alpha level for multiple comparisons, thirteen of the 15 total eVAX items were significantly associated with COVID-19 vaccine intent. There were strong associations between eVAX items involving trust in authorities and vaccine safety and a preference for "natural" exposure to infectious disease (see Table 2).

As shown in Table 3, multiple linear regression showed vaccine hesitancy was significantly associated with COVID-19 vaccine intent ($\beta$ = −1.07; 95% CI, −1.30 to −0.83), adjusting for gender, underlying chronic conditions, employment location, years worked as an RN, household members 65 years or older, household members <18 years, and race/ethnicity. Age range was not included in this model because of how strongly associated it was with years worked as an RN ($\chi^2$ = 142.54, df = 30, p <.0001).

**Table 1**
Characteristics of study sample.

| Characteristic | | N (%) |
|---|---|---|
| Gender | | |
| | Male | 18 (16.22) |
| | Female | 93 (83.8) |
| | Non-binary | 0 (0.0) |
| Age (years) | | |
| | 20–29 | 10 (9.0) |
| | 30–39 | 27 (24.3) |
| | 40–49 | 22 (19.8) |
| | 50–59 | 23 (20.7) |
| | 60–69 | 24 (21.6) |
| | ≥70 | 5 (4.5) |
| Race/Ethnicity[a] | | |
| | Asian or Asian American | 28 (24.1) |
| | Black or African American | 6 (5.2) |
| | Native American, American Indian, or Alaska Native | 4 (3.5) |
| | Native Hawaiian or other Pacific Islander | 3 (2.6) |
| | Latino or Hispanic | 15 (12.9) |
| | White or Caucasian | 58 (50.0) |
| | Other | 2 (1.7) |
| Presence of chronic conditions[b] | | |
| | Yes | 33 (30.6) |
| | No | 75 (69.4) |
| Currently pregnant | | |
| | Yes | 1 (0.9) |
| | No | 110 (99.1) |
| Highest level of nursing education | | |
| | Certificate or diploma | 1 (0.9) |
| | Associate's degree | 31 (27.9) |
| | Bachelor's degree | 54 (48.7) |
| | Master's degree | 23 (20.7) |
| | Doctoral degree | 2 (1.8) |
| RN work experience (years) | | |
| | ≤1 | 4 (3.6) |
| | 1–5 | 16 (14.4) |
| | 6–10 | 15(13.5) |
| | 11–15 | 20 (18.0) |
| | 16–20 | 12 (10.8) |
| | 21–25 | 7 (6.3) |
| | ≥25 | 37 (33.3) |
| Region of Residence[c] | | |
| | Northern California[d] | 3 (2.7) |
| | Greater Sacramento[e] | 12 (10.8) |
| | Bay Area | 28 (25.2) |
| | San Joaquin Valley[f] | 15 (13.5) |
| | Southern California[g] | 53 (47.8) |
| ≥65 Years Old Household Member | | |
| | Yes | 37 (33.3) |
| | No | 74 (66.7) |
| <18 Years Old Household Member[b] | | |
| | Yes | 39 (35.5) |
| | No | 71 (64.5) |
| Primary place of RN employment[b] | | |
| | Rural | 8 (7.3) |
| | Suburban | 42 (38.5) |
| | Urban | 59 (54.1) |
| Have you had or do you currently have COVID-19?[b] | | |
| | I have been tested. The result was positive. | 6 (5.5) |
| | I have been tested. The result was negative. | 47 (42.7) |
| | I have been tested. I do not know the result. | 1 (0.9) |
| | I have not been tested, but a healthcare professional has diagnosed me as having or probably having COVID-19. | 1 (0.9) |
| | I have not been tested or diagnosed, but I think I have been infected with COVID-19. | 2 (1.8) |
| | I have not been tested or diagnosed. I do not think I have been infected with COVID-19. | 53 (48.2) |
| Whether or not you have been tested for or diagnosed with COVID-19, have you sought medical care for COVID-19?[b] | | |
| | Yes | 14 (12.7) |
| | No | 96 (87.3) |
| Has somebody you live with tested positive for or been diagnosed with COVID-19?[b] | | |
| | Yes | 9 (8.2) |
| | No | 101 (91.8) |
| At work, have you cared for a patient with COVID-19?[b] | | |
| | Yes | 69 (62.7) |
| | No | 41 (37.3) |

Abbreviation: RN, registered nurse.
[a] Numbers total greater than 111 because respondents could select all that apply.
[b] Numbers total <111 because of missing data.
[c] Regions as defined by the California Department of Public Health for COVID-19 monitoring and implementation of mitigation interventions.
[d] No surveys were sent to Del Norte, Glenn, Lassen, Modoc, or Trinity Counties.
[e] No surveys were sent to Alpine, Colusa, Plumas, or Sierra Counties.
[f] No surveys were sent to Mariposa County.
[g] No surveys were sent to Inyo or Mono Counties.

**Table 2**
Correlation of Vaccine Hesitancy (Total and Item-Level Scores) with COVID-19 Vaccine Uptake Intent.

| | | COVID-19 Vaccine Intent | |
|---|---|---|---|
| | | Pearson's *r* | *P*[e] |
| Mean VAX score | | −0.64 | <0.0001 |
| Mean eVAX score | | −0.67 | <0.0001 |
| **VAX and eVAX Scale Items** | **% Endorsed**[b] (***N***) | | |
| I feel safe after being vaccinated.[a] | 82.9 (92/111) | −0.54 | <0.0001 |
| I can rely on vaccines to stop serious infectious diseases.[a] | 85.5 (94/110[c]) | −0.48 | <0.0001 |
| I feel protected after getting vaccinated.[a] | 54.1 (60/111) | −0.55 | <0.0001 |
| Although most vaccines appear to be safe, there may be problems that we have not yet discovered. | 86.5 (96/111) | −0.09 | 0.36 |
| Vaccines can cause unforeseen problems in children. | 50.5 (56/111) | −0.22 | 0.02 |
| I worry about the unknown effects of vaccines in the future. | 68.5 (76/111) | −0.49 | <0.0001 |
| Vaccines make a lot of money for pharmaceutical companies, but do not do much for regular people. | 36.9 (41/111) | −0.43 | <0.0001 |
| Authorities promote vaccination for financial gain, not for people's health. | 30.9 (34/110[c]) | −0.59 | <0.0001 |
| Vaccination programs are a big con. | 16.2 (18/111) | −0.5 | <0.0001 |
| Natural immunity lasts longer than a vaccination. | 54.1 (60/111) | −0.46 | <0.0001 |
| Natural exposure to viruses and germs gives the safest protection. | 47.7 (53/111) | −0.54 | <0.0001 |
| Being exposed to diseases naturally is safer for the immune system than being exposed through vaccination. | 30.6 (34/111) | −0.56 | <0.0001 |
| Authorities can be trusted to ensure new vaccines are safe.[a,d] | 60.9 (67/110[c]) | −0.59 | <0.0001 |
| A good diet and frequent exercise will prevent me from getting infections that vaccines are meant to protect against.[d] | 35.1 (39/111) | −0.41 | <0.0001 |
| People are given too many vaccines.[d] | 37.8 (42/111) | −0.54 | <0.0001 |

Abbreviations: VAX, vaccine attitudes examination; eVAX, expanded vaccine attitudes examination.
[a] Reverse scored.
[b] Ratings from slightly agree to strongly agree were categorized as endorsed.
[c] Total number <111 because of missing data.
[d] eVAX items.
[e] Bonferroni-corrected significance level was set at P = 0.003.

**Table 3**
Association Between Vaccine Hesitancy and COVID-19 Vaccine Intent: Multiple Linear Regression Model Adjusting for Potential Confounders.

| Variable | Beta (95% CI) | *P* |
|---|---|---|
| Vaccine Hesitancy (eVAX) | −1.07 (−1.30 to −0.83) | <0.001 |
| **Gender** | | |
| Female | [Reference] | 0.851 |
| Male | −0.02 (−0.86 to 0.71) | |
| **Underlying Chronic Condition** | | |
| No | [Reference] | 0.393 |
| Yes | 0.07 (−0.35 to 0.88) | |
| **Area of Employment** | | |
| Urban | [Reference] | |
| Suburban | −0.07 (−0.83 to 0.36) | 0.429 |
| Rural | −0.16 (−2.45 to −0.02) | 0.047 |
| **RN Work Experience** | | |
| ≤10 years | [Reference] | 0.570 |
| >10 years | 0.05 (−0.46 to 0.83) | |
| **≥65 Years Old Household Member** | | |
| No | [Reference] | 0.802 |
| Yes | 0.02 (−0.51 to 0.66) | |
| **<18 Years Old Household Member** | | |
| No | [Reference] | 0.796 |
| Yes | −0.02 (−0.63 to 0.48) | |
| **Race/Ethnicity** | | |
| White or Caucasian | [Reference] | |
| Asian or Asian American | 0.02 (−0.69 to 0.86) | 0.821 |
| Black or African American | −0.06 (−1.64 to 0.68) | 0.411 |
| Latinx or Hispanic | −0.09 (−1.41 to 0.46) | 0.316 |
| Other[a] | −0.07 (−1.23 to 0.50) | 0.401 |

Abbreviations: eVAX, expanded vaccine attitudes examination; RN, registered nurse.
[a] Includes Native American, American Indian, Alaska Native, Native Hawaiian, other Pacific Islander, and multiracial responses.

## Discussion

This study was conducted during a period characterized by rising COVID-19 hospitalizations, historic wildfires, and a U.S. Postal Service slowdown. Despite these challenges, our response rate of 27.7% was higher than the response rate of 23.8% for a 2018 survey of California RNs employing the same mailing list [15]. Our random sample stratified by county was largely representative of California RNs in terms of age and race/ethnicity according to a 2016 survey conducted by the CA Board of Registered Nursing [16]. However, it should be noted that, compared to the national RN workforce, California has fewer White and Black RNs and more Asian and Latinx RNs [17]. Male RNs (16.2%) were slightly overrepresented relative to the 2016 survey (10.7%) [16].

One limitation of this study is the time during which the survey was conducted. The survey closed prior to the first COVID-19 vaccines receiving emergency use authorization. Thus, respondents' answers to survey items about a hypothetical COVID-19 vaccine may have differed from their practice when COVID-19 vaccination became a reality.

This survey is the first time the VAX scale, which measures general vaccine hesitancy, has been used among nurses and during the COVID-19 era. We found that California RNs had similar levels of vaccine hesitancy compared to U.S. West Coast adults in prior research [12]. We observed a strong relationship between higher vaccine hesitancy and lower intent to be vaccinated against COVID-19. This association was substantially greater in strength than the relationship observed between vaccine hesitancy and ebola vaccine intent in the event of a hypothetical outbreak. Our COVID-19 finding was also greater in strength than the relationships observed between vaccine hesitancy and vaccine intent for other emerging infectious diseases in prior research [12], highlighting unique aspects of COVID-19 vaccine hesitancy.

Few studies have investigated nurses' COVID-19 vaccine intent [18] despite nurses being the largest portion of the healthcare workforce [3]. As personal vaccine hesitancy has been shown to affect professional support for patient vaccination, understanding nurses' general vaccine hesitancy in relation to COVID-19 intent is fundamental [6,7]. This study identified the ability of our expanded eVAX scale to predict COVID-19 vaccine intent after controlling for relevant confounders.

To reach widespread immunization coverage and expedite an end to the COVID-19 pandemic, the vaccine hesitancy of nurses

and other HCWs must be addressed. The SAGE Working Group on Vaccine Hesitancy determined that poor health communication can contribute to vaccine hesitancy and undermine vaccine acceptance, recommending that targeted communication be developed to address vaccine hesitancy and improve vaccine uptake [19]. Health communication has been shown to influence population behavior on vaccine hesitancy [20]. However, effective health communication requires understanding the perspectives of the target population, not merely sharing information [20]. Therefore, public health messaging should be tailored to nurses' unique vaccination concerns, accounting for their healthcare training and experience. For example, COVID-19 vaccine-hesitant Palestinian nurses reported they would feel more vaccine confident if scientists assured them the COVID-19 vaccine is safe and recommended [21]. Additionally, it is imperative that HCWs' vaccine hesitancy be expediently addressed as a systemic review of global surveys on COVID-19 vaccine intent conducted later in the COVID-19 pandemic found smaller proportions of people willing to be vaccinated [22].

While most nurses surveyed reported feeling safe or protected after vaccination, a fair proportion endorsed distrust of authorities' ability to offer safe vaccination programs and a belief that immunity from "natural" exposure to disease is safer and better than vaccination. These vaccine concerns are consistent with the those of nurses in Palestine [21], France [23], and Hong Kong [24]. These elements must be incorporated into messaging targeted at nurses to adequately address their vaccine hesitancy. For example, the majority of respondents endorsed the statement that immunity from "natural" exposure to disease lasts longer than vaccination, suggesting that information about the stability of COVID-19 vaccine immunity should be disseminated to frontline nurses and frequently updated as these data emerge. This is consistent with survey data from the Riverside University Health System in California finding vaccine-hesitant HCWs were the least knowledgeable about COVID-19 disease [25] and from HCWs in five European countries showing that high self-perceived knowledge about COVID-19 vaccines was correlated with increased COVID-19 vaccine intent [26]. Additionally, directly addressing the unique circumstances under which COVID-19 vaccine development was expedited but still approved for emergency use through the standard rigorous requirements could also help assuage nurses' safety concerns, especially since the oft-cited fears about the COVID-19 vaccines' rapid development and potential side effects, including possible effects on fertility, continue to persist [27,28].

This study adds to the body of knowledge on HCWs' vaccine hesitancy and will contribute to the efforts to increase frontline nurses' COVID-19 vaccine uptake, which may lead to an increased willingness to promote COVID-19 vaccination for the general public.

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## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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