

# Impact of an Education Intervention on COVID-19 Vaccine Hesitancy in a Military Base Population

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## ABSTRACT

### Background:

Coronavirus disease 2019 (COVID-19) vaccine hesitancy is a major impediment to achieving herd immunity and overcoming the current pandemic. Our aim was to decrease the prevalence of vaccine hesitancy through an education intervention.

### Method:

An education intervention, consisting of a PowerPoint presentation addressing the two mRNA COVID-19 vaccine concerns/myths and a question and answer panel comprising health care providers from various specialties, was implemented to address vaccine hesitancy among personnel associated with Wright-Patterson Air Force Base through a series of virtual and in-person seminars. Participants completed a post-seminar survey as a retrospective self-assessment to identify attitudes and views surrounding vaccine hesitancy and the impact of the education intervention. Chi-squared test was used to examine relationships between categorical variables, and multiple logistic regression was used to identify risk factors for vaccine hesitancy pre- and post-seminar. All analyses were done using SPSS Statistics Version 25.0 (IBM, Armonk, NY). Institutional Review Board approval was not obtained before this study as it began as a non-research initiative and received non-research determination post hoc.

### Results:

Five hundred participants completed the survey. Mean age was 44.7 years with 13.4 and 86.6% medical and non-medical personnel, respectively. Nearly all (98.8%) had not received their first shot of the vaccine series. 402 (80.9%) were receptive to vaccination, and 95 (19.1%) were hesitant post-seminar. Of the 139 participants who reported they were initially hesitant after our intervention, 50 (36%) indicated that they were now receptive to the vaccine, while 89 (64%) remained hesitant. Of those 50, 48 (96%) had moderate to great amount of trust in COVID-19 vaccine information presented by physicians/other providers. Six respondents who wanted the vaccine before the intervention no longer wanted the vaccine. A medical occupation (OR = 4.85, 95% CI = 2.63-8.96,  $P < .001$ ), little or no trust in COVID-19 vaccine information from physicians/other providers (OR = 19.48, 95% CI = 7.31-51.90,  $P < 0.001$ ), and being age 30 or younger (OR = 1.81, 95% CI = 1.02-3.2,  $P = 0.041$ ) were independent predictors of vaccine hesitancy. Trust in providers was a significant factor in change of intent from vaccine hesitant to receptive post-intervention (OR 0.13, 95% CI = 0.03-0.59,  $P = .008$ ). Age and occupation were not significant factors associated with change in intent.

### Conclusion:

Our education intervention was effective in reducing COVID-19 vaccine hesitancy in a military base population. Study limitations include applications toward other military and non-military populations, the possibility of nonresponse bias, and absence of prior validated interventions. Area for future studies includes improvement upon educational intervention, development of other effective methods, and application of intervention in other populations.

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## INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has had a monumental impact on daily lives worldwide while leading to enormous morbidity and mortality. Over the course of the 2020 calendar year, there were over 83 million documented cases of severe acute respiratory syndrome coronavirus 2 infection worldwide with over 1.8 million deaths, and numbers increase daily.<sup>1</sup> With 23% of cases and 19% of deaths globally, the USA has worse outcomes than any other country. However, with the development of novel mRNA vaccines came a means to curtail the pandemic. In December 2020 through Emergency Use Authorization (EUA), the FDA approved two vaccines that are effective against COVID-19.

However, given the limited supply of these vaccines, a graded vaccine priority system was established by the CDC in which health care workers and first responders were prioritized in the initial rollout.<sup>2</sup> Despite being given this priority, there was a noticeable amount of vaccine hesitancy among the medical group (MDG) at Wright Patterson Medical Center. This phenomenon persisted even when criteria were expanded to include other personnel at Wright-Patterson Air Force Base (WPAFB), many of whom were active duty military. Although the issue of vaccine hesitancy is heterogeneous and complex, education initiatives have been shown to be successful in increasing vaccine uptake as well as knowledge, awareness, and attitudes about vaccines and their underlying disease, especially when coming from health care providers.<sup>3,4,5</sup> With the hope of curbing the pandemic and improving the capabilities of the U.S. Air Force, the authors established a physician-led seminar as part of a performance improvement process to reduce vaccine hesitancy through education among active duty military and WPAFB employees.

## METHODS

### Intervention Overview

The physician-led curriculum for vaccine hesitancy consisted of a live PowerPoint presentation followed by a question and answer (Q&A) panel during a seminar led by active duty internal medicine residents. The short PowerPoint presentation addressed the impact of COVID-19, information regarding mRNA vaccines (mechanism of action, clinical trial data, ingredients, adverse events, etc.) and common myths/concerns surrounding the vaccines. Information was compiled using Johns Hopkins live COVID-19 tracker, Pfizer/Moderna's EUA Vaccination Provider Fact Sheets, the CDC website, and articles from *The Journal of the American Medical Association*.<sup>6,1,7,8,9,10</sup> Common myths and concerns from various news, social media, and internet sources as well as word-of-mouth were addressed. These myths/concerns included that the vaccines may alter DNA, lead to infertility, have embedded microchips or tracking devices, may not be safe because of their rapid approval, may cause COVID-19 infection, and may induce Bell's palsy.

The Q&A panel consisted of military physicians and nurse practitioners from different specialties: internal medicine, pulmonary/critical care, infectious disease, allergy and immunology, obstetrics and gynecology, and nephrology. Nine live seminars were conducted in January 2021 (six in-person and socially distanced, two via Microsoft Teams, and one with Facebook Live through the 88th Air Base Wing Group). Each session was 30-60 minutes in length. Participants were encouraged to ask questions through various means including in-person inquiries, web-based polling platforms, and streaming services. Questions could be submitted anonymously either before the seminar or through multimedia applications.

### Selection Criteria

The initial target population was personnel in the MDG at WPAFB but later, at the request of WPAFB leadership, was expanded to include the Wing, which are comprised of 1,877 and 35,367 individuals. The MDG is a basic unit in the Air Force dedicated specifically to medical operations, whereas the Wing is the umbrella organization composed of all groups on base. All participants were notified of the seminars via email, advertisements, and word of mouth. The six in-person sessions took place during a training day, which occurs on the first Thursday of every month. Training day is dedicated time to train staff members to improve the function of the medical center. Time slots were set aside for different MDG departments such as nursing, medical technicians, dental, etc. Interested parties signed up and attended or sent a representative from their department. The virtual sessions took place in subsequent weeks and were made available to the entire Wing. There were no exclusion criteria for this study.

### Survey Content

Data were collected through a post-seminar questionnaire using SurveyMonkey. The questionnaire items were age, occupation, concerns before seminar (and if they had been addressed), post-seminar opinion of the vaccine, plan regarding COVID-19 vaccination, degree of trust in health care professionals, helpfulness of the seminar, and whether or not they would recommend the vaccine to others. Survey questions can be viewed in the Supplemental Material section.

### Outcomes

The primary outcome was change from vaccine hesitant to receptive, which was collected in the post-seminar survey question of: "Which of the following best describes your current opinion regarding COVID vaccination now compared to before completing the seminar?". Specific focus was paid to those who retrospectively reported that they did not want the vaccine before or after the seminar in relation to those who initially did not want the vaccine but were receptive afterward. Other answer choices were wanting the vaccine pre- and post-seminar, wanting the vaccine pre-seminar but not after, or having already received the vaccine. Secondary outcomes were

1. trust in COVID-19 information from physician/health care professionals
2. likelihood of recommending the vaccine to others
3. how adequately the seminars addressed concerns about the COVID-19 vaccine
4. characteristics associated with vaccine hesitancy
5. factors associated with respondents who changed their minds from hesitant to receptive.

### Survey Administration

A post-seminar survey was available to participants as both a direct link and a scannable QR code embedded within the

PowerPoint presentation. Participation in the survey was voluntary. Approximately 5 minutes were allotted at the end of each session to allow participants to complete the survey.

**Statistical Analysis**

The chi-squared test was used to examine the relationship between categorical variables. Inferences were made at the 0.05 level of significance with no corrections for multiple comparisons. Multivariate logistic regression was used to identify independent risk factors of vaccine hesitancy. All analyses were performed using SPSS Statistics Version 25.0 (IBM, Armonk, NY).

**RESULTS**

We educated over 12,000 members across WPAFB and had a total of 500 post-seminar survey respondents. Table I shows that the mean age of respondents was 44.73 years and nearly 87% had non-medical occupations. Nearly all (98.8%) respondents had not received their first shot of the COVID-19 vaccine series.

**Primary Outcome**

Table II shows the results for the primary outcome. Nearly 70% (346 of 497) indicated that they wanted the vaccine both before and after the seminar, 89 (18%) did not want the vaccine before or after the seminar, and 50 (10%) did not want the shot before but wanted it after the seminar. Six respondents wanted the vaccine before but not after the seminar, and six had already received the vaccine.

**Secondary Outcomes**

After the seminar, 94.4% of respondents reported trust in the COVID-19 vaccine information provided by health care professionals, and 82.4% of respondents were likely to recommend the vaccine to others. Figure 1 shows the percent who indicated which aspects of the seminar were addressed adequately.

Three key predictors were investigated for their relationship to vaccination hesitancy: age 30 years or younger vs.

**TABLE II.** Vaccine Intent Post-seminar

Response	n <sup>a</sup> (%)
Wanted before and after seminar	346 (69.6)
Wanted before but not after seminar	6 (1.2)
Not want before or after seminar	89 (17.9)
Not want before but want after seminar	50 (10.1)
Already received vaccine	6 (1.2)

Survey responses for primary outcome in regard to vaccine intent pre- and post-seminar. Only 497 of 500 respondents answered the question: “Which of the following best describes your current opinion regarding COVID vaccination now compared to before completing the seminar?”.  
<sup>a</sup>n = 497.

31 years or older, a medical vs. non-medical occupation, and level of trust in the COVID-19 information provided by health care professionals. Table S1 shows that the three predictors were related to vaccine hesitancy on both a univariate and multivariate basis. Respondents of 30 years or younger were nearly two times more likely to be vaccine hesitant, those in a medical occupation had a greater than three-fold likelihood of being vaccine hesitant, and those with little or no trust in COVID-19 vaccine information from physicians/other providers were nearly five times more likely to be hesitant of inoculation. To determine if the predictors were independently associated with vaccine hesitancy, multivariate logistic regression was conducted. All three predictors were independent risk factors for vaccine hesitancy (Table S1 and Fig. 2).

Of the 139 respondents who reported after the intervention that they did not initially want the vaccine, 50 (36%) indicated that they would like to receive the vaccine while 89 (64%) remained hesitant. Those with little or no trust in COVID-19 information provided by medical professionals were more likely to remain hesitant (91.3% vs. 58.6%, *P* = .003). Neither age group nor occupation differed on proportion remaining hesitant. To determine if these three factors were independently associated with remaining persistently hesitant, multivariate logistic regression was conducted. Moderate to great amount of trust in provider COVID-19 information showed a decreased likelihood of remaining hesitant (OR = 0.13, 95% CI = 0.03-0.59, *P* = .008). Age group and occupation were not independent predictors (Table S2 and Fig. S1).

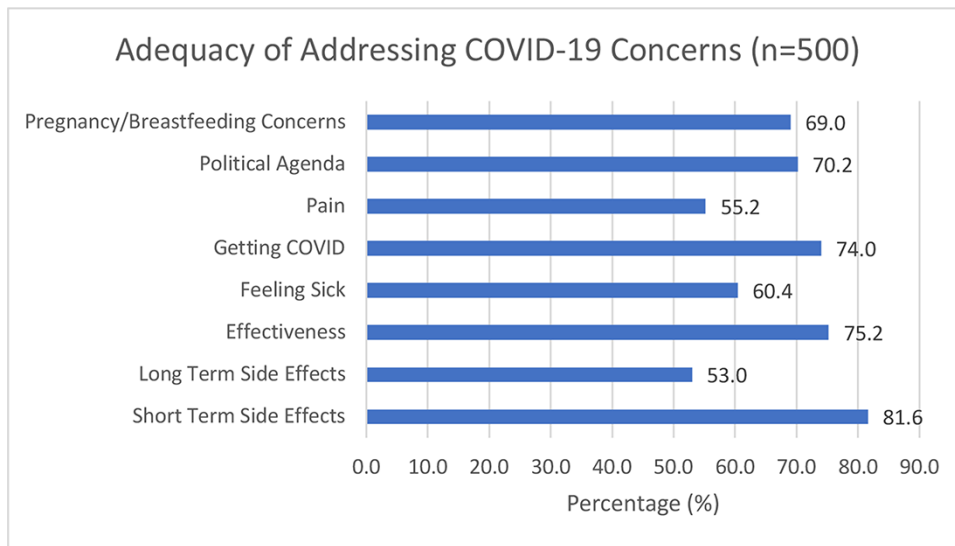
**TABLE I.** Characteristics of Post-seminar Survey Participants

Characteristic	
Age, years—mean	44.73 <sup>a</sup>
Occupation, n (%)	
Non-medical	433 (86.6)
Medical	67 (13.4)
Physician	4 (0.8)
Nursing	10 (2.0)
Technician	25 (5.6)
Other	28 (5.6)

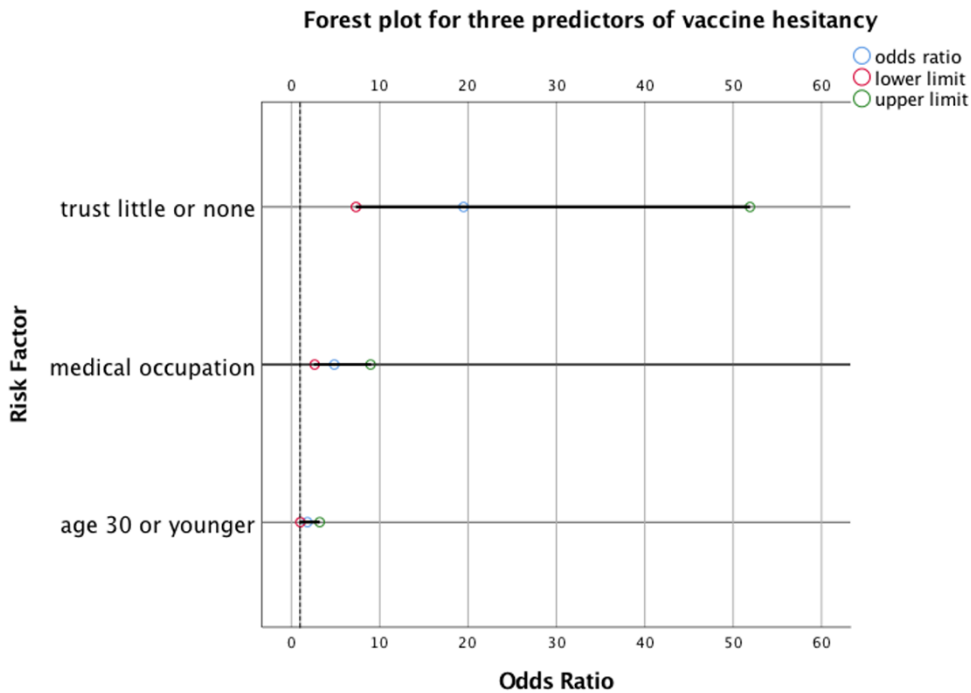
Demographics of survey respondents in regard to age and occupation. Only 497 of 500 respondents answered the age question with numeric values.  
<sup>a</sup>n = 497.

**DISCUSSION**

Our COVID-19 vaccine education intervention led by physicians resulted in a retrospective self-reported change to receptiveness from hesitant in 36% of respondents (50 of 139) post-seminar. Recent publications estimated that 60%-85% of a population needs to be immune from COVID-19 to achieve herd immunity.<sup>11,12,13</sup> Although immunity can be achieved by either natural infection or vaccination, the latter leads to significantly reduced morbidity, mortality, and health care costs when compared to the former.<sup>14</sup> After our COVID-19 seminar, 81% (402 of 497) were receptive to



**FIGURE 1.** Bar graph of survey results regarding the adequacy of education intervention in addressing certain COVID-19 concerns as a percentage.



**FIGURE 2.** Line of significance drawn at OR 1.00. Left of line represents tendency toward vaccine receptiveness, whereas right of the line represents vaccine hesitance. Little to no trust in health care providers, medical occupation, and age 30 years or younger were all significant risk factors for vaccine hesitancy as indicated by their confidence intervals lying to the right of the line.

vaccination, potentially a sufficient proportion needed to reach the projected herd immunity threshold, if extrapolated to the rest of the base population. However, there are a few caveats to this extrapolation. Although the respondent population appear to be representative sample of the base population, respondents were self-selected and only a small percentage of the seminar participants (<4%), which subjects our data to some unknown uncaptured margin of error. Additionally, vaccine intent does not necessarily translate into vaccinations

which is the crux of herd immunity. However, intent is likely a strong correlate for getting vaccinated.

Because of the newness of COVID-19 disease and the rapid development of its vaccines, there is not a validated education model for addressing hesitancy toward inoculation. A randomized controlled trial showed that a physician-targeted communication intervention did not reduce vaccine hesitancy in a primary care setting.<sup>15</sup> However, as with our intervention, population-based education strategies utilizing

influential leaders and targeting specific populations have increased knowledge, improved awareness, and enhanced vaccine acceptance.<sup>16–18,19</sup> In addition, interventions that have addressed reluctance to earlier vaccination campaigns (e.g., influenza and human papillomavirus) can provide valuable guidance.<sup>20,21,17</sup> Finally, the use of social media, like with our virtual sessions, may contribute to improvement in vaccine acceptance.<sup>21</sup>

Our finding that age 30 years or younger was a risk factor for vaccine hesitancy is consistent with CDC surveys conducted between September and December 2020 that found younger adults were less intent on getting the COVID-19 vaccine.<sup>20</sup> Younger individuals may be more willing to risk becoming sick from COVID-19 since they are more likely to survive an infection.<sup>5</sup> Furthermore, lower education attainment is associated with higher rates of COVID-19 vaccine hesitancy.<sup>3,22,20,23</sup> In broad terms, the military's profile represents a younger and less educated demographics, with the average age of 27.7 and 34.0 years for enlisted and officers, respectively, and less than a quarter having more than a high school or high school equivalent diploma.<sup>24,5</sup> In contrast, older individuals tend to trust their health care providers, viewing them as advocates who recommend well-informed options. The patient-centered approach and continuity of care found in military medicine result in high levels of patient satisfaction.<sup>25</sup> Unexpectedly, among the initially hesitant to receive COVID-19 vaccination, those 31 or older were no more likely than their younger colleagues to become vaccine receptive after an informational seminar led by knowledgeable physicians. This suggests that the intervention had a similar impact on both groups, as demonstrated by a ~35% reduction in hesitancy for each group, stressing the importance of education and combating misinformation irrespective of age. Other factors relating to persistent hesitancy should be explored in future studies.

We found that an occupation in the medical field was a risk factor for vaccine hesitancy. Roy et al. showed that among health care workers at least one in six was reluctant to receive the vaccine for reasons that included safety, side effects, data transparency, and pregnancy.<sup>26</sup> Dror et al. found that being a nurse and parenthood were negative predictors of vaccine receptiveness, while being a physician and having been exposed to COVID-19 patients were positive predictors.<sup>3</sup> Of the 67 medical respondents in our study, four were physicians and ten were nurses. Medical personnel may be skeptical of scientific data until they personally evaluate the evidence. Among those initially hesitant to receive COVID-19 vaccination, medical professionals and their non-medical colleagues did not differ on vaccine receptiveness after an informational seminar led by knowledgeable physicians.

We reported that little or no trust in COVID-19 information provided by health care professionals was a stronger risk factor for vaccine hesitancy than both young age and medical occupation. Further, among the initially hesitant to

receive COVID-19 vaccination, trust was the sole univariate and multivariate risk factor for change to vaccine receptiveness after the informational seminar. Nearly all respondents (96%) who switched from being vaccine hesitant to receptive had a moderate to great amount of trust in health care provider COVID-19 information. Trust in health care professionals may be a surrogate for trust in vaccines since health care providers are usually the ones offering and recommending vaccines.<sup>11,5</sup> All physicians on the seminar panel disclosed to the audience that they had received at least one dose of the vaccine. Self-disclosure by physicians and other health care professionals may be an important component in combating vaccine hesitancy for vaccine-critical patients.<sup>27</sup> Kahana et al. noted that self-disclosure and direct communication are effective strategies to counter vaccine hesitancy and misinformation.<sup>28</sup>

Our study had limitations. The education intervention and data collection took place at a single U.S. Air Force military base. Non-military health care systems and other patient populations may not have the same resources to facilitate in-person and/or virtual sessions with large groups. Consequently, generalizability to other settings should be done with caution. Nonetheless, our military population likely is similar to many general population environments. Second, despite the magnitude of our outreach to over 12,000 members, there were only 500 (<4%) respondents, subjecting our data to nonresponse bias. Most notably, the mean age of study respondents was about 45 years old, while active duty military members are of a younger demographic.<sup>29</sup> This could suggest that younger individuals were more likely to be non-responders and thus possibly making our study population a non-representative sample. On the other hand, our study population also included civilian personnel, who have a mean age of 47.5 years<sup>30</sup>. This inclusion could be another explanation for our findings and may suggest that our population was a representative sample of the base population. Unfortunately, our survey did not distinguish between active duty and civilian personnel and so generalizability again should be made with reservations. Lastly, our survey was constructed locally and did not undergo formal test instrument validation. However, the questionnaire was carefully vetted, and the findings had no apparent ambiguous interpretations. Furthermore, since the COVID-19 pandemic is a unique occurrence, the seminar sessions were first-time events with no previous history of being evaluated and improved. Although literature search/review showed various studies that examined risk factors associated with COVID-19 vaccine hesitancy and the impact of education interventions for other vaccines, we did not find any studies quantifying the impact of an educational intervention specifically for COVID-19 vaccine hesitancy, making our study one of the first. Auspiciously, our experience with COVID-19 seminars and the resulting survey data will allow us to be better prepared for future one-off health crises.

## CONCLUSION

Physician-led engagement appears to be an effective method to address vaccine hesitancy with a military base population. In a time when misinformation can spread rapidly, the importance of providing accurate information through reliable sources cannot be overstated. Our study's findings support the implementation of an open forum, allowing for direct communication with a multidisciplinary team of medical professionals. Offering an open, honest, and potentially anonymous dialogue where individuals discuss their concerns with health care professionals may be an effective tool for managing not only vaccine hesitancy but also other health-related crises. Future studies are needed to improve educational interventions, develop other effective instructional methods, and address additional challenges in both military and non-military populations with regard to vaccine hesitancy. The end of the COVID-19 pandemic is not known but improving receptiveness to safe and effective vaccines will hasten that day.

## SUPPLEMENTARY MATERIAL

Supplementary material is available at *Military Medicine* online.

## FUNDING

None declared.

## CONFLICT OF INTEREST STATEMENT

None declared.

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