

Assessment of a Virtual Educational Program on Health Professional Students' Vaccine Knowledge, Attitudes, and Confidence Managing Patient Hesitancy

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Abstract

Background: Health professionals are cited as the most trusted source for vaccine information, even among the unvaccinated. Research suggests that health professional educational programs lack training and education related to vaccine safety and addressing vaccine-hesitant patients and caregivers. Education for health professional students has been shown to impact knowledge, individual hesitancy, and confidence in ability to address patient vaccine hesitancy. **Methods:** A virtual educational program was developed and delivered to pharmacy, nursing, and medical students to impact vaccine-related knowledge, hesitant attitudes, and confidence in addressing vaccine-related topics with patients and caregivers. A survey was delivered before and after the training to identify the educational impact. **Results:** In total, 8 nursing programs, 1 school of pharmacy, and 1 medical school participated in the program. There was a significant ($P < 0.05$) increase in confidence and knowledge for pharmacy, nursing, and medical students. There was a significant ($P < 0.05$) decrease in vaccine-hesitant attitudes among nursing students. Overall satisfaction with the program was high, with 92% of students stating they would recommend the virtual educational program. **Conclusions:** A virtual education program designed for multiple health professional disciplines increased student knowledge, decreased individual hesitancy, and increased confidence in their ability to address patient vaccine hesitancy.

Keywords: Health professional education, medical students, nursing students, pharmacy students, vaccine education, vaccine hesitancy, vaccine knowledge

INTRODUCTION

Vaccines are considered one of the major public health achievements of the last century.^[1] Vaccination not only prevents a vast number of illnesses and hospitalizations but also prevents 2–3 million deaths a year associated with vaccine-preventable diseases.^[2,3] However, vaccine hesitancy threatens those achievements both within the United States and globally.^[4] Even before coronavirus disease 2019 (COVID-19), the World Health Organization (WHO) recognized vaccine hesitancy as one of the leading threats to global health.^[2]

On March 11, 2020, the WHO declared COVID-19 as a pandemic.^[5] COVID-19 has caused millions of illnesses, hospitalizations, and deaths globally. The United States

has access to multiple COVID-19 vaccines that are rigorously tested, highly effective, and safe.^[6,7] As of July 2021, COVID-19 vaccination has saved an estimated 279,000 lives and prevented 1.25 million hospitalizations in the United States.^[7] Yet, COVID-19 vaccination rates remain suboptimal, and overall routine immunization rates have declined in the United States during the pandemic.^[8-10] Concerns on vaccine safety and efficacy are

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often cited as reasons why individuals will not receive a COVID-19 vaccine and/or other commonly recommended vaccines.^[10-12]

The reasons why individuals choose not to vaccinate are complex. Research has shown that perceptions of trustworthiness related to health information can significantly impact health behaviors.^[13] Health professionals are often cited as the most trusted source of vaccine information and play a fundamental and direct role in promoting vaccination.^[4,10,13-16] Additionally, health professionals with greater knowledge on vaccines are more likely to engage in dialogue with patients on the topic of vaccinations and make a strong vaccine recommendation. Such behavior can increase vaccine confidence and acceptance.^[17-19]

Research has shown that future and currently practicing health professionals are unprepared to address patient-related questions and concerns regarding vaccines. This can be contributed to lack of knowledge on the topic, confidence in their individual abilities, and strategies to address the vaccine conversation, all of which may lead to an absence of vaccine recommendation to patients and their caregivers.^[20-24] Health professional training programs have noted that students could benefit from additional education related to risks and benefits of vaccination, vaccine safety, and how to address vaccine hesitancy.^[16,20,22,25-30]

Education and training can equip future health professionals with strategies and tools to address vaccine-hesitant patients and caregivers.^[31] Once a health professional has an established practice, it is challenging to change their behaviors. Thus, students are an important target for education on this topic as they are still developing their skills and are open to changing their habits.^[32,33] There is a paucity of data exploring the training and education health professionals receive regarding vaccination and addressing hesitancy. What studies have been conducted suggest that training related to vaccination can improve students' knowledge and confidence in addressing vaccine hesitancy.^[18,21,23,24,34] However, most of these studies have primarily targeted medical students, and little has been done to address other disciplines that may also have a significant impact on patients' perceptions of vaccine safety and necessity.^[18,31,34] Pharmacists are increasingly acting as vaccine providers, and nurses are often the first health professionals patients may interact with during the medical encounter.^[35,36] More research is needed on the impact of educational programs designed to address all health professional students' vaccine-related knowledge, confidence in discussing various topics related to vaccine administration, and hesitancy.

METHODS

The objective of this study was to assess the impact of a virtual education program on health professional students' vaccine-related knowledge, vaccine-hesitant

attitudes, and confidence in addressing vaccine-related topics with patients and caregivers. Additionally, the education sought to provide students with tools and strategies for conversations with vaccine-hesitant parents and caregivers.

This educational intervention was conducted with health professional students in higher education institutions in the state of North Dakota. All institutions that housed nursing, pharmacy, or medical programs in the state were invited to participate in the virtual educational program offered by the North Dakota State University Center for Immunization Research and Education (NDSU CIRE). The study was approved by the NDSU Institutional Review Board (IRB), and all participants provided their informed consent before participating in the research. The hypothesis of this cohort study was virtual education program would increase student knowledge on, decrease hesitant attitudes about, and increase confidence discussing vaccine-related topics.

Educational intervention

The virtual education was developed by the NDSU CIRE for staff, who have extensive expertise in vaccine safety and efficacy and tools to address vaccine hesitancy. Topics were selected based on previous research conducted within the state to determine what vaccine-related topics and themes should be addressed in the curriculum.^[23] The intervention was designed in accordance with previous research in the field, specifically addressing what is desired for health professional vaccine education.^[22,23]

The education had three main objectives. The first objective was to increase vaccine knowledge, specifically knowledge related to vaccine development, licensure, and safety monitoring processes. The second objective was to address students' vaccine-hesitant attitudes. The third objective was to increase students' confidence in addressing vaccine-hesitant messages. Two unique communication strategies were introduced to students to address patients' and caregivers' vaccine-related questions and concerns. The designed three-hour education included lecture content, case studies, role-playing, discussions, and question and answer sessions. In addition, the authors provided supplemental resources addressing communication strategies (C.A.S.E. Approach and Motivational Interviewing), immunization schedules, and interactive course notes.^[37]

At the beginning of the 2020–2021 academic year, all health professional programs across the state of North Dakota were contacted and invited to participate in the virtual education. This included 14 nursing programs, 1 medical school, and 1 school of pharmacy. Health professional program participation was completely voluntary and free of charge to participants. The

educational offering was developed and provided from a grant from the North Dakota Department of Health. Programs were contacted through an email invitation, and interested health professional programs coordinated with the NDSU CIRE team to choose dates and times that worked within their schedules. All education was delivered between the fall of 2020 and the spring of 2021.

Survey development

To measure the impact of the virtual educational intervention, a survey was developed and distributed before and after the virtual education was given. The survey included questions to assess students' knowledge (12 questions), individual hesitant attitudes (11 questions), and confidence in addressing patients' and caregivers' vaccine-related questions (9 questions). Survey questions were designed from previously published and validated tools.^[22,28,37-39] The survey is available from authors upon request.

Before completion of the educational program, the pre-survey was distributed to the participating health professional students. Students were asked to create a unique identifier to track students' survey responses pre- and post-training. Initial pre-survey questions collected demographic information, such as students' age, gender, health professional program, and associated year, along with questions assessing students' perceptions on how well their health professional programs addressed vaccine-related topics within their curriculum (5 questions).

Immediately following the virtual education, students were asked to complete a post-survey using the same unique identifier used in the pre-survey. Post-survey questions used the same questions as the pre-survey in addition to questions seeking students' opinions and feedback on the value and benefit of the virtual education. Although completion of the surveys was highly encouraged, it was not a requirement.

Descriptive statistics were used to evaluate questions related to students' assessment of their program's vaccine-related education and their general satisfaction with the NDSU CIRE virtual education. These data were

presented in the form of percent agreement. The overall data set was reduced to those with pre-post-matched responses to measure the programmatic and individual change in knowledge, hesitant attitudes, and confidence in addressing patients' and caregivers' vaccine-related questions. Hesitancy and confidence questions were assigned scores between 1 to 5 based on the Likert scale (strongly disagree = 1 to strongly agree = 5) for each category to take the mean score for each question. Knowledge questions were assessed based on the number of questions answered correctly. A paired *t*-test was used to determine the mean change values between pre- and post-intervention mean scores. Statistical significance was determined with a *P*-value < 0.05.

RESULTS

Throughout the 2020–2021 academic year, 8 out of the 14 state nursing programs and both the medical school and school of pharmacy agreed to participate in the virtual education. From those programs, 178 pharmacy students, 137 medical students, and 247 nursing students completed the pre-survey, representing 100%, 97%, and 84% of each health professional group, respectively. Of those, 76.6% were in the age group between 18–24 years, 72% of participants were female, and 26.5% were male.

Overall, participants perceived their respective health professional programs were providing adequate training related to vaccines [Table 1]. Students across all health professional programs acknowledged gaps in their vaccine curriculum, most notably training on the vaccine testing and approval process and how to communicate with vaccine-hesitant patients/caregivers.

In total, 26 medical students (18%), 63 pharmacy students (34%), and 152 nursing students (52%) had paired pre/post-survey responses to measure changes in confidence, individual hesitancy, and knowledge before and after delivery of the educational intervention [Table 2]. There was a significant increase (*P* < 0.05) in confidence and knowledge for each health professional student group. There was a significant decrease (*P* < 0.05) in vaccine-hesitant attitudes with nursing students, but there was no

Table 1: Health professional students' assessment of current education related to vaccines within their respective discipline

	Medicine % positive agreement	Pharmacy % positive agreement	Nursing % positive agreement	Total % positive agreement
Assessing health professional program training and education (pre-training survey)				
My health profession education program includes adequate training and/or education in:				
Vaccine-preventable diseases	85%	97%	86%	89%
How vaccines work	85%	97%	83%	88%
The safety of vaccines	81%	97%	83%	87%
Vaccine testing and approval process	47%	83%	54%	62%
How to communicate with vaccine-hesitant patients/caregivers	56%	78%	63%	66%

Table 2: Change in confidence, hesitancy, and knowledge among pharmacy, nursing, and medical students who completed the pre- and post-intervention surveys

	Paired <i>t</i> -test value (pre/post-survey)	95% confidence interval	<i>P</i> -value
Medical (<i>n</i> = 26)			
Confidence	6.63	(0.5675 to 1.0787)	<0.001
Hesitancy	1.93	(-0.0099 to 0.3099)	0.06
Knowledge	3.56	(0.0779 to 0.02913)	<0.001
Pharmacy (<i>n</i> = 63)			
Confidence	5.15	(0.3107 to 0.7049)	<0.001
Hesitancy	1.63	(-0.0178 to 0.1731)	0.108
Knowledge	4.31	(0.0941 to 0.2570)	<0.001
Nursing (<i>n</i> = 152)			
Confidence	13.16	(0.7267 to 0.9836)	<0.001
Hesitancy	6.03	(0.2095 to 0.4136)	<0.001
Knowledge	5.64	(0.1003 to 0.2086)	<0.001

significant change among medical and pharmacy students. The greatest overall change in all three categories was seen with the nursing students.

When further analyzing each category by the question, it was apparent that pharmacy students and medical students already had low vaccine hesitancy [Table 3]. Therefore, there was not as much growth within most topics for these disciplines on this topic. However, students from all three professional programs showed significant growth in agreement that their strong recommendation for a vaccination will impact a patient's decision on whether or not to vaccinate.

All health professional programs had significant growth when comparing pre- and post-training knowledge scores. High scores reflected greater vaccine-related knowledge. Pharmacy students had the highest mean scores both pre- and post-training, followed by medical and lastly nursing student scores [Figure 1]. When assessing specific knowledge-related questions by health professional program, all three student groups showed significant growth in two questions assessing students' understanding of the hierarchy of evidence. These questions assessed students' ability to interpret data and understand the vaccine development and regulatory process related to the COVID-19 vaccine. Both pharmacy and nursing students had significant growth in a question assessing data and causal relationships when interpreting a fictional case related to intussusception and the rotavirus vaccine.

Overall satisfaction with the program was high, with 92% of respondents stating they would recommend the education they received to other health professional programs. Similarly, 92% of post-survey respondents stated that they intended to use the communications strategies learned in the virtual education to address vaccine-hesitant patients and caregivers in the future as health professionals.

DISCUSSION

The objective of this study was to assess the impact of a virtual education program on health professional students'

vaccine-related knowledge, vaccine-hesitant attitudes, and confidence in addressing vaccine-related topics with patients and caregivers. Overall, all three health professional programs showed statistically significant growth in knowledge and confidence. This is important as health professionals are often cited as the most trusted source of vaccine information.^[10,13,16,40] Our study found similar results to other health professional vaccine education programs in relation to the growth in knowledge.^[23,31,34]

Pharmacy and medical students did not see a statically significant decrease in hesitant attitudes. Yet, when looking at the individual questions, it was apparent that they already had low vaccine hesitancy. Although there was not a statistically significant change in vaccine hesitancy within these two groups, all three health student groups showed a statistically significant change in believing their strong recommendation for a vaccination will impact a patient's decision on whether or not to vaccinate. This is noteworthy because health professional students who recognize the influence of their recommendation increase patient vaccine confidence and acceptance.^[17,18]

There was also a significant growth in knowledge among all three health professional student disciplines. Knowledge-based questions assessed basic principles of immunizations and interpreting research. It is critical that physicians, pharmacists, and nurses have the skills and knowledge to address patients' vaccine-related questions. In addition, a health professional's vaccine awareness and knowledge has been shown to be directly related to their willingness to recommend vaccination.^[20] Although there was a significant gain in knowledge for all three health professional groups when comparing pre- and post-training scores, when assessing solely post-training scores, none gained an overall percentage correct over 70%, a standard benchmark. This was mainly because there were a few questions that decreased the total average, specifically knowledge questions that required more clinical reasoning. The authors recognize that this finding needs to be further investigated.

Table 3: Mean changes in individual questions assessing confidence and hesitancy before and after the virtual education among health professional student disciplines

Medical	Pharmacy	Nursing
Pre/post-mean average; P-value	Pre/post-mean average; P-value	Pre/post-mean average; P-value
<i>Questions assessing student confidence in discussing various topics related to vaccines</i>		
I am confident discussing with a patient the benefits of vaccines. 3.87/4.33; P = 0.0021	4.30/4.63; P = 0.0232	3.80/4.36; P ≤ 0.0001
I am confident discussing with a patient the risk of vaccines. 3.28/4.12; P ≤ .0001	4.04/4.44; P = 0.0005	3.48/4.25; P ≤ 0.0001
I am confident establishing ongoing dialogue about vaccines with a patient. 3.76/4.21; P = 0.0041	4.09/4.52; P ≤ 0.0001	4.54/4.28; P ≤ 0.0001
I am confident discussing patient's concerns about the safety of vaccines. 3.64/4.24; P = 0.0003	4.13/4.48; P = 0.0022	3.70/4.43; P ≤ 0.0001
I am confident discussing patient's concerns about the effectiveness of vaccines. 4.01/4.39; P = 0.0007	4.38/4.62; P = 0.0937	3.80/4.44; P ≤ 0.0001
I am confident discussing patient's concerns about vaccines and autism. 4.20/4.64; P = 0.0054	4.50/4.56; P = 0.7917	3.73/4.52; P ≤ 0.001
I am confident discussing patient's concerns about vaccines and whether or not they overwhelm the immune system 3.78/4.52; P = 0.0012	4.21/4.59; P < 0.0001	3.39/4.47; P ≤ 0.0001
I am confident discussing patient's concerns about vaccines and whether or not they cause chronic auto-immune disease. 3.23/3.94; P = 0.0005	3.89/4.35; P < 0.0001	3.12/4.32; P ≤ 0.0001
I am confident discussing with a patient the risk of vaccine-preventable diseases 3.93/4.36; P = 0.01112	4.40/4.68; P = 0.0080	3.83/4.49; P ≤ 0.0001
<i>Hesitancy: Assessing student hesitancy related to vaccination</i>		
Routine childhood vaccines are safe. 4.89/4.97; P = 0.3269	4.85/4.77; P = 0.4186	4.60/4.82; P = 0.2051
For a majority of the population, the protective benefits obtained from vaccinating outweigh the possible risks that may occur as a result of vaccinating (e.g. adverse events, side effects). 4.96/4.97; P = 1.00	4.87/4.92; P = 0.8433	4.53/4.77; P = 0.0867
For some infections (e.g. Chicken Pox, Measles, etc.), immunity from natural (wild type) infection is preferred over vaccination* 2.01/1.52; P = 0.4505	2.08/1.73; P = 0.0241	2.59/2.62; P = 0.1808
The current number of recommended childhood vaccines, when received in accordance with the ACIP and the CDC recommended schedule, place an undue burden on a child's immune system* 1.53/1.33; P = 0.7835	1.74/1.44; P = 0.0455	2.36/2.27; P = 0.9547
State and local vaccination requirements for school and daycare entry are an over-reach of government. These decisions should be left up to parents alone* 1.55/1.53; P = 0.3269	1.92/1.73; P = 0.8976	2.32/2.44; P = 0.0272
Parents and caregivers should have the right to request non-medical exemptions (philosophical and/or religious exemptions) from state and local vaccination requirements for school entry* 2.31/2.18; P = 0.8615	2.75/2.46; P = 0.1417	2.99/3.10; P = 0.0073
Spreading out recommended vaccines over several visits versus following the ACIP and the CDC recommended vaccine schedule is an acceptable approach to reducing parental stress about vaccinating* 2.89/1.82; P ≤ 0.0001	3.17/3.07; P = 0.0147	3.25/3.43; P = 0.0403
As a health professional, I believe that I am responsible for advocating the benefit of vaccines and educating patients on the diseases they prevent. 4.83/4.91; P = 0.6636	4.81/4.93; P = 0.0582	4.56/4.65; P = 0.9073
As a health professional, I believe that my strong recommendation for a vaccination will impact a patient's decision on whether or not to vaccinate. 4.40/4.79; P = 0.0094	4.40/4.79; P = 0.0001	P = 3.97/4.61; P ≤ 0.0001
Annual influenza vaccines should be mandated for health care workers. 4.57/4.67; P = 0.1154	4.29/4.46; P = 0.2033	3.85/4.25; P = 0.0003

ACIP = Advisory Committee on Immunization Practices, CDC = Center for Disease Control and Prevention. *Inverse relationship (low mean means lower hesitancy)

Overall, before the educational intervention, health professional students felt their program adequately covered topics on vaccine-preventable disease, how vaccines work, and

the safety of vaccines. Only 66% of students stated they were adequately trained on how to communicate with vaccine-hesitant patients/caregivers, and only 62% felt they were

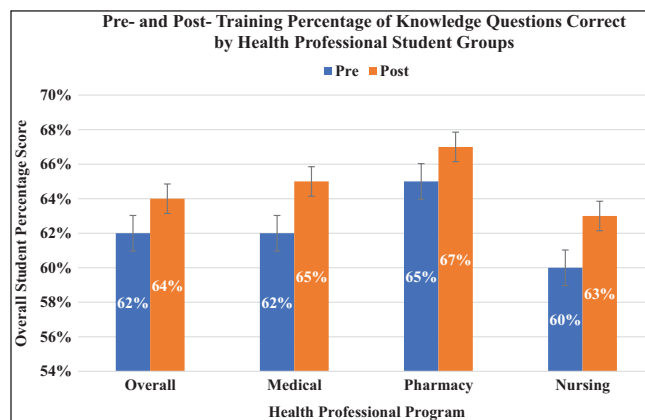


Figure 1: Comparison of pre/post knowledge scores based on the percentage of questions answered correctly by health professional groups and overall. *The difference in percentage knowledge scores were significant with a P -value < 0.05 for each professional group

adequately educated on the vaccine approval process. This highlights a need for more education on these topics for future health professionals. Because we did not ask the participants about their perceptions of vaccine-related education after the education intervention, we are unable to determine if the information provide caused a change in perception.

Overall, participating students showed strong satisfaction with the virtual education. Providing the education virtually saved time and resources that would be devoted to travel and in-person delivery. In addition, statistically significant changes were seen within all health professional student groups, although the entire education was presented and experienced virtually. This could be considered for future institutions that integrate multiple health professional disciplines, for institutions could integrate education with multiple disciplines simultaneously.

There were some limitations to our study. First, our study took place within only one state in the United States. In addition, we were only able to study one pharmacy and medical program. Although we provided our education to a significant number of health professional students, limited matched pre/post-surveys caused a decrease in sample size, and we did not provide a control group. Finally, we are unable to determine if our educational intervention will have long-term effects and influence future patient/health professional relationships. Future research is needed on the long-term effects of vaccine educational programs.

CONCLUSION

The development of a virtual educational program allowed the ability to provide education to multiple programs and multiple disciplines. In addition, each program showed a statistically significant change, which could lead to a strong vaccine recommendation in the future.

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Conflicts of interest

There are no conflicts of interest.

Author contributions

All authors have contributed in three components of concept and design, acquisition of data and interpretation of data, drafting of the article and revising it, and final approval prior to submission for publication.

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