Student Nurse Knowledge and Confidence Regarding Childhood Immunizations

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Student Nurse Knowledge and Confidence
Regarding Childhood Immunizations

Heather Westergard

A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of
Masters of Science

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ABSTRACT

Student Nurse Knowledge and Confidence Regarding Childhood Immunizations

Heather Westergard
College of Nursing, BYU
Master of Science

Background: Immunization training is essential for nursing students. However, Brigham Young University’s (BYU) Nursing Program lacks data regarding the current curriculum’s effect on vaccination knowledge and confidence.

Purpose: The purpose of the study is to explore BYU nursing students' knowledge and confidence regarding vaccinations.

Methods: Nursing students at BYU in the second and fourth semesters were surveyed using pre-and post-test questionnaires designed to measure student nurses’ knowledge of and confidence about immunizations. To help evaluate current curricula established immunization content was taught during both the public health course and pediatric course via direct instruction, assigned reading, quizzes, exams, lab, and simulation experiences. Curriculum content varied between a public health course and a pediatric course. Data were collected at the beginning and end of the fall semester of 2019.

Results: Seventy-seven students completed both pre and post-assessment questionnaires. After education, students' ability to identify pediatric immunizations increased for several vaccines. Students were more likely to seek evidence-based sources of vaccination information. Students’ knowledge of correct biohazard waste disposal and confidence in their ability to administer vaccinations also increased. Additionally, several gaps were identified regarding specific guidelines for vaccination storage, preparation, and administration.

Discussion: The data from this study showed several gains and gaps in student knowledge. Student nurses in this study were similar in immunization knowledge and performance to student nurses in current vaccination knowledge literature.

Nursing Applications: Nursing faculty can implement immunization education into current curriculum by assessing student knowledge, repeating exposure to immunization content in multiple courses, and utilizing simulation for students to practice challenging immunization conversations.

Conclusion: The understanding gained in this study could facilitate positive changes in nursing faculty members’ ability to provide exceptional education and produce knowledgeable, confident, and prepared nurses to address vaccination concerns.

Keywords: students, nursing, faculty, vaccination, curriculum, vaccines, pediatric
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Student Nurse Knowledge and Confidence Regarding Childhood Immunizations

Since their development, vaccinations have extended life expectancy and improved global health (World Health Organization [WHO], 2013, 2020). The ongoing SARS-CoV-2 pandemic has drawn international attention to vaccinations and life-threatening vaccine-preventable diseases (VPD). Prior to the SARS-CoV-2 pandemic, the World Health Organization (WHO) estimated that vaccinations prevented between 2-3 million deaths each year (WHO, 2019a, 2019b). VPDs have a significant impact on global mortality rates. Although vaccines have significantly decreased and even eradicated VPD, many people view vaccinations with uncertainty and mistrust. Hesitation to receive vaccinations is a growing international concern and can dramatically increase VPD morbidity and mortality. As a result, the WHO has identified vaccination hesitation as one of the top ten public health threats (WHO, 2019b).

The rise in vaccination hesitation has placed greater importance on healthcare providers (HCPs) as immunization advocates. HCPs have been identified as a driving force for vaccination administration, patient/caregiver education, and a pivotal role in reaching and sustaining optimal immunization coverage (Vorsters et al., 2010). Recommendations from HCPs have been identified as an influential factor in patients' and caregivers' immunization decisions (Larson et al., 2018). Parents’ questions regarding potential adverse effects and general benefits of immunizations, as well as apprehension in following recommended vaccination schedules, have become more common (National Vaccine Advisory Committee, 2015). As a result, many patients or caregivers seek reliable vaccination recommendations from their HCPs.

A caregiver’s decisions to vaccinate can also be influenced by perceived reliability in immunization information, trust in a provider, as well as a provider's attitudes towards
vaccination (Larsen et al., 2018, Vorsters et al., 2010). Future HCPs will be at the center of addressing patients’ vaccination concerns. Thus, student nurses (SNs) must be educated and prepared to advocate for immunizations confidently. SNs must understand immunization misinformation and be prepared to address vaccination concerns, and confidently provide patients with accurate information (Wilson et al., 2020).

As future frontline HCPs, SNs have the potential to promote preventative medicine and champion public health initiatives, such as immunizations. However, their potential could be limited if they lack accurate and adequate knowledge. In many nursing programs, vaccination training is spread over several courses and semesters. Little is known regarding a curriculum’s effect on student vaccination knowledge and confidence. Understanding how current education influences immunization knowledge and confidence in nursing students at one western university may help instructors adjust educational material to better prepare students as vaccination advocates. The purpose of the study is to explore vaccination knowledge and confidence levels of undergraduate nursing students before and after taking either the public health course or the pediatric course.

**Research Questions**

1. What are gaps and gains in student nurse immunization knowledge before and after education?
2. What are student nurse confidence levels regarding immunizations before and after education?

**Method**

Students were given an identical pre and post questionnaire designed to measure immunization knowledge and confidence. Each questionnaire was estimated to take 10 minutes
to complete, for a total of 20 minutes. Data were collected approximately 14 weeks apart, at the beginning and end of the fall semester of 2019. Each participant was compensated with a full-size candy bar when attending the first meeting and final meeting. Additionally, participants who complete both questionnaires were entered into a drawing for either a $25 or $50 Visa gift card. Participants put names on both pre and post-questionnaires to match responses. Institutional Review Board approval was obtained before data collection.

**Setting and Participants**

Potential participants were students in two separate cohorts in a public health course taken in the second (of six) semester of the nursing program (n= 64) and students in a pediatric course taken in the fourth semester of the nursing program (n=64). All students who were currently enrolled in those courses were eligible to participate in this study. Established immunization curriculum was taught in both the public health course and pediatric courses via online modules, readings, direct instruction, classroom discussions, lab/simulation performance, and exams.

Curriculum content varied between the public health course and pediatric courses. Content in the public health course was limited to preparation assignments and one (2-hour) lecture. Topics covered in the public health course included a brief overview of the following topics: vaccine-preventable diseases, principles of immunity, vaccine development, types of vaccines, vaccine information- CDC schedule, VAERS, vaccination barriers, legal issues, and nurses’ professional responsibility to keep current with immunizations. Additionally, during the second-semester simulation and lab instruction included no need to aspirate for immunizations, no need to hold for 5-10 seconds before withdrawing the needle for immunizations, no need to z-track for immunizations not necessary to wear gloves (unless required by site policy).
Immunization content presented during the pediatric course included vaccine information-CDC schedule, the process of consent for immunization, risks associated with immunizations, and introduction that some children might need be on an alternate schedule. Students in the fourth semester also participated in simulations and labs that were immunization-focused and completed two pre-sim assignments for children of different ages to utilize the CDC schedule.

**Instrument**

The search for an established and valid instrument for this study was unsuccessful. Hence, a questionnaire was created for this study. The questionnaire consisted of seven demographic questions, two check-all-that-apply questions to identify evidence sources and identify CDC recommended vaccines, 14 multiple-choice or true-false knowledge questions, and eight Likert-style confidence questions on a 6-point scale (strongly disagree to strongly agree). Content for questions was based on current literature and information from the Centers for Disease Control and Prevention (CDC) guidelines. Content experts reviewed the questionnaire for content and format. After editing per experts’ advice, a small pilot group of nursing students took the questionnaire. Per pilot feedback, no changes were made to the questionnaire.

**Results**

Due to the descriptive nature of this study, power and sample size analyses were not conducted. The sample size was estimated to include as many participants as were in each eligible semester, N=128. Our sample included 71 students for a response rate of 55%. Demographic and nominal data were analyzed using descriptive statistics. Pre/post ordinal data were analyzed using a Wilcoxon signed-ranked test. No statistical differences were found in knowledge or confidence between groups; hence, data were combined for analysis.
Gaps and Gains in Student Nurse Immunization Knowledge

Students were asked what sources they used to access information about vaccines at pre-test and post-test. Differences in student selections at pre-test and post-test were analyzed using McNemar’s test for paired dichotomous data. Sources of information and results for McNemar tests are reported in Table 1. Student selections of most sources demonstrated only minor differences, except significantly fewer students selected parents/family/friends as a source for vaccine information at post-test.

Students were asked to indicate which vaccines the CDC recommends for children at pre-test and post-test. All vaccines on the students' list were on the CDC’s Birth-18 Years Immunization Schedule and should have been selected by the students. Differences in student selections for individual vaccines at pre-test and post-test were analyzed using McNemar’s test for paired dichotomous data. The number of students who selected each vaccine and the results of McNemar tests are reported in Table 2. Fewer than half of the participants selected PCV13, Meningococcal B, and PPSV23 as recommended pediatric vaccines at pre-test. Significantly more students correctly selected several vaccines at post-test compared to pre-test, including Hib, VAR, and HPV. The total number of correct vaccines selected by each student was summed at pre-test and post-test. Differences in the number of total correct selections between the two time points were compared using paired t-tests. The results for the paired t-test are reported in row 1 of Table 3. Students scored higher at post-test. While the result was statistically significant, the mean score only went from 10.24 correct to 10.94 correct. Descriptive statistics for the t-test are reported in row 1 of Table 4.

Students were asked general knowledge questions about pediatric vaccinations and asked to select correct options. Differences in student selections at pre-test and post-test were analyzed
using McNemar’s test for paired dichotomous data. There were some general knowledge choices that fewer than half of students correctly selected at pre-test: those questions included how to prepare vaccines, if gloves are required during vaccination administration, and if vaccinations should be administered during a mild illness. Significantly more students correctly selected several general knowledge items at post-test compared to the pre-test. The topics included glove requirements, no need for aspiration, if multiple vaccines can overwhelm the immune system, appropriateness of vaccination during a mild illness, and whether the flu vaccine can cause influenza. The number of students who correctly selected each option and the results of McNemar tests are reported in Table 3. Descriptive statistics for the t-test are reported in row 2 of Table 4.

**Student Nurse Confidence Levels Regarding Immunizations**

Students were asked to rate their confidence in several areas regarding vaccines and vaccine administration. The questions about confidence are reported in rows 2 – 9 in Table 5. Students rated confidence on a level of strongly disagree (1) to strongly agree (6). Means of pre-test and post-test responses were compared using paired t-tests. Results of the pre-post comparisons on confidence questions are reported in rows 3 – 10 of Table 6. Mean scores at post-test were higher than mean scores at pre-test for all questions. The differences for six of the eight questions were statistically significant. Comparisons that demonstrated a small effect size (Cohen’s $d < 0.4$) included questions about their comfort having differing opinions from family and friends, comfort discussing differing opinions, and feeling knowledgeable about biohazard waste disposal. Comparisons that demonstrated a medium effect size for the difference (Cohen’s $d > 0.4$ but $< 0.7$) included comfort in obtaining accurate information about vaccines and feeling knowledgeable about how vaccines work in the body. Comparisons that demonstrated a large
effect size (Cohen’s $d > 0.7$) included confidence in knowledge of childhood vaccines, confidence in ability to administer a vaccine, and confidence in ability to educate parents about childhood vaccines. Descriptive statistics for paired t-tests are reported in Table 4.

**Discussion**

This study’s investigation into how one nursing program's public health and pediatric curriculum influences student nurse immunization knowledge and confidence revealed several knowledge gains and gaps and significant increases in SN confidence levels. However, several findings indicate a disconnect between students’ confidence in their immunization knowledge and knowledge application. We noted no significant differences between students beginning the second and students beginning the fourth semesters. This could be attributed to the approximately 8-month lapse in completing the second-semester classes and the beginning of the fourth-semester classes. Students may need more repetition of immunization content within and between courses to help bridge this gap.

**Gaps and Gains in Student Nurse Immunization Knowledge**

**Sources of Information**

Participants selected “evidence-based electronic sources,” “textbooks,” and “healthcare providers” as primary sources of immunization information. These findings are consistent with knowledge-seeking behavior and resource use in other student nurses and recently graduated nurses. Electronic resources were reported as the most common information source, with print materials and health professionals as other common resources (Wahoush & Banfield, 2012). Additionally, Lam et al. (2020) found that recent graduate nurses' transitioning to practice used Google as the predominant search engine to find electronic information. Student nurses may also use Google as a primary search engine as they transition to practice. The ease of finding
misinformation and non-evidence-based information via a simple internet search is cause for alarm. However, the data from our study indicate that fewer than one-fifth of SNs selected “other electronic sources” for vaccination information after education. These findings may show that our nursing program’s current immunization curriculum positively impacts and increases SNs seeking evidence-based immunization information sources.

Yörük (2020) found a correlation between healthcare students' vaccination hesitation and negative vaccination attitudes of relatives and friends. Our study found a statistically significant decrease in student nurses using parents/family/friends as sources of vaccine information after vaccination education. However, SNs in this study did not feel more comfortable having a different opinion than family or friends regarding vaccinations after education. Additionally, SNs didn’t feel more comfortable discussing differing immunization opinions. This finding may represent a gap in this nursing program's vaccination education, and an increased emphasis on advocating for vaccination and having difficult conversations may be needed.

**Identification of CDC Recommended Pediatric Vaccines**

There were gains in SN's ability to identify CDC-recommended pediatric vaccination in post-testing. The vast majority of students correctly identified MMR, DTaP, Tdap, influenza, VAR, Hepatitis B, and human papillomavirus (HPV) as recommended vaccination after education. Additionally, statistically significant increases were noted in post-education with more SNs correctly identified haemophilus influenzae type B (Hib), VAR, and HPV as CDC recommended pediatric vaccinations.

While the study showed gains in knowledge, there were notable gaps in student knowledge of pneumococcal vaccines. Few students correctly identified pneumococcal vaccine 23 (PCV23) as a recommended vaccination for children, and less than half of students correctly
identified pneumococcal vaccine 13 (PCV 13) as a pediatric vaccination. Similarly, Nikula et al.
(2011) report that approximately half of graduating public health nursing students were able to
identify the names of vaccines against communicable diseases. However, Nikula et al. (2011) did
not break down the specific names of vaccines, so it is challenging to correlate their findings
with the current study findings.

Knowledge Questions about Pediatric Vaccinations

Several gaps were identified regarding specific guidelines for vaccination storage,
preparation, and administration. Best practice vaccination storage recommendations include
storing vaccines in their original packaging at the correct temperature and monitoring and
maintaining room, refrigeration, and freezer temperature within specified ranges (National
Center for Immunization and Respiratory Diseases 2020). Our study found no statistically
significant improvement in knowledge regarding vaccination storage guidelines, and nearly half
of the students lacked knowledge on both the pre and post-test.

Additional gaps in knowledge centered on the preparation of immunizations for
administration. The CDC recommends the vaccine administrator should first perform hand
hygiene with either alcohol-based hand sanitizer or soap and water before preparing vaccines.
Following the vaccine manufacturer's directions, the vaccine administrator can prepare the
vaccine in a designated distraction-free medication preparation area. Each vaccine should be
drawn up in a separate needle and syringe. When giving a vaccine, another nurse or physician
has prepared it, and the administrator should double verify its contents before administrating it
(Wolicki & Miller, 2020). Nikula et al. (2011) found that greater than three-quarters of
graduating public health nurses showed competence in preparing vaccinations. Only one-fourth
of SNs at our university correctly identified steps for preparing immunizations after education, illuminating a significant gap in SN knowledge.

A third knowledge gap is related to giving multiple shots. If a child receives more than three shots in one visit, the CDC recommends that injection sites be separated by at least 1 inch. Multiple vaccines should be injected into the thigh/vastus laterals in younger children and the deltoid for older children. One of the reasons for this recommendation is in the case of localized vaccination reactions when a separation in vaccine sites can help differentiate the cause of the reaction (Wolicki & Miller, 2020). The SNs in this study showed no significant increase in knowledge after education, with two-thirds of students correctly identifying the recommended distance between multiple injections.

At the time of this study, gloves are not required for vaccination administration if there is minimal risk for contact with body fluids and no open lesion on the vaccine administrator’s hands. The CDC’s guidelines have been slightly changed during the SARS – Covid 19 pandemic to recommend wearing gloves when administering oral or intranasal vaccines (Wolicki & Miller, 2020). Although there was significant growth in student knowledge, this study found that only half of SNs could identify the current guidelines for wearing gloves while administering vaccinations after education. Compared to another study where greater than three-quarters of graduating public health nurses' showed knowledge of vaccination administration aseptic practices, the SNs’ knowledge in our study is lacking (Nikula et al., 2011).

A common misconception is that pediatric immunizations should not or cannot be given to children with a mild illness, such as a low-grade fever, cold, cough, rhinorrhea, acute otitis media, and/or mild diarrhea (CDC, 2019). After receiving vaccination education, approximately one-third of student nurses at our university correctly identified CDC’s recommendation
regarding vaccination administration to children with a mild illness or fever. Although statistically significant, only 26 students answered this question correctly, showing a sizeable gap in vaccination knowledge. Dybsand et al. (2019) found that nursing lacked the most knowledge regarding immunizations and mild illness compared to other healthcare professional students. They reported that one-third of BSN students were able to identify the correct answer.

Surprisingly, one of the largest knowledge gaps identified in this study was student understanding of influenza’s transmission methods from human to human. It was also the only area the study found a statistically significant decline in knowledge after vaccination education. In addition to a decline in knowledge, approximately half of students chose incorrect modes of transmission on the post-test. The decrease in knowledge of influenza transmission found in this study is unprecedented and difficult to justify.

The CDC no longer recommends aspiration with intramuscular vaccination administration. Injection aspiration was recommended to potentially decrease tissue distention, injection pain, intravenous vaccination administration, and injury (Wolicki & Miller, 2020). More SNs correctly identified the CDC’s current recommendation that aspiration is not needed with-vaccination administration after receiving education.

Knowledge regarding evidence linking vaccinations with chronic conditions represented ceiling knowledge in our study, with nearly all students correctly identifying immunization safety. Similarly, in current literature, nearly all public health nursing students and BSN nursing students correctly identified that no scientific evidence supports a connection between vaccines and chronic conditions, autism, and multiple sclerosis (Dybsand et al., 2019; Nikula et al., 2011). However, Pelly et al. (2010) found that approximately one-quarter of BSN students believed there were connections between immunizations and chronic conditions, autism, and multiple
sclerosis. This study also showed that nursing students' knowledge lagged compared with medical and pharmacy students (Pelly et al., 2010).

Our study showed a statistically significant increase in SN knowledge, with greater than three-quarters of students correctly identifying that vaccines do not overwhelm a child's immune system. These results show that understanding concerning pediatric vaccinations and immune system overload is greater in nursing students at this university after education when compared to nursing students in previous studies (Dybsand et al., 2019; Pelly et al., 2010).

After education, more SNs in this study understood that the influenza vaccine can cause an immune response but does not cause influenza. However, almost 20% of students in the present study incorrectly thought that you can get influenza from the influenza vaccine. In comparison, nearly 40% of nursing and midwife students either partially or totally agreed that the influenza vaccine can cause influenza (Mellucci et al., 2020).

Our findings indicate several noteworthy discrepancies between SNs’ confidence and knowledge. Overall, there was a significant improvement in SNs' confidence regarding their vaccination knowledge and less improvement on knowledge-based questions. Similarly, Nikula et al. (2011) found a weak correlation between student’s self-assessment of knowledge and competence and results of a knowledge test, with most nursing students overestimating their immunization competence and knowledge.

**Student Nurse Confidence Levels Regarding Immunizations**

Nurses are central to patient immunization education. Hence, SNs must prepare to educate and administer vaccinations confidently. The current study’s findings suggest that the immunization curriculum at this nursing program has a significantly positive effect on SNs’ confidence. There was a statistically significant increase in SN’s confidence in their knowledge
of childhood vaccines, knowledge of how vaccines work, ability to administer pediatric immunizations, and knowledge of biohazard waste disposal and bloodborne pathogen regulations.

Wilson et al. (2020), found that approximately half of the undergraduate nursing students agreed or strongly agreed that they could find information to educate parents about immunizations and received sufficient training to teach patients confidently. Likewise, Dybsand et al. (2019) found that less than half of BSN students had a high confidence level when establishing a dialogue about immunizations with patients. In contrast, our study result suggests that current nursing education and curriculum at this western U.S. university significantly increases student nurses’ belief in their ability to provide parents education about childhood vaccinations. Our students also reported seeking evidence-based information sources with a significant decrease in seeking immunization information from parents/friends/family.

Although SNs gained confidence in acquiring and disseminating immunization information, our research showed students were not more comfortable having or discussing differing vaccination opinions. Dybsand et al. (2019) found that BSN students were less likely to agree that education had prepared them to communicate with vaccine-hesitant parents. Moreover, Vorsters et al. (2010) found that less than half of nursing students felt competent in their ability to address anti-vaccine concerns.

With decreased rates of international vaccination and increased vaccination hesitation, there is an increased need to educate future HCPs (WHO 2019). This study’s findings indicate that the current curriculum in this nursing program does not adequately prepare student nurses to address vaccination hesitation or misinformation confidently and highlight the need for additions to the current curriculum that improves SNs’ comfort with difficult conversations.


**Nursing Applications**

Our study confirms the current literature that there is a need to improve immunization curricula for healthcare students and, more particularly, nursing students. Nurse educators are a vital part of the solution to student nurse knowledge and confidence gaps. Nursing faculty can implement immunization education into current curriculum by assessing student knowledge, repeated exposure to immunization content in multiple courses, and utilizing simulation for students to practice challenging immunization conversations.

**Assessment**

Each nursing programs' unique student demographic and curriculum make it impractical to extrapolate this study’s data and apply it to all undergraduate nursing programs. To accommodate their students' knowledge and needs, we suggest that nursing educators assess student immunization knowledge and base instruction on identified gaps. Evaluation of knowledge after vaccination education would help nursing faculty know what information was retained and where persistent gaps remain.

**Reinforcement of Immunization Knowledge**

Repetition in learning has been shown to activate memory formation and is connected to long-term memory retrieval (Zhan et al., 2018). Incorporating immunization content over several courses throughout a nursing program will reinforce immunization knowledge. This integrative approach could be enhanced by reviewing vaccination content from previous classes, allowing the students to refresh prior knowledge before additional information is presented (Aliakbari et al., 2015; Tabibian et al., 2019).

Additionally, various educational methods, such as visual, direct, interactive, simulation, and evidence-based instruction, could increase immunization knowledge and retention. Berenson
et al. (2021) found that student nurses’ knowledge of HPV increased after attending a 45-minute PowerPoint presentation. de Oliveria Costa et al. (2020) found that incorporating simulation into nursing immunization curricula increased SNs’ knowledge and retention shortly after education and 20 days post-education. Costa et al. (2019) also reported that objective structured clinical examinations (OSCE) in immunization education improved nursing student knowledge and performance.

**Including Immunization Conversations in Simulation to Increase Confidence**

Nursing students often lack real-world clinical experience discussing immunizations. Simulation-based education can provide a realistic and safe space for nursing students to gain confidence and practice interacting with parents who express vaccination hesitancy. Chidume et al. (2020) studied a specific curriculum and its effect on preparing nursing students to address patients and families with immunization hesitancy. Students completed the CDC’s web-based training course “You Call the Shots,” read an article, and viewed the corresponding video by Meissonier (2017), “Vaccine Communication with Parents: Best Practices.” Students then engaged in simulation-based experiences with parents seeking immunization information. Post education, greater than 95% of nursing students strongly agreed that they were more confident in communicating with their patients (Chidume et al., 2020). Nold et al. (2019) conducted a semi-scripted simulation in which undergraduate SNs addressed childhood vaccination refusal. Qualitative data after the simulation showed that the students were better prepared to address vaccine hesitancy with parents (Nold et al., 2019). High fidelity simulation regarding pediatric immunizations not only increases SNs’ knowledge but decreases students’ anxiety while increasing self-confidence (Harris, 2013). Integrating similar high-fidelity vaccination refusal
simulation into a nursing programs’ current curriculum could improve SNs’ comfort with difficult conversations and increase SNs’ confidence.

**Limitations**

Like all studies, this study has limitations. This study included a homogenous sample of nursing students from one university in the Western U.S. Only 70-71 nursing students completed both pre and post-questionnaire out of 128 potential participants. The voluntary nature of this study potentially skewed findings by attracting nursing students who viewed vaccination more favorably and felt more confident in their vaccination knowledge. An increased sample size, including other colleges of nursing, would increase generalizability. An additional limitation is due to subjective self-assessment measures. Correlating subjective measures with objective measures, such as simulation and written test performance, would strengthen future studies.

**Future Research**

An area for future research would include repeating an identical pre-test of immunization knowledge and confidence before education with nursing students at the beginning of the public health course and pediatric course. Assessing gaps in knowledge and confidence and adjusting curricula to address the gaps are essential. Additional research could also include replicating studies of high-fidelity simulations that addressed parental vaccination concerns and then comparing changes in student nurse confidence with previously conducted studies.

**Conclusion**

As future frontline healthcare providers, student nurses need to understand and have confidence in recommending immunizations. Student nurses in this study showed gaps and gains in immunization knowledge. Student nurses also showed increases in self-confidence regarding childhood vaccination and administration, confidence finding accurate vaccination information,
and confidence in educating parents about childhood vaccinations. However, there may be inconsistencies between SNs’ confidence and knowledge. Nursing faculty can improve immunization education opportunities by assessing students’ needs and tailoring courses to meet those needs. Faculty can also reinforce immunization information by weaving content throughout a program and providing simulation experiences for students to practice communication skills. As future nurses, well-prepared students can take their place as guardians of health and advocates for immunizations.
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Table 1

*Sources of Vaccine Information*

<table>
<thead>
<tr>
<th>Source</th>
<th># Pre</th>
<th># Post</th>
<th>N</th>
<th>$\chi^2$</th>
<th>df</th>
<th>p</th>
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</thead>
<tbody>
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<td>Print materials (i.e. Red Book)</td>
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<td>21</td>
<td>71</td>
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<td>0.695</td>
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<td>71</td>
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<td>71</td>
<td>1.960</td>
<td>1</td>
<td>0.162</td>
</tr>
<tr>
<td>Textbooks</td>
<td>52</td>
<td>54</td>
<td>71</td>
<td>0.167</td>
<td>1</td>
<td>0.683</td>
</tr>
<tr>
<td>Parents/family/friends</td>
<td>44</td>
<td>30</td>
<td>71</td>
<td>8.910</td>
<td>1</td>
<td>0.003*</td>
</tr>
<tr>
<td>Healthcare providers $^1$</td>
<td>60</td>
<td>60</td>
<td>71</td>
<td>0.000</td>
<td>1</td>
<td>1.000</td>
</tr>
<tr>
<td>Religious leaders</td>
<td>0</td>
<td>1</td>
<td>71</td>
<td>1.000</td>
<td>1</td>
<td>0.317</td>
</tr>
</tbody>
</table>

$^1$ Some individuals answered differently at post.

* Indicates a statistically significant result.
Table 2  
*CDC Recommended Pediatric Vaccines*  

<table>
<thead>
<tr>
<th>Vaccine</th>
<th># Pre</th>
<th># Post</th>
<th>N</th>
<th>$\chi^2$</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotavirus (RV)</td>
<td>36</td>
<td>45</td>
<td>71</td>
<td>2.310</td>
<td>1</td>
<td>0.128</td>
</tr>
<tr>
<td>Diphtheria, tetanus, &amp; acellular pertussis</td>
<td>66</td>
<td>65</td>
<td>71</td>
<td>0.090</td>
<td>1</td>
<td>0.763</td>
</tr>
<tr>
<td>(DTaP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haemophilus influenza type b (Hib)</td>
<td>37</td>
<td>49</td>
<td>71</td>
<td>6.550</td>
<td>1</td>
<td>0.011*</td>
</tr>
<tr>
<td>Pneumococcal conjugate (PCV13)</td>
<td>26</td>
<td>33</td>
<td>71</td>
<td>1.400</td>
<td>1</td>
<td>0.237</td>
</tr>
<tr>
<td>Inactivated poliovirus (IPV)</td>
<td>46</td>
<td>43</td>
<td>71</td>
<td>0.333</td>
<td>1</td>
<td>0.564</td>
</tr>
<tr>
<td>Influenza (IIV)</td>
<td>57</td>
<td>62</td>
<td>71</td>
<td>1.470</td>
<td>1</td>
<td>0.225</td>
</tr>
<tr>
<td>Measles, mumps, rubella (MMR)</td>
<td>71</td>
<td>69</td>
<td>71</td>
<td>2.000</td>
<td>1</td>
<td>0.157</td>
</tr>
<tr>
<td>Varicella (VAR)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hepatitis A (HepA)</td>
<td>53</td>
<td>50</td>
<td>71</td>
<td>0.600</td>
<td>1</td>
<td>0.439</td>
</tr>
<tr>
<td>Meningococcal</td>
<td>56</td>
<td>51</td>
<td>71</td>
<td>1.190</td>
<td>1</td>
<td>0.275</td>
</tr>
<tr>
<td>Tetanus, diphtheria, &amp; acellular pertussis</td>
<td>63</td>
<td>63</td>
<td>71</td>
<td>0.000</td>
<td>1</td>
<td>1.000</td>
</tr>
<tr>
<td>(Tdap)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human papillomavirus (HPV)</td>
<td>54</td>
<td>63</td>
<td>71</td>
<td>4.760</td>
<td>1</td>
<td>0.029*</td>
</tr>
<tr>
<td>Meningococcal B</td>
<td>34</td>
<td>33</td>
<td>71</td>
<td>0.032</td>
<td>1</td>
<td>0.857</td>
</tr>
<tr>
<td>Pneumococcal polysaccharide (PPSV23)</td>
<td>10</td>
<td>15</td>
<td>71</td>
<td>1.670</td>
<td>1</td>
<td>0.197</td>
</tr>
</tbody>
</table>

1 Some individuals answered differently at post.  
* Indicates a statistically significant result.
Table 3
Paired Samples T-Test

<table>
<thead>
<tr>
<th>No.</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>Mean diff</th>
<th>SE diff</th>
<th>Lower</th>
<th>Upper</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-2.26</td>
<td>70</td>
<td>0.027 *</td>
<td>-0.704</td>
<td>0.312</td>
<td>-1.326</td>
<td>-0.083</td>
<td>-0.268</td>
</tr>
<tr>
<td>2</td>
<td>-6.78</td>
<td>70</td>
<td>&lt;.001 *</td>
<td>-0.845</td>
<td>0.125</td>
<td>-1.094</td>
<td>-0.596</td>
<td>-0.804</td>
</tr>
<tr>
<td>3</td>
<td>-4.82</td>
<td>69</td>
<td>&lt;.001 *</td>
<td>-0.457</td>
<td>0.095</td>
<td>-0.646</td>
<td>-0.268</td>
<td>-0.577</td>
</tr>
<tr>
<td>4</td>
<td>-9.03</td>
<td>69</td>
<td>&lt;.001 *</td>
<td>-1.757</td>
<td>0.195</td>
<td>-2.145</td>
<td>-1.369</td>
<td>-1.079</td>
</tr>
<tr>
<td>5</td>
<td>-0.99</td>
<td>70</td>
<td>0.326</td>
<td>-0.141</td>
<td>0.142</td>
<td>-0.425</td>
<td>0.143</td>
<td>-0.118</td>
</tr>
<tr>
<td>6</td>
<td>-1.45</td>
<td>70</td>
<td>0.153</td>
<td>-0.169</td>
<td>0.117</td>
<td>-0.402</td>
<td>0.064</td>
<td>-0.172</td>
</tr>
<tr>
<td>7</td>
<td>-2.77</td>
<td>69</td>
<td>0.007 *</td>
<td>-0.400</td>
<td>0.145</td>
<td>-0.688</td>
<td>-0.112</td>
<td>-0.331</td>
</tr>
<tr>
<td>8</td>
<td>-4.01</td>
<td>70</td>
<td>&lt;.001 *</td>
<td>-0.380</td>
<td>0.095</td>
<td>-0.570</td>
<td>-0.191</td>
<td>-0.476</td>
</tr>
<tr>
<td>9</td>
<td>-6.47</td>
<td>70</td>
<td>&lt;.001 *</td>
<td>-0.916</td>
<td>0.142</td>
<td>-1.198</td>
<td>-0.633</td>
<td>-0.768</td>
</tr>
</tbody>
</table>

* Indicates a statistically significant result.

Table 4
Descriptive Statistics for t-tests

<table>
<thead>
<tr>
<th>No.</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pre</td>
<td>post</td>
<td>pre</td>
</tr>
<tr>
<td>1</td>
<td>71</td>
<td>71</td>
<td>10.24</td>
</tr>
<tr>
<td>2</td>
<td>71</td>
<td>71</td>
<td>3.37</td>
</tr>
<tr>
<td>3</td>
<td>70</td>
<td>70</td>
<td>4.99</td>
</tr>
<tr>
<td>4</td>
<td>70</td>
<td>70</td>
<td>3.49</td>
</tr>
<tr>
<td>5</td>
<td>71</td>
<td>71</td>
<td>4.99</td>
</tr>
<tr>
<td>6</td>
<td>71</td>
<td>71</td>
<td>4.83</td>
</tr>
<tr>
<td>7</td>
<td>70</td>
<td>70</td>
<td>4.60</td>
</tr>
<tr>
<td>8</td>
<td>71</td>
<td>71</td>
<td>4.58</td>
</tr>
<tr>
<td>9</td>
<td>69</td>
<td>71</td>
<td>3.38</td>
</tr>
</tbody>
</table>
Table 5

*Questions for t-tests*

<table>
<thead>
<tr>
<th>No.</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The total number of CDC-recommended vaccines correctly identified.</td>
</tr>
<tr>
<td>2</td>
<td>I feel confident in my knowledge about childhood vaccinations.</td>
</tr>
<tr>
<td>3</td>
<td>I feel confident in my ability to obtain accurate information about vaccines.</td>
</tr>
<tr>
<td>4</td>
<td>I feel confident in my ability to give a vaccine to a child.</td>
</tr>
<tr>
<td>5</td>
<td>I feel comfortable having a different opinion than my family or friends regarding vaccinations.</td>
</tr>
<tr>
<td>6</td>
<td>I feel comfortable discussing differing opinions about vaccinations.</td>
</tr>
<tr>
<td>7</td>
<td>I am knowledgeable about biohazard waste disposal and bloodborne pathogen regulations.</td>
</tr>
<tr>
<td>8</td>
<td>I am knowledgeable about how vaccines work in the body.</td>
</tr>
<tr>
<td>9</td>
<td>I feel confident in my ability to educate parents about childhood vaccines and vaccinations.</td>
</tr>
</tbody>
</table>
Table 6  

**Knowledge Questions about Pediatric Vaccinations**

<table>
<thead>
<tr>
<th>Question</th>
<th># Pre</th>
<th># Post</th>
<th>N</th>
<th>$\chi^2$</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Store vaccines (correct)</td>
<td>34</td>
<td>36</td>
<td>71</td>
<td>0.182</td>
<td>1</td>
<td>0.670</td>
</tr>
<tr>
<td>Prepare vaccines (correct) ¹</td>
<td>16</td>
<td>16</td>
<td>70</td>
<td>0.000</td>
<td>1</td>
<td>1.000</td>
</tr>
<tr>
<td>Distance between injection sites (correct)</td>
<td>38</td>
<td>47</td>
<td>71</td>
<td>2.790</td>
<td>1</td>
<td>0.095</td>
</tr>
<tr>
<td>Gloves required (correct)</td>
<td>12</td>
<td>35</td>
<td>70</td>
<td>17.100</td>
<td>1</td>
<td>&lt; .001 *</td>
</tr>
<tr>
<td>Aspiration not needed (correct)</td>
<td>49</td>
<td>61</td>
<td>71</td>
<td>5.140</td>
<td>1</td>
<td>0.023 *</td>
</tr>
<tr>
<td>Flu spread (correct)</td>
<td>41</td>
<td>36</td>
<td>71</td>
<td>1.000</td>
<td>1</td>
<td>0.317</td>
</tr>
<tr>
<td>Multiple overwhelm system (correct)</td>
<td>36</td>
<td>55</td>
<td>71</td>
<td>15.700</td>
<td>1</td>
<td>&lt; .001 *</td>
</tr>
<tr>
<td>Mild illness (correct)</td>
<td>9</td>
<td>26</td>
<td>71</td>
<td>13.800</td>
<td>1</td>
<td>&lt; .001 *</td>
</tr>
<tr>
<td>Evidence link/cause chronic conditions (correct)</td>
<td>65</td>
<td>68</td>
<td>69</td>
<td>3.000</td>
<td>1</td>
<td>0.083</td>
</tr>
<tr>
<td>Get flu from vaccine (correct)</td>
<td>50</td>
<td>59</td>
<td>71</td>
<td>5.400</td>
<td>1</td>
<td>0.020 *</td>
</tr>
<tr>
<td>Most follow CDC schedule (correct) ²</td>
<td>70</td>
<td>70</td>
<td>71</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Vaccine way to prevent disease (correct)</td>
<td>70</td>
<td>69</td>
<td>71</td>
<td>1.000</td>
<td>1</td>
<td>0.317</td>
</tr>
<tr>
<td>Not need polio (correct)</td>
<td>47</td>
<td>50</td>
<td>69</td>
<td>0.391</td>
<td>1</td>
<td>0.532</td>
</tr>
<tr>
<td>Healthy people don't need vaccine (correct) ¹</td>
<td>68</td>
<td>68</td>
<td>69</td>
<td>0.000</td>
<td>1</td>
<td>1.000</td>
</tr>
</tbody>
</table>

¹ Some individuals answered differently at post.
² No individuals answered differently at post.
* Indicates a statistically significant result.