Assessing primary health care nurses’ knowledge toward immunizations: A quantitative study

Ebtesam Abdulla,1 Jessie Johnson,2 Sadia Munir,3 Robin O’Dwyer1

1Primary Health Care Corporation, Doha; 2Faculty of Nursing, University of Calgary, Doha; 3University of Calgary, Doha, Qatar

Abstract

Background: The current nursing workforce needs to be skilled, confident, and competent to address the rapid change in Primary Health Care services, to align with the National Vision of Qatar. This is emphasized in the Primary Health Care Strategy 2018-2023. This strategy outlines the need of having a skilled nursing workforce to administer and educate the public about the importance of immunizations. Primary Health Care nurses emanate from several nationalities and hence possess various level of knowledge and background related to immunization administration.

Design and methods: To assess Primary Health Care nurses’ knowledge before and after the delivered immunization education program in Qatar. The study was part of a Sequential mixed method research study that aimed to assess the Primary Health Care nurses’ knowledge, attitude, and practice of nurses before and after the conducted training program. A self-administered survey, specifically developed for the research project was loaded in Qualtrics and sent to participants of the immunization education program before and after training. Participants were trained in two cohorts from October to December, 2018 in Qatar. For the purposes of this paper, data about the immunization knowledge was statistically analyzed using the SPSS Software version 25 and Microsoft Excel.

Results: Specific areas were identified as knowledge gaps among the participants of the two cohorts. Moreover, the developed education program showed overall improvement in the participants’ knowledge.

Conclusions: The study results have demonstrated that the delivered immunization education program significantly increases the participants’ knowledge about immunization in certain areas of the primary healthcare clinics they work, including vaccine safety, efficiency, and contraindications in the delivery of vaccines to the public.

Introduction

The Qatar National Vision (QNV) 2030 guides the development of the national health services in Qatar. The QNV aims to provide a comprehensive world-class health care delivery system that has accessible health care services to the population. In order to achieve this, there is a need to have world-class skilled health care providers, including nurses. This is further emphasized with the National Health Strategy (NHS) 2018-2022 and the Primary Health Care Strategy (PHCS) 2018-2023. Nurses within primary health care deliver a variety of services within the health centers in the community either as part of a multidisciplinary team or independently. As a result, having a skilled, confident, and competent workforce is needed to overcome the rapid change in Primary Health Care Centers’ (PHCCs) services to meet QNV’s high standards. One of the aims of the PHCS is to have a skilled nursing workforce to administer and educate the public about the needed immunizations. As most of the nurses come from various nationalities and backgrounds, it is not clear what level of knowledge, background, and education they have related to safe immunizations practice and patients’ education.

PHCC enlisted the expertise of Qatar University School of Pharmacy, Weill Cornell School of Medicine, and University of Calgary in Qatar faculty of nursing, to formulate a nursing vaccination course for Primary Health Care. This program, the first of its kind in Qatar, was developed in collaboration with PHCC to be a competency training course. The training aimed to increase the confidence and competence of the PHCC nurses and to enhance their attitudes towards safe vaccinations practices. Currently, there is a limited quantity of research in Qatar that has been conducted that specifically explores and defines nurses’ knowledge regarding immunizations. Thus, this research study aimed to identify the knowledge of PHCC nurses in the administration of vaccinations to infants, children, adolescents, and adults living in Qatar before and after program delivery.
Methodology

The overall study was a sequential mixed method research study, which consisted of quantitative pre- and post-survey and qualitative interviews inquired about the knowledge, attitudes, and practices of PHCC nurses towards immunizations. The purpose of this paper is to identify PHCC nurses’ knowledge level related to immunizations. This research was conducted using a longitudinal quantitative methodology where the PHCC nurses’ knowledge was assessed prior to and post the vaccination education program.

Study population and sampling

Purposive sampling was utilized for the distribution of the survey to a sample of nurses, who worked in Qatar between October and December, 2018. Nurses were selected based on the inclusion criteria, which consisted of those nurses who had a Diploma or Bachelor in Nursing, were the focal person in the well-baby clinic (WBC), communicable disease clinic (CDC), and Travel Clinic; were school, home healthcare, and health center nurses; had a minimum of 3 years’ experience within PHCC as a minimum requirement from PHCC work force training department (WFTD); were licensed by Qatar Council for Healthcare Practitioners (QCHP); and had a good command of English skills, including reading and writing as the education program was delivered in English. The authors felt it takes at least three years to become acclimated to the cultural mores of the citizens of the state of Qatar.

The total number of nurses who participated in the program was 340. Power analysis using the Australian Bureau Statistics online website (2018),1 determined that a sample size of 125 participants was required to keep the confidence level of 95%, the confidence interval of .05, and a response rate of 85%. The study sample size consisted of 120 participants and response rate was 99.16% when inputted in the calculator yielded a response rate of 85%. The 120 participants were divided into two cohorts for training purpose as it was difficult to release this number of nurses at one time and it is difficult to accommodate a large number of participants, which could have an impact the trainings efficiency. Participants were divided in cohort one, which consisted of 64 participants, and cohort two, which consisted of 56 participants.

Setting

PHCC facilities consisted of health centers, school health, home healthcare, or community health. In particular, participants were recruited from those facilities that included those nurses who were directly related to the administration or education of vaccination.

Survey

The survey consisted of selected items that were included in the VaxEd survey. This survey was developed earlier, in 2010, by Pelly et al.,2 to assess health care providers “who were in their last year of training related to knowledge, attitudes, and behaviors regarding immunizations” (p. 2). This survey “consisted of 77 items and was a web-based self-administered questionnaire, which was validated at the Center for Vaccinology in Halifax, NS.”2 Of the 77 questions included in the VaxEd survey, 20 questions were utilized for this study. Selected questions from the Canadian National Survey were used as it contained particular questions on vaccine safety, efficacy, acceptability, and opposition to vaccines, which were not explicitly found in the VaxEd survey. This included a cross-sectional survey to assess knowledge and attitude of Canadian adults regarding vaccine preventable diseases.3 Questions from this survey were developed by reviewing of the previous surveys of attitudes and knowledge toward vaccines by an expert panel, which consisted of two psychologists, 2 internal medicine specialists, 4 immunologists, 1 public health epidemiologist, 1 survey expert, and 2 nurses.2 This survey consisted of 20 items which included six major vaccine related domains such as: vaccine safety, vaccine effectiveness, vaccine knowledge, vaccine acceptability, vaccine concern, and opposition to vaccine.3 Of the 20 items included in the survey seven were included and added to the VaxEd survey.

The research team members in this current study included three expert health care providers who are registered nurses. These team members reviewed and selected the items to be included in the final survey. Items from both surveys were combined to create an overall survey used to test knowledge, attitude, and practice related to immunization. The survey was then entered into the Qualtrics program to be delivered online to the participants. The developed survey included 42 items broken down into three parts. Part one consisted of 13 demographic questions, part two consisted of 9 general immunization knowledge questions while part three consisted of 20 questions related to attitudes toward immunization. Part two questions required responses on a Likert scale, which ranged from strongly agree to strongly disagree. Part three consisted of vaccine knowledge questions, which required either “true” or “false” statements.

Data collection

A pre-survey was sent by a representative of the PHCC WFTD to the participants via email one week prior to the education program. The purpose of the pre- survey was to have baseline data related to Primary Health Care nurses’ knowledge, attitude, and practice regarding immunization before commencing the immunization training course. Once the nurses had completed the training and had been given the opportunity to practice their new skill, as well as educate patients regarding vaccines, they were then certified as nurse vaccinators. After four weeks, each participant had to demonstrate that they did indeed perform at least 10 injections to either adults or children post training. Once completed and certified by a representative from PHCC, a post-survey consisting of the same questions was sent to each of the participants; the time period for completion of this was also one week.

Data analysis

The data was analyzed by using the SPSS software ver. 25 (IBM SPSS statistics, Armonk, NY, USA) and Microsoft Excel. Descriptive and inferential statistics were used to compare the pre and post- survey data of the two cohorts. Descriptive statistics were performed to estimate the portion of participants who correctly answered the knowledge-based questions. The mean, percentage, and frequency were determined. Inferential statistics were used to compare the knowledge of the participants before and after immunization educational training. The paired sample t-test was not used to explore the difference between the pre and post- survey because mean had not provided meaningful data. Wilcoxon Signed-rank test as a non-parametric statistical hypothesis test was used.

Results

Characterises of the participants

In cohort one, sixty-four nurses responded to the survey during the study period (Table 1). Although there was some missing data, which was predominantly demographic data (Table 1); all 64
Table 1. Demographic characteristics of cohort one and two.

| Characteristics                                      | Cohort one |         |        | Cohort two |         |        |
|------------------------------------------------------|------------|---------|--------|------------|---------|--------|
|                                                      | n          | %       | n      | %          | n       | %      |
| 1. Gender                                            |            |         |        |            |         |        |
| Male                                                 | 4          | 6.1     | 3      | 5.26       |         |        |
| Female                                               | 60         | 90.9    | 53     | 92.9       |         |        |
| Missing                                              | 2          | 3       | 1      | 1.8        |         |        |
| 2. Age                                               |            |         |        |            |         |        |
| 25-33 years                                          | 40         | 60.6    | 28     | 49.1       |         |        |
| 34-44 years                                          | 21         | 33.8    | 22     | 38.59      |         |        |
| 45-54 years                                          | 3          | 4.5     | 6      | 10.5       |         |        |
| Missing                                              | 2          | 3       | 1      | 1.8        |         |        |
| 3. Duration of work at PHCC                          |            |         |        |            |         |        |
| Less than one year                                   | 1          | 1.5     | 1      | 1.75       |         |        |
| 1-5 years                                            | 42         | 63.6    | 32     | 56.1       |         |        |
| 6-10 years                                           | 7          | 10.6    | 11     | 19.29      |         |        |
| 11-15 years                                          | 12         | 18.2    | 9      | 15.78      |         |        |
| 16-20 years                                          | 2          | 3       | 4      | 7.0        |         |        |
| Missing                                              | 2          | 3       | 1      | 1.8        |         |        |
| 4. Professional classification                      |            |         |        |            |         |        |
| Staff nurse                                          | 58         | 87.9    | 55     | 96.5       |         |        |
| School nurse                                         | 4          | 6.1     | 2      | 3.5        |         |        |
| Home healthcare                                      | 2          | 3       | 2      | 3.5        |         |        |
| Missing                                              | 2          | 3       | 2      | 3.5        |         |        |
| 5. Highest level of education                       |            |         |        |            |         |        |
| Diploma level                                        | 5          | 7.6     | 4      | 7.0        |         |        |
| Bachelor's level                                     | 54         | 81.8    | 47     | 82.45      |         |        |
| Masters level                                        | 4          | 6.1     | 4      | 7.0        |         |        |
| Fundamental license                                  | 1          | 1.5     | 1      | 1.75       |         |        |
| Missing                                              | 2          | 3       | 2      | 3.5        |         |        |
| 6. Years since graduated from nursing school         |            |         |        |            |         |        |
| Less than 5 years                                    | 4          | 6.1     | 3      | 5.26       |         |        |
| 5-10 years                                           | 31         | 47      | 24     | 42.10      |         |        |
| 11-15 years                                          | 16         | 24.2    | 17     | 29.8       |         |        |
| 16-20 years                                          | 9          | 13.6    | 6      | 10.5       |         |        |
| Over 20 years                                        | 4          | 6.1     | 6      | 10.5       |         |        |
| Missing                                              | 2          | 3       | 2      | 3.5        |         |        |
| 7. Years worked as practicing nurse                  |            |         |        |            |         |        |
| 1-5 years                                            | 1          | 1.5     | 1      | 1.75       |         |        |
| 6-10 years                                           | 37         | 56.1    | 27     | 47.36      |         |        |
| 11-15 years                                          | 14         | 21.2    | 16     | 28.07      |         |        |
| 16-20 years                                          | 8          | 12.1    | 7      | 12.28      |         |        |
| Over 21 years                                        | 4          | 6.1     | 6      | 10.5       |         |        |
| Missing                                              | 2          | 3       | 2      | 3.5        |         |        |
| 8. Country of origin of first education as a nurse    |            |         |        |            |         |        |
| Egypt                                                | 5          | 7.6     | 2      | 3.5        |         |        |
| India                                                | 24         | 38.4    | 15     | 26.3       |         |        |
| Philippines                                          | 26         | 39.4    | 29     | 50.87      |         |        |
| Qatar                                                | 4          | 6.1     | 2      | 3.5        |         |        |
| Jordan                                               | 3          | 4.5     | 5      | 3.5        |         |        |
| Tunis                                                | 2          | 3       | 3      | 4.5        |         |        |
| Missing                                              | 2          | 3       | 2      | 3.5        |         |        |
| 9. Locality of work place                            |            |         |        |            |         |        |
| School health                                        | 4          | 6.1     | 6      | 10.5       |         |        |
| CDC travel clinic                                    | 1          | 1.5     | 3      | 5.26       |         |        |
| Well-baby clinic                                     | 26         | 39.4    | 26     | 45.6       |         |        |
| Home health clinic                                   | 3          | 4.5     | 3      | 5.26       |         |        |
| Rotating                                             | 15         | 22.7    | 15     | 25.8       |         |        |
| General                                              | 3          | 4.5     | 3      | 5.26       |         |        |
| PHC                                                  | 1          | 1.5     | 1      | 1.75       |         |        |
| Family medicine                                      | 2          | 3       | 2      | 3.5        |         |        |
| Staff nurse                                          | 1          | 1.5     | 1      | 1.75       |         |        |
| Vaccination room                                     | 2          | 3       | 2      | 3.5        |         |        |
| Treatment room                                       | 2          | 3       | 2      | 3.5        |         |        |
| Vaccination unit / CDC travel clinic                 | 1          | 1.5     | 1      | 1.75       |         |        |
| Walk in area                                         | 1          | 1.5     | 1      | 1.75       |         |        |
| Well baby clinic and other areas                     | 1          | 1.5     | 1      | 1.75       |         |        |
| Missing                                              | 2          | 3       | 2      | 3.5        |         |        |
| Other                                                |             |         | 22     | 38.5       |         |        |
| 10. Giving vaccination is part of job description    |            |         |        |            |         |        |
| Yes                                                  | 60         | 90.9    | 56     | 98.2       |         |        |
| No                                                   | 1          | 1.5     | 1      | 1.8        |         |        |
| Not sure                                             | 2          | 3       | 2      | 3.5        |         |        |
| Missing                                              | 3          | 4.5     | 3      | 4.5        |         |        |
| 11. Years of vaccination experience                  |            |         |        |            |         |        |
| Less than one year                                   | 3          | 4.5     | 3      | 5.26       |         |        |
| 1-5 years                                            | 32         | 48.5    | 27     | 47.36      |         |        |
| 6-10 years                                           | 16         | 24.2    | 27     | 47.36      |         |        |
| 11-15 years                                          | 11         | 16.7    | 16     | 28.07      |         |        |
| 16-20 years                                          | 1          | 1.5     | 1      | 1.75       |         |        |
| Over 21 years                                        |             |         | 6      | 10.5       |         |        |
| Missing                                              | 3          | 4.5     | 3      | 5.26       |         |        |
| 12. Vaccine doses per month                          |            |         |        |            |         |        |
| None                                                 | 3          | 4.5     | 3      | 5.26       |         |        |
| Less than 25 doses                                    | 9          | 13.6    | 4      | 7.017      |         |        |
| 20-50 doses                                          | 15         | 22.7    | 13     | 22.9       |         |        |
| 51-100 doses                                         | 20         | 30.3    | 19     | 33.3       |         |        |
| More than 101 doses                                   | 15         | 22.7    | 18     | 31.57      |         |        |
| Missing                                              | 4          | 6.1     | 4      | 6.1        |         |        |
| 13. Age group vaccinated                             |            |         |        |            |         |        |
| Infant and young children (0-5 years)                | 59         | 89.4    | 53     | 93         |         |        |
| Children and teenagers (6-17 years)                  | 22         | 33.3    | 36     | 63.15      |         |        |
| Adults (18 years and older)                          | 26         | 39.4    | 34     | 59.6       |         |        |
responses were included in the analysis. Most of the participants were female: n=60; 90.9% and ages ranged from 25 to 33 years old (60.6%). Most of the participants’ duration of work in PHCC ranged from one to five years (36.4%) and were staff nurses: n=58; 87.9%. The highest level of education for the majority of participants was bachelor’s level: n=54; 81.8%. Forty-seven percent of the respondents graduated from the nursing school for five to ten years. More than half of the participants had been working as a practicing nurses from six to ten years: n=37; 56.1%, and origin of first education as nurses was the Philippines (n=26; 39.4%) and India (n=24; 36.4%). Twenty-six participants (39.4%) workplaces were WBCs. Most of the participants had given vaccination before their training as part of their job description: n=60, 90.9%. Less than half of the participants (n=32; 48.5%) had from one to five years of vaccination experience while twenty of the participants (n=20, 30.3%) were giving fifty-one to hundred doses vaccine per month and some participants (n=15; 22.7%) were giving twenty-six to fifty doses, and some participants who gave upwards of hundred one doses per month (n=22; 7%). The majority of the respondents were responsible for vaccinating infants and young children from zero to five years (n=59; 89.4%).

In cohort two, fifty-six nurses responded to the survey during the study period (Table 1). There was some missing data, which was predominantly demographic data (Table 1). However, all fifty-six respondents were included in the analysis. Most of the respondents were female (n=53; 92.9%) and half of the respondents (49.1%) were in the age range from 25 to 33 years old. More than half of the respondents (56.1%) worked at PHCC from one to five years and were staff nurses (n=55; 96.5%), with the highest level of education for the majority of respondents as bachelor’s level (n=47; 82.4%). Less than half of the respondents graduated from nursing school from five to ten years ago (n=24; 42.1%). Forty-seven percent of the respondents have been working as practicing nurses from 6 to 10 years ago to the present (n=27; 47.3%). Fifty percent of the respondents educated in nursing in the Philippines (n=29; 50.8%). WBCs were the workplace of 26 of the respondents’ place. Most of the respondents were responsible for giving vaccination as part of their job description (n=56; 98.2%) and close to half of the respondents (n=27; 47.3%) had from six to ten years of vaccination experience. Nineteen of the participants (33.3%) administered from fifty-one to hundred doses of vaccine while some of the participants gave more of hundred one doses (n=18; 31.5%). Most of the participants were responsible for vaccinating infants and young children 0 to 5 years old (n=53; 93%).

Knowledge items with incorrect response

In cohort one, most of the participants incorrectly answered Q1 (n=42; 66.7%), Q4 (n=38; 60.3%), and Q5 (n=39; 61.9%). Some of the participants incorrectly answered Q3 (n=27; 42.9%), Q6 (n=23; 36.5%), Q7 (n=19; 30.2%), Q8 (n=23; 36.5%), and Q9 (n=25; 39.7%). However, very few (n=4; 5.8%) of the participants had incorrectly answered Q2 (see Table 2).

In cohort two, the participants incorrectly answered Q1 (n=35; 62.5%), Q4 (n=35; 62.5%), and Q6 (n=30; 53.6%). A number of the participants incorrectly answered Q3 (n=23; 41.8%), Q4 (n=27; 48.2%), Q7 (n=22; 39.3%), Q8 (n=22; 39.3%), and Q9 (n=17; 30.4%). Conversely, the number of participants who correctly answered Q2 increased to four (7.1%) (Table 2).

Results of pre-post comparison

Immunization training of cohort one showed a significant difference in the immunization knowledge about questions 1, 2, 4, 6, 7, and 8. Similarly, in cohort two, a significant difference in the immunization knowledge about questions 1, 2, and 8 pre versus post immunization training was observed (p≤0.05). However, no significant difference in the knowledge of participants about questions 3, 5, and 9 was noticed in both cohorts (Table 3).

Discussion

In our study, a significant number of participants demonstrated a lack of immunization knowledge about question 1 (Is mild illness, with fever, is a reason to withhold vaccination?), question 4 (Can varicella vaccine prevent chicken pox or reduce the severity of the disease if given within 3-5 days of exposure?) and question 5 (Children who have had culture positive pertussis disease should not receive pertussis containing vaccine?). Our results are in congruence with the study conducted by Pelly et al., which reported that 49% of the study participants incorrectly answered question 1, 46% of the participants incorrectly answered question 4, and 40% of the participants wrongly answered question 5. Immunization knowledge deficit among PHC nurses indicated a need for a carefully developed, routinely repeated training and educational program. In another study lack of knowledge in immunization handling, storage and route of administration of measles mumps and rubella was identified among health care personnel in Idaho, USA. They recommended a continuous education program for vaccine handling, administration and stability. A study conducted in Australia had concluded low level of awareness and knowledge about rotavirus, diarrhea and vaccine among midwives and nurses. They suggested a training program for public health nurses and midwives to clearly identify and differentiate rotavirus from other causes of diarrhea.

Therefore, identification of the knowledge gaps is of significant value for further management and development of a focused educational/training program to overcome those gaps. According to Riccò et al. filling these knowledge gaps among the HCWs require a continuous medical education. Da Silva Fagundes et al. highlighted the importance of education in order to overcome the immunization related knowledge gaps. In Canada, the evaluation of the contents of the guidelines of national curriculum for the training on immunization was carried out in a national study. The study suggested that educators should assess the current curricula to adapt the proper teaching resources, including immunization competencies. Many studies highlighted the importance of training and continued education of the health care workers. In Finland, some gaps in knowledge were identified in a study carried out to evaluate the vaccination skills of nurses and participants who were interested in receiving updates on the subject. Nilsen et al. had investigated the knowledge gaps and attitude of public health nurses in Norway in the school-based vaccination program. The study has recommended that curricula for the medical and nursing students should be updated because the self-reported knowledge of public health nurses was much higher than the actual knowledge of public health nurses and general practitioners.

In our study, only 6.1% of the participants in cohort one and 3.5% of the participants in cohort two had received their first nursing education from Qatar. A large number of this study’s participants had received their education from India (36.4%) and the Philippines (39.4%). Variation in the immunization education programs can be a contributing factor to the knowledge gaps, lack of consistency and standardization in term of the quality of immunization knowledge received by health care professionals. There could be many differences in the health professionals’ schools including the amount of time allocated to immunization related theory, education tools, and the evaluation methods used to assess the students’ level of knowledge.
Nurses with more experience in terms of years develop more contextual practical knowledge about their everyday work. Our data showed that a high percentage of nurses (56.1% of cohort 1 and 47.56% of cohort 2) have only 6-10 years of experience as a practicing nurse. A recent study was conducted to investigate the factors associated with the knowledge of Rubella after introducing Rubella vaccine in Tanzania.\textsuperscript{10} The data revealed that the knowledge of rubella was associated with education level ($p=0.01$), experience ($p=0.04$), and working department ($p=0.04$).

Public health nurses have a central role in promoting, delivering, and evaluating vaccine programs worldwide.\textsuperscript{7} Lack of immunization knowledge of nurses contributes to lack of confidence level of vaccination efficacy, fears of associated complications, and vaccination contraindications, which will all result in low vaccine coverage among the entire population, including public health care providers.\textsuperscript{6} Moreover, positive attitudes of nurses are associated with the level of vaccination knowledge.\textsuperscript{11,12} Immunization knowledge gaps of nurses also influence the parents’ decision about their children’s vaccination. Misconceptions among school nurses and personnel were also identified by Salmon \textit{et al.}\textsuperscript{13} as a common reason of the decrease in the likelihood of vaccine uptake. According to Angadi \textit{et al.},\textsuperscript{14} more than fifty percent of the parents highlighted that the HCPs were the primary source of their information. A lack of knowledge and motivation were identified as significant factors that partially impact the parents’ decision-making.\textsuperscript{14} A local example of this was noticed in Qatar during 2016 influenza campaign by PHC. The influenza vaccination report\textsuperscript{15} cited that only sixty percent of PHCC workers consented to the influenza vaccine. The PHCC report also highlighted the PHCC HCPs’ attitudes and beliefs as significant challenges, which directly impact their decision-making on influenza vaccine uptake. Filling the knowledge gaps among the school nurses will directly influence their vaccine uptake and overcome some of their negative attitudes.\textsuperscript{6,10,12,16}

In our study a significant overall improvement in the knowledge of participants in both cohorts was observed. However, questions 3, 5, and 9 showed no significant improvement in the participants’ knowledge as a result of the immunization education program. In literature, different educational programs were designed for different target populations and they have shown significant increase in the participants’ knowledge toward immunization. According to Peddecord \textit{et al.}\textsuperscript{17} a web-based follow-up survey was conducted on vaccination broadcast for public health professional (PHPs) that had been taken over six weeks. A significant improve-

| Question                                                                 | Cohort one  | Cohort two  |
|-------------------------------------------------------------------------|------------|------------|
| 1. Mild illness, with fever, is a reason to withhold vaccination         | 42         | 35         |
| 2. Given multiple vaccines at the same time can overload the immune system | 4          | 4          |
| 3. Pneumococcal vaccination is contraindicated for a splenic patient     | 27         | 23         |
| 4. Varicella vaccine can prevent chicken pox or reduce the severity of the disease if given within 3-5 days of exposure | 38         | 27         |
| 5. Children who had culture positive pertussis disease should not receive pertussis containing vaccine | 39         | 35         |
| 6. Routine childhood vaccines can be given to a child taking antibiotics for an ear infection | 23         | 30         |
| 7. Prior egg ingestion is a prerequisite for immunization with measles, mumps and rubella | 19.0       | 22         |
| 8. Pertussis vaccine can cause sudden infant death syndrome              | 23.0       | 22         |
| 9. Current scientific evidence supports associations between vaccines and chronic conditions such as autism and multiple sclerosis | 25         | 17         |

\textit{Asymp. Sig(2 tailed), }z\textit{-value based on the 2 tailed approximation; }z\textit{-value based on negative ranks; }z\textit{-value based on positive ranks.}

\textit{Table 3. Pre- versus post immunization training for knowledge items of two cohorts.}

| Question                                                                 | Cohort one  | Cohort two  |
|-------------------------------------------------------------------------|------------|------------|
| 1. Mild illness, with fever, is a reason to withhold vaccination         | -4.017°    | -2.667°    |
| 2. Given multiple vaccines at the same time can overload the immune system | -3.900°    | -2.000°    |
| 3. Pneumococcal vaccination is contraindicated for a splenic patient     | -0.784°    | -0.742°    |
| 4. Varicella vaccine can prevent chicken pox or reduce the severity of the disease if given within 3-5 days of exposure | -3.272°    | -0.493°    |
| 5. Children who had culture positive pertussis disease should not receive pertussis containing vaccine | -0.275°    | 0.783      |
| 6. Routine childhood vaccines can be given to a child taking antibiotics for an ear infection | -2.117°    | -1.446°    |
| 7. Prior egg ingestion is a prerequisite for immunization with measles, mumps and rubella | -4.441°    | -0.756°    |
| 8. Pertussis vaccine can cause sudden infant death syndrome              | -2.403°    | -2.502°    |
| 9. Current scientific evidence supports associations between vaccines and chronic conditions such as autism and multiple sclerosis | -1.742°    | 0.081      |

n, number of participants.
Conclusions

As major part of multidisciplinary teams, public health nurses have a significant role in controlling and organizing immunization programs for the public. Significant knowledge gaps were identified in this study among the PHCC nurses related to the safe handling, and administration of vaccines as well vaccines efficiency, contraindications before the education program. However, there was significant improvement after the education program was delivered. This highlights the significance of the immunization education in order to overcome the current and any future knowledge gaps among PHCC nurses in Qatar.

References

1. Australian Bureau of Statistics. Sample size calculator. Australian Government. available from: www.abs.gov.au/websitedbs/D3310114.nsf/home/Sample+Size+Calculator
2. Pelly LP, MacDougall DMP, Halperin BA, et al. The Vaxed Project: An assessment of immunization education in Canadian health professional programs. BMC Med Ed 2010;10:86.
3. Ritvo P, Irvine J, Klar N, et al. A Canadian national survey of attitudes and knowledge regarding preventative vaccines. J Immune Based Ther Vaccines 2003:05:1-9.
4. Strohfuß PK, Collins T, Phillips V, Remington R. Health care providers' knowledge assessment of measles, mumps, and rubella vaccine. Appl Nurs Res 2013;26:162-7.
5. Seale H, Sitaresmi MN, Atthobari J, et al. Knowledge and
attitudes towards rotavirus diarrhea and the vaccine amongst healthcare providers in Yogyakarta Indonesia. BMC Health Serv Res 2015;15,528.

6. Riccò M, Cattani S, Casagranda F, et al. Knowledge, attitudes, beliefs and practices of Occupational Physicians towards seasonal influenza vaccination: a cross-sectional study from North-Eastern Italy. J Prev Med Hyg 2017;58:e141.

7. Da Silva Fagundes L, Frota OP, Silva EM. Nursing practices in vaccination: An integrative review. J Nurs Ed Pract 2018;8:128-36.

8. Nikula A, Nohynek P, Puukka P, Leino-Kilpi H. Vaccination competence of graduation public health nurse students. Nurse Educ Today 2011;3:361-76.

9. Nilsen K, Aasland OG, Klouman E. The HPV vaccine knowledge and attitudes among public health nurses and general practitioners in Northern Norway after introduction of the vaccine school-based vaccination programme. Scand J Prim Health Care 35:4:387-95.

10. Chotta NA, Mgongo M, Uriyo JG, et al. Awareness and factors associated with health care worker’s knowledge on rubella infection: A study after the introduction of rubella vaccine in Tanzania. Int J Environ Res Public Health 2019;16:1676.

11. Smith S, Sim J, Halcomb E. Australian general practice nurse's knowledge, attitudes and practices regarding influenza vaccination: a cross-sectional survey. J Clin Nurs 2016;25:2502-10.

12. Smith S, Sim J, Halcomb E. Nurses' knowledge, attitudes and practices regarding influenza vaccination: an integrative review. J Clin Nurs 2016;25:2730-44.

13. Salmon DA, Moulton LH, Omer SB, et al. Knowledge, attitudes, and beliefs of school nurses and personnel and associations with nonmedical immunization exemptions. Pediatrics 2004;113:e552-9.

14. Angadi MM, Jose AP, Udgiri R, et al. A study of knowledge attitude and practices on immunization of children in urban slums of Bijapur city, Karnataka, India. J Clin Diagn Res 2013;7:2803-6.

15. CDC Team-Clinical Affairs. Influenza vaccination campaign report: Primary Health Care Staff. 2017. As retrieved https://portal.phcc.gov.qa/intranet_new/index.php/en/documents-center/search-result?filter_search=flu&btnSearch=++&4ef299654200867d7821d94c426b5177

16. Ha C, Rios LM, Pannaraj PS. Knowledge, attitudes, and practices of school personnel regarding influenza, vaccinations, and school outbreaks. J School Health 2013;83:554-61.

17. Peddecord KM, Holsclaw P, Jacobson IG, et al. Nationwide satellite training for public health professionals: Web-based follow-up. J Contin Educ Health Prof 2007;27:111-7.

18. Rhodes D, Visker JD, Cox C, et al. Effects of an online educational module on school nurses’ knowledge of HPV vaccination. J Contin Educ Nurs 2017;48:431-6.