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

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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.

Significance for public health

Qatar is a multinational country containing expatriates from all over the world from either developing or developed nations that are transient in their length of stay. As a result, having misconceptions related to vaccine administration can be varied, these may include such things as vaccine schedules, varying beliefs and myths related to vaccine administration as well as knowledge about each of the vaccines. For this reason, Primary Health Care nurses need to be equipped with the immunization related knowledge and skill to deliver the required education that encourages vaccine uptake to mitigate the transmission of vaccine preventable diseases.

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 on 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.³ 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	%
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	31.8	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		
4. Professional classification	Staff nurse	58	87.9	55	96.5
	School nurse	4	6.1	2	3.5
	Home healthcare	2	3		
	Missing	2	3		
5. Highest level of education	Diploma level	5	7.6	4	7.0
	Bachelors 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		
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		
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		
8. Country of origin of first education as a nurse	Egypt	5	7.6	2	3.5
	India	24	36.4	15	26.3
	Philippines	26	39.4	29	50.87
	Qatar	4	6.1	2	3.5
	Jordan	3	4.5	5	8.75
	Tunis	2	3	4	7.0
	Missing	2	3		
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		
	Rotating	15	22.7		
	General	3	4.5		
	PHC	1	1.5		
	Family medicine	2	3		
	Staff nurse	1	1.5		
	Vaccination room	2	3		
	Treatment room	2	3		
	Vaccination unit / CDC travel clinic	1	1.5		
	Walk in area	1	1.5		
	Well baby clinic and other areas	1	1.5		
	Missing	2	3		
	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		
	Missing	3	4.5		
11. Years of vaccination experience	Less than one year	3	4.5		
	1-5 years	32	48.5		
	6-10 years	16	24.2	27	47.368
	11-15 years	11	16.7	16	28.07
	16-20 years	1	1.5	7	12.28
	Over 21 years			6	10.5
	Missing	3	4.5		
12. Vaccine doses per month	None	3	4.5	3	5.26
	Less than 25 doses	9	13.6	4	7.017
	26-50 doses	15	22.7	13	22.8
	51-100 doses	20	30.3	19	33.3
	More than 101 doses	15	22.7	18	31.57
	Missing	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 (63.6%) and were staff nurses: $n=58$; 87.9%. The highest level of education for the majority of participants was bachelors' 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 have 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 bachelors' level ($n=47$; 82.45%). 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 ($n=29$; 50.87%). 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 ($n=27$; 47.36%) 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 ($n=18$; 31.57%). 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 ($p \leq 0.05$). 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 congruance with the study conducted by Pelly *et al.*,² 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.⁴ 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.⁵

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.*⁶ filling these knowledge gaps among the HCWs require a continuous medical education. Da Silva Fagundes *et al.*⁷ 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.² 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.⁸ Nilsen *et al.*⁹ 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.²

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.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.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.⁶ Moreover, positive attitudes of nurses are associated with the level of vaccination knowledge.^{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 *et al.*¹³ as a common reason of the decrease in the likelihood of vaccine uptake. According to Angadi *et al.*,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.¹⁴ A local example of this was noticed in Qatar during 2016 influenza campaign by PHC. The influenza vaccination report¹⁵ 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.^{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 *et al.*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-

Table 2. Knowledge items with incorrect response, cohort one and two.

Question	Cohort one		Cohort two	
	n	%	n	%
1. Mild illness, with fever, is a reason to withhold vaccination	42	66.7%	35	62.5%
2. Given multiple vaccines at the same time can overload the immune system	4	5.8%	4	7.1%
3. Pneumococcal vaccination is contraindicated for a splenic patient	27	42.9%	23	41.8%
4. Varicella vaccine can prevent chicken pox or reduce the severity of the disease if given within 3-5 days of exposure	38	60.3%	27	48.2%
5. Children who had culture positive pertussis disease should not receive pertussis containing vaccine	39	61.9%	35	62.5%
6. Routine childhood vaccines can be given to a child taking antibiotics for an ear infection	23	36.5%	30	53.6%
7. Prior egg ingestion is a prerequisite for immunization with measles, mumps and rubella	19.0	30.2%	22	39.3%
8. Pertussis vaccine can cause sudden infant death syndrome	23.0	36.5%	22	39.3%
9. Current scientific evidence supports associations between vaccines and chronic conditions such as autism and multiple sclerosis	25	39.7%	17	30.4%

n, number of participants.

Table 3. Pre- versus post immunization training for knowledge items of two cohorts.

Question	Cohort one		Cohort two	
	z	Asymp. Sig. (2-tailed)	z	Asymp. Sig. (2-tailed)
1. Mild illness, with fever, is a reason to withhold vaccination	-4.017°	*0.000	-2.667°	*0.008
2. Given multiple vaccines at the same time can overload the immune system	-3.900#	*0.000	-2.000°	*0.046
3. Pneumococcal vaccination is contraindicated for a splenic patient	-0.784°	0.433	-0.742#	0.458
4. Varicella vaccine can prevent chicken pox or reduce the severity of the disease if given within 3-5 days of exposure	-3.272#	*0.001	-0.493°	0.622
5. Children who had culture positive pertussis disease should not receive pertussis containing vaccine	-0.275#	0.783	-0.687#	0.492
6. Routine childhood vaccines can be given to a child taking antibiotics for an ear infection	-2.117#	*0.034	-1.446#	0.148
7. Prior egg ingestion is a prerequisite for immunization with measles, mumps and rubella	-4.441#	*0.000	-0.756°	0.450
8. Pertussis vaccine can cause sudden infant death syndrome	-2.403#	*0.016	-2.502#	*0.012
9. Current scientific evidence supports associations between vaccines and chronic conditions such as autism and multiple sclerosis	-1.742#	0.081	-0.218°	0.827

Asymp Sig(2 tailed), z-value based on the 2 tailed approximation; z, Wilcoxon Signed Ranks test' values; °based on negative ranks; #based on positive ranks.

ment of the PHPs' knowledge ($p < 0.001$) prior and after the training was observed. Others have used online educational modules among school nurses in Missouri to improve their knowledge toward HPV vaccination. A significant difference ($p < 0.05$) in the knowledge was identified pre vs post teaching of the online educational module.¹⁸ Our education program was successful; however, further revision of the education program is needed to overcome knowledge gaps. Carefully designed education programs are necessary and important not only for increasing immunization knowledge of PHC nurses but also to fill the population knowledge gaps and increases the vaccine uptake among health care providers and population.

Strengths and limitations

This study has several strengths one of which is that it is a quantitative study. It consisted of a high response rate at 99.16% participation. Population sample size was ($n = 120/340$) and is considered a significant sample size. PHC nurses included in this study were from various facilities, including Health Clinic, Home Care and School health nurses. Limitations for this study is the fact the survey was not psychometrically tested. The focus of this paper was on PHC nurses' knowledge and hence it is not enough to assess their knowledge post-education without evaluating their attitudes and practices in comparison to the other studies. This paper also doesn't include the qualitative data collected by the researchers to round out the whole study as it is being published as a second piece of work.

Recommendations

There are many recommendations to be considered to improve PHCC nurses' knowledge. Nursing schools need to consider standardizing the curriculum to include immunization education as a part of its focus. In terms of research, follow-up is needed of the trained nurses in order to know how much knowledge they gained and assess sustainability of that knowledge. Having a focus group with the participants to assess whether they believe there are any other knowledge gaps that may assist in order to update and develop any future education programs. Using prior trained nurses to deliver future education programs related to immunizations. Having these nurses become a focal person/resource in each HC, school health, and home healthcare is needed in order to achieve continued success of vaccine uptake in Qatar. Expanding the education program to be inter-professional be tantamount to success. Nursing leaders' roles should advocate for immunization nurse led clinic. Examining the data of the qualitative of this study will lead to a better understanding of how the PHCC nurses' knowledge improved as well as their attitudes and practices.

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.

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Ethics approval and consent to participate: This study was approved by the Primary Healthcare Research Ethics Board PHCC/IEC/18/02/004. The survey consisted of information about the study and dissemination of results. Potential participants were also informed that by completing the survey it meant implied consent to participate in the study.

Consent for publication: Each of the participants included in the study were informed about the process of dissemination of the information from the survey prior to completing the survey and this was reviewed with them prior to the commencement of the continuous professional development program.

Availability of data and materials: All data generated or analyzed during this study are included in this published article.

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