



## **Knowledge and Practices of Primary Health Care Providers Regarding Childhood Immunization**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

**Background:** Uptake of vaccination services isn't only dependent on provision of these services, but also in knowledge and practice of health care providers (HCPs), so WHO indicated that training of HCPs is an essential component of all expanded programs on immunization (EPI) activities. The aim of this study is to lower primary vaccine failure, morbidities and mortalities among children.

**Methods:** This cross-sectional study included 150 HCPs and 16 primary healthcare units and one center in Shubra Khit District, Beheira Governorate, Egypt. Predesigned questionnaire and observational checklist were applied to collect data. The questionnaire assessed the knowledge of health care providers about storage, handling, administration, scheduling, doses, routes and contraindications of the different vaccines routinely. The checklist assessed the practice of health care providers regarding cold chain, room layout, preparation for vaccination session, general and specific practice related to each vaccine.

**Results:** The majority of health care providers had adequate level of knowledge about all vaccines except for MMR vaccines & Hib vaccines. There were significant associations between

knowledge levels and place of work with ( $p = <0.001$ ), qualification ( $P = 0.015$ ), site of task ( $P = <0.001$ ) and training courses ( $P = <0.001$ ) among studied health care providers.

**Conclusions:** As regards knowledge levels among studied health care providers, nearly two third had a good knowledge; the same for practice, it was very good in about two thirds of the studied units/center.

*Keywords: Health care providers, childhood< immunizations, primary healthcare facilities, practice.*

## 1. INTRODUCTION

Immunizations are widely recognized as a major tool for achieving public health successes. [1] It is the most cost-effective preventive health intervention known in modern medicine, achieving high immunization coverage, tended to decline the morbidity and mortality rates of vaccine-preventable diseases [2]. "With the exception of safe water, no other modality, not even antibiotics, has had such a major effect on mortality reduction like vaccines....". [3].

So, the WHO through its expanded program on immunization (EPI) launched in 1974, significantly contributed towards increasing levels of immunization coverage in many parts of the world and controlling six childhood diseases: tuberculosis, diphtheria, pertussis (whooping cough), tetanus, polio and measles [4].

The WHO estimates that immunization programs prevent two to three million deaths per year worldwide and is widely considered to be 'overwhelmingly good' by the scientific community [5]. However, 2.5 million deaths a year continue to be caused by vaccine preventable diseases, mainly in Africa and Asia among children less than 5 years old [6].

EPI in Egypt has achieved several successes in controlling vaccine preventable diseases, including strong national vaccination coverage of over 90%, through an increase of vaccine coverage and continuous surveillance leading to reduced illness, disability and death from diseases such as diphtheria, tetanus, whooping cough, measles and polio. With high coverage rates for routine immunization, vaccine-preventable diseases have shown a remarkable decline in past decades. However, several factors indicate that there are still challenges, with measles outbreaks occurring in 2013 and 2014 [7].

Uptake of vaccination services isn't only dependent on provision of these services, but also on knowledge and practice of health care providers, so WHO indicated that training of

health care providers is an essential component of all EPI activities [7].

Increasing knowledge regarding childhood immunizations through EPI and the cold chain system for personnel could increase vaccination coverage and increase the efficiency of childhood immunizations through EPI and cold chain practices [8].

The aim of the study was to assess the knowledge and practice among HCPs regarding immunizations in primary health care settings and to identify the determinants for levels of knowledge and practices among HCPs in these settings.

## 2. METHODS

### 2.1 Place & Type of the Study

A cross sectional study was conducted in all primary health care facilities in Shubrakhit District, Beheira Governorate, Egypt (16 units and one primary health care center) and included 150 HCPs working in these facilities and accepted to participate in the study.

This study was conducted during the period from October 2019 and completed by the end of 2020.

### 2.2 Tools and Methods of Data Collection

Data was collected through using a predesigned validated questionnaire sheet and check list after El Shazly et al 2000. [7,9]

- 1- **The questionnaire** was self-administered directed for all included health care personnel and included the followings:
  - Sociodemographic data
  - Qualification & duration of work and training courses.
  - Assessment of their knowledge regarding EPI, especially:
    - a. Cold chain system, preparation for vaccination session and vaccination place ( 21 items)

- b. Vaccines given: nature, dose, site of administration, side effects and contraindication. (51 items)
- c. Answers to knowledge questions was either by correct or incorrect.

**2- Observation checklist: that** was directed to nurses responsible for vaccinations sessions

- The vaccination room and cold chain procedures for each health care facility, which was assessed by part one and two of the checklist (21 items).
- The practices of nurses regarding vaccinations were assessed from part three to part six of the checklist. This included: Preparation for vaccination session (3<sup>rd</sup> Part ,5 items), general practice related to all vaccine (4<sup>th</sup> part, 4 items), practices to each vaccine individually: as position of the child, route, dose, site of administration and angle of needle insertion (5<sup>th</sup> part, 12 items) and post vaccination practice (6<sup>th</sup> part, 2 items).
- The practice checklist was presented as practiced or not practiced.
- Only one nurse in charge was observed in each unit/center, during vaccination sessions [N=17].

## 2.1 Scoring System

Scoring system for knowledge of health care providers about each vaccine: The respondent was given one point (1) for each correct answer and (0) for incorrect one and the knowledge score of each vaccine was divided as follow: Adequate knowledge:  $\geq 75\%$  of the total knowledge score of each vaccine. Inadequate knowledge:  $< 75\%$  of the total knowledge score of each vaccine coring system for total knowledge of health care providers:

The respondent was given one point (1) for each correct answer and (0) for incorrect one. The total knowledge score was 51 points divided as follow: Fair knowledge:  $<75\%$  of the total knowledge score (0-38). Good knowledge:  $90\% - \leq 75\%$  of the total knowledge score (39-45). Very Good knowledge:  $> 90\%$  of the total knowledge score (46-51).

## 2.2 Scoring System for Practice in Health Care Units and Centers

Each item in the observational checklists done correctly was scored (1) and that was not done

or done incorrectly was scored (0). The total score of practice was 48 and divided as follow:

- Good practice:  $90\%-75\%$  of the total practice score (0-43)
- Very good practice:  $> 90\%$ : of the total practice score (44-48)

## 2.3 Sample Size Analysis

This study included (N= 150) health care providers who were available during the period of the study in all the studied rural units and one urban center. Power analysis and sample size was calculated to justify the number of the studied subjects at a power of 90%. The smallest sample size needed from all primary health care units/center was calculated by epi-information program of statistics version 7. The total number of health care providers working in all units/center were (N =227), so with 40% level of poor & fair knowledge based on a previous study Elshazly et al. 2016, at a power of 90%, and margin of error of 5%, the minimal sample size was (N= 121) health care providers. This number should be increased by 10% to overcome any discontinuity or missed data, to reach up to (N= 133 HCPs). So, the study subjects 150 (for both rural and urban HCPs) were enough at a power of 90%. [9].

## 2.4 Statistical Analysis

The collected data were organized, tabulated and statistically analyzed using SPSS software (Statistical Package for the Social Sciences, version 19, SPSS Inc. Chicago, IL, USA). For quantitative data, the range, mean and standard deviation were calculated. For qualitative data, which describe a categorical set of data by frequency, percentage or proportion of each category, Chi-square test (X<sup>2</sup>) was used to study the association between two qualitative variables and more. P value of less than 0.05 was considered statistically significant.

## 3. RESULTS

### 3.1 Part I: Knowledge of the Studied Health Care Providers Regarding Childhood Immunization

The majority of the sample (97.3%) comprised female population and (85.4%) of them were nurses. Only (24.7%) of them worked at vaccination room. [Table 1].

**Table 1. Socio-demographic characteristics of the studied health care providers**

Socio-demographic data	The health care providers (n = 150)	
	No	%
<b>Age groups (in years)</b>	85	56.7
• < 40	65	43.3
• ≥40	38.11 ± 7.88	
• Mean ± SD	21 - 59	
Minimum-maximum		
<b>Sex</b>		
• Male	4	2.7
• Female	146	97.3
<b>Place of work</b>		
• Urban center	19	12.7
• Rural units	131	87.3
<b>Duration of work (in years)</b>	19	12.7
• < 10	131	87.3
• ≥10	17.84 ± 7.84	
Mean ± SD	1 – 39	
Minimum-maximum		
<b>Qualification</b>		
• Physician	8	5.3
• High nurse	13	8.7
• Health supervisor	14	9.3
• Nurse	115	76.7
<b>Site of task</b>		
• Vaccination room	37	24.7
• Others	113	75.3
<b>Training courses</b>		
• Yes	39	26.0
• No	111	74.0
<b>Duration since last training:</b>		
• less than 5 years	24	16.0
• 5 years and more	15	10.0

The percentage of knowledge of HCPs about different vaccines as regards time, dose, and route of administration, storage, and contraindications are high, except for contraindication of vaccine of HBV and Hib, Sensitivity of vaccine to (heat, light or freezing) to MMR and Hib. [Table 2]

Most of the healthcare providers who had "very good" or "good" level of knowledge worked in rural units (P <0.001). There were significant associations between knowledge levels and Place of work (p= <0.001), educational qualification (P = 0.015), site of task (P =<0.001) and receiving training courses (P = <0.001) among studied health care providers. [Table 3]

All cold chain the measurements were applied correctly (100%) by all studied units/center. [Table 4].

The practices of different studied units/center regarding vaccination room layout, Preparatory steps and General vaccine measures was 100%, except welcome the beneficiaries, ask for contraindications, explain the vaccine and the disease it prevented and washing their hands properly before conducting vaccination. [Figs. 1,2,3]

The Practices of different studied units/center regarding specific measures for each vaccine was significant except for OPV. [Table 5]

There was no significant association between practice levels and place of work. [Table 6]

#### 4. DISCUSSION

This study showed that as regards the knowledge of HCPs about storage sites of different types of vaccines, the majority of them showed satisfactory knowledge about proper places in the refrigerator of (95.3%, 87.3%, 93.3%, 84.7%,70% & 82%) for (OPV, BCG, DPT, HBV, MMR & Hib vaccines) respectively. These results agree with the study done by Esa et al. [12] who studied 80 nurses in Zagazig city, Sharquia to assess their performance in vaccination session and reported that majority of their participants have high knowledge about places in places in the refrigerator of (OPV, DPT, MMR, HBV vaccines) were (100%, 81.2%, 73.8% & 85%) respectively while disagree with their knowledge regarding BCG vaccine storage in the refrigerator which was 5% only.

Our results were supported by study of El Shazly et al. [9] who studied 140 health care providers in Quewisna district, Menoufia to assess their knowledge about different vaccines used for children less than 5 years and reported that majority of their participants have high knowledge about places in places in the refrigerator of (OPV, DPT, MMR, HBV vaccines) were 89.3%, 84.3%, 79.3%, 87.9%, 79.3% and 77.9% respectively [10,11].

Our participants reported that sensitivity of HBV vaccines to freezing were 62.7% and 92% of our HCPs stated that OPV is the most sensitive vaccine to heat, while 86% of HCPs stated that direct light spoil BCG. Our results were better than Rogie et al. [13] who studied 116 health

**Table 2. Knowledge of healthcare providers about different vaccine**

Knowledge of HCPs Correct answer	Different vaccines						
	OPV (n (%))		BCG (n (%))	DPT (n (%))	HBV (n (%))	MMR (n (%))	Hib (n (%))
	Sabine	Salk					
Dose and route of administration	149 (99.3)	132 (88)	149 (99.3)	140 (93.3)	146 (97.3)	137 (91.3)	134 (89.3)
Time of vaccine administration	141(94)	129 (86)	150 (100)	146 (97.3)	148 (98.7)	137 (91.3)	146 (97.3)
Contraindication of vaccine	101 (67.3)		138 (92)	133 (88.7)	72 (48)	109 (72.7)	69 (46)
Right site of vaccine in refrigerator	143 (95.3)		131 (87.3)	140 (93.3)	127 (84.7)	105 (70)	123 (82)
Sensitivity of vaccine to (heat, light or freezing)	138 (92)		129 (86)		94 (62.7)	68 (45.3)	71 (47.3)

**Table 3. Association between knowledge levels and socio- demographic characters among studied health care providers**

Socio- demographic characters	Total knowledge levels			χ <sup>2</sup> - test P-value
	Very good No (%)	Good No (%)	Fair No (%)	
Age groups:				
• less than 40 years	20(23.5)	57(67.1)	8 (9.4)	2.92
• 40 years and more	23 (35.4)	35(53.8)	7(10.8)	0.232
Place of work:	5(26.3)	6(31.6)	8(42.1)	
• Urban center	38(29.0)	86(65.6)	7(5.3)	25.607
• Rural units				<0.001*
Duration of experience:				
• less than 10 years	7 (36.8)	11(57.9)	1(5.3)	1.037
• 10 years and more	36(27.5)	92(61.3)	15(10)	0.595
Qualification:				
• Physician	5(62.5)	3(37.5)	0 (0.00)	
• High nurse	8(61.5)	4(30.8)	1(7.7)	15.813
• Nurse	27(23.5)	74(64.3)	14(12.2)	0.015*
• Health supervisor	3(21.4)	11(78.6)	0(0.00)	
Site of task:				21.051
• Vaccine room	21(56.8)	16(43.2)	0(0.00)	<0.001*
• Others	22 (19.5)	76(67.3)	15(13.3)	
Training courses:				
• Yes	24 (61.5)	15(38.5)	0(0.00)	29.631
• No	19(17.1)	77(69.4)	15(13.5)	<0.001*
Duration since last training:				
• less than 5 years	14(58.3)	10(41.7)		0.271
• 5 years and more	10(66.7)	5(33.3)		0.603

**Table 4. Practices of different studied units/center regarding cold chain measurements**

Cold chain measurements	Correct practice The studied units (n = 17)	
	No	%
Right place & position of refrigerator.	17	100
The diluents and vaccines are at +2 <sup>o</sup> c to +8 <sup>o</sup> c.	17	100
BCG &MMR on the 1 <sup>st</sup> shelf of refrigerator.	17	100
DPT &Hib on the 2 <sup>nd</sup> shelf of refrigerator.	17	100
Clearly separate different types of vaccines.	17	100
Newest vaccines placed on right side and oldest one on the left side of refrigerator.	17	100
No food or any drugs rather than the vaccines in the refrigerator.	17	100
Keep OPV vaccine and ice packs in the freezer.	17	100
Containers of water in the bottom of refrigerator.	17	100
Presence of thermometer inside the refrigerator.	17	100
Check the thermometer twice daily.	17	100
Record thermometer reading on the refrigerator temperature sheet.	17	100
Presence of a flowchart detailing what to do in case of electrical power outage.	17	100
Vaccines brought to the session in a vaccine carrier with 4 conditioned ice packs.	17	100
Put packing material between DPT vaccine and ice.	17	100
Take the number of vaccines needed for the entire session.	17	100
Are vaccines carriers kept in shade & didn't open frequently?	17	100

workers included to assess cold chain status for immunization in central Ethiopia and documented that 44.8%, 21.6% and 50% respectively of

health workers had knowledge about which vaccines were most sensitive to heat, extreme cold or light. [13] While our results were similar to

Noor et al. [14] who did his study on 89 practitioners in Kelantan, Malaysia to assess and document that majority of respondents knew that vaccine will be spoiled if exposed to heat (98.8%), while unfortunately his result concerning sensitivity of HBV vaccines to freezing were 88.8%. [14] The results of Al-Ayed [15] illustrated that 96.5% of his participants knew that the sensitivity of BCG vaccine to light which agree us, while unfortunately his result concerning the sensitivity of HBV vaccines to freezing were 86.5%. Our results were similar to El Shazly et al. [9] who reported that 92% of his participants knew that OPV is the most sensitive vaccine to heat. While unfortunately his result concerning the sensitivity of HBV vaccines to freezing were 86.5%. were better than our study.

Our study revealed that (99.3%, 99.3%, 93.3%, 97.3%, 97.3% and 91.3%) of HCPs knew the proper dose and route of (OPV, BCG, DPT, HBV Pentavalent and MMR) vaccines respectively. These results were better than Widsanugorn et al. [16] who assessed the knowledge and practice of 117 health care workers and ninety primary care units regarding expanded program on immunization in Kalasin, Thailand whose study reported that 78.6%, 63.2%, 68.4% and 59% knew the proper dose and route of BCG, DPT, HBV and MMR vaccines respectively [16]. Also, the same result obtained by Al-Ayed. [15] that 92% and 96.5% knew the proper dose and route of OPV and BCG vaccination respectively.

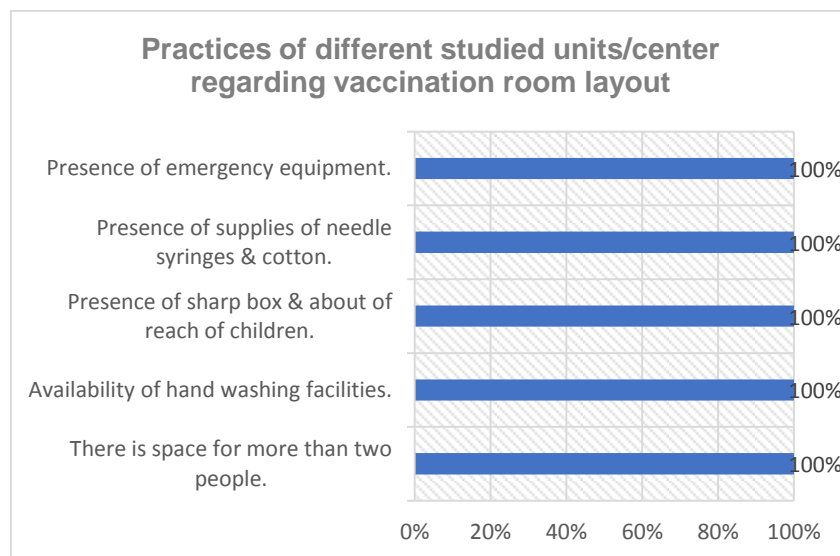


Fig. 1. Practices of different studied units/center regarding vaccination room layout

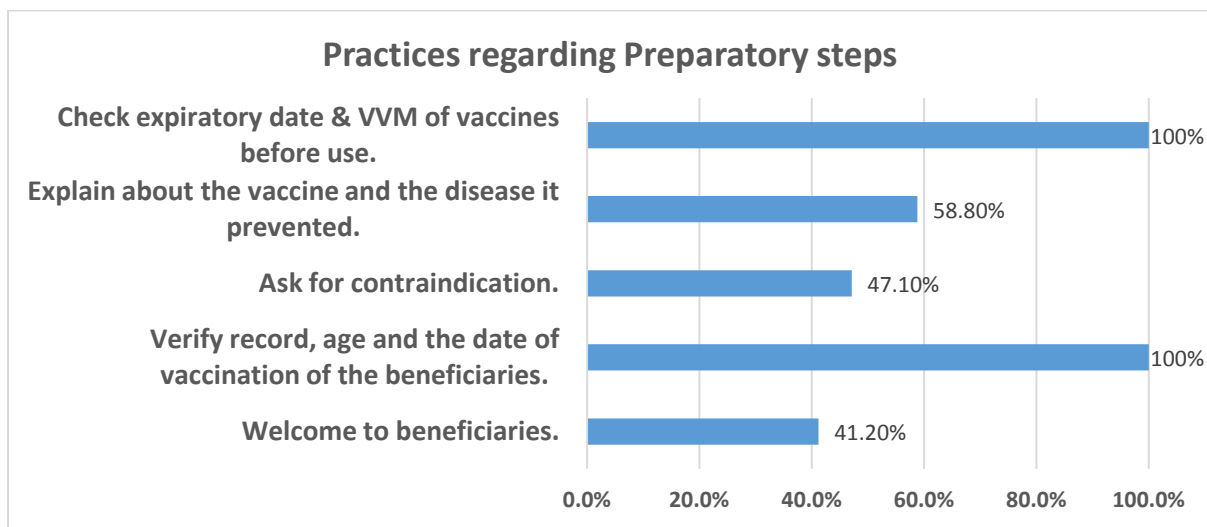


Fig. 2. Practices of different studied units/center regarding Preparatory steps

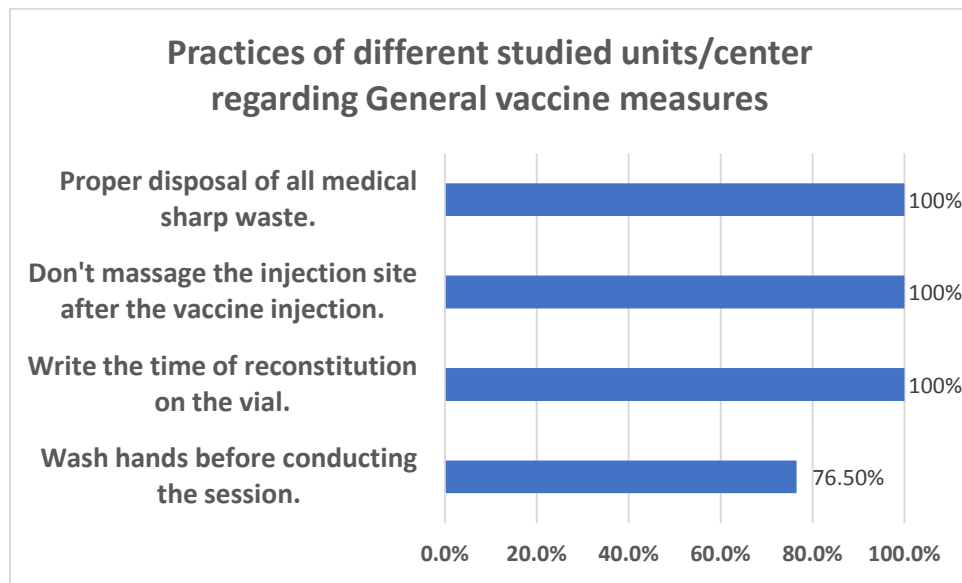


Fig. 3. Practices of different studied units/center regarding General vaccine measures

Table 5. Practices of different studied units/center regarding specific measures for each vaccine

Specific measures regard each vaccine	Correct practice The studied units (n = 17)	
	No	%
1-BCG	17	100
Proper position of the child for BCG vaccination		
Proper dose and injection site of BCG vaccine	17	100
Proper angle of needle insertion, which is 15° for BCG vaccination	17	100
2- DPT, HBV, and Hib	17	100
Proper position of the child for DPT, HBV, and Hib vaccination		
Angle of insertion of needle is 90° for DPT, HBV & Hib vaccines injection	14	86.7
3- MMR	17	100
Proper position of the child for MMR vaccination		
Proper dose and site of MMR vaccine injection	17	100
Angle of insertion of needle is 45° for MMR vaccine injection	17	100
4-OPV	17	100
Proper position of the child for OPV vaccination		
Proper site, dose, and route of OPV vaccination	17	100
Explain that BCG sore is normal after injection, and it heals by scar	17	100
Explain that fever may occur after some injections & disappears after 3 days	7	41.2
Tell the parents to return if side effects seem serious	6	35.3
Remind parents about the next visit and tell them to bring the card with them	11	64.7

Table 6. Association between practice levels and place of work among studied health care providers

Place of work	Practice levels			χ <sup>2</sup> –test P-value
	very good No (%)	Good No (%)	Total	
Urban Centre	0(0.0)	1(100.0)	1	1.95
Rural units	11(68.8)	5(31.3)	16	0.353
Total	11(64.7)	6(35.3)	17	





**Fig. 4. Practices level were "very good" in approximately two third of studied units/center (64.7%) and "good" in 35.3% of them**

Our results were supported by study of El Shazly et al. [9] as they reported that the percentage of knowledge of HCPs about different vaccines as regards time, dose, and route of administration, storage, and contraindications were high, except for Hib vaccine knowledge, which was less than that for the other vaccines. There was a satisfactory level of knowledge for all vaccines except for Hib vaccine. The varying levels of knowledge between this study and El Shazly et al [9], reveals the need to pay more systematic efforts in different primary health care settings all over the country among HCPs towards vaccines knowledge and practice.

This study revealed that receiving training courses has significant effect on the total knowledge of health care providers about vaccination with. These results agree with Widsanugorn et al. [16] and El Shazly et al. [9] who mentioned that trained healthcare workers had better knowledge than untrained healthcare workers and to ensure optimal immunization effectiveness, continuous training and regular supervision on EPI and the cold chain system are necessary.

Also, Al-Ayed. [15] mentioned that Insufficient knowledge and inadequate training about immunizations by health professionals have a heavy negative impact on the quality of immunization services for children. This highlights the need for more efficient training and continuous education of primary health care providers in the field of immunization practices. [15] Also 100% of PCUs had a temperature chart and recorded the temperature inside the refrigerator 2 times daily and 100% of PCUs had a flowchart about what to do in case of a power outage. Our results were supported by El Shazly et al. [9] who reported the same results.

Our results were better than Widsanugorn et al. [16] who found that in 86.7% of PCUs the temperature inside refrigerators was in the range of 2–8°C. A total of 95.6% of PCUs that kept OPV on the freezer shelf, and 100% of PCUs kept DPT, diphtheria-tetanus vaccine (DT) and hepatitis B vaccine on the normal shelf and only 61.1% of PCUs had a temperature chart and recorded the temperature inside the refrigerator 2 times daily. Only 63.3% of PCUs had a flowchart about what to do in case of a power outage.

Our results showed a better result than Rogie et al. [13] who found that of 22 facilities that had functional refrigerators, only 63.6% had a temperature recording chart and among these, 92.9% maintained the twice daily recording practice.

This study revealed that none of the studied units put food or other drugs rather than vaccines in the refrigerator. This result goes in line with Noor et al. [14] and Al-Ayed. [15] who illustrated that 97.8% and 97.5% respondents agree that vaccines cannot be placed with food or drugs in vaccine refrigerator. On the other hand, this result disagrees the result of Rogie et al. [13] which showed that vaccines were sharing space with laboratory reagents and other medicines in 40.9% fridges.

Regarding taking the number of vaccine vials needed for the entire session, our result was 100% which is better than Al-Ayed. [15]who found that 86.6% take vaccines vials out from the refrigerator at the arrival of the first child for that immunization session. Also, our results were better than Esa et al. [12] who stated that 72.5% of their providers take from the refrigerator the number of vaccines vial needed for the entire session.

This study demonstrated that 100% of the studied units check the expiry date of the vaccines before use shown in Table 6, which is better than Esa et al. [12] who stated that only 2.5% of their respondents check the expiry date of the vaccine before use. Our result is the same Al-Ayed. [15] and El Shazly et al. [9] who documented that 99% and 100% of his providers stated that they check the expiry date before use.

Concerning infection control, there were 76.5% of the studied PCUs washing their hands which completely opposite to Esa et al. [12] who recorded that none of their participants washing their hands.

Regarding availability of equipment needed for the session as cotton, needles and syringes, there were found in 100% of our studied units. Comparing to Esa et al. [12] there were sterile equipment for the vaccination session by 98.75% which agree with our results. Also, there were disposal boxes in 100% of the studied units while Esa et al. [12] stated that disposal boxes found by 76.25% only.

## 5. CONCLUSION

As regards knowledge levels among studied health care providers, the majority of them were "good". There were significant association between knowledge levels and Place of work, qualification, site of task and training courses among studied health care providers. As regards practice levels of different studied units/center, practice level was "very good" in most of studied units/center. There was no relationship between practice levels and place of work.

## ETHICAL APPROVAL

The protocol of the study was approved from the ethical committee of Tanta faculty of Medicine. Permission was taken from local health authority.

## CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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