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The Effectiveness of Interactive Workshop Concerning Parenteral Methods of Administration of Medication on Nurses Knowledge toward Best Techniques

فاعلية ورشة عمل تفاعلية على معرفة الممرضين فيما يخص أفضل تقنيات إعطاء الحقن

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الخلاصة:

خلفية البحث: تعطى الحقن بشكل روتيني من قبل الممرضين في المؤسسات الصحية والمجتمع. لذا لابد من تحسين معرفة الممرضين عن أفضل ممارسات الحقن التي تحد من خطر المضاعفات على المرضى.

الهدف: تهدف الدراسة الحالية إلى تقييم فاعلية تطبيق ورشة عمل تفاعلية على معرفة الممرضين فيما يخص أفضل تقنيات اعطاء الحقن.

المنهجية: أجريت دراسة وصفية في 1/ شباط / 2016 إلى 30 / تموز / 2016. وقد تكونت مجموعة الدراسة من (30) ممرضة من مستشفى الهلال للتامين الصحي بمحافظة سوهاج كجزء من برنامج التدريب أثناء الخدمة وقد تغير هذا العدد خلال مدة الدراسة ليكون 27 مشاركة فقط أثناء المتابعة. وقد استخدمت الباحثة استبيان مكون من جزأين (الاول): البيانات الشخصية للممرضين, (الثاني): استبيان قياس معرفة الممرضين للخطوات الصحيحة للحقن 3 مرات متتالية: قبل البرنامج، بعد البرنامج مباشرة، وأثناء المتابعة. واشتمل الاستبيان على (20) سؤال اختيار من متعدد حول القواعد الصحيحة لإعطاء الدواء، أماكن الحقن، الآثار الجانبية للدواء، المكان والمدة المناسبة لحقن الهيبارين، استخدامات قسطرة الوريد المركزي، مضاعفات القسطرة الوريدية وأسبابها وأعراضها، التدابير الوقائية لمنع التسريب الوريدي. بالإضافة الى تصميم برنامج تدريبي حول الخطوات الصحيحة للحقن بين الممرضين لتحسين معلوماتهم وأدائهم من خلال ورشة عمل تفاعلية تعتمد على المحاضرة وقد تم مراجعة الاستبيان المعرب والبرنامج من خلال خبراء في التمريض لتحديد مصداقيته تمهيدا لتطبيقه بالإضافة الى أجراء اختبار الثبات وعمل العينة الاستطلاعية واجريت التعديلات المطلوبة من قبل الخبراء. وقد استخدام الاحصاء الوصفي (التكرار والنسب المئوية ، المدي، والانحراف المعياري) والإحصاء الاستدلالي (اختبار مربع كاي، واختبار التائي) وذلك لإيجاد الاختلافات بين متوسطات المجموعات باستخدام برنامج التحليل الاحصائي (SPSS).

النتائج: متوسط معارف الممرضين عن الخطوات الصحيحة للحقن قبل البرنامج كانت ضعيفة للغاية وقد تحسنت معرفتهم في الاختبار البعدي واستمر هذا التحسن أثناء المتابعة رغم حدوث تقلص في معرفتهم في مرحلة المتابعة ولكن ليس بشكل ملحوظ مع فرق ذو دلالة احصائية (6.6±2.1 ; 16.3±1.4 ; 10.5±2.2)علي التوالي). وجدت الدراسة ايضا ان الاصغر سنا أحسن في مستوى احتفاظهم بالمعرفة سواء قبل البرنامج او أثناء المتابعة مع فروق ذات دلالة إحصائية بين المجموعات قبل تطبيق البرنامج. ووجدت الدراسة أيضا أن الذين لديهم سنوات خبرة تتراوح من 11سنة فأكثر كانوا اقل مستوى في المعرفة مقارنة بالمجموعات الأخرى مع فروق ذات دلالة إحصائية بين المجموعات قبل واثناء المتابعة. كما وجد البحث أيضا أن أحسن المجموعات احتفاظا بالمعلومات أثناء المتابعة الممرضين خريجي المدارس الثانوية والمعاهد الفنية للتمريض في حين أن اخصائيات التمريض كانوا اقل فئة مع وجود فروق ذات دلالة إحصائية بين المجموعات بعد التدريب مباشرة. وجد البحث أيضا أن هناك علاقة ذات دلالة احصائية بين مستوى المعرفة والسن وسنوات الخبرة للممرضين.

الاستنتاج: أديّ تنفيذ برنامج تدريبي من خلال ورشة عمل تفاعلية حول أفضل تقنيات إعطاء الحقن الى تحسينات ذات دلالة إحصائية في معرفة الممرضين والتي استمرت الي مرحلة المتابعة.

التوصيات: توصي الدراسة الي ضرورة التركيز بشكل أكبر على برامج التعليم والتدريب المستمر للممرضين لتوفير الرعاية التمريضية عالية الجودة وأيضا تعميم بروتكول عن أفضل تقنيات اعطاء الحقن مع إجراء دراسات مكثفة حول هذا الشأن على عدد كبير من الممرضين.

Abstract:

Background: Injection is routinely administered by nurses in healthcare facilities and in the community. There for, improving the knowledge base for the best practice techniques of injections administration among nurses limit risk of undesirable complications among patients.

Aim of the study: The current study tends to assess the effectiveness of interactive workshops concerning parenteral methods of administration of medications on nurses' knowledge toward best techniques.

Subjects and Methods: A pre-posttest quasi-experimental study was carried out starting from 1\ February \2016 to the 30\ July \ 2016. The subjects consisted of 30 nurses from Al-Hilal Hospital for Health Insurance in Sohag governorate as part of the in-service training program. The number has been changed during the study period to only 27 participants during the follow-up procedure. A questionnaire was used. It had two parts. (The first part): collects the nurses' personal data (socio-demographic data part, and (the second part): measures nurses' knowledge of the right techniques of injections along 3 stages: before, immediately after, and during follow-up phase. The questionnaire has 20 MCQs revolving around the best techniques of parenteral administration such as 10 patient rights, injections sites, and side effects, the time and places of heparin injection, the uses of central venous catheter, and the risk factors of phlebitis with its symptoms and preventive procedures of extravasation. The data were analyzed by using the SPSS, version 19.

Results: The mean score of nurses' knowledge concerning the best techniques of injection in pre-intervention phase was noticeably poor. It improved in posttest phase; and such improvement continued in the follow-up phase in spite of the slight knowledge shortage during this stage. The success of the interactive workshop has been highlighted by higher immediately posttest and follow-up scores (16.3 ±1.4, 10.5 ±2.2) respectively, compared with the scores obtained prior to training on parenteral administration (6.6 ±2.10), with statistical significant differences ($p<0.00$). The study indicates that the more a nurse' is young; the more she is able keep knowledge and information in both the pre-intervention or follow-up phases, with statistical significant differences among group before the application of the program. The study also finds that those who have about 11 years' experience and more are less knowledgeable compared to other group. The study also finds that

graduates of secondary schools and technical institutes are more able to keep information during the follow-up phase compared to other group of nursing specialists, with statistical significant differences exists among groups in post intervention phase. The study indicates that there is a statistical relation between nurses' age, years' of experience and levels of acquiring knowledge.

Conclusion: The implementation of an interactive workshop concerning the best parenteral methods of administration of medication on nurses knowledge leads to, the improvement of nurses' knowledge immediately after the intervention and for 3 months after the workshop.

Recommendations: The study recommends that more emphasis should be put continuous on interactive educational in order to provide high quality nursing care. A protocol about the best techniques of injection should be distributed among nurses, with intensive studies in this regard on a large scale of nursing specialists.

Keywords: Interactive workshops, injection, best practice techniques, nurses, test.

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INTRODUCTION

Giving injections is probably one of the most important duties of nurses since the resulting errors may have unwitting, serious consequences for the patient. However, proficiency of injection techniques without updating the knowledge base from which to work can still put a client at risk of undesirable complications [(1)]**.** Nurses spend about forty percent of their time for administering medications; therefore they play a crucial role in the reduction of drug errors [(2)]. There may be increased risk of injury to patient that can lead to ache, nerve injury, hemorrhage, abrupt intravenous administration and sterile abscesses due to unsuitable selection of site and poor mechanism of injection [(3)]. According to WHO estimates, out of 12 billion injections practiced worldwide yearly, fifty percent are unsafe and seventy-five percent are dispensable [(4)]. Once a parenteral medication has been administered, it cannot be recouped. Therefore, the double and triple-checks should be made to assure the drug dose tallies with a valid prescription, and the patient's identity. Identification of the right patient for the right drug, in the right dose, at the right time, via the correct route is essential to prevent drug errors. All medications should be prepared based on the manufacturer's recommendations, and nurses need to ensure they are aware of the actions, contraindications, adverse effects and drug expiration date. The nurses must also use their professional experience to determine the appropriateness of the drug for the patient at that time [(5)].

Safe injection, administration of medication using the proper equipment, does not harm the recipient, does not expose the healthcare providers to any jeopardize and does not result in any waste that is serious to other people. An safety injection practice includes hand washing, the use of gloves where it is needed, skin preparation and disinfection and proper trashes management [(6)]. A safe injection practice along with proper disposal in health care places is a reflection of suitable resource allocation, adequate supportive oversight and proper technical support in addition to strict regulation [(7)]. The use of injection is done for therapeutic and preventive purposes. Although there are different techniques of taking drugs, injection will be preferred by some describers and users as the full effects of the drug are experienced very fast. Unsafe injection put the healthcare workers and patients at risk of communicable and non-communicable diseases [(8)].

In-service education is considered one of the cornerstones in professional development for nursing personnel workers that help them to update, promote, and coordinate their career with rapid changes. Therefore, each nurse needs permanent training for his/her professional and scientific growth and that is through conferences, interactive workshops, short professional courses, seminars, as well as researches, and self-learning activities [(9)]. Borimnejad et al, [(10)] reported that various types of human resource improvement programs, including continuing education to fulfill the needs of nursing community to some extent and repetition of

workshops in regular time intervals at most twice a year, seems necessary. There are several studies done to assess the proper methods of the administration of injections. One of them is a study that was conducted in India by Mehta et al, [(1)] to investigate the knowledge and awareness of nurses regarding safe injection practice. The study concluded that the knowledge and skills of nursing personnel are nearly up to mark. More emphasis should be put on the fundamental nursing education and on their introduction to injection procedures in the clinical practice to improve the nurses' knowledge and to reduce the adverse events. Other study was done in Serbia by Šakić et al, [(11)] to assess the general aspects of parenteral methods and its commitment with current recommendations. It noted that injection techniques were carried out traditionally and the current recommendations in this regard were not used by nurses. In an Egyptian study by Ismail et al, [(12)] it has been stated that safe injection practices within healthcare facilities are not as good as they should be. And the study recommended that further training courses should be conducted to upgrade the level of knowledge and skills about safe injection practices for all providers. For these reasons, the present study aims to investigate the impact of interactive workshop on the best practices techniques for injection administration among nurses.

SIGNIFICANCE oF THE STUDY

Nurses spend about forty percent of their time in drugs administration and this procedure may involve many risks on tissues or nerves. And training on practices founded on the available best evidence through educational programs and the interactive workshop plays a key role in the reduction of medication errors which is devastating to both the personal and professional life of nurses and patients. Moreover, the results of the current study will refurbish and update the nurses' knowledge and practice on the best techniques of the administration of injections to reduce the errors. So, I sought to assess the impact of an interactive workshop on best parenteral methods of medication among nurses.

AIM OF THE STUDY:

The aim of the present study was to assess the effectiveness of an interactive workshop concerning parenteral methods of administration of medication on nurses' knowledge toward best techniques.

RESEARCH HYPOTHESIS:

The level of nurses' knowledge regarding best parenteral techniques after intervention will be higher than before interactive education.

SUBJECTS AND METHOD:

Design: A pre-posttest Quasi-experimental study was used.

Setting: The present study was conducted at Al-Hilal Health Insurance Hospital Sohag Governorate as a part of the in-service training program.

Subjects: the subjects consist of a convenience sample of 30 nurses working at different wards in the hospital mentioned above.

Instrument: The questionnaire consists of two parts:

First part: Demographic data: It was prepared by the researcher to collect personal and job-related data of nurses and it included age, qualifications, job title, years of work experience and previous training on injection administration techniques.

Second part: Knowledge questionnaire sheet: It included 20 Multiple Choice Question (MCQs), designed by Altun et al,[(13)] and modified by the researcher to suit the respondents, to assess their knowledge concerning the best parenteral methods such as the ten rights of medication administration, the proper injection site, the complication of injections, the proper

time for heparin injection, the uses of central venous access devices, the complications and risk factors of phlebitis, the aseptic technique and safety measures taken to prevent infiltration and extravasations.

Scoring system: Nurses' responses were scored as (zero) for incorrect answer and (one) for correct answer and the total score of nurses' knowledge ranged from (0-20) degree.

Validity and reliability: The tool was tested by 5 experts in Adult Nursing Department to ensure its content validity and relevance. The panelists indicated that some items need to be rewording, and the required modification was carried out accordingly. The reliability test for the tool was done using test-retest reliability and the Cronbach alpha was 0.77.

Pilot study: Once the tool was modified and tested for validity by experts, a pilot study was done on (5) nurses to check the clarity, applicability and to estimate the time needed to fill the tool and the pilot study was excluded from the study sample.

Filed work:

Data was collected in the period from 1/ February /2016 to 30 / June / 2016 in three phases: before the education, immediately after the education and 3 months later using the same test. At first, all participants in the study were asked to answer pre-lecture MCQ test to test their baseline knowledge about best techniques of parenteral methods of administration of medication. The MCQ test was derived from topics covered in the presentation. After that, all participants were invited to attend an interactive lecture-based workshop on the best parenteral methods of medication in the conference hall of the hospital mentioned previously. The content of lecture was prepared by the researcher after reviewing the related literature. The interactive education session lasted about 4 hours and covered the following items: patient rights, proper injection sites, side effect of medication and post-injection massage, proper site and time duration for heparin injection, the uses of central venous access devices, the complications and risk factors of phlebitis, the aseptic technique, and measures taken to prevent the extravasation. Immediately after the education program and three months later from the implementation of the workshop, re-assessment of nurses using the same pre-test to evaluate the retention and application of knowledge delivered from the lecture and success of the education session. Nurses were not informed that they would be tested before to the lecture, immediately at the end of the workshop or will be repeated after three months to follow-up. The educational methods were a formal lecture using data show and poster as a media, demonstration and re-demonstration, group discussion in addition to, questions and answers, which were persistent until it was noted the nurses had enhanced their knowledge. After that, short video about the best parenteral methods of medication was also provided. At the end of workshop, each participant was given a booklet written in simple Arabic language which included all information guidelines about the topic delivered in the workshop. Tool filling took about 15-20 minutes.

Administrative and ethical considerations:

Prior to data collection the researcher has got an official permission from the director of El Halal Health Assurance Hospital and competent authority of the Faculty of Nursing Sohag University after explaining the aim and the nature of the study. Also, participants′ consent was obtained concerning the use of their responses for the research purpose only and they were informed that they are able to share or not share in the study and they have the right to withdraw at any time.

Statistical analysis

The collected data was organized, tabulated and analyzed using (SPSS) Vs. 19. For quantitative data the range, mean, and standard deviation was used. For qualitative data the number and percent distribution were calculated. Chi-square and the paired (t) test were used to find differences. Level of significant was threshold at $p<0.05$ for interpretation of results of tests of significance.

RESULTS:

Table (1): Demographic characteristics of the study sample

Personal Characteristics		**N0. (%)**
Age (Years)	**20-29** **≤30**	**27(90.0)** **3(10.0)**
Mean ± SD= 24.53 ± 3.148 **Minimum=20, Maximum=32**		
Experience (years)	1-5 years or 6-10 years ≥11 years	18(60.0) 8(26.7) 4(13.3)
Mean ± SD= 5.93 ± 3.713 **Minimum=1, Maximum=14**		

Table1 shows the personal characteristics of nurses. The majority of nurses (90%) at ages of 20-29 years old with 1-5 years' experience.

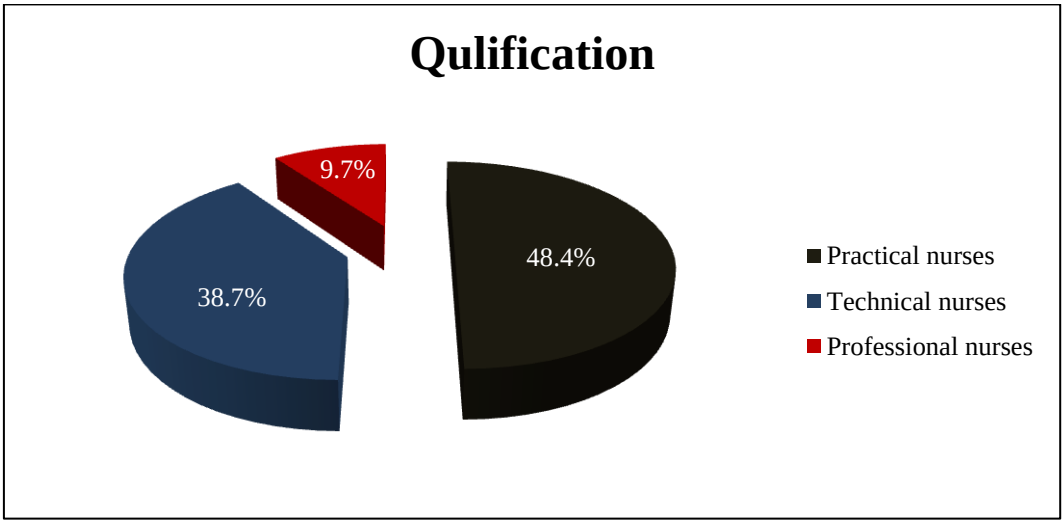

Figure 1: Distribution of the participants' qualification in the study

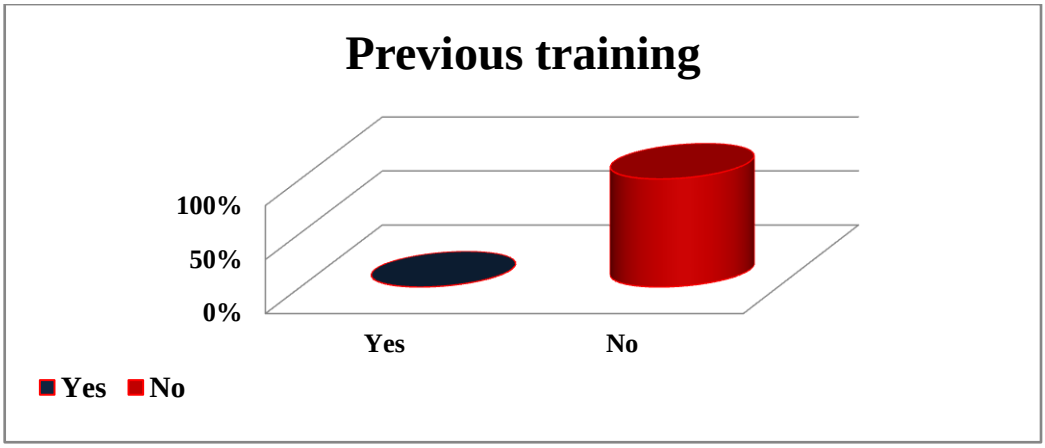

Figure 2: Previous training courses taken by participants concerning the best parenteral methods of medication**.**

Table(2): Frequency distribution of participants' knowledge pre/post-test, and after three months later

Questions (Percentages are based on the correct answers)	**Pre-intervention n=30**	**Post-intervention n=30**	**Three months later n=27**	**P. value**
Q1: Practice standards for medication administration (ten patient rights).	87.0%	96.8%	87.1%	.000
Q2: The safety site for an IM injection.	13.3%	70.0	10.0%	.000
Q3: Unsafe site for an IM injection.	26.7%	60.0%	60.0%	.000
Q4: Maximum dosage of injection in deltoid muscle.	26.7%	83.3%	40.0%	.011
Q5: The muscle that flow the largest amount of blood to it and are used to IM injection.	10.0%	60.0%	50.0%	.000
Q6: Degree of injection angle for the densest part of the muscle.	60.0%	100.0%	70.0%	.273
Q7: Disinfect the injections site.	3.3%	93.3%	66.6%	.000
Q8: Complications of post-injection massage.	10.0%	90.0%	63.3%	.000
Q9: Proper muscle to use Z-track technique.	13.3%	90.0%	60.0%	.000
Q10: Potential complications for IM injections.	13.3%	73.3%	56.7%	.000
Q11: Proper site for subcutaneous heparin injections.	53.3%	90.0%	56.7%	
Q12: Time duration for subcutaneous heparin injections.	20.0%	96.7%	53.3%	.000
Q13: The critical elements of an intra-dermal injection.	53.3%	96.8%	70.0%	.001
Q14: Nurses responsibilities in intravenous catheters management.	60.0%	100.0%	63.3%	.144
Q15: Uses of Central Venous Access Devices (PICs).	40.0%	93.6%	46.6%	.715
Q16: Complications associated with central venous catheters.	36.7%	96.7%	50.0%	.144

Q17: Factors which influence Central Venous Access Devices (PICC) function.	20.0%	66.7%	46.6%	.068
Q18: The first symptom of phlebitis.	16.7%	80.0%	60.0%	.000
Q19: Risk factors of phlebitis.	26.7%	76.7%	66.7%	.003
Q20: Preventive methods of infiltration and extravasations for medication.	36.7%	76.7%	46.7%	.003
Total mean ± SD	**6.63±2.14**	**16.33±1.49**	**10.53±2.28**	**.000**

Table2: shows results of participants' knowledge which include the percentages of nurses who selected the correct answers in the three stages. As evident in the table, nurses showed low scores of knowledge in pre-intervention phase. Immediately after intervention the post-test of nurses' assessment shows a significant improvement in their knowledge towards best parenteral medication methods as evident in the all listed questions. However, these scores decreased slightly after 3 months of intervention although the percentages of correct answers in this phase were still significant higher than pre-test phase which ranged from 10 % to 87. 1% compared to the percepts of pre-test which were from 3.3% to 87.0 %, with statistical significant difference between pre/post and follow-up test (3 months) for knowledge of nurses regarding parenteral administration(p-value <.05).

Table (3): Comparison of participants' knowledge according to age

	Age (years)		**P-value**
	20-29	**≤ 30**	
	Mean ± SD	**Mean ± SD**	
Pre-test	6.81±2.18	5.00±0.00	**0.000**
Post-test	16.33±1.51	16.33±1.52	1.000
Follow-up	10.70±2.33	9.00±1.00	0.067

Table3 displays the difference in total mean scores between the pre and post-test regard to age. The current study revealed that the mean of total score of nurses, with knowledge were higher in the younger nurses than older group in the three phases respectively (6.8±2.1, 16.3±1.5, 10.7±2.3; 5.0±0.0, 16.3±1.5, 9.0.3±1.0) with statistical significant differences between two groups in pre and follow-up test.

Table (4): Comparison of participants' knowledge according to year of experience

	Level of experiences			**P-value**
	1-5 years	**6-10 years**	**≥11 years**	
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	

Pre-test	7.64±2.11	5.62±1.40	4.80±1.09	**0.006**
Post-test	14.94±2.41	15.75±2.18	15.60±2.19	0.680
Follow-up	11.58±1.87	9.75±2.25	8.20±1.48	**0.004**

Table4 shows the knowledge of participants with regard to years of experience. It was found that the total mean scores of knowledge for those with longest years of experience were ≥ 11 years it was low in pre/posttest and follow-up (4.8±1.0; 15.6 ± 2.1; 8.2±1.4) compared to other groups where they were respectively (7.6 ± 2.1, 14.9 ± 2.4, 11.5 ±1.8; 5.6±1.4, 15.7 ±2.1, 9.7 ± 2.2). A statistical significant difference was found between pre and follow-up scores only ($p<0.000$).

Table (5): Comparison of participants' knowledge according to qualification

	Qualifications			**P-value**
	Practical nurses	**Technical nurses**	**Professional nurses**	
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	
Pre-test	6.66±1.83	6.50±2.31	7.00±3.60	0.938
Post-test	13.80±2.36	16.83±0.71	16.33±0.57	**0.000**
Follow-up	11.00±2.20	10.33±1.92	9.00±4.00	0.368

Table5 shows the comparison of participants' knowledge according to qualifications. It was found that the level of knowledge on best parenteral methods of medication was improved immediately after intervention in all group, means but the worst degree of knowledge obtained by the professional nurses in follow-up after 3 months (9.0±4.0) compared to technical nursing and secondary school of nursing where they were respectively(11.0±2.2,10.3±1.9) with statistical significant differences was found between the qualifications groups in post-test only.

Table (6): Correlation between level of knowledge and qualification, level of experiences and age

		Qualification	**Level of experiences**	**Pre-test knowledge**	**Post-test knowledge**	**Follow-up knowledge**
Age	**R-value**	-0.091	791	- 0.308	0.086	-0.223
	P-value	0.633	**0.000***	0.098	0.653	0.236
Qualification	**R-**		-0.355	0.229	0.205	0.255

	value					
	P-value		0.054	0.223	0.276	0.174
Level of experiences	**R-value**			-0.515	0.129	-0.516
	P-value			**0.004***	0.499	**0.004***
Pre-test knowledge	**R-value**				0.061	0.802
	P-value				0.748	**0.000***
Post-test knowledge	**R-value**					-0.054
	P-value					0.777

Table6 shows the relation between total knowledge level of nurses' and their demographic characteristics. It was found that a statistically significant relation between total knowledge of nurses in pretest, follow-up, and years of experience, also, between nurses' ages and their years of experience. On the other hand, a relation was found between total knowledge level of nurses in pretest and follow-up.

DISCUSSION:

In-service training is the unofficial training for nurses to enhance their professional knowledge, skills and attitudes according to the demands of the departments and it is consider the key to quality nursing care.

The current study showed that the mean age and standard deviation of respondents were 24.5±3.1, about sixty percent of them were less than six years of experience, and the majority of them were graduates of Secondary School of Nurses and Technical Nurses. In addition, none of them received any training courses in the medication administration field, except for what were received during academic education. These findings are in concordance with previous study carried out by Rasoul et al, [(14)] who reported that about ninety percent of participants' age ranged between 20 and < 30 years, nearly more two third had less ten years of experience. Also, these results were in agreement with a previous study done by Fathy and Kabeel [(15)] who found that the majority of the participants didn't receive any medication administration program before. This indicates that nurses in this setting need training in this area. Along same line in another study, Ebrahem and Elnagar [(16)] recommended that the assessment of medications administration should be done periodically by improving clinical guidelines of drugs administration; and educational training program about drugs administrations and errors with patient safety should be applied. This program can provide the accurate information needed to achieve optimal knowledge, practice and promote patient safety. With regard to a nurses' knowledge, the study revealed that the knowledge of the nurses was in low level in pre-intervention phase. But immediately after intervention, the post-test of nurses' assessment showed a significant improvement in their knowledge towards the best parenteral techniques as evident in all listed questions. However, these scores decreased slightly alter after 3 months of intervention although the percentages of correct answers in this phase were still especially higher than pre-test phase. This indicates the important of the ability of nurses to maintain knowledge. These results were in consistence with the results of the study done by Habibzadeh et al, [(17)] who stated that the mean score of the quality of nurses' performance significantly increased after implementing the interactive workshop compared to pre the intervention.

According to the knowledge of nurses about the standards of practice (ten patient's rights) for medication administration such as right drug, dose, route, patient and time, it was found that about

eighty percent of nurses know the ten 'Rs' of safe drug administration in pre-intervention and this increased immediately in post-intervention and three months later to about ninety percent. These findings were conforming with Fathy and Kabeel [15] who stated that the majority level of nurses' knowledge about ten rights of medication administration before program was low about eight percent, then it immediately increased after the training program and after one month after training to highest rate about ninety percent. Attari et al, [18] added that nurses are frequently exposed to modern advancements during their work and should upgrade their knowledge about medication specially the generic names of medications, dosage and forms, adverse action and contraindications. With regard to the level of knowledge of nurses towards the safest area of IM injection, the present study found that the level of knowledge of the majority of nurses have shifted from negative to positive after receiving of the interactive workshop in concerning with use the safe places for intramuscular injection and continued after 3 months training. And there was a difference between test rate before and after the test. In consistence with the results of the present study, Gülnar and Özveren [19] stated that before the training program, the majority of nurses used the dorsogluteal area for IM injections while the lowest percent of nurses used the ventrogluteal region. After four months of training, however, it was found that the rate of nurses using the safest area for IM injection had fallen to about fifty percent, while the rate of using the unsafe region rose to forty percent. It was seen that there was a significant difference between the nurses' pre-training and post-training knowledge scores and their scores four months after the interactive training.

According to the level of knowledge of nurses about the maximum dosage for injection in deltoid muscle and degree of injection angle for the densest part of the muscle, the present study revealed that the level of knowledge of nurses in pre-intervention period was high and remained in the same level immediately in post-test and after 3 months of follow-up with regard to the degree of injection angle for the densest part of the muscle, while the knowledge of nurses about the maximum dose which was injected in deltoid muscle was low in follow-up test; although this proportion increased immediately in post-intervention period. These results were in contrast with Srividya et al, [20] who found that the majority of nurses answered correctly the question concerning the maximum dose of injection in deltoid muscle and the degree of injection angle for the densest part of the muscle by proportion ranged from eighty to ninety percent. Along the same line, the study done by Huang et al, [21] on the effectiveness of interactive workshop of medication administration an nurses' knowledge concluded that the effect of interactive workshop concerning medication administration has enhanced the knowledge of nurses about drug-dose calculation and the densest part of the muscle for IM injections, and should always be injected at a 90 degree to ensure the drug is deposited into muscle.

In our study almost all respondents didn't answer correctly about the disinfect of the skin at needle insertion site in pre-education, but by the end of the workshop the percent of correct answers increased to about ninety percent and continued for 3 months after workshop by a reasonable rate. Mehta et al, [1] in their study reached different results and reported that almost all respondents correctly answered that the injection area should be disinfected by aseptic precautions in circular manner from inward to outward by alcohol swab. This is a good practice as it prevents the contamination of the injection site from the periphery of the limb. The injection site may be harbor and source of infection both from blood or body fluids, soiled linens, cotton or other substances.

According to the effect of interactive workshop on the level of knowledge of nurses about the proper muscle to use Z-track technique, it was found that the knowledge of nurses about the proper muscle for using Z-track technique was low (about ten percent before intervention), and it improved immediately after the intervention to around ninety percent, and this percentage continued high for up to three months. In consistence with the results of

the present study, Šakić et al, [11] showed that more than sixty percent of respondents correctly answered the use of Z-technique for all IM injections. Concerning the knowledge of the nurses of the potential complications of the massage in the site of injection, the present study showed that before the educational program almost all nurses' answers were wrong. Immediately after the intervention the nurses showed a significant improvement in their knowledge, but these scores declined slightly after three months from follow-up although the proportion of correct answers in this phase were still significantly higher than those in the pre-intervention period. In a previous study done by Šakić et al, [11] about IM injection practices among nurses' the researchers mentioned that most of nurses do not massage the injection site because it causes bruises and tissue irritations.

According to the potential complications of IM injections, it was found that about ninety percent of the nurses didn't answer this question correctly in pre-test phase. This confirms the fact that they were not familiar with the complications. However, this score was significantly improved immediately in post-test assessment, while this score was significantly retracted at the follow-up phase. These results are contradicted to El-Demerdash et al, [22] who reported that about seventy percent of nurses have adequate knowledge about the complications of techniques and procedure of IM injection such as nerves injury, IM hemorrhage, sterile abscess, allergic reaction, cellulitis, muscle fibrosis and needle phobia. Another variable investigated in the current study was the determination of the level of knowledge of nurses for potential complications associated with indwelling Central Venous Catheters (CVCs). The current study found that only forty percent of nurses know the potential complications associated with indwelling CVCs before intervention and the percentage changed to the best immediately after intervention; but this change was significantly retracted in the follow-up stage to the same proportion before the workshop. In Ahmed and Ali study, it was revealed that an in-service training program should be necessarily held and conducted on regular basis for nurses in order to prevent infections and other complications [23]. The training would relate to theoretical and practical aspects of CVC and the clinical part should be carried out under supervision using simulation models and practice on patients later. In addition, refresh courses and conferences established should be for nurses to provide them with the recent advances in this regard. El-Sol and Badawy [24] added that in-service training programs for nurses are very important to updating and refreshing knowledge and skills related to CVCs and the prevention of complications. These services must include the recent and older graduates; and the infection control committee should follow up infection control process application in all hospital unities. With regard to nurses' knowledge about the uses and factors affecting central venous access devices functioning such as material, patient status, and medication, the current study revealed that a significant increase was observed in the nurses' knowledge immediately after and 3 months after intervention compared to pre- intervention phase. El-Sol and Badawy [24] reported that there are risk factors affecting CVCs functions such as characteristics of the devices and vascular access, drugs and solution, and patient health status. Aminoroaia et al, [25] concluded that continuing education notably affected the promotion of nurse's knowledge and should be designed and organized based on consent needs assessment. These shows in the mean scores of nurses' knowledge significantly increased immediately after and three months after holding the workshop compared to pre-program phase.

With regard to the effect of age, qualification, and years of experience on the level of knowledge of nurses toward the best parenteral techniques, the current study showed a statistically significant relation between the total of nurses' knowledge in pre, and follow-up test and years of experience, also, between nurses' ages and their years of experience. On the other hand, a relation was found between the total knowledge level of nurses in pre and follow-up test. These findings are in agreement with study of El-Sol and Badawy [24] who found that a strong relation was existent between the nurses' knowledge and years of

experience and their age. These findings are consistent also with the results of the study carried out by Fathy and Kabeel [15] who stated that a highly statistical significant difference was found among the nurses' level of knowledge about medications administration during different phases of training program and personal demographic characteristics. On the contrary, Aminoroaia et al. have shown that there is no significant association between the age of nurses and their years of experience when comparing the mean scores of nurses' knowledge before, immediately after, and 3 months after intervention phase [25]. In the evaluation of the effectiveness of interactive education on nurses' knowledge concerning the proper site and duration of subcutaneous heparin injections, the results showed that nurses' knowledge was low in pretest but more adequate in post-test and follow-up test. These results were in-compatible with Mahmood et al, [26] who reported that most of the respondents had adequate knowledge about subcutaneous heparin injections. With regard to the effect of an interactive education on the nurses' knowledge about the preventive methods of infiltration and extravasation, the result showed a significant increase in nurses' knowledge about preventive methods of extravasation immediately after the workshop and continued high for 3 month after intervention and the difference detected was statistically meaningful. This finding was in accordance with Sisan et al, [27] who observed that only about twenty percent of nurses have a good knowledge about infiltration and extravasation. Although the closed units' nurses reported relatively higher level of knowledge than open units' nurses, their level of knowledge was still inadequate. There is a need for structuring a permanent training program due to the shortage of technical and scientific knowledge about the prevention and management of extravasation medications. Sankar et al, [28] recommend six month intervals as the optimum time for the re-training of professional nurses to update the skills and theoretical knowledge and prevent underwent a major deterioration.

CONCLUSION:

The study concludes that the knowledge of nurses towards the best techniques of parenteral methods of injection was generally poor at the beginning but more improved in after intervention and during the follow-up period. Statistical significance differences were found between the ages of nurses' and the years of experience, and also between the years of experience and the total scores of knowledge of nurses in pre-test and follow up phase. Moreover, a relation existed between pretest and follow-up test after implementing the interactive education. The low level of nurses' knowledge might in part be attributable to the fact that all respondents had no in-service training on policy and guidelines of the best techniques of parenteral methods.

RECOMMENDATIONS:

1. Holding ongoing in-service training which has many benefits for all categories of nurses as well as overcoming all obstacles to in-service training.
2. Maximizing the benefit of advanced technology such as barcodes, computerized order system, and smart pumps in order to enhance the best parenteral methods and to minimize the undesirable complications in healthcare facilities.
3. Establishment of continuous training centers in all hospitals to be responsible for refurbishing and updating the knowledge and practices of nurses: These services must include the old and recent graduates they should provide logistical services and oversee support to ensure that the nurses are committed with standard guidelines and practices.
4. Doing further interventional studies that should be conducted on a large numbers of nurses′ for the sake of generalization of results, and additionally for investigating the elements affecting the practice standards for parenteral techniques and monitoring the undesirable complications.

5. The information obtained from this study will be as a basis for further researches, and will help to guide to improvements in parenteral methods with the ultimate goal of promoting safe and good patient care.

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