DOI: https://doi.org/10.53350/pjmhs211561700

ORIGINAL ARTICLE

Effect of Training Program about Extravastion Injuries on Nurses' Performance

MANAL YAHIA IBRAHEM[1], HANAN MOHAMAD RASHAD[2] & MOHGA ABD ELAZIZ SELIM[3]
[1]*Assistant lecturer, Department of Pediatric Nursing, Faculty of Nursing, Kafrelsheikh University, Egypt*
[2]*Assistant Professor, Department of Pediatric Nursing, Faculty of Nursing, Cairo University, Egypt*
[3]*Professor, Department of Medical Surgical Nursing, Faculty of Nursing, Kafrelsheikh University, Egypt*
Email: omyouha98@yahoo.com, Telephone No: +20 01000789394

ABSTRACT

Intravenous extravasation is a significant problem and one of the most commonly seen morbidity in infants admitted to the neonatal intensive care unit. Nurses play a key role in preventing extravasation injuries. The study aimed to evaluate the effect of a training program about extravasation injuries on knowledge and practice of neonatal nurses. One-group pre-posttest quasi-experimental design was used. A convenient sample of 45 nurses was recruited from two different NICUs at Kafrelsheikh General Hospital Governorate and Health Insurance Hospital (El Ebour Hospital) at Kafrelsheikh city. Tools: Structured questionnaire interview and observational checklist were used. Results revealed that minority of nurses had satisfactory level of knowledge and performance in pre-program compared to all nurses in post- program. A significant differences for nurses total mean knowledge and performance scores between pre and posttest (P =0.00) was evident. In conclusion, knowledge and performance of nurses were significantly increased after receiving the training program suggesting its effectiveness. The study recommended that nurses who working in NICUs especially newly hired should be equipped with updated information about extravasation injuries through continuous educational programs. As well, an emphasis should be done regarding their practices and periodic checkup for their knowledge.

Keywords: Preterm, NICU, Extravasation injuries, Nurses' performance, Training program

BACKGROUND

In 2018 World Health Organization "WHO" [1] pointed out that every year around 15 million babies are born preterm (i.e. before 37 weeks of gestation); and this number is liable for rising. Those preterm infants are usually admitted to neonatal intensive care unit (NICU). The environment of NICU presents numerous challenges for maintaining skin integrity. Extravasation injury is a common and challenging problem which results from peripheral intravenous therapy (PIV). It is defined as the damage caused by the accidental leakage of intravenous solution from a vessel into surrounding tissue [2].

The extravasations injuries can be devastating if not appropriately managed. They are recognized as an important cause of iatrogenic morbidity and mortality, serious extravasation injuries can result in skin necrosis, infection, disfigurement, prolonged hospitalization, increased hospital stay & costs, nerve or tendon injury and compartment syndrome. Scarring with cosmetic and functional sequelae, complex regional pain syndrome and deformities are potential long-term sequelae [3].

Early detection plays a crucial role for decreasing the devastating consequence of extravasation injuries. Prevention of extravasation is the best management approach which requires hyper vigilant monitoring of the intravenous site. In addition; there is no consensus on the best approach for management of extravasation although treatment options are many and varied because of the limited research evidence available, particularly in newborns and infants. So well-informed nurses can serve as patient advocates and may be instrumental in detecting, managing, and documenting these injuries. Most importantly, nurses play a key role in preventing extravasation injuries [4].

Significance of the Study: Intravenous extravasation is a significant problem and one of the most commonly seen morbidity in infants admitted to the neonatal intensive care unit (NICU). The intravenous extravasation in infants can rapidly progress to severe stages i.e. stage three and stage four with necrosis if not early detected and timely treated [5].

The incidence of intravenous extravasation in preterm infants varies widely in different places. This may be due to under-reporting of these adverse events, or may also be due to the fact that the preterm infants represent a small portion of the patient population. It has been estimated to range from 23-63% and still rising to be high as 70% [3]. A study done in Egypt in many NICUs, found that extravasation was among the most common errors in NICU according to The Egyptian Neonatal Safety Training Network (ENSTN) [6].

Moreover, complications of extravasation are costly in terms of patient's quality of life, treatment expense, the possibility of an extended hospital stay, and destructive to the neonate's fragile skin. Ultimately, the awareness of the problem with evidence-based quality improvement measures may help in early detection of extravasation and decrease the severe grades of extravasation. Furthermore extravasation injuries can lead to secondary infection and high morbidity in neonates [5].

Up till now there is a lack of consensus regarding the management of neonatal extravasation injuries although several treatment modalities have been developed and used for managing these injuries with variable results. On the other hand, a recent quality improvement project conducted by a safety event response team at Cincinnati Children's Hospital Medical Center found a significant decrease in extravasation rates immediately following an

educational intervention to promote hourly peripheral IV site assessments by the clinical team [7].

Studies reported that extravasation injuries can be easily prevented by nurses because they are first one who can easily notice and detect these events through vigilant monitoring. It was proved that continual educational programs help maintaining sustainability and standardization of care provided to preterm infants, improve nurses' knowledge about extravasation, and significantly reduce its rates as well. Therefore, nurses are in need for in-service education to ensure that the information received about extravasation up to date and lasting [8].

Based on the researcher's clinical experience, it has been observed that early detection of an extravasation may be difficult, even for the most experienced nurse. It is an inevitable issue in neonatal care. Nurses are in a unique position to assess early signs and symptoms of extravasation injuries, when they are present. Nurses are often the first to respond to acute changes in clinical status and physical assessments, initiating the series of events to manage extravasation injuries and incorporating training on critical nursing assessments, signs of injury and key actions to treat it are an important part of every NICU's education plan. In addition, the research investigators can provide neonatal nurses with an in-depth understanding of extravasation injuries to enable them to be competent and safe in delivering peripheral IV infusion with decreased risk of pain, stress, and infection to the preterm infant. On the other hand, the research investigators can add evidence-based practice study to the body of knowledge in nursing especially high-risk neonates' specialty.

Aim of the Research: The current study was carried out to evaluate the effect of a training program about extravasation injuries on nurses' knowledge and performance

Research Hypotheses

1. Nurses who will receive the training program about extravasation injuries will have higher mean post test score of knowledge than in pre-test.
2. Nurses who will receive the training program about extravasation injuries will have higher mean score of performance after program than pre-program.

Subjects and Methods

Research Design: One-group pre-posttest quasi-experimental research design was adopted in this research.

Setting: The research was conducted at two different NICUs at Kafrelsheikh General Hospital Governorate and Health Insurance Hospital (El Ebour Hospital) at Kafrelsheikh city Kafrelsheikh.

Sample: Convenient samples of 45 nurses who are working in the previously mentioned NICUs and approved to participate in this study were recruited.

Tools: two tools were constructed by the researchers after reviewing related literatures (structured questionnaire interview and observational checklist were developed & utilized).

1. Structured questionnaire interview. It included questions categorized under two main parts:

Part I*: *nurses' characteristics: it included personal data about nurses such as age, level of education, years of experience in general, years of experience in NICUs, if they attended clinical conferences or clinical rounds about extravasation injuries, and if they had attended on job training about extravasation injuries.

Part II: nurses' knowledge (pre & post-test): it included 41 questions to assess nurses' knowledge about extravasation injuries; it composed of three sections: a) questions about anatomy of the veins, b) extravasation injuries' definition, risk factors, pathophysiology, grades, and complications; and c) management and nurse's role in early detection of extravasation. This part was applied before beginning of the program (pretest) and after implementation of the program (posttest).

Scoring system:

Knowledge: a total score of 41 grades (equal 100%) for all questions. A score of one was given to each correct answer and zero for incorrect, missed, and didn't know answers. Accordingly, the scoring system of nurses' knowledge was classified into either satisfactory level (> 60% = > 25 grades) or unsatisfactory level (< 60 % = < 25 grades).

3. **Observational checklist.** It involved 25 steps of demonstration of the peripheral IV access insertion and monitoring procedure. It was used to evaluate nurses' practice and re demonstration of the procedure. It was fulfilled by the research investigator through observing the nurses during IV access insertion. Nurses were observed in both previously mentioned NICUs before beginning of the program and after implementation of the program.

Scoring system:

Performance: one score was given to done correctly step; and zero for not done or incorrect done with the total number of 25 steps. The total scores of the procedure were 25 grades (equal 100%). The total scores of nurses' performance were categorized into; satisfactory performance level (> 60% = > 15 grades) and (< 60 % = < 15 grades) for unsatisfactory nurses' performance level.

Tools Validity and Reliability

Validity: data collection tools were submitted to three experts (one neonatologist/ pediatrician and two high risk neonatal nursing experts) to test the content validity.

Reliability of the tools was performed to confirm consistency of the tool and was calculated statistically. The internal consistency was measured to identify the extent to which the items of the tool measured the same concept and correlated with each other. Reliability of the study's tools was done by Cronbach's alpha test and the result of knowledge part (tool I) was 0.78 and the result for practice part (tool II) was 0.75.

Ethical Consideration: Primary and final approvals by the research ethical committee in the Faculty of Nursing, Cairo University were taken. As well as, an official permission was taken from authoritative personnel in NICUs at both hospitals. A written consent was obtained by the researchers from them. The research investigators emphasized that participation in the study was voluntary, and participant could refuse to participate in the study without any reason and obtained data was only used for the research purpose. The anonymity and confidentiality issues of information were assured and the nurses had the

right to withdraw from the study at any time during the study without any effect on their job.

Pilot Study: A pilot study was conducted on 10% of the sample to test the feasibility of the study tools, application of tools, clarify of sentences and estimate the time required to collect the required data. No modifications were done and the pilot sample was included in the study sample.

Procedure

Data collection procedure: Official permissions were obtained from the directors of both previously mentioned hospitals and permissions from the head of NICUs after giving simple explanation about the program, its expected outcomes to nurses working in the two NICUs as well to the preterm infants. The research investigators gave nurses clear and simple explanations about the aim and nature of the study. As well, assessments for nurses' characteristics, knowledge about extravasation, and level of performance about IV access insertion and monitoring done by the research investigators. Data were collected over a period of eight months started from the beginning of October 2018 to the end of May 2019 in the morning or long day shift according to nurses' availability.

Assessment phase: The research investigator introduced their self to the nurses and gives them simple explanation about the program comprising its benefits for them and for the preterm infants. Nurses were assigned as study and control group at the same time. The pretest format was distributed in order to collect the required data at break time. This sheet was to assess nurses' knowledge about extravasation injuries to be used as baseline data for training program. The research investigator was available for more clarification whenever needed. The time taken by nurse to complete this tool was ranged from 15-25 minutes. Also, nurses' performances were assessed by using the observational checklist (tool two) for the peripheral cannula insertion and monitoring. Nurses were observed during the procedure of cannula insertion and after insertion of cannula for their monitoring to it.

2- Implementation phase. The extravasation training program was designed to be interactive rather than prescriptive in style so that nurses were motivated and encouraged to have optimal knowledge to improve care provided for preterm infants. Each nurse received two sessions (theoretical and practical). In NICU of General Hospital, these sessions were provided in the nurses' room which was suitable. Regarding the NICU of Health Insurance Hospital, the educational sessions were conducted at the nursing station of that NICU. The sessions were provided in the morning shift whereas no nursing shortage at that particular time. The first session was for the theoretical content (everything related to extravasation) while the second session was for the practical content of the training program (the procedure of cannula insertion and monitoring).

Each session had specific objectives and time. The actual number of sessions received was determined by the nurses' availability (their monthly schedule) in the both NICUs and the acuity of cases. Each session was approximately 30- 45 minutes with three to five nurses in the group. They were ten groups and each group of nurses attended two sessions per week until the entire sample (45) was covered. During the first session (theoretical part) the researchers provided and explained knowledge related to anatomy of the peripheral vein, extravasation injuries' definition, risk factors, prevention, early detection, management, nursing care, and complications. The research investigator used PowerPoint presentation during both theoretical and practical content to help in clarifying presented information.

Concerning the practical content (second session) of the training program, it was about administration of peripheral cannula insertion, monitoring, care, and documentation. It was done by the research investigators and then re-demonstration was done by each nurse individually in the presence of the researchers. The time taken for demonstration by research investigators were about 15 minutes and re-demonstration by each nurse was about five to seven minutes. The two sessions carried out in a group discussion. In addition to that an educational arm and all needed supplies as cannula, transparent sterile adhesive dressing, alcohol swab, syringe with distilled water, stretchy Elastoplast, and plaster were used during demonstration and remonstrations.

During and after the presentation the researchers encouraged active participation of nurses through asking questions and receiving feedback. After completion of program for all nurses, printed materials prepared by the research investigators after reviewing related literature in the form of simple Arabic booklet were distributed to nurses. This booklet included all information that was given during the two sessions to meet nurses' actual educational needs regarding extravasation injuries among preterm infants.

3-Follow up and evaluation phase: it took three months after the implementation phase to evaluate the program. The nurses' knowledge and performance were evaluated using post-test and observational checklist (tool one and two). Each nurse was evaluated by posttest individually to prevent contamination of the results. The observational checklist was filled by the researchers through close observation to each nurse during cannula insertion and monitoring for the preterm infant.

Statistical Analysis: The collected data were coded, and then Statistical Package for Social Science (SPSS.26) was used for data analysis. Quality control was done at the stages of coding and data entry. Arithmetic mean was used to describe the central tendency of observations for some variables, standard deviation as a measure of dispersion of results around the mean, and frequency distribution was used for each variable. Within group comparison of numerical variables was done using paired t test. Comparison for categorical variables was done using chi-square test. Level of significance was pre- set at $P \leq 0.05$.

RESULTS

The study results indicate that studied nurses' mean age was 28.82 ± 3.55, with mean years of experience 5.77 ± 5.32 in nursing; and 4.95 ±3.77 in NICUs. Regarding educational level, the technical nursing institute nurses and secondary nursing school diploma represent the same percentage 44.4%; however; only 11.2 % of the total sample with bachelor degree **(Table, 1).**

Concerning knowledge about neonatal veins, extravasation definitions, stages, prevention and

management **table 2** represents that, the mean scores of knowledge pre-program implementation was 2.22 ±1.20, 4.33 ±1.74, 3.41 ±2.84, and 9.57 ± 3.16 respectively compared to 4.66 ± 0 .77, 8.48 ± 0.66, 4.84 ± 0.82, and 16.08 ± 1.67 post-program respectively. A significant difference for total mean knowledge score between pre & posttest (*P* =0.00) was evident.

Table (3) reveals the total mean scores of performance about intravenous access insertion and its monitoring, post-program were significantly higher than the corresponding total mean scores in pre-program (21.16 ± 1.58, 10.68 ± 4.87 & *p* = 0.00) respectively.

As can be seen from **table (4)**, the majority of nurses got unsatisfactory level of knowledge and performance about extravasation injuries pre-program (86.7%, 84.4) respectively; while, post-program 100% got the satisfactory level. As well, there were statistically significant difference in their knowledge and performance pre and post-program (*P* = 0.000 & 0.000) respectively.

Table (5) highlighted that, there was a strong significant correlation between nurses' knowledge and performance (r= 0.855, p = 0.000).

Table (6) proved that there was a negative weak correlation between nurses' knowledge and their age; while a positive weak correlation was detected between age and their performance (r = - 0.314 & 0.329 and p = 0.036 & 0.027) respectively.

Table (1): Nurses' characteristics in percentage distribution (n=45)

Age		
20 < 30 years	26	57.8
30 < 40 years ≥ 40	14 5	31.1 11.1
M±SD	28.82 ± 3.55	
Educational level		
Bachelor	5	11.2
Technical	20	44.4
Secondary	20	44.4
Experience in nursing / years:		
<5	25	55.6
5-10	15	33.3
>10	5	11.1
M±SD	5.77 ± 5.32	
Experience in NICUs / years:		
<5	32	71.1
5-10	9	20
>10	4	8.9
M±SD	4.95 ±3.77	

Table (2): Comparison of nurses' knowledge means scores pre/post-test

Nurses' knowledge	Pre-test Mean ± SD	Post-test Mean ± SD	P
Neonatal blood vessels	2.22 ±1.20	4.66 ± 0 .77	0.000
Extravasation definition and risk factors	4.33 ±1.74	8.48 ± 0.66	0.000
Extravasation stages and complications	3.41 ±2.84	4.84 ± 0.82	0.000
Extravasation prevention and management	9.57 ± 3.16	16.08 ± 1.67	0.000
Total	19.53 ± 8.94	34.78 ± 3.92	0.00

Table (3) Comparison of nurses' performance means scores pre/post-program

Nurses' performance about IV access insertion and monitoring	Pre-program Mean ± SD	Post-program Mean ± SD	P
Intravenous access insertion	6.67 ± 2.71	12.97 ± 1.07	0.000
Intravenous access monitoring	4.01 ± 2.16	8.19 ± 0.51	0.000
Total	10.68 ± 4.87	21.16 ± 1.58	0.000

Table (4) Comparison of nurses' knowledge and performance level pre / post program

Knowledge and performance level	Pre-program		Post-program		P
	N	%	N	%	
▪ Satisfactory (≥ 60%)	6	13.3	45	100	0.000
▪ Unsatisfactory (≤60%)	39	86.7	0	0	
▪ Satisfactory (≥ 60%)	7	15.6	45	100	0.000
▪ Unsatisfactory (≤60%)	38	38.4	0	0	

Table (5) Correlation between nurses' knowledge and performance

		Knowledge	Performance
Total Knowledge	r	-	0.855
	P	-	0.000
Total Performance	R	0.855	-
	P	0.000	-

Table (6) Correlation between nurses' characteristics to their knowledge and performance

Nurses' characteristics	Knowledge		Performance	
	r	P	R	P
Age	-0.314	0.036	0.329	0.027
Educational level	-0.025	0.734	-.198	0.381
Years of experience in NICUs	-0.149	0.422	-0.075	0.624

DISCUSSIONS

The research hypotheses of this study are accepted as the mean knowledge and performance scores were increased post training program.

Part (I): demographic characteristics of nurses: The results of the present study revealed that, the highest percentages of studied nurses were less than 30 years, held technical nursing institute and secondary nursing school diploma **(table1)**. These findings are parallel to findings of Malek, [10] who studied the effect of an education program on nurses performance regarding electrocardiography, found that the majority of them were between 18-30 years and held technical nursing institute.

Concerning years of experience in NICU the results of the current study indicated that majority of nurses had less than five years' experience. In the same line Belal, [11] who investigated the impact of intervention program on nursing performance provided for neonates with sepsis at intensive care units at Benha University Hospital, and documented that, nearby two thirds of the nurses had less than five years' experience in NICU.

Part (2): knowledge and practice levels of nurses: In relation to the nurses' knowledge regarding extravasation injuries pre/post program implementation, the result of the current study clarified highly statistically significant differences. Whereas, the minority of the studied nurses had satisfactory knowledge about the anatomy of blood

vessels, definition, risk factors of extravasation, pre-program compared to post- program **(table 2)**. These results might recommend such course contents should be emphasized during their study. These results were supported also by Forsberg and Engström [12] who conducted study about critical care nurses' experiences of performing successful peripheral intravenous catheterization in difficult situations and emphasized the responsibility of critical care nurse for identifying characteristics of veins as being fragile or/and invisible.

Moreover, a study by Sisan, [12] aimed at assessment of knowledge regarding noncytotoxic medications extravasation among registered nurses working in Western Saudi Arabia, and concluded that less than one quarter of closed units' the nurses were able to identify the correct definition of the term extravasation as well, out of 33 medications known to cause extravasation, only 9 medications were correctly identified by 50% of nurses.

Concerning stages of extravasation and complications, the present study showed an increase of nurses' mean scores of knowledge post-program than pre-program. Similar finding was obtained by Ibrahim, [13] who assessed nursing care provided to neonates undergoing phototherapy, and reported that more than two quarters of studied nurses had poor level of knowledge regarding complications of phototherapy.

On the other hand, the current study result was contradicted by Mahmoud, [14] who studied the quality of nurses' performance regarding parenteral nutrition at neonatal intensive care units and illustrated that, more than three quarters of the studied nurses had correct and complete knowledge about complications of cannula.

In the present study, there were a significant increase in nurses' mean score of knowledge about neonatal extravasation prevention and management in posttest than in pretest. These findings are in agreement with Atay, [15] who examined the incidence of infiltration /extravasation in newborns using peripheral venous catheter reporting that extravasation injuries are preventable. As well, those authors recommended that NICU staff must be aware of factors which cause extravasations; and they use these factors for prevention and early identification of extravasation.

Regarding nurses' performance about peripheral cannula insertion, the current study stated that statistically significant difference was detected in the mean score between post-program and preprogram **(table 3)**. This finding is congruent with EL-Shafey, [16] who studied effect of an educational training program for nurses about infection control precautions in their practice in the pediatric critical care revealed that the majority of nurses had unsatisfactory level of practice pre- program compared to majority of them had satisfactory level of practice immediate post-program and in follow up phase.

As regards to intravenous access monitoring, the current study results illustrated that, nurses' mean score of performance post-program higher than pre-program. In congruent with these findings Alfar, [17] who investigated the effect of applying nursing care bundle on controlling central venous line infection in neonatal intensive care units at Mansoura University reported that, the majority of the studied nurses didn't monitor site of central line site regularly for redness or swelling pre-program compared to majority of them did immediate post and 3 months post program.

The statistical findings of the current research revealed that, pre-program a small percentage of studied nurses had satisfactory level of knowledge and performance compared with post-program. As well, there were highly statistically significant differences between total mean scores of knowledge and practice pre-program and post-program (**table 4**).

These findings are in agreement with Ismail, [18] who conducted a study to evaluate nurses' performance in premature transition from gavage to breastfeeding after the educational program. They concluded that there were highly statistical significant differences concerning nurses' knowledge, practice and beliefs pre/post-implementation of the educational program.

Similarly, study by Kahraman, [8] found that there was a significant difference in the knowledge scores before and after the education, proving that the education increased the information level of the nurses.

Regarding correlation between nurses' knowledge and performance, the current study results highlighted that, there was a positive significant correlation ($p = 0.000$) **(table 5)**. The current study finding is compatible with a similar study done by Belal, [11] reported that there was a positive correlation between nurses' knowledge and practices scores post-program implementation compared with preprogram implementation. And that nurses' performance is significantly improved post program implementation.

The study results demonstrated that there were negative weak correlation between nurses' knowledge and their age; while a strong positive correlation was detected between age and their performance **(table 6)**. These results are partially matched with Mahmoud, [14] who highlighted that, there was a statistically significant relation between of the studied nurses' total performance scores and their personal data (age, qualification level, years of experience and training).

CONCLUSION

The results of this study indicated that knowledge and performance of nurses were significantly increased after application of the training program suggesting its effectiveness.

Based on the findings of this study, the following are recommended:

- Nurses who working in NICUs especially newly hired should be equipped with updated information about extravasation injuries through compulsory educational programs. As well, an emphasis should be done regarding their practices and periodic checkup for their knowledge.
- Replication of the study on a large sample is recommended to obtain generalization.
- Future researches about the best modalities to be used for management of extravasation injuries among preterm infants.

Acknowledgement: Praise to Allah, the Merciful, the compassionate for all gifts I have been offered one of these

gifts is the accomplishment of this work. Also, I would to express my deepest thanks to all nurses who participated actively in the study.
Source of Support: Self
Conflict of Interest: None

REFERENCES

1. World Health Organization (WHO) (2018). World health statistics 2018. Available at: http://www.who.net
2. Kostogloudis, N., Demiri, E., Tsimponis, A., Dionyssiou, D., Ioannidis, S., Chatziioannidis, I., & Nikolaidis, N. (2015). Severe Extravasation Injuries in Neonates: A Report of 34 Cases. Journal of Vascular Access; 32(6) 830–835
3. Adrian, D. M., Robert, F. G., & Chris, J. C. (2017).Extravasation Injury in A pediatric Population. Available at https://pubmed.ncbi.nih.gov/28682011/.
4. Corbett, M., Marshall, D., Oddie, R., Harden, M., Phillips, R., & McGuire, W. (2019). Treatment of Extravasation Injuries in Infants and Young Children: A Scoping Review and Survey; 22 (46), 1-112. Available at: http://eprints.whiterose.ac.uk/135316/.
5. Odom, B., Lowe, L., & Yates, C. (2018). Peripheral Infiltration and Extravasation Injury Methodology: A Retrospective Study. Journal of Infusion Nursing; 41(4): 247–252. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/ PMC6082416
6. Elmeneza, S., & Abushady, M. (2019). Anonymous Reporting of Medical Errors from the Egyptian Neonatal Safety Training Network. Available at https://doi.org/10.1016/j.pedneo.2019.5.008 http://www.pediatr-neonato1.com
7. Masuoka, H., Saito, S., Nakamura, Y., & Suzuki, S. (2016). Non-Operative Treatment for Extensive Skin Necrosis of A neonatal Dorsal Foot Caused by Extravasation. Available at http://clinmedjournals.org/articcles/cmrcr/clinical-medical-reviews-and-case-reports-cmrcr-3-082.php?jid=cmrcr.
8. Kahraman, A., Gerçeker, G. A., Yardımc, F., Bilsin, E., Yaz, B. S., Özdemir, C. H., Karakul, A., Zengin, D., Sevgili, S. A., Gümüş, M., Akpınar, S., Başbakka, D. Z. (2020). The Effect of a Nurse Education Program on Infiltration and Extravasation in Pediatric Patients at a University Hospital. The Journal of Pediatric Research; 7(4):309-15.
9. Forsberg, A., & Engström, A. (2018). Critical Care Nurses' Experiences of Performing Successful Peripheral Intravenous Catheterization in Difficult Situations. Journal of Vascular Nursing ; 36 (2) : 64-70
10. Malek, R. N., Abd-Allah, K. F., Rezk, M. M., & Mohamed, S. S. (2018). The Effect of an Education Program on Nurses Performance Regarding Electrocardiography. Egyptian Journal of Health; (9)1; 38-49.
11. Belal, F. M., Ismail, S. S., & Bayoumi, M. H. (2019). Impact of Intervention Program on Nursing Performance Provided for Neonates with Sepsis at Intensive Care Units. Egyptian Journal of Health Care; 8 (1), 2-14.
12. Sisan, M., Rayan, A., Elmorsy, S., Elyan, H., & Salahat, M. (2018). Knowledge Regarding Noncytotoxic Medication Extravasation among Registered Nurses Working in Western Saudi Arabia. Journal of Vascular Nursing. Available at: https://doi.org/10.1016/j.jvn.2017.09.007
13. Ibrahim, M. M., Ouda, W. E., Ismail, S. S., & Elewa, A. A. (2019). Assessment of Nursing Care Provided to Neonates Undergoing Phototherapy. Egyptian Journal of Health Care; 10(1), 1-12.
14. Mahmoud, N. A., Mahmoud, F. S., & Khalaf, S. M. (2018). Quality of Nurses' Performance Regarding Parenteral Nutrition at Neonatal Intensive Care Unit. Egyptian Journal of Health Care; 9 (2), 116-128.
15. Atay, S., Sen, S., & Cukurlu, D. (2018). Incidence of Infiltration/Extravasation in Newborns Using Peripheral Venous Catheter and Affecting factors. Journal of School of Nursing. Canakkale Onsekiz Mart University, School of Health, Nursing Department, Canakkale, Turkey. Available at: http://dx.doi.org/10.1590/S1980220X2017040103360. https://doi.org/10.1016/j.jvn.2018.02.002
16. EL-Shafey, S. A., El-Dakhakhny, A. M., & Mohammed, B. M. (2019). Effect of an Educational Training Program for Nurses about Infection Control Precautions in Their Practice in the Pediatric Critical Care. Afro-Egypt J Infect Endem Dis 2019; 9(1): 20-30. Available at http://aeji.journals.ekb.eg/http://mis.zu.edu.eg/ajied/home.aspx
17. Alfar, N. M., Hassan, R. E., Selim, M. A., & EL-Sheikh, O. Y. (2019). The Effect of Applying Nursing Care Bundle on Controlling Central Venous Line Infection in Neonatal Intensive Care Units at Mansoura University, Master dissertation in Nursing Science Pediatric Nursing, Faculty of Nursing, Mansoura University. Pp. 62-65.
18. Ismail, S. S., & Bayoumi, M. H. (2017). Nurses' Performance Transition from Gavage to Breastfeeding: Effect of Education Program. Egyptian Journal of Health Care; 8(1), 163-181.