

ORIGINAL ARTICLE

Knowledge and Practice Of Peripheral Intravenous Catheter Among Nurses in a Teaching Hospital in Malaysia: Universiti Kebangsaan Malaysia Medical Centre

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ABSTRACT

Introduction: Insertion of Peripheral intravenous catheter (PIVC) is a common invasive procedure performed on patients that may contribute to several complications. Nurses are required to have adequate knowledge and practice to ensure the successful of the procedure. The objective of this study was to determine the knowledge and practice of nurses towards PIVC insertion procedures. **Methods:** A descriptive cross-sectional study design was conducted at Universiti Kebangsaan Malaysia Medical Centre. A total of seventy- seven nurses working in the emergency department, obstetrics & gynecology patient admission centre, daycare oncology were participated in this study. The data was gathered using a modified questionnaire and standard PIVC insertion guidelines. **Results:** 21 (27.3%) nurses had high knowledge and 56 (72.7%) had low knowledge of PIVC insertion ($M=7.77$, $SD=1.87$). All 77 (100%) nurses performed insertion of PIVC according to the standard of practice ($M=23.16$, $SD=1.51$). A positive correlation between age and knowledge ($\rho=0.123$) but a negative correlation towards practice ($\rho=-0.413$). A positive correlation between working experience and knowledge ($\rho=0.094$) but a negative correlation towards practice ($\rho=-0.047$). There was a positive correlation between nurses' knowledge and practice ($\rho=0.038$). **Conclusion:** Nurses with good knowledge of PIVC insertion performed better as they were aware of the negative consequences of the procedure if conducted incorrectly. Knowledgeable and competent nurses are essential to ensure the quality of nursing care and safe practice towards patients. Future studies with larger samples of nurses involved in more hospitals in Malaysia are recommended.

Keywords: Knowledge, Practice, Nurses, Peripheral intravenous catheter, Peripheral venous catheters

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INTRODUCTION

Peripheral Intravenous Catheterization (PIVC) insertion is the prevalent procedure performed on patients as majority of them required intravenous (IV) access for IV fluids, IV medications, blood products administration, or blood sampling purposes during an acute phase (1,2). In a study on the use of IV catheters, it is found that over 70% of inpatients need PIVC (3). Although it is essential in the treatment of patients, daily use could increase patients high risk for local and systemic complications (4). The PIVC insertion could arise several common problems such as leak, occlusion, infiltration, phlebitis, pain, dislodgement, extravasation and catheter-related infection (5-7). As a result, cost increases due to prolong hospital stays and extra diagnostic, investigations and treatment needed (8).

The placement and maintenance of PIVC insertion by incompetent and inexperienced nurses in clinical service are among the leading risks for complications of PIVC insertion (9). Instances from several studies proved that nurses have inadequate knowledge of PIVC insertion (10). Nurses' knowledge and early recognition on development of complication could improve the quality care, patient safety and satisfaction, and thus reduces hospital stays and financial burden of patients and hospital (6).

Several past studies have discovered the relation between knowledge and practice with education level and working experiences (8,11-12). However, studies on the relationship between knowledge and practice with nurses' demographic data are still lacking. Nurses with more working experience reported to choose the appropriate site for PIVC insertion compared to nurses with less experience (8). The purpose of this study was to determine the knowledge and practice of nurses of PIVC insertion in Universiti Kebangsaan Malaysia Medical Centre (UKMMC).

MATERIALS AND METHODS

A cross-sectional study was conducted to determine the knowledge and practice of nurses on insertion of PIVC in UKMMC as well as the relationship with nurses' demographic from March to July 2017. UKMMC is a public teaching hospital owned by the Ministry of Education. The nursing service department is the largest department and is responsible to provide nursing services to inpatients and outpatients. This study took place in an emergency department, obstetrics & gynecology patient admission centre (O&G PAC), and daycare oncology. This is because those areas required nurses to perform the insertion of PIVC in their daily tasks. Carr et al. stated that the majority of PIVC insertion procedures in the hospital were the responsibilities of the doctors (13). This is in line with the practice done in UKMMC as the majority of PIVC insertion is done by houseman officers. However, in certain areas that managing an acute cases, nurses are allowed to insert PIVC for blood taking and infusion. Thus a total of seventy-nine nurses who experienced at least six months working in UKMMC and performed PIVC insertion procedures became the respondents of this study.

The data collection of the study was carried out in two stages. In the first stage, nurses were required to answer questionnaires on information related to demographic data and knowledge on insertion of PIVC. In the second stage, observation of PIVC insertion was carried out using the PIVC guidelines. There are two ways in which the researchers have tried their best to reduce biases during data collection. Firstly, the researchers assigned a head nurse for each ward involved and a medical assistant in the emergency department to observe nurses performed the PIVC insertion. The explanation about the study and the used of PIVC guidelines were given to them by the researchers. Secondly, in second stage, nurses were not informed that they were being observed during performing the PIVC insertion procedure. This avoid nurses to perform the procedure more cautiously as they know they are being observed. Hence the consistency of data on performing the PIVC insertion by nurses is considered valid and reliable as the observer used the same guidelines for all nurses who participated in this study.

Data collection started after the researcher had obtained approval from the Research Ethics Committee (reference number: UKM FPR 4/244/FF-2017-107). Permission to carry out this study was also obtained from the Head Departments of Nursing, UKMMC.

Instruments

There were three instruments used in the study namely demographic data form, questionnaire on nurses' knowledge towards PIVC insertion and PIVC insertion guidelines.

Demographic data forms of respondents consisted questions on age, gender, working areas, level of education, and working experience. The questionnaire on nurses' knowledge towards PIVC insertion consists of 11 items. The questionnaire was modified and obtained from two studies (12,13). The items number 1, 7, and 8 were extracted from the instrument of PIVC insertion knowledge by Carr et al. (13), and the remaining items were from Coomarasamy et al. (12). The Researchers of the National University of Ireland and Medical Educator validated the former instrument and Joanna Briggs Institute (JBI), validated the latter instrument. Before the data collection, an expert panel from the Malaysian Infusion Nurses Special Interest Group (MINSIG), Malaysian Nurses Association (MNA) validated the modified questions and permission was obtained from the original authors of the instrument. The questions are close-ended questions which the respondents need to tick 'Yes' or 'No' to all questions. Each correct answer received 1 point, and each incorrect answer received 0 point, for a total of 0 to 11 points. The obtained knowledge score was classified using the total score as 'Low knowledge' (score 0 to 6) and 'High knowledge' (score 7 to 11). A pre-test involving ten nurses was carried out to measure the reliability, validity, and practicability of the modified questionnaire and Cronbach's Alpha value was 0.712.

The PIVC insertion guidelines was used to assess nurses practice of insertion of PIVC procedure. The guidelines of PIVC insertion was obtained permission from the author (12). The guidelines constituted 36 steps. However, in this study, only 28 steps pertaining to insertion of PIVC were adopted as those steps are common steps to perform for the PIVC insertion procedure in UKMMC. The modified guidelines was validated by an expert panel from MINSIG, MNA. The respondents were given 1 point if they performed the steps and 0 points if they missed the steps. Possible total knowledge score was 0 to 28 categorised into 'Practice' (score 11 to 28) and 'Non-practice' (score 0 to 10).

Statistical analyses

The data was analysed using the Statistical Package for the Social Sciences (SPSS) version 23.0. The knowledge and practice of PIVC insertion among the respondents were assessed using descriptive statistics such as frequency, mean, standard deviation and percentage.

Inferential statistics were performed by presenting the mean of the total score for the relationship between demographic data and respondents' level of knowledge on PIVC insertion, the relationship between demographic data and respondents' practice of PIVC insertion, and finally the relationship between respondents' PIVC insertion practices and their level of knowledge. The significant level was set at $p < 0.05$.

RESULTS

Respondents' Demographic Information

The researchers approached 79 nurses in the study settings during the data collection process. However, the total number of nurses who became respondents in this study was 77 making the response rate 97.5% as two nurses were excluded from the study as they were on confinement leave. The mean age of respondents was 32.87 (SD ± 5.36). Mainly of the respondents were female 76 (98.7%). The majority of respondents qualified with a diploma in nursing qualification 54 (70.1%) followed by a diploma with post basic 16 (20.8%) and with degree 7 (9.1%). Of the total respondents, 55 (71.4%) were from emergency department, 15 (19.5%) were from O&G PAC and 7 (9.1%) were from daycare oncology. Respondents working experience ranged from less than five years 12 (15.6%), 6 to 10 years 27 (35.1%) and 11 to 15 years 27 (35.1%). The mean working experience of the respondents was 10.39 (SD ± 4.10) years.

The knowledge of respondents on PIVC insertion

In respect of respondents' knowledge on PIVC insertion, all 77 (100%) respondents had excellent knowledge on the importance of using a transparent, semi-permeable polyurethane dressing to help in detecting early signs of phlebitis. Seven (9.1%) respondents believed that the documentation was an unnecessary task done by the staff nurses after the insertion of a peripheral intravenous catheter. Table I showed that 76 (98.7%) of the respondents agreed that handwashing should be done when palpating veins during the insertion of PIVC insertion and the factors of changing peripheral intravenous catheters were dislodgement, oedema, and blockage of the catheter.

The respondents' knowledge of PIVC insertion was analysed according to the total score for knowledge by the distribution of the questionnaire which consists of 11 items. The cut-off points for low knowledge were 0-6 points and 7-11 points for high knowledge.

Results showed that 56 (72.7%) respondents had low knowledge, while 21 (27.3%) had high knowledge of PIVC insertion.

The practice of PIVC insertion

The result of respondents' practice showed that all 77 (100%) of them performed the vital steps of PIVC insertion (all the vital steps marked by * in Table II). Forty-four (57.1%) of the respondents did not perform hand hygiene before preparation of equipment for PIVC insertion, 67 (87%) before the PIVC insertion and 57 (74%) after the procedure was completed. As for gloving, 57 (74%) of the respondents did not wear gloves during insertion of PIVC insertion, and 58 (75.3%) did not remove the gloves after the procedure.

The respondents' practice of PIVC insertion was analysed according to the total score of practice by the distribution of procedure covering 28 items. The cut-off points for not-practising was 0 -10 points 11 - 28 points for practicing. Results showed that all 77 (100%) of the respondents practiced PIVC insertion according to the standard of procedure.

Relationship between respondents' demographic data and knowledge on PIVC insertion

The relationship between respondents' knowledge of PIVC insertion and demographic data such as age, gender, level of education, unit or ward of working and working experience was investigated using Spearman's rank-order correlation coefficient and the Kruskal-Wallis test. A positive correlation between knowledge and age was shown ($\rho=0.123$, $p=0.286$), wherein the older the respondents the higher the knowledge on PIVC insertion. A positive correlation between knowledge and working experience was also discovered ($\rho=0.094$, $p=0.415$), whereby longer working experience was associated with higher knowledge of PIVC insertion. On the other hand, level of education and unit or ward of working were not associated with knowledge level across four different levels of education ($p=0.804$) and four different

Table I: Respondents knowledge of PIVC (N=77)

Questions	Yes		No	
	n	%	n	%
Insertion of peripheral intravenous catheterisation is a "clean procedure".	53	68.8	24	31.2
Handwashing needs to be done when palpating veins during insertion of peripheral intravenous catheter.	76	98.7	1	1.3
The aseptic technique needs to be done when inserting or replacing peripheral intravenous catheter.	59	76.6	18	23.4
The position of peripheral catheter needs to be rotated within 72 to 92 hours of placement.	49	63.6	28	36.4
The factors of changing peripheral intravenous catheter are dislodgement, oedema, and blockage of catheter.	76	98.7	1	1.3
Veins in the ante-cubital fossa and lower extremities are to be used routinely in the insertion of peripheral intravenous catheter.	70	90.9	7	9.1
All fluid (drip) and tubing should be changed when the peripheral intravenous catheter is replaced.	39	50.6	38	49.4
The complications of peripheral intravenous catheter are infiltration, extravasation, and neuropathy.	56	72.7	21	27.3
Extravasation is a major problem that leads by peripheral intravenous catheterisation.	40	51.9	37	48.1
Documentation is not necessarily done by staff nurses after the insertion of peripheral intravenous catheter.	7	9.1	70	90.9
Transparent, semi-permeable polyurethane dressing helps in detecting early signs of phlebitis.	77	100	0	0

Table II:: Practice of PIVC by respondents (N=77)

Procedures	Practice		Non-practice	
	n	%	n	%
Verify the patient's identity	76	98.7	1	1.3
Introduce yourself to patient	62	80.5	15	19.5
Explain procedure	74	96.1	3	3.9
Perform hand hygiene	33	42.9	44	57.1
*Prepare the complete necessary equipment <ul style="list-style-type: none"> • Tray • Tourniquet • Glove • Peripheral intravenous catheter • Alcohol swab • Transparent dressing • Heparin saline 	77	100	0	0.0
*Select site for insertion of the intravenous catheter	77	100	0	0.0
*Apply tourniquet 7 – 10cm proximal to the selected vein	77	100	0	0.0
*Assess vein by palpation	77	100	0	0.0
*Select site for insertion of the intravenous catheter	77	100	0	0.0
Perform hand hygiene.	10	13.0	67	87.0
Wear gloves	20	26.0	57	74.0
*Clear skin surface with an antiseptic solution Apply friction using forth strokes, backstrokes or circular motion if alcohol swab is used	77	100	0	0.0
*Pull skin taut	77	100	0	0.0
*Puncture skin with needle at 30 – 45 angle	77	100	0	0.0
*Lower the angle, advance the cannula into the vein and observe for blood return	77	100	0	0.0
*Advanced cannula into the vein until the desired position obtained	77	100	0	0.0
*Remove tourniquet	77	100	0	0.0
*Remove stylet while pressing one inch above the cannula hub	77	100	0	0.0
*Dispose stylet into the biohazard bin	77	100	0	0.0
*Connect to an appropriate IV administration set or injection cap	77	100	0	0.0
*Commence infusion solution slowly/ flush with heparin saline	77	100	0	0.0
*Observe insertion site for any swelling and blanching	77	100	0	0.0
*Stabilize cannula with a sterile transparent dressing	77	100	0	0.0
Remove gloves	19	24.7	58	75.3
Label the date and time of insertion	46	59.7	31	40.3
Document procedure in the patient's case notes	36	46.8	41	53.2
*Clear equipment	77	100	0	0.0
Perform hand hygiene	20	26.0	57	74.0

working units (p=0.179).

Relationship between respondents' demographic data and practice of PIVC insertion

As shown in Table III, there was a negative correlation between age and practice of PIVC insertion, rho=-0.143, n=77, p=0.712, in that the older the respondents, the lesser the practice of proper insertion of PIVC insertion. There was also a negative correlation between the working experience and practice, rho=-0.047, n=77, p=0.685, where the longer the working experience

Table III: Relationship between respondents' age, working experience with knowledge and practice of PIVC

Variables	Knowledge of respondents on PIVC		Practise of respondents on PIVC	
	rho value	p-value	rho value	p-value
Age	0.123	0.286	-0.143	0.712
Working experience	0.094	0.415	-0.047	0.685

the lesser they would practice a proper insertion of PIVC insertion. In contrast, there was no statistically significant difference in knowledge levels across education (p=0.114) and between knowledge level in three different units (trauma and emergency department, O&G PAC and daycare oncology) (p=0.061).

Relationship between respondents' knowledge and practice of PIVC insertion

The relationship between respondents' knowledge and practice of PIVC insertion was investigated using Spearman's rank-order correlation coefficient. Table IV showed a positive correlation between the two variables, rho=0.038, n=77, p=0.742, in that the higher the knowledge of PIVC insertion, the more they will practice proper insertion of PIVC insertion.

Table IV: Relationship between respondents' knowledge and practice of PIVC

Variable	Practising of respondents on PIVC	
	rho value	p-value
Level of knowledge	0.038	0.742

DISCUSSION

In the current study, 72.7% of the nurses scored low of knowledge on the PIVC insertion procedure. Most nurses have low knowledge of complications of PIVC which could lead to infiltration, extravasation, and neuropathy. Surprisingly, 68.8% of nurses stated that PIVC insertion is a clean procedure which is a wrong answer. This reality is alarming because PIVC insertion required an aseptic technique as this could be the possible route of infection. This result is quite similar with the finding by Salueiro-Oliveira et al. where only 44.7% of nurses used the aseptic 'non-touch' technique in the PIVC insertion procedure (14). Further, 70% of nurses felt that the documentation is not necessary after the insertion of PIVC. Although the knowledge of PIVC was only tested in three areas, the result could be very crucial, as stated by Hossain et al. nurses should have sufficient knowledge of the PIVC insertion to decrease PIVC related complications (10). The current findings were similar with Ho et al. where nurses in a specialty unit had higher mean scores on knowledge and practice compared to nurses in the medical and surgical wards. It showed that not all nurses are knowledgeable about the care of PIVC (15). Further, the up-to-date knowledge about the procedure should include in staff continuous education. This was proven in a previous study done in UKMMC by Coomasamy et al., showed that education

through intensive training in PIVC insertion and discussion of the national evidence-based guidelines had improved patients' care with a compliance rate of 85% (12). Kapucu et al. also recommended on-the-job training programs or courses to improve nurses' knowledge on the care of PIVC (16). A study by Hossain et al. among nurses of a tertiary care hospital in Dhaka City, reported poor knowledge of the PIVC insertion among one-third of the nurses (10). The findings of the present study revealed that despite the nurses having low knowledge on PIVC insertion but 100% of them agreed on the importance of using transparent, semi-permeable polyurethane dressing to help in detecting early signs of phlebitis and factors of changing the peripheral intravenous catheter.

Based on the correlation analysis between age and working experience, there was a positive correlation between the two variables. The older and the longer working experience of the nurses the higher the knowledge of PIVC insertion. Unfortunately, the strength of the correlation was small. Researchers could say that since this has been their daily work task, thus, nurses did not notice that they are not following each step of the PIVC guidelines. Thus missed some steps of the procedure.

In current study, all nurses fully practiced and performed the vital steps of PIVC insertion according to the standard of procedure of the guidelines. According to a study by Hossain et al. only half of the nurses practiced the steps of the PIVC insertion guidelines and prepare all the required PIVC insertion equipment prior to the procedure (10). The finding of this study showed that majority of the nurses did not practice hand hygiene before and after PIVC insertion. This is consistent with the findings of a study conducted by Hossain et al. (10), who discovered that only 53% of the nurses practiced hand hygiene and 42% were unconcerned about the aseptic technique. Further, Coomarasamy et al. highlighted that, only 42% of the nurses complied with handwashing and aseptic technique before a training workshop on PIVC insertion (12). However, in the post-intervention of PIVC insertion, compliance with handwashing increased by 89%. As widely known, hand hygiene is vital to reduce the transmission of nosocomial pathogens and prevents cross infections, which should not neglected by nurses. Nurses who lack information about infection prevention and proper nursing care, find it difficult to follow evidence-based recommendations for preventing intravenous catheter-related infections (17). Even though documentation is essential in nurses' routine work, however, only 36 (46.8%) of the nurses documented PIVC insertion in the nurses' notes as reported in the study. This is supported by Coomarasamy et al. as nurses in their study reported low compliance with documentation of PIVC insertion (12). The result also revealed that there was a negative correlation between age and working experience

towards practice. The older and the longer working experience of the nurses, the less likely they will practice proper insertion of PIVC. Although nurses had high knowledge of PIVC insertion, it is not translated into their practices (10). However, the strength of correlation was small between the two variables. To the best of our knowledge, there is no study to support this findings. Despite that, the hands on course needed for the nurses to improve their practice and enhance competency on PIVC insertion. The latest and varied teaching methods on the PIVC insertion need to be planned to enable them to gain theoretical and practical knowledge of PIVC insertion. This is very crucial since nurses in this study working in the area involving oncology and acute patients. Therefore this procedure needs to be done efficiently to avoid any complications. A study done by Keleekai et al. shows that the knowledge, confidence and skills of nurses on PIVC insertion had improved through simulation-based blended learning program incorporated online learning course and simulation based training (18). The simulation training for practical session is beneficial for nurses in order to improve patient safety in PIVC insertion procedure (19). It revealed that nurses who had six and ten years of working experience choose better veins and performed good practice of PIVC, in comparison to those with less experience (8). Findings from the current study may indicate that nurses need to practice according to the obtained knowledge (8). Although all of the nurses practised proper PIVC insertion, some steps, such as hand hygiene, may have been overlooked. Nurses should have high knowledge and practice skills to ensure better quality care and safe practice for their patients.

The current study showed that there was a positive correlation between knowledge and practice. The more knowledge of the nurses on PIVC, the more they will practice proper insertion of PIVC. The strength of the correlation is medium. Coefficient of determination is 0.144 which indicates knowledge and practice shared 0.144% of the same variance. 0.144% of the variance in knowledge can be explained by knowing practice or vice versa. Even though we know that nurses with good knowledge of PIVC tend to perform better because they understand the consequences of the procedure, this study differs from one by Hossain et al., in which nurses had high levels of knowledge but their practises were not appropriate for their knowledge levels (10). As stated by Ajani and Moez, to keep up balance between theory and skills, a nurse has to up-to-date the current practice and knowledge in their specific field (20). Thus, the nursing management should emphasized their nurses not only providing them with information in continuous education but also training involving nursing practice is no less important.

The strength of this study was clear with the observation method and proper guidelines of the PIVC insertion procedure in the data collection. Appropriate

considerations in minimising any biases when observing the nurses performed the PIVC insertion, increase the strength of this study. The small sample of participants from a single hospital in this study hindered generalisation of the findings. However, the study's findings could serve as preliminary data for future studies on PIVC insertion among nurses involving more Malaysian hospitals.

CONCLUSION

The current study determined the knowledge and practice of PIVC insertion among nurses. This study found that nurses have low knowledge but all of them practicing the PIVC insertion according to standard of procedure. However, majority of nurses lacked of knowledge in certain important areas and omit to practice certain proper steps on insertion of PIVC according to the standards of procedure. The nurses should able to attain good skills in the PIVC insertion and provide the best care on PIVC insertion towards patients. The nurses should perform PIVC insertion regularly through continuous training programs. Although it is a minor invasive procedure, but the detrimental consequences to the health of and life-threatening are possible if done incorrectly. Thus need immediate medical attention.

REFERENCES

- Hasselberg D, Ivarsson B, Andersson R, Tingstedt B. The handling of peripheral venous catheters - from non-compliance to evidence-based needs. *J Clin Nurs*. 2010; 19, (23–24):3358–3363. doi:10.1111/j.1365-2702.2010.03410.x
- Wallis MC, McGrail M, Webster J, March N, Gowardman J, Playford EG, Rickard CM. Risk factors for peripheral intravenous catheter failure: a multivariate analysis of data from a randomized controlled trial. *Infect Control Hosp Epidemiol*. 2014; 35(1):63-8. doi:10.1086/674398.
- Banks JM. Identifying risk factors for high incidence of peripheral intravenous catheters complications: reducing infiltration rate within the hospital. Thesis Dr. Of Philosophy, Walden University. 2015
- Sagueiro – Oliveria A, Parreira, P. and Veiga P. Incidence of phlebitis in patients with peripheral intravenous catheters: the incidence of some risk factors. *Australian Journal of Advanced Nursing*. 2012; 30(2): 32-39.
- Ascoli GB, DeGuzman PB, Rowlands A. Peripheral intravenous catheter complication rates between those indwelling > 96 hours to those indwelling 72-96 hours: a retrospective correlational study. *International Journal of Nursing*. 2012; 1920: 7-12.
- Abolfotouh, MA, Salam M, Bani-Mustafa A, White D and Balkhy HH. Prospective study of incidence and predictors of peripheral intravenous catheter – induced complications. *Therapeutic and Clinical Risk Management*. 2014; 10: 993-1001.
- Helm RE, Klausner JD, Klemperer JD, John D, Lori M, Huang E. Accepted but unacceptable: peripheral IV catheter failure. *Journal of Infusion Nursing*. 2015; 38(3): 189-203.
- Li XF, Liu W, Qin Y. Nurses' Perception of Risk Factors for Infusion Phlebitis: a Cross-sectional Survey. *Chinese Nursing Research* 2016; 3(1): 7–40. doi: 10.1016/j.cnre.2016.03.002
- Milutinović D, Simin D, Zec D. Risk factor for phlebitis: a Questionnaire Study of Nurses' Perception. *Rev Lat Am Enfermagem*. 2015; 23(4):677–846. doi: 10.1590/0104-1169.0192.2603.
- Hossain AM, Hassan MIA, Haque M. Assessment of the level of knowledge and practice on intravenous cannulization among staff nurses of selected tertiary care hospital in Dhaka city. *MOJ Public Health*. 2016; 4(5):156-159. doi: 10.15406/mojph.2016.04.00095.
- Erdogan BC, Denat Y. The development of phlebitis and infiltration in patients with peripheral intravenous catheters in the neurosurgery clinic and affecting factors. *International Journal of Caring Sciences*. 2016; 9(2):619–630. http://www.internationaljournalofcaringsciences.org/docs/28_denat_original_9_2.pdf
- Coomarasamy JD, Wint NN, Saleh ZM. Insertion and management of peripheral intravenous cannula in the Adult Medical Wards of Universiti Kebangsaan Malaysia Medical Centre: a Best Practice Implementation Project. *The JBI Database System Rev and Implement Rep*. 2014; 12(7): 534–551. doi:10.11124/jbisrir-2014-1672.
- Carr PJ, Glynn RW, Dineen B, Devitt D, Flaherty G, Kropmans TJB, Kerin M. Interns' attitudes to IV cannulation: a knowledge, attitude practice (KAP) study. *British Journal of Nursing* 2011; 20(4):S15–S20. doi.org/10.12968/bjon.2011.20.Sup1.S15
- Sagueiro – Oliveria A, Graveto J, Cosme A, Santos Costa P, Gama Costa F, Parreira P, Asoria N. Nurses' peripheral intravenous catheter-related practices: a descriptive study. *Revista de Enfermagem Referencia*. 2019. IV: 111-120.
- Ho SE, Liew LS, Tang WM. Nurses' knowledge and practice in relation to peripheral intravenous catheter care. *Medicine & Health*. 2016; 11(2):181-188. doi:10.17576/MH.2016.1102.07
- Kapucu S, Azkaraman AO, Uysal N, Bagcivan G, Seref FC and Eloz A. Knowledge level on administration of chemotherapy through peripheral and central venous catheter among oncology nurses. 2017; 4(1): 61-68.
- Wafaa El-Sayed O, M anal FM, Rehab K and Hadeer HM. Nurses knowledge and practices regarding peripheral intravenous cannulation and blood sampling in paediatric health care settings. *Port Said Scientific Journal of Nursing*. 2019; 6(3) Special issue: 50-67.
- Keleeki NL, Schuster CA, Murray CL, King MA,

Stahl BR, Labrozzi LJ, Gallucci S, et al. Improving nurses' peripheral intravenous catheter insertion knowledge, confidence, and skills using a simulation-based blended learning program: a randomized trial. *Simulation in Healthcare: Journal of the Society for Simulation in Healthcare*. 2016; 11(6): 376-384.

19. Forsberg A and Engstrom A. Critical care nurses' experiences of performing successful peripheral intravenous catheterization in difficult situations. *Journal of Vascular Nursing*. 2018; 36(2): 64-70.
20. Ajani K and Moez S. Gap between knowledge and practice in nursing. *Procedia social and Behavioral Sciences*. 2011; 15(2011): 3927-3931.