

## Nurses' Practice and Knowledge of Peripheral Intravenous Cannula Flushing Pre-Therapy Administration at Medical-Surgical Wards

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### Abstract

**Background:** Peripheral intravenous cannula (PIVC) are a frequent nursing technique used for the infusion of beverages, medicines, and blood products and are required by the majority of patients. As a result, it is critical to maintain a sufficient supply of PIVC because they are prone to problems such as obstruction, phlebitis, and exudation, necessitating frequent replacement. However, post-insertion PIVC failure is common, most likely due to inconsistencies in maintenance practices such as flushing. As a result, hospital policies contribute to a lack of practice and awareness about this issue, which improves clinical education for nurses and patient care. **Aim:** This study aimed to assess nurses' practice and knowledge of peripheral intravenous cannula flushing pre-therapy administration at medical-surgical wards. **Subjects and Methods:** A descriptive research design was utilized. A purposive sample of sixty-two nurses who were working in the medical-surgical wards at Teaching Hospital, Ismailia city, was used. Two tools were used for data collection: a self-administered questionnaire to identify nurses' personal data and knowledge and an observational checklist to assess nurses' practice. **Results:** The findings of this study revealed that most of the studied nurses had a fair level of knowledge and an unsatisfactory level of practice with regard to peripheral intravenous cannula flushing. Furthermore, there was a statistically significant positive correlation between their total knowledge and practice scores, with a  $p$  value  $\leq 0.05$ . **Conclusion:** In the present study, the nurses' level of practice was inadequate, and their knowledge of peripheral intravenous cannula flushing was fair. Additionally, there was a highly statistically significant relationship between total performance score (practices and knowledge) and their qualifications, with a  $p$  value  $\leq 0.05$ . **Recommendations:** Nurses should have access to ongoing educational opportunities and in-service training programs on short peripheral catheter intravenous flushing to improve their expertise.

**Keywords:** Knowledge, flushing, medical-surgical, nurses' practice, peripheral intravenous cannula.

### Introduction

Peripheral intravenous catheters (PIVC) in the hand or arm are commonly used in hospitals to administer hydration fluids, medicines, and blood transfusions (Atay et al. 2023). An estimated 70% of hospitalized patients will require an SPIVC, with nurses inserting and caring for the majority of them. Historically, vascular access device research and practice have concentrated on lowering bloodstream infection rates, notably with central venous catheters (Santos-Costa et al., 2022).

The most common clinical procedure performed by nurses is the insertion and maintenance of peripheral intravenous cannula flushes. Even if there are specific instructions, nurses are responsible for keeping the PIVC clean and functional (Norton et al. 2019). A failing PIVC is disturbing for patients because they must deal with both the discomfort of the PIVC and the

misery of replacement (Vincent et al. 2022). Complications and failure can increase healthcare expenses, with an estimated per-patient replacement cost of \$70 and additional costs associated with a longer hospital stay due to delayed or interrupted IV administration. Annually, nearly two billion PIVC are purchased globally, resulting in millions of dollars in waste due to complications (Karaođlan et al., 2022).

A reduction in PIVC failure of just 10% could save significant healthcare dollars and reduce unnecessary discomfort and risks for patients. Standards of practice for PIVC maintenance globally include statements pertaining to flushing for maintaining patency and function (Keogh, et al., 2020). Flushing the catheter before and after the administration of intravenous medication creates an opportunity for the assessment of the insertion site and catheter performance and helps maintain catheter patency

by avoiding the mixing of incompatible fluids and medications, as well as minimizing the build-up of fibrin and biofilm that contribute to thrombophlebitis and catheter dysfunction (Campbell, et al. 2015). However, practice surveys and observational studies have revealed significant variation in practice (e.g., use of syringes smaller than 10 mL, use of heparinized saline) and other variations from guideline recommendations. These inconsistencies and failure to implement recommended practices likely contribute to current relatively high PIVC failure rates (Gorski, et al., 2016; Lavalley, et al. 2017).

Although conducting continuous education programme is a guarantee for providing the best PIVC care and standardizing its performance, such programmes are not always implemented. Therefore, the foundation for nurses' PIVC care practices is usually institutional policy or the experiences of professional nurses in the health care setting (Morse, et al., 2019), which leads to uncertainty and inconsistencies in care practices, especially when knowledge is based on outdated evidence. However, there is currently little evidence toward PIVC care, and the available guidelines are inconclusive. Some studies determined that an every twelve-hour frequency was effective, while others found that a flushing schedule every 24 hours was sufficient to prevent issues. (Perry, et al., 2021).

The amount of 0.9% sodium chloride used in clinical settings varies depending on whether prefilled syringes are used, the size of the available syringes (3 mL, 5 mL, or 10 mL), institutional policy, or other factors. Three milliliters of 0.9% sodium chloride was sufficient to maintain catheter patency. The policy may specify how catheter sites should be evaluated and flushed (Elasrag, et al. 2023). Additionally, nurses consider aspects such as the patient's level of care, vascular health, catheter dwell time, and the type, frequency, and infusion rates of any medications or fluids. Nurses frequently choose the appropriate flushing frequency based on these factors (Berndt, & Steinheiser, 2019).

The subtlety of short peripheral cannula care, the context in which it occurs, and the limitations of documentation to consider the intricacies of ordinary short peripheral cannula care make it difficult to understand nurses' practices, as is the case with much expert knowledge and expertise (Wilbanks et al., 2018).

Despite surveys and observations of nurses' care for short peripheral intravenous cannulas, there is a lack of information on the factors that influence nurses' decisions and the outcomes of these actions. This information could be used to guide clinical education, best practices, and patient care (Keogh, et al., 2014). The most frequent invasive clinical technique is peripheral intravenous cannula installation, which is performed by nurses in hospitals worldwide (Graveto, et al. 2019).

Complications are acknowledged as important contributors to short peripheral catheter failure, which results in the early termination of intravenous therapy, removal of the device, and repositioning of new PIVC. One of the primary reasons for SPC failure and poor durability has been recognized as a knowledge and practice deficit on the part of healthcare practitioners (Keleekai et al., 2016; Cicolini, et al., 2019). Past evidence suggests that confidence, practice, and understanding of PIVC placement are related to success on the first attempt and that patient problems decrease when experienced nurses perform procedures (Garner, et al. 2018 & Johansson et al., 2019).

#### **Significance of the study:**

Globally but not nationally, there is a lack of studies on this topic. Additionally, assessing nurses' knowledge deficit, inadequate observed skills and severe complications related to malpractice related to peripheral intravenous cannulas, which supported the development of the study (Atay, et al. 2023 & Elasrag, et al. 2023). However, catheter-related bloodstream infection rates in PIVC are extremely low, at 0.03–0.1% or 0.5 per 1000 catheter days, whereas PIVC failure rates due to occlusion, infiltration, dislodgement, phlebitis, or infection are 36% (Saliba, et al. 2020).

Therefore, awareness of the dangers associated with PIVC use should be improved, and adherence to flushing practice standards should be encouraged. The purpose of this study was to assess nurses' level of practice and knowledge of PIVC flushing guidelines with manufacturer-prepared prefilled flush syringes. To identify the required access to the most up-to-date information and evidence, the Infusion Nurses Society advises that all nurses receive brief peripheral catheter care training at the time of hire and on an annual basis (Elasrag, et al. 2023).

### Aim of the study:

This study aimed to assess nurses' practice and knowledge of peripheral intravenous cannula flushing pre-therapy administration at medical-surgical wards. The following objectives were pursued:

- 1) Identify nurses' level of knowledge toward peripheral intravenous cannula flushing pre-therapy administration.
- 2) Assess nurses' level of practices toward peripheral intravenous cannula flushing pre-therapy administration.
- 3) Determine correlation between nurses' level of practices and knowledge toward peripheral intravenous cannula flushing pre-therapy administration.

### Subjects and Methods

**Design of the study:** A descriptive research design was utilized to fulfill the current study's objectives.

**Setting:** This study was conducted from December 2022 to February 2023 in the surgical ward at Teaching Hospital, Ismailia city, Egypt. These settings were selected because they serve the most populated region and have a high prevalence of patients.

**Sampling:** A nonprobability purposive sample of sixty-two nurses who were working in predetermined settings was enrolled as study participants. Participants who agreed to participate were of both genders, had more than six months of experience, and volunteered to participate. Participants who declined to participate, who had a vacation planned, or who had any debilitating conditions (e.g., chronic illness, pregnancy, low back pain) were excluded. The Epi-Calc tool was used to determine the sample size, considering precision (5%), population (290) and confidence level (95%). The students recruited at the mentioned settings made up the final study sample size of (62), with a dropout rate of 10%.

#### The data collection process of this research

It involved the utilization of two tools. It was divided into two parts:

**Tool I. A self-administered questionnaire:** This questionnaire was developed by researcher-based related studies and the current national and international literature (Piper et al., 2018; Berndt, et al., 2019). It consisted of two parts:

Part (a): Nurses' Data Sheet: This part includes five elements to examine the demographic data of the studied nurses, such as age, sex,

qualification, years of experience, and attendance at peripheral intravenous cannula flushing training sessions.

Part (b): Nurse knowledge questionnaire sheet: This questionnaire was developed by the researcher based on a review of the literature and related previous studies (Piper, et al., 2018; Perry, et al., 2021; Elasrag, et al., 2023) to assess nurses' knowledge concerning peripheral intravenous cannula flushing. It includes the following topics: definition, frequency, and kind of PIVC flushing, reinforcing and encouraging adherence to current practice recommendations, the problems of short peripheral catheter flushing, and nursing care.

**Scoring system:** A total of twenty questions were asked. There were 40 total points. A percentage less than 50% (less than 20 degrees) is considered poor. Fair level: those with grades ranging from 50 to 70% (20 to 28 degrees). A good grade exceeds 70% (greater than 28 degrees).

**Tool II: Nurse practice observation checklist:** An observation checklist was developed by the researcher based on a literature review (Roszell, et al., 2018; Bahza, 2019; Santos-Costa, et al., 2022). It was used to evaluate nurses' practical aspects of basic competences, such as brief peripheral catheter flushing. The following items were included: the catheter inserter selected the catheter gauge, attachments, pre- and post-medication flushing, peripheral catheter flushing, and positioning based on the patient's needs. In a careful, pulsatile manner, the skin was washed before the needle was inserted, the region was cleansed before and after the administration of the medication, and flushing syringes were used to limit the amount of pressure applied.

**Scoring system:** The observation checklist contained 34 items, each of which received one of the following scores: each correctly performed step received two points, each incorrectly completed step received one point, and a step that was not finished received a zero for achieving less than 60% with enough practice. If the score was above 60%, the practice level was considered satisfactory.

#### Tools developments:

The researchers made some modifications to the data collection tools after reviewing previous related studies and recent literature and considering the same research variables.

**Content validity and reliability:** Five experts in medical-surgical nursing and medicine assessed the data collection tool's clarity, comprehensiveness, appropriateness, and relevance as indicators of validity. In this study, the internal consistency approach was employed to assess the reliability of the two measures. With Cronbach's alpha coefficients of 0.97 for the first tool and 0.91 for the second, both demonstrated high dependability.

**Fieldwork:**

The researchers carried out the study in the following three phases:

A- Preparatory phase: The researchers examined the contemporary and related literature that was available as textbooks, journals, magazines, and internet searches to develop the instruments for data collection.

**Ethical consideration:** Upon being provided with a clear explanation of the study's objectives, the nurses expressed their willingness to participate, and before initiating the data collection process, they were thoroughly briefed on the study's purpose and its overall nature. The directors of the settings gave their written approval after being informed of the study's objectives. Ethical approval after the conduction letter was obtained from the Research Ethics Committee (REC), Faculty of Nursing, Sohag University, Egypt.

It was coded NUR 15/1/2023 (2). Informed consent was obtained from the participating nurses. They were explicitly informed of their right to decline participation or withdraw from the study at any stage or to give any reasons without obligations. Furthermore, a crucial emphasis was placed on maintaining the confidentiality of the information they provided, ensuring that the collected data would be used solely for research purposes.

**Pilot study:** This study was conducted with 10% of the nurses from the chosen unit (5 nurses) to assess the tools' applicability, clarity, and projected time for each. The primary study subjects were nurses who participated in the pilot research.

B- Implementation phase: The data collection period lasted six months, from the beginning of December 2022 to February 2023, in the surgical ward at Teaching Hospital, Ismailia city, Egypt. The purpose, nature, and anticipated results of the study were explained to the nurses before the study was implemented.

The researchers started the data collection by first gathering personal information. After that, each participant's knowledge of peripheral cannula flushing was evaluated using tool I as a baseline measure, along with their practices of peripheral cannula flushing using tool II. instructions for PIVC flushing.

This extensive timeframe enabled the researchers to effectively collect data from the participants and ensure the accuracy and reliability of the findings. The researcher was always available to answer any questions or concerns. The researcher observed the nurses' practices twice using an observational checklist to evaluate the nurses' practices during procedure preparation, during the actual procedure, and after the procedure for short peripheral catheter flushing pre-therapy administration.

The researcher observed each nurse for 5-10 minutes for each practice. A total of fifty-five data collection sessions were included, with an average of eight hours for belief assessment and nine hours for observing nurses' practices. Following the data collection, the researcher rechecked the collected data, provided simple feedback on the questionnaire results, and greeted the nurses and healthcare workers who participated in the study.

**Statistical Design**

Statistical analysis and data entry were carried out with SPSS for Windows, version 23. The Kolmogorov-Smirnov test was used to determine if the acquired data were normal, and it was determined that the data were parametric. For qualitative and quantitative variables, frequencies and percentages, as well as the means and standard deviations, were used. A P value < 0.05 was considered to indicate statistical significance.

**Results:**

**Table (1):** concerning the studied nurses' frequency and distribution concerning their demographic data. it clarified that more than two-third (68%) of the studied nurses had age between 20 < 35 with (X±SD): 29.23±6.2. toward less than three-quarters of them (66%) were female and mostly (50%) had nursing diploma qualification. Furthermore, less than half (42%) had 5<10 years of experience.

**Figure (1):** regarding the studied nurses regarding their attended training course toward peripheral intravenous cannula flushing it simplified that less than two-thirds (64%) of the

studied nurses did not attend training course toward peripheral intravenous cannula flushing pre-therapy administration at the prementioned setting.

**Table (2):** toward nurses' satisfactory level of knowledge of peripheral intravenous cannula flushing, it clarified that less than half (42%) of the studied nurses had satisfactory levels of knowledge regarding the definition of peripheral intravenous cannula flushing.

Moreover, more than two-quarters (58%) of them had a satisfactory level of knowledge regarding complications of peripheral intravenous cannula flushing. In total, most (40%) of the studied nurses had a fairly satisfactory level of knowledge regarding peripheral intravenous cannula flushing.

**Figure (2):** regarding nurses' satisfactory level of practice of peripheral intravenous cannula flushing. It demonstrated that less than three-quarters (66%) of the studied nurses reported unsatisfactory levels of nursing practices of peripheral intravenous cannula flushing pre-therapy administration in the

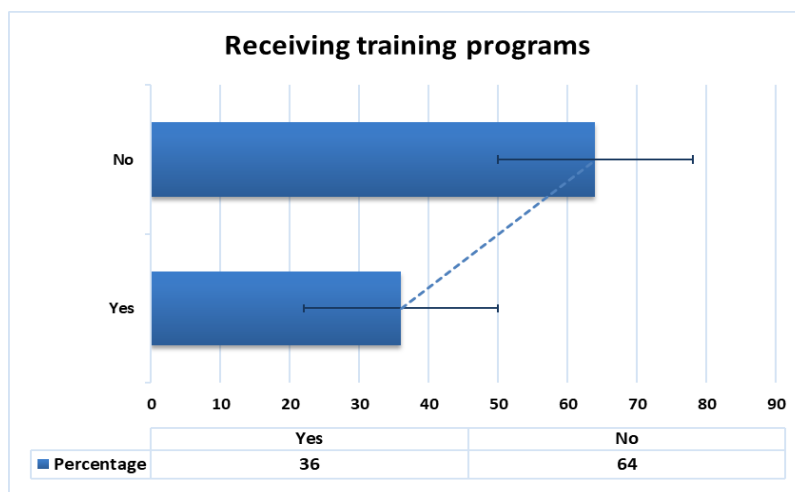
abovementioned setting, while fewer than two-quarters (34%) had a satisfactory levels of nursing practices.

**Table (3):** related the correlation between total knowledge and practices of peripheral intravenous cannula flushing. This table shows that there was a statistically significant positive correlation between total knowledge and practice scores, with a p value  $\leq 0.05$ .

**Table (4):** associated with the relationship between the studied nurses' total performance level toward peripheral intravenous cannula flushing and their qualifications. This table shows that there was a statistically significant relationship between the studied nurses' total performance level (practice and knowledge) toward peripheral intravenous cannula flushing and their qualifications in the abovementioned settings, with a p value  $\leq 0.05$ .

**Table (1):** The studied nurses' frequency and distribution concerning their demographic data. (n=62)

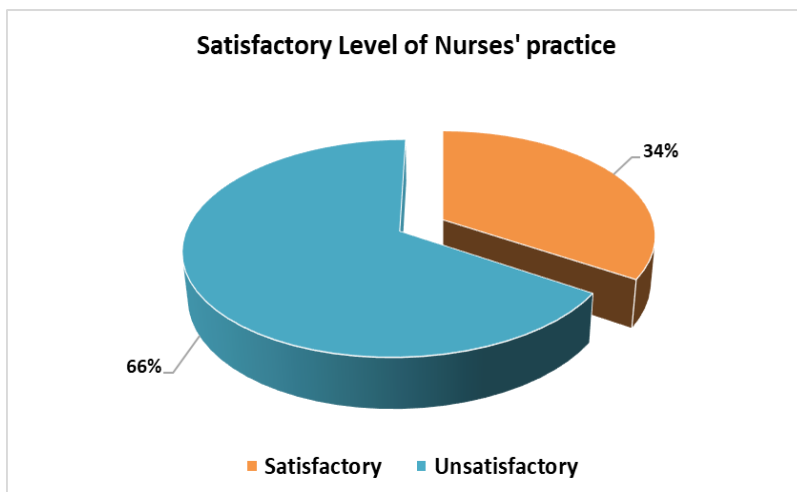
Demographic data:	Frequency	
	N	%
<b>Age:</b>		
▪ 20 < 35	44	68
▪ $\geq 35$	18	29
<b>(<math>\bar{X} \pm SD</math>): 29.23 <math>\pm</math> 6.2</b>		
<b>Gender:</b>		
▪ Male	21	34
▪ Female	41	66
<b>Qualification:</b>		
▪ Nursing Diploma.	31	50
▪ Bachelor of nursing.	19	31
▪ Post graduate studies.	12	19
<b>Years of experience:</b>		
▪ < 5	20	32
▪ < 10	26	42
▪ > 10	16	26
<b>X:</b> Mean	<b>SD:</b> Standard deviation	



**Figure (1):** Percentage distribution of the studied nurses regarding their attended training course toward peripheral intravenous cannula flushing. (n=62)

**Table (2):** Nurses' satisfactory level of knowledge toward peripheral intravenous cannula flushing. (n=62)

Knowledge items	Frequency					
	No	%				
▪ Definition of peripheral intravenous cannula flushing	29	48				
▪ Importance of peripheral intravenous cannula flushing	38	61				
▪ Type of peripheral intravenous cannula flushing	22	35				
▪ Frequency of peripheral intravenous cannula flushing	29	47				
▪ Complication of peripheral intravenous cannula flushing	36	58				
▪ Nursing care of peripheral intravenous cannula flushing	33	53				
<b>Total</b>						
	<b>Poor</b>	38%	<b>Fair</b>	40%	<b>Good</b>	22%



**Figure (2):** Nurses' satisfaction level of practice of peripheral intravenous cannula flushing. (n=62)

**Table (3):** Correlation between total knowledge and practices toward peripheral intravenous cannula flushing. (n=62)

Items	Total knowledge scores	
	r	p value
<b>Total practices scores</b>	0.81	0.000**

r: Spearman's rank correlation coefficient    \*\* Highly significant at the < 0.01 level.

**Table (4):** The relationship between the studied nurses' total performance level toward peripheral intravenous cannula flushing and their qualification. (n=62)

Qualification	n	Total performance level of studied nurses	Test (U)	Value (P)
		Mean ± SD.		
▪ Nursing Diploma.	31	4.0± 1.11	24.02	0.01*
▪ Bachelor of nursing.	19	8.01± 1.0	22.10	0.01*
▪ Post graduated studies.	12	2.3± 0.30	12.82	0.01*

**SD:** Standard deviation    **U:** Mann–Whitney test    \*significant at  $p \leq 0.05$

## Discussion

Peripheral intravenous cannula (PIVC) use is widespread in inpatient and outpatient settings. It is commonly the most widely used method worldwide. International data indicate that more than 1 billion PIVC are used annually for hospitalized patients. In the United States, at least 85% of hospitalized patients receive some form of intravenous therapy (**Vincent et al. 2022**). The use of peripheral catheters allows patients to receive all types of therapy, such as medications and fluids, which can be life-sustaining or even lifesaving, the devices also present a challenge when managing associated complications (**Elasrag, et al. 2023**).

Therefore, a review of related previous studies revealed that simplifying procedures and products for peripheral intravenous cannula flushing dramatically decreased the proportion and failure risk, even with relatively low preintervention complication rates. It showed that reducing practice variation required increasing public awareness of the value of maintaining vascular access and the methods for doing so, together with goods that make following practice guidelines easier. The use of prefilled flush syringes and the instructional intervention received good support from the nursing staff.

Based on the study's findings, less than half of the studied nurses had a nursing degree and more than ten years of experience, and half of them were between the ages of 20 and less than 35 years. The results of this study show that more than two-thirds of the nurses in the study said they had not attended a training session on flushing a short peripheral catheter. A minority of nurses attended continuing education classes, which is consistent with the results of **Alexandrou et al. (2018)**.

This finding is consistent with **Aziz's (2019)** assertion that professional education and training have an impact on nurses' knowledge. **Keogh et al. (2017)** agreed with their findings, which showed that most nurses had more than six years of experience. The findings of **Helm et al. (2015)** contradicted the findings of other studies showing that most of the studied nurses received training programs regarding PIVC flushing and had more years of experience. The researchers' perspective

clarified that most Egyptian nurses are female and graduated from nursing institutes.

The present study revealed that most of the studied nurses had a fair level of knowledge of peripheral intravenous cannula flushing before therapeutic agent administration. From the researcher's point of view, this reflects the positive effects of educational courses at the time of study and close reading and follow-up with updated references, generally associated with improved knowledge and a better understanding of peripheral intravenous cannula flushing among the studied nurses.

These results were in line with those of **Ray-Barruel et al. (2020)**, who reported that the studied nurses had a moderate level of knowledge regarding peripheral intravenous cannula flushing. Additionally, **Keoghm et al. (2016)** revealed a moderate level of knowledge among the studied nurses. In contrast, **Ray-Barruel et al. (2019)** reported that the studied nurses mostly had an adequate level of knowledge during the study phase, which reflects the positive impact of training and education.

Moreover, the findings of the present study show the general practice of peripheral intravenous cannula flushing among nurses and that most of the nurses studied had unsatisfactory levels of practice. From the researchers' point of view, this is reflected in the need to provide continuous training programs regarding SPICF, periodically provide updated guidelines, and increase the burden of the work. This study's results were supported by those of **de-Graveto et al. (2019)**, who reported that all the study participants had an adequate level of nursing practice regarding PIVC flushing. Additionally, **Elasrag et al. (2023)** reported satisfactory results at the prephase of surgery. This study's results are unsupported by **Oren, & Cuvadar, (2020)**, who stated that the participants had increasing compliance with short peripheral catheter flushing.

As a result, the findings of the current study are congruent with those of their investigation. According to studies by **Alexandrou et al. (2018)** and **Cicolini et al. (2019)**, nurses' mean practice scores



significantly differed. Regarding the correlation between nurses' general knowledge and general practices related to short peripheral catheter flushing, the current study showed that there was a highly significant positive correlation between nurses' general knowledge and general practices. This may be because knowledge is the basis for practice. This reflects the importance of improving nurses' knowledge and practice to help them learn, gain good knowledge, and apply it.

The researcher's point of view is that nurses have sufficient knowledge to help them practice well, which is reflected in their patient care. Similarly, there was a significant relationship between the studied nurses' total performance level toward peripheral intravenous cannula flushing and their qualifications, with a  $p$  value  $\leq 0.05$ . The limitations of the study included repetition of the observation even more than time, which put the observer and nurses under stress and biases. Additionally, it can have an unpredictable effect on the results. Therefore, the researcher was present during several different work shifts to greatly decrease this limit.

### **Conclusion**

In line with the findings of the present study, the researchers can conclude that more than two-thirds of the studied nurses were aged between 20-35 years, and less than three-quarters of them were female, and mostly had a nursing diploma with 5-10 years of experience.

Most of the studied nurses had a fair level of knowledge and an unsatisfactory level of practice of peripheral intravenous cannula flushing in the abovementioned setting. Furthermore, there was a statistically significant positive correlation between their total practice and knowledge scores. Additionally, there was a highly statistically significant relationship between total performance score (practices and knowledge) and their qualifications, with a  $p$  value  $\leq 0.05$ .

### **Recommendations:**

1. There is a clear need to design a manual instructional scheme for intravenous cannula flushing for dissemination in the nursing clinical field in addition to theoretical education.

2. Nurses should have access to ongoing educational opportunities and in-service training programs on peripheral intravenous cannula flushing to advance their expertise.
3. The nurses used the booklet and illustrated pamphlets for each one to improve their information and practices.
4. Further research studies in different study settings are essential to identify their further education-training needs and the factors that influence them.

**Acknowledgments:** I am very thankful to the studied nurses and other healthcare workers in the medical-surgical wards at abovementioned setting for their cooperation and participation.

**Abbreviations:** Peripheral intravenous cannula (PIVC); Research Ethics Committee (REC).

**Competing interests:** This study has no conflicts of interest.

**Funding Statement:** The current study received no funding or financial assistance for any reason.

**Availability of Data:** The datasets used and/or analyzed during the current study are available upon reasonable request from the corresponding author.

**Author Contribution:** The author used automated data collection, methodology preparation, introduction, interpretation, conceptual framework, and tool conceptualization, as well as reference, paper design, and journal submission.

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