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Effect of Nursing Training Regarding Peripheral Intravenous Cannula on Nurses Performance and Incidence of Complications

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Abstract
Peripheral intravenous (IV) cannula is the most used invasive method for delivering fluids and medications. It can be associated with complications; therefore, prompt intervention is required by nurses. **The study aimed to** evaluate the effect of nursing training regarding the care and maintenance of peripheral intravenous cannula on nurses' performance and the incidence of intravenous complications. **Design:** quasi-experimental was used. Setting: Medical and surgical wards at Menoufia University Hospital. **Subjects:** A convenience sample of all available nurses (n=50) working in the medical and surgical wards and a purposive sample of 80 adult patients participated in the study. **Four tools were used**: **Tool 1:** The nursing demographic data sheet, **Tool II:** the nurses' knowledge self-administered questionnaire sheet, **Tool III:** the nurses' practice self-administered questionnaire sheet, and **Tool IV:** the related Local Complications with Peripheral Intravenous Cannula Observational Checklist. **The results:** The obtained data confirmed the proposed study hypotheses. After receiving nursing training, there was a noticeable improvement in the performance of nurses. Furthermore, the study group showed a notable reduction in the incidence of peripheral IV cannula-related local complications compared to the control group, including blockage, phlebitis, infiltration, and local infection. **The study concluded** that the implementation of the nursing training resulted in significant improvements in nurses' knowledge and practice, as well as lowering the incidence of local complications related to peripheral IV cannula. **The study recommended** that prior to caring for patients in a medical-surgical setting who are utilizing peripheral IV cannula, nursing training should be considered helpful.

Keywords: Care & Maintenance, Local complications, Medical & Surgical patient & Nursing training.

Introduction
The most frequent invasive clinical procedure conducted on hospitalized patients is the insertion of peripheral intravenous (IV) cannulas **(Bayoumi, et al. 2022)**. This technique is associated with dangers and issues that can hurt patients' long-term health **(Kaur et al., 2019).** Even in the best hands, the failure rate is significant at 35%–50%, and the frequency of complications is to be as high as 70% **(Helm et al., 2015 &Sou et al., 2017).**

Local or systemic complications from peripheral IV cannula might occur. Hematoma, blockage, phlebitis, thrombophlebitis, infiltration, extravasation, unintentional removal, and local infection are some examples of peripheral IV cannula -related local complications **(Bonsall, 2020 & Ray-Barruel, 2019)**. Air embolism, pulmonary edema, catheter fragment embolism, infection, hypersensitivity, and intra-arterial insertion are some of the common side effects **(Kaur et al., 2019)**. Peripheral IV cannulas are associated with higher rates of complications, which raise the risk of morbidity and death, according to recent data from worldwide point prevalence studies **(Bayoumi, et al. 2022 & Alexandrou et al., 2018)**.

Significant patient suffering unneeded or extended hospital stays, higher expenses, and further downstream morbidity can all be caused by complications **(Kaur et al., 2019)**. As a result, evidence-based guidelines and recommendations have been created to prevent or manage local problems caused by peripheral IV cannula. Positive clinical results have been obtained using a recently established clinical care standard technique of preventive care actions against peripheral IV cannula -related local complications. Peripheral IV cannula care standards have improved healthcare professionals' compliance with best practices by condensing lengthy recommendations into point-of-care signals **(Ray-Barruel et al., 2019).** A Clinical care standard covers a small number of quality statements that explain the level of clinical care anticipated for a special clinical procedure. A clinical care standard converges a key range of care where the need for quality enhancement is greatest.

Clinical care standards aim to improve quality and safety of health care by using the best available evidence **(The Australian Commission on Safety and Quality in Health Care, 2021 &Takahashi et al., 2020).** Nurses should be qualified in practical

skill performance to enhance high quality patient care. Peripheral IV cannula is one of the famous repeatedly performed invasive skills in hospitals **(Abo-Seif, et al.2021).** Traditional, basic routine care for peripheral a significant share of nurses and other healthcare professionals provide IV cannulas. Unfortunately, in part due to an overestimation of the safety of these devices, healthcare professionals fail to notice the difficulties associated with peripheral IV cannulas. Additionally **(Oliveira et al. 2019)** concluded that many peripheral IV cannula -related procedures do not follow the current international standard of care (SoC) and that this non-compliance may endanger patient safety and the standard of care.

All staff members who manage peripheral IV cannulas participate in educational sessions to ensure compliance with the specified IV cannulas care standards. It has been demonstrated that problems can be decreased by strictly adhering to the evidence-based recommendations for inserting IV cannulas and caring for catheters. These suggestions are meant to offer evidence-based advice for reducing IV cannulas-related problems. The use of a clinical care standard during the insertion and maintenance of IV cannula, as well as the education and training of healthcare professionals who insert and maintain catheters, are major areas of focus **(Bayoumi, et al. 2022).**

Significant of the study

A recent study found that more thorough research was required since it was still unknown how IV clinical care standard affected the incidence of their complications **(Marsh et al., 2017).** To minimize peripheral IV cannulas-related local complications, improve patient outcomes, and ensure ongoing improvements in the safety, quality, and competency of healthcare, conducting studies on the impact of implementing insertion and maintenance clinical care standard on peripheral IV cannulas-related local complications may be beneficial to nurses, other healthcare professionals, researchers, patients, and health care decision-makers. Moreover, previous research on the care and maintenance of peripheral IV cannulas training sessions for nurses demonstrated that education in evidence-based care and maintenance gives nurses the chance to enhance their capacity to use theoretical knowledge in actual situations. As a result, the purpose of this study was to evaluate the effect of nursing training regarding care and maintenance of peripheral intravenous cannula on nurses' performance and the incidence of intravenous complications (**Takahashi et al., 2020).**

Aim of the study

To assess the effect of nursing training regarding care and maintenance of peripheral intravenous cannula on nurses' performance (knowledge and practice) and the incidence of intravenous complications.

Research Hypotheses

To achieve the aim of the study, the researchers hypothesized that:

H1: The post-mean knowledge scores of nurses exposed to nursing training sessions will be significantly higher than before training.

H2: The post-mean practice scores of nurses exposed to nursing training sessions will be significantly higher than before training.

H3: The incidence of peripheral IV cannula-related local complications for the study group who received insertion and maintenance peripheral IV clinical care standards will be significantly less than for the control group.

Materials and Methods

Study Design

A quasi-experimental research design (pre/post-test for nurses' performance, study/control group for the incidence of intravenous related-local complications) was applied to accomplish this study.

Setting

This study was carried out in medical and surgical wards at Menoufia University hospital, Egypt.

Subjects

Group (1): A convenience sample of all available nurses (50) working in the medical and surgical wards and agreed to participate in the study.

Group (2): A purposive sample of 80 adult patients from both genders, able to provide their permission, having accessible, easily palpable, and/or visibly discernible peripheral veins. The exclusion criteria included having undergone radical mastectomy, having an arm cellulitis, a burn, an arteriovenous fistula, having a fever, being allergic to adhesive tape, having received chemotherapy, having a cerebrovascular accident, being immunocompromised, or having blood infections.

Group (2) is divided into two groups:

- Pre-nursing training implementation group (control group=40).
- Post nursing training implementation group (study group=40)

The control group was subjected to hospital routine of care regarding care and maintenance of peripheral IV cannula by the nurses before nursing training sessions. However, the study group patients received insertion and maintenance IV cannula care standard from nurses who were enrolled in the nursing training sessions. Based on the 95% confidence interval, 5% margin of error, and the anticipated frequency of peripheral IV cannula problems from prior research, the sample size was calculated using the Epi Info

software program **(Rosenblad, 2009 & Abolfotouh, et al., 2014).**

Tools of data collection:

The data was gathered using each of the four tools listed below:

Tool 1: Nurses demographic data sheet includes nurses' age, gender, educational level, years of experience and training courses regarding care and maintenance of peripheral IV cannula.

Tool 2: Nurses Knowledge self-administered questionnaire sheet: it was developed by (**Arbaee, Ghazali, 2013)** and consisted of 19 items, of which 9 related to maintenance of the peripheral I.V. line and 10 related to care of the peripheral I.V. line. The total score of the tool is 19, whereas each correct answer has a score of "1", while an incorrect answer has a score of "0." The content validity of the study tool was evaluated by a panel of five experts in the field of medical-surgical nursing and the medical field. Reliability was performed using Cronbach's alpha, which was 0.793.

Tool 3: The nurse's practice self-administered questionnaire sheet, which was developed by **Arbaee & Ghazali (2013),** consisted of 16 items, of which 7 related to maintenance of the peripheral I.V. line and 9 related to care of the peripheral I.V. line. The total score of the tool is 16, whereas each done answer has a score of "1", while the not-done answer has a score of "0." The content validity of the study tool was evaluated by a panel of five experts in the field of medical-surgical nursing and the medical field. Reliability was performed using Cronbach's alpha, which was 0.756.

Tool 4: "Peripheral Intravenous Catheter-related Local Complications Observational Checklist" was utilized to collect data pertinent to the studied patients' pre- and post-implementation of the nursing training. This tool was developed by the researchers after an extensive review of related the tool has three parts: Part one collects demographic data, such as patients' age, gender, and level of education. Part two contains clinical data related to patients and the peripheral IV cannula. The clinical data related to patients includes body mass index (BMI), history of smoking, and history of previous peripheral IV cannula within the last 30 days. The clinical data related to peripheral IV cannula include catheter material, insertion site, number of successful attempts, indications, type of IV fluids, cannula gauge, catheter dwell time, and method of administration. Part three includes peripheral IV cannula -related local complications, such as phlebitis, filtration, extravasation, blockage, accidental removal, and local infection. The signs and symptoms of each local complication, such as pain, erythema, swelling, the presence of a palpable venous cord-like mass, and purulent discharge, were also included **(Miliani et al., 2017; Patel et al., 2017; Higginson and Parry, 2011; McCallum and Higgins, 2012).** The content validity of the study tool was evaluated by a panel of five experts in the field of medical-surgical nursing and the medical field. Its reliability was tested using Cronbach's alpha test, which yielded a value of 0.89.

The data collection process prolonged over 12 months, from the beginning of October 2019 to the end of September 2020. The research was conducted in four stages (preparatory and assessment, planning, implementation, and evaluation). During the preliminary (preparatory and assessment) phase, textbooks, evidence-based articles, internet periodicals, and journals were used to examine the available literature and studies connected to the study problem.

Preparatory and assessment phase:

For nurses: The researchers visited the medical and surgical wards five days a week (morning) to collect data using the mentioned tools. The researchers interviewed the available nurses, interviewing four to five nurses every day on average. Before data collection, the researchers greeted nurses I, explained the nature, goals, and expected outcomes of the study, and obtained their verbal consent to participate in the study. The researchers then assessed the nurses' knowledge and practice level regarding caring for and maintaining peripheral IV cannulas using Tools II and III. This interview lasted around 25–35 minutes. This is known as the pre-implementation phase of nursing training (pre-test), and it lasts one month.

For patients: Five days a week (morning), the researchers interviewed control group patients (pre-nursing training implementation) who received routine hospital care to complete the sociodemographic and clinical data related to patients and types of intravenous infusion (Tool IV) as well as detect the incidence of IV cannula-related local complications. This stage lasted three months.

Planning phase: Researchers created a plan based on an assessment of nurses' requirements, a study of the literature, the researchers' experience, and the opinions of experts. The researchers created PowerPoint lectures with illustrations that included theoretical information. General information, IV infusion kinds, IV infusion indications, descriptions of insertion and maintenance bundles of care for IV cannulas, and probable local complications of IV cannulas were included in the theoretical section. Each session lasted 45 minutes. For the clinical part, use IV manikin arms to demonstrate insertion and maintenance in accordance with clinical care standard. Each session was 30 minutes long. To prevent disrupting nurses' work schedules, sessions

were repeated twice a day. Posters describing the most prevalent local consequences of infusion treatment were also shown. This phase was scheduled to continue for 3 weeks.

Implementation phase:

The implementation phase was completed through two-week sessions for each subgroup of nurses. This stage lasted five months. Each session began with a recap of the previous session and the objectives of the current one, considering the usage of Arabic language appropriate for the nurses' educational level. Motivation and reinforcement were employed during the session to increase motivation for sharing in this study.

A total of six sessions were conducted. It is split into two sessions for knowledge and four sessions for practice. The duration of the knowledge sessions ranged from 45 to 60 minutes. Groups of nurses have been formed. Each group consists of 4-5 nurses who will acquire the necessary information. The researchers enabled each nurse to demonstrate and proceeded to reinforce the acquired information, answering any questions presented and providing comments.

The duration of practical sessions ranged between 45 and 60 minutes, with four sessions for each group (4-5 nurses). Group discussion, demonstration, and re-demonstration were used as teaching approaches. Videos and data shows were used as media.

Evaluation phase:

For nurses, the researchers compared the effectiveness of applying nursing training. Nurses' knowledge and practice levels were assessed before and after training by completing study tools such as nurses' knowledge (tool II) and nurses' practice (tool III), which were used twice, before and after training implementation. It took about a month.

For patients: The researchers interviewed study group patients who received care and maintenance of IV cannulas based on nursing training to complete the socio-demographic, clinical data, used types of intravenous infusion (Tool IV) as well as to determine the frequency of related local complications. This period lasted three months.

A pilot study.

Five nurses and seven patients, who made up 10% of the total study subjects, participated in the pilot study to evaluate the tools' clarity, applicability, relevancy, and capacity to predict the duration of time needed for data collection. It also examined the practicality of the research process. The tools used by nurses had certain modifications applied to them. Five nurses who were part of the pilot research sample were thus left out of the final sample; however, the methods used to collect data on the seven patients who participated in the study were left unchanged.

Ethical considerations

Administrative process: Medical and surgical department administrators at Menoufia University Hospital approved the data collection.

Obtaining ethical committee permission: Prior to performing the study, obtain ethical permission from the faculty of nursing ethics committee with approval number 814.

Ethical and legal consideration

a. The nature of the study did not in any way hurt or inconvenience the entire sample.
b. When collecting the data, privacy and confidentiality were taken into account.
c. Nurses and patients provided informed consent to take part in the study, with the option to withdraw at any time.

Statistically analysis

The SPSS version 20 statistical software application was used to evaluate, code, analyze, and tabulate data. Frequencies and percentages were used as descriptive data. To analyze the association between two or more qualitative variables, the Chi square (χ^2) test was utilized. Qualitative data were reported as numbers and percentages (n, %). The mean and standard deviation (SD) of quantitative data were used. For comparing two normally distributed quantitative variables, the student t-test was utilized. P-value $\leq$ 0.05 was established as the significant level.

Results

Table (1): Percentage distribution of the studied nurses according to their demographic characteristics among the studied group (n=50)

Demographic characteristics for nurses	N=50	%
Age in years:		
20-<30	26	58.0
30-<40	15	30.0
40-<60	9	12.0
Mean ±SD	35.72±8.66	
Gender:		
Male	6	12.0
Female	44	88.0
Educational level		
Secondary nursing education	30	60.0
Technical nursing education	15	30.0
Bachelor's degree	5	10.0
Years of experience		
Less than one year	4	8.0
1-<5	12	24.0
5-<10	14	28.0
>10	20	40.0
Mean ±SD	8.66±4.80	
Training courses related to care and maintenance of short PIVC		
Yes	2	4.0
No	48	88.0

Note. SD = standard deviation

Table (2): Comparison of total mean scores of nurses' knowledge before and after nursing training (N=50)

Variables	Before training	After training	t-test	p-value
	Mean + SD	Mean + SD		
Knowledge regarding maintenance of peripheral IV Cannulas	6.8 + 1.1	7.9 + 0.9	8.739	0.000**
Knowledge regarding care of peripheral IV Cannulas	8.1 + 1.2	9.3 + 0.7	10.597	0.000**
Total Knowledge toward maintenance and care of peripheral IV Cannulas	14.9 + 2.3	17.2 + 1.1	11.181	0.000**

Statically significant P>0.5* * highly statistically significant P>0.001*

Table (3): Comparison of total mean scores of nurses practice before and after nursing training (N=50)

Variables	Before training	After training	t-test	p-value
	Mean + SD	Mean + SD		
Practice regarding maintenance of peripheral IV Cannulas	5.8 + 0.6	6.6 + 0.1	11.468	0.000**
Practice regarding care of peripheral IV Cannulas	7.3 + 0.9	8.3 + 0.6	10.310	0.000**
Total practice toward maintenance and care of peripheral IV Cannulas	13.1 + 1.3	14.9 + 0.8	13.137	0.000**

Statically significant P>0.5* * highly statistically significant P>0.001*

Table (4): Demographic characteristics of the patients before and after training (N=80).

Variables	Before training		After training		χ2 or t	P-value
	N	%	N	%		
Age						
- 18–<30	13	32.5	14	35	1.51b	.140
- 30–<45	16	40	20	50		
- ≥45	11	27.5	6	15		
Mean + SD	35.1 ± 11.5		33 ± 10.6			
Gender						
- Male	21	52.5	22	55.0	0.12a	.726
- Female	19	47.5	18	45.0		
Level of education						
- Cannot read and write	5	12.5	4	10	1.92a	.987
- Can read and write	7	17.5	5	12.5		
- Primary education	10	25	13	32.5		
- Secondary education	17	42.5	14	35		
- Higher education	1	2.5	4	10		

Note. SD = standard deviation; aχ2 test; bt test

Table (5): Clinical data related to patients before and after training (N=80).

Variables	Before training		After training		χ^2 or t	P-value
	N	%	N	%		
BMI						
- Underweight (16–<18.5)	2	5	2	5	1.43[b]	.160
- Normal (18.5–<25)	25	62.5	25	62.5		
- Overweight (25-≥30)	13	32.5	13	32.5		
Mean + SD	23.2 ± 3.3		23.1 ± 3.2			
Smoking						
- Never	10	25.0	8	20.0	0.76[a]	.125
- Current	29	72.5	29	72.5		
- Ex-smoker	1	2.5	3	7.5		
History of peripheral IV Cannulas within 30 days						
- Yes	17	42.5	16	40.0	0.08[a]	.967
- No	23	57.5	24	60.0		

Note. SD = standard deviation; BMI = body mass index; [a]χ^2 test; [b]t test

Table (6): Clinical data related to peripheral IV Cannulas before and after training (N=80).

Variables	Before training		After training		χ2 or t	P-value
	N	%	N	%		
Insertion site of peripheral IV Cannulas						
- Antecubital	13	32.5	10	25	11.2a	0.010**
- Hand	16	40	0	0		
- Forearm	11	27.5	30	75.0		
No. of peripheral IV Cannulas attempts						
- First	17	42.5	29	72.5	3.76b	0.001**
- Second	17	42.5	10	25.0		
- Third	6	15.0	1	2.5		
Mean + SD	1.7 + 0.7		1.3 + 0.5			
Peripheral IV Cannulas needle gauge						
- 18	12	30	0	0	5.99a	0.050*
- 20	13	32.5	24	60.0		
- 22	15	37.5	16	40.0		
Catheter dwell time (hour)						
- 0–24	2	5	0	0`		<.001
- 25–48	1	2.5	0	0	64a	
- 49–71	10	25	0	0		
- 72–96	10	25	40	100		
- 97 or more	17	42.5	0	0		
Method of administration						
Bolus	11	27.5	9	22.5	0.55a	0.497
Intermittent	23	57.5	26	65		
Continuous	6	15	5	12.5		

**Statically significant P>0.5 ** highly statistically significant P>0.001*

Table (7): Incidence of peripheral IV Cannulas -related local complications before and after training (N=80).

peripheral IV Cannulas complications	Before training		After training		χ^2	P-value
	n[a]	%	n[b]	%		
Blockage	16	40	2	5	14.05	0.001
Infiltration	7	17.5	1	2.5	5.0	0.010**
Phlebitis	14	35	2	5	11.25	0.001
Extravasation	5	12.5	2	5	1.32	0.250
Accidental removal	3	7.5	0	0	3.12	0.100
Local infection	10	25	1	2.5	8.54	0.001

Note.[a] The number of patients is different because some participants developed more than one local complication.
[b] Onlyeight patients developed peripheral IV Cannulas -related local complications.
**Statically significant P>0.5 ** highly statistically significant P>0.001*

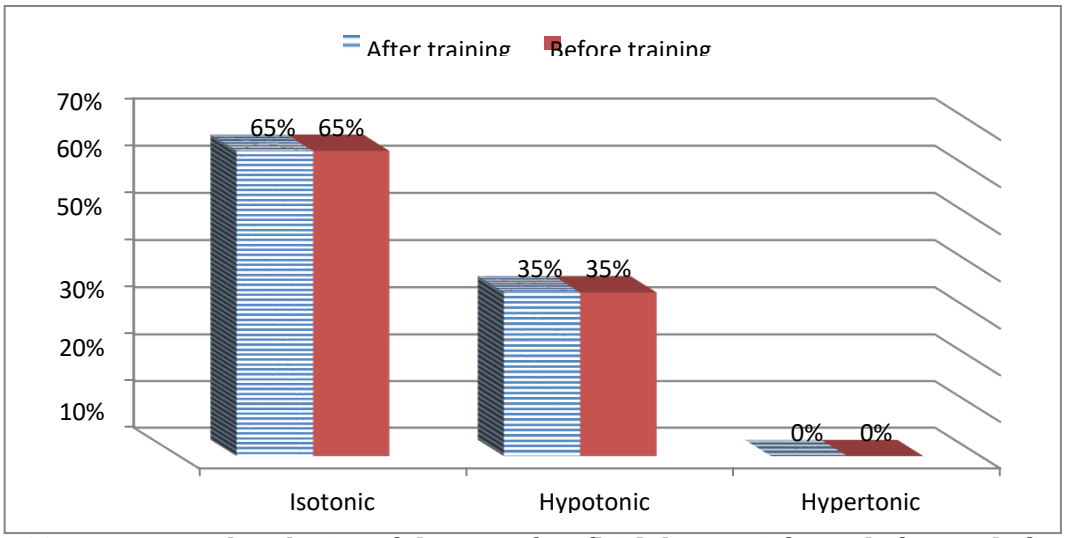

Figure (1): Percentage distribution of the type of IV fluid therapy infusion before and after training (N=80)

Table (1): Reveals the demographic features of the nurses. It was discovered that more than half (58%) of nurses ranged in age from 20 to 30 years old with the mean and SD 35.72±8.66 years. Most nurses were female with a secondary nursing degree (60%), and they had worked for more than 10 years (40%). At the same time, the majority (88%) had not previously attended any training sessions related to the care and maintenance of peripheral IV Cannulas.

Table (2): Provides a comparison of nurses' knowledge of peripheral IV Cannulas care and maintenance before and after training sessions. It demonstrates that the mean score of overall knowledge improved significantly after training. P< 0.000, highly statistically significant changes were discovered.

Table (3): Compares nurses' practices in the care and maintenance of peripheral IV Cannulas. It demonstrates that the average total score following the implementation of training improved significantly. P< 0.000, highly statistically significant improvement was revealed.

Table (4): Shows that 40% of the control group and 50% of the study group had age between 30 and 45 years, and the mean age of the patients in the control and study groups were 35.1 ± 11.5 and 33 ± 10.6 years, respectively. In addition, 52.5% of the control group and 55% of the study group were males. In terms of education level, 42.5% of the control and 35% of the study group had secondary education. No statistical significance was found between the study and control groups in terms of demographic characteristics (P>0.05).

Table (5): Reveals that the study and control groups had no statistical significance in terms of clinical data related to patients. In addition, the results recorded that 57.5% of the control group and 60% of the study group had no history of peripheral IV Cannulas within the last 30 days (P >0.05).

All the catheters used in both groups were Teflon (Bio-Flon).

Table (6): Reveals that the dominant peripheral IV Cannulas insertion site in the control group was the hand (40%), and that in the study group was the

forearm (75%). About 42.5% of the control group and nearly three quarters (72.5%) of the study group were successfully inserted with peripheral IV cannulas at the first attempt. Approximately 37.5%, 32.5%, and 30% of the control group were inserted with cannula gauge 22, 20, and 18, respectively, whereas 60% and 40% of the study group were inserted with cannula gauge 20 and 22, respectively. All of the participants in the study group had peripheral IV Cannulas for 96 hours, whereas 42.5% of the control group had peripheral IV Cannulas for 97 hours or more. Both groups had statistical significance in the insertion site of peripheral IV Cannulas, the number of peripheral IV Cannulas attempts, peripheral IV Cannulas gauge, and the catheter dwell time (χ^2=11.2, P=0.01; t=3.76, P=0.001; χ^2=5.99, P=.05; t=64, P <.001).However, no statistical significance was noticed between the two groups regarding the methods of administration.

Table (7): Shows that the study group had significantly greater reduction in the incidence of peripheral IV Cannulas -related local complications, namely, blockage (χ^2=4.05, P <0.001), phlebitis (χ^2=11.25, P <.001), infiltration (χ^2=5, P =.01), and local infection (χ^2=8.56, P <0.001), than the control group after implementing the insertion and maintenance clinical care standards.

Figure (1): Reveals no statistically significant differences between the control and study groups regarding the type of IV fluid therapy used as an indication of peripheral IV Cannulas insertion (P >0.05).

Discussion:

Regarding the demographic characteristics among the studied group. The current study showed that the mean age of studied nurses was 35.72±8.66. The majority of studied nurses were female. The interpretation of this result because, the majority of nurses career in Egypt was a female for a long time. Male nurses in Egypt were newly joined in nursing career. The previous finding was in the same line with **Bayoumi, et al. (2022)** in her study of Changes in nurses' knowledge and clinical practice in managing local IV complications following an education intervention, in Egypt. She clarified that; the majority of studied nurses were female. The previous finding was inconsistent with **Ali, et al. (2021)** in her study of assessment of nurses' knowledge towards infections of peripheral intravenous cannula in Al-Basrah Teaching Hospital. She mentioned that the majority were male.

More than half of nurses have a secondary nursing degree. The previous finding was in the same result of **Abo-Seif (2021),** in her study of effect of an educational program on nurses' practice regarding management of patients undergoing peripheral vascular access in Egypt. She discussed that the majority of studied nurses had diploma level of education. Less than half of them have worked for more than 10 years. The interpretation of the previous results may be because the nurses graduate from a longer time, there is no update in their knowledge and clinical practice. At the same time, the majority had not previously attended any training sessions regarding care and maintenance of peripheral IV Cannulas; this means nurses were highly needs for training program regarding care and maintenance of IV cannula. The previous finding was in the same line with **Ali, et al. (2021) s**he explained that, more than half of studied nurses didn't have any previous training about cannula care and maintenance.

Concerning nurses' total knowledge of peripheral IV Cannulas care and maintenance before and after training sessions. This study mentioned that there was a highly statistically significant improvement of overall knowledge after training (P< 0.000). The previous results were coherent with **Bayoumi, et al. (2022).** She founded that, there were statistically significant improvement in Nurses' theoretical knowledge (P<0.001). From the researchers point if view the rational of previous finding was the effect of training session for nurses especially the majority of nurses did not have any training course regarding IV cannula care and maintenance.

As regards nurses' practices in the care and maintenance of peripheral IV Cannulas before and after training sessions. The current study clarified that, there was a highly statistically significant improvement of overall practice after training (P< 0.000). The previous finding was in the same line with **Abo-Seif (2021),** she mentioned that there was statistically significant difference between pre and immediately post program implementation. Also, there was statistically significant improvement was notices among pre & follow up program applications for total practice. The previous finding was inconsistent with **Patidar, (2022).** He clarified that the majority of staff nurses reached an average level in practices.

There was no apparent difference in demographic features between the two groups. The patient characteristics of both groups were comparable to those in prior studies that assessed peripheral IV cannulas and associated local **problems. Marsh et al. (2018)** Furthermore, there was no significant difference in clinical data linked to patients or certain clinical data related to peripheral IV cannulas, such as the mode of administration and type of IV fluid infusion as an indicator of peripheral IV cannula insertion, between the two groups. However, statistically significant variations in insertion site,

number of peripheral IV cannula insertion attempts, cannula gauge, and dwell duration were observed between the two groups. In terms of insertion location, fewer than half of the control group had peripheral IV cannulas placed in the hand, whereas three-quarters of the study group had peripheral IV cannulas placed in the forearm.

This conclusion is congruent with that of **Cicolini et al., (2014)** who conducted a prospective multicenter field study to determine if the location of a peripheral venous catheter insertion increases the risk of catheter-related phlebitis. The authors said that inserting a peripheral venous cannula into forearm veins rather than the dorsum of the hand can reduce the risk of phlebitis by 70%. **Kassahun, et al. (2022)** corroborated this theory by allowing the placement of a variety of various diameter cannulas in a region.

According to this study, the number of successful initial attempts at cannula insertion was less than half in the control group and over three-quarters in the research group. Failure to implant an IV cannula on the first try results in vascular damage, increasing the risk of phlebitis**.** The current study's findings are similar to prior research by **Kassahun et al. (2022)**. who determined that patient characteristics, nursing staff factors, and product and technology factors are all independently linked with the probabilities of success.

In this study, cannula gauge 22 was used in more than one third of the control group, while gauges 20 and 18 were used in less than one-third of the control group. In comparison, more than half of the research participants had a cannula gauge of 20, whereas the remainder had a gauge of 22. This observation was similar to the findings of many earlier studies **Ray, & Madhusoodan (2022),** which revealed that the gauge of peripheral IV cannulas, particularly small-gauge (22 gauge) and large-gauge (18 gauge), is a risk factor for device failure.

Finally, the dwell duration of peripheral IV cannulas may be related to the previous findings. The whole research group had peripheral IV cannulas in place for 72–96 hours, but just less than half of the control group had them in place for more than 96 hours. **Osti et al. (2019)** and national recommendations for peripheral IV cannulas [29] said in this context that elective removal of peripheral IV cannulas should be considered if they have been in situ for 72–96 hours to reduce the risk of problems. **Infusion Therapy Standards (2021)** on the other hand, suggested that peripheral IV cannulas be removed depending on clinical indication rather than at regular intervals.

The incidence of peripheral IV cannula-related local problems differed statistically between the two groups. The research group experienced fewer local issues after adopting the insertion and maintenance bundles than the control group, which received routine hospital care. As a result, the findings confirmed the research hypothesis. This finding is nearly identical to that of a previous study by **Ray-Barruel et al., (2018)** who conducted a systematic review from January 2000 to December 2018 to assess the effectiveness of insertion and maintenance bundles in preventing peripheral IV cannula-related complications in hospital patients. Their findings found that 12 studies reported a decrease in phlebitis rates, whereas just one research study reported an increase in phlebitis rates. The existence of numerous variables, such as catheter size, catheter dwell duration, insertion location, and insertion site preparation, might explain the increased frequency of local problems in the control group compared to the study group in the current investigation. Time, insertion site preparation, kind of infusion, insertion technique, and insertion site are all factors to consider. This explanation is consistent with the findings of a previous study **Mandal & Raghu (2019),** who found that a variety of factors, including catheter size, catheter dwell time, insertion site preparation, type of infusion, insertion method, and insertion site, contribute to the development of complications. Furthermore, the procedures used to secure catheters may be linked to the occurrence of infections and problems. In the current study, however, 100% of peripheral IV cannulas in both groups were secured using adhesive tape.

Furthermore, the current study discovered that the incidence of peripheral IV cannula-related local consequences (phlebitis and infiltration) is regarded as high in the control group (35% and 17.5%, respectively). The findings of this study are consistent with those of **Marsh et al., (2017)** who indicated that millions of patients globally use peripheral IV cannulas.

Recent data from international point prevalence studies has shown that peripheral IV cannulas are associated with increased rates of complications, which raise morbidity and mortality concerns. However, the current research's findings contrast from those of previous studies, such as the descriptive study conducted by **Makafi & Marfega, (2017)** who discovered that the rates of phlebitis and infiltration are 21% and 3.5%, respectively. According to **Keogh & Matthew (2019)**, the frequency of phlebitis varies substantially among studies, ranging from 2% to 80%. This gap, however, may reflect variation in the methods used to assess phlebitis rather than the disorder's frequency. Infiltration can also be caused by the device becoming dislodged from the vein or a lumen obstruction.

According to **Mandal & Raghu. (2019),** the most common consequence is phlebitis, which is followed by blockage or infiltration and dislodgement. **Marsh et al., (2017)** said that the worldwide standards of the Intravenous Nurse Society propose that the ideal prevalence of phlebitis in any particular group be 5% or below.

In terms of local infection, the current study's findings are congruent with those of **Othman & Awad, (2017)** who investigated the impact of implementing a peripheral IV cannula care standard on infection incidence. Their findings revealed a decrease in the incidence of infection following the implementation of the peripheral IV cannula care bundle. They also suggested that a peripheral IV cannula care bundle be used to prevent infection and peripheral IV cannula-related local consequences. Peripheral IV cannula-related local infection, according to **Keogh & Mathew (2019),** can develop during insertion if an infected catheter is used or at any moment by bacterial immigration while the catheter is in place. As a result, during peripheral IV cannula insertion, care, and removal, all health practitioners must follow infection prevention and control principles, as well as the aseptic, non-touch method.

In this study, most nurses in the control group who positioned peripheral IV cannulas did not use gloves, did not wash their hands before and after the procedure, and did not appropriately prepare the equipment and patient's surroundings. Furthermore, the nurses' practices during the management of peripheral IV cannulas did not follow or comply with the required SOC or national recommendations. Furthermore, there was no frequent surveillance or monitoring of peripheral IV cannula outcomes. This conclusion is consistent with **Oliveira et al. (2019),** who did descriptive research to identify nurses' practices in peripheral IV cannula insertion and maintenance. They determined that a considerable proportion of operations involving peripheral IV cannulas do not adhere to existing SoC recommendations and may endanger patient safety and quality of care.

Conclusion:

Based on the study findings, the current concluded that after implementing the nursing training, the nurses' knowledge and practice scores regarding the care and maintenance of periphery IV cannulas were higher than before, and the frequency of local complications was statistically significant lower in the study group compared to the control group. Training for nurses may minimize the occurrence of IV cannula-related complications in the study group compared to the control group.

Recommendation:

This study recommended that, every health organization must define well-trained IV teams as an efficient method to decrease complications associated with peripheral IV cannulas. Continuing education in percutaneous IV cannula care and maintenance encourage nurses to seek information and refresh their skills. Further research on a larger number of participants drawn from different regions in Egypt is needed to generalize the findings. Future research should identify the obstacles that prevent health care practitioners from using peripheral IV cannula insertion and maintenance bundles.

References

- **Abolfotouh M., Salam M., Bani-Mustafa A., White D, & Balkhy H., (2014):** Prospective study of incidence and predictors of peripheral intravenous catheter-induced complications. Ther Clin Risk Manag. Vol (10), pp.993-1001. doi:10.2147/TCRM.S74685
- **Abo-Seif, H., Hassanein, A., Sobh, D., & Abd El-Reheem, H., (2021):** Effect of an educational program on nurses' practices regarding management of patients undergoing peripheral vascular access, Port Said Scientific Journal of Nursing, Vol (8), No. (3), pp.1.23
- **Alexandrou E, Ray-Barruel G, Carr P. (2018):** Use of Short Peripheral Intravenous Catheters: Characteristics, Management, and Outcomes Worldwide. J Hosp Med. Vol (13), No (5). doi:10.12788/jhm.3039
- **Ali, A., & Saud, A., (2021):** Assessment of Nurses' Knowledge Towards Infections of Peripheral Intravenous Cannula In Al-Basrah Teaching Hospital. IJFMT. July-September Vol. (15), No. (3)pp.2216-2221 https://doi.org/10.37506/ijfmt.v15i3.15644
- **Arbaee, I., & Mohd Ghazali, M., (2013):** Nurses Knowledge and Practice Towards Care and Maintenance of Peripheral Intravenous Cannulation in Pantai Hospital, Batu Pahat, Johor, Malaysia. Published thesis, available at:https://www.researchgate.net/publication/236982617_Nurses_Knowledge_and_Practice_Towards_Care_and_Maintenance_of_Pe
- **Bayoumi M., Khonji L., & Gabr W. (2022):** Changes in nurses' knowledge and clinical practice in managing local IV complications following an education intervention. British journal of nursing, Apr. Vol (31), No (8):pp.24-30. doi: 10.12968/bjon.2022.31.8.S24. PMID: 35439081
- **Bonsall, L. (2020):** Complications of Peripheral I.V. Therapy – Nursing Center. February 10, AccessedMay 10, 2020. https://nursingcenter.com

- **Cicolini G, Manzoli L, & Simonetti V., (2014):** Phlebitis risk varies by peripheral venous catheter site and increases after 96 hours: a large multi-center prospective study. J Adv Nures. Vol(70), No(11):pp.2539-2549. doi:10.1111/jan.12403
- **Hallam C. (2019):** Right Hub Disinfection for Compliance. Vessel Heal Preserv Right Approach Vasc Access. Published online 2019:235-241. doi:10.1007/978-3-030-03149-7_18
- **Helm E, Klausner D, Klemperer JD, Flint LM, & Huang E. (2015):** Accepted but Unacceptable. J Infus Nurs. Vol(38), No(3):pp.189-203. doi:10.1097/nan.0000000000000100
- **Higginson R, & Parry A., (2011):** Phlebitis: Treatment, care and prevention. Nurs. Time; Vol(10), No(36):pp.18–21 https://pubmed.ncbi.nlm.nih.gov/35439081/
- **Infusion Therapy Standards (2021):** Infusion Therapy Standards practice update, The Art and Science of Infusion Nursing, Vol.(44),No(4), August, available at:https://www.ins1.org/publications/infusion-therapy-standards-of-practice/
- **Kassahun, C., Abate, A., Tezera, Z., Bashah, D., Agegnehu, C., Getnet, M., & Alemu, M. (2022):** Incidence and Associated Factors Of Failed First Peripheral Intravenous Catheters Among Adult Patients At Medical Surgical Wards In Public Referral Hospitals Of West Amhara, Ethiopia, Nursing Research and Practice, vol (2022), pp. 1-9. https://doi.org/10.1155/2022/8261225
- **Kaur P, Rickard C, Domer G, & Glover K. (2019):** Dangers of Peripheral Intravenous Catheterization: The Forgotten Tourniquet and Other Patient Safety Considerations. Vignettes Patient Saf – Vol(4) Published online 2019. doi:10.5772/intechopen.83854
- **Keogh, S., & Mathew, S., (2019):** Peripheral intravenous catheters: A review of guidelines and research, Australian Commission on safety and quality of health care, Available at: https://www.safetyandquality.gov.au/publications-and-resources/resource-library/peripheral-intravenous-catheters-review-guidelines-and-research
- **Makafi S, Marfega, & MACM (2017):** Peripheral Intravenous Catheter (PIVC) Related Local Complications among Patients in KFCHJizan. Adv Practice Nurse Vol (2), No (138). doi:10.4172/2573-0347.1000138
- **Mandal A, & Raghu K. (2019):** Study on incidence of phlebitis following the use of peripheral intravenous catheter. J Family Med Prim Care. 2019 Sep; Vol(8), No(9):pp.2827-2831. doi: 10.4103/jfmpc.jfmpc_559_19. PMID: 31681650; PMCID: PMC6820419
- **Marsh N, Webster J, & Larsen E., (2018):** Expert versus generalist inserters for peripheral intravenous catheter insertion: a pilot randomized controlled trial. Trials. Vol (19), No(1). doi:10.1186/s13063-018-2946-3
- **Marsh N, Webster J, Larsen E, Cooke M, Mihala G, & Rickard C., (2017):** Observational Study of Peripheral Intravenous Catheter Outcomes in Adult Hospitalized Patients: A Multivariable Analysis of Peripheral Intravenous Catheter Failure. J Hosp Med. Published online 2017. doi:10.12788/jhm.2867
- **McCallum L, & Higgins D., (2012):** Care of peripheral venous cannula sites. Nurs. Time; Vol(108),No.(34/35):pp.12–15
- **Miliani K, Taravella R, & Thillard D., (2017):** et al. Peripheral Venous Catheter-Related Adverse Events: Evaluation from a Multicenter Epidemiological Study in France (the CATHEVAL Project). PLoS One; Vol. (12), No. (1): pp: 252-260.e0168637. doi: 10.1371/journal.pone.0168637
- **Oliveira A, Costa P, & Graveto J., (2019):** Práticas dos enfermeiros na cateterização intravenosa: umestudo descritivo. Rev Enferm Ref. 2019; IV Série.Vol. (21):pp.111-120. doi:10.12707/19006
- **Osti C, Khadka M, Wosti D, Gurung G, & Zhao Q. (2019):** Knowledge and practice towards care and maintenance of peripheral intravenous cannula among nurses in Chitwan Medical College Teaching Hospital, Nepal. Nurse Open. 2019 Apr Vol. (15); No. (3): pp.1006-1012. doi: 10.1002/nop2.288. PMID: 31367425; PMCID: PMC6650670.
- **Othman, W., & Awad, S.A. (2017):** Effect of Execution of the Peripheral Intravenous Cannula Care Bundle on Reducing the Incidence of Infection, available at: https://www.semanticscholar.org/paper/Effect-of-Execution-of-the-Peripheral-Intravenous-*-Othman-Awad/03863ae618d7bcf84e27da6301c36bc7affcdf74
- **Patel SA, Alebich MM, & Feldman L. (2017):** Routine Replacement of Peripheral Intravenous Catheters. JHosp Med. Vol. (12), No (1):pp.42-45. doi:10.1002/jhm.2676
- **Patidar, P. (2022):** A Study To Assess the Knowledge And Practices Regarding Prevention And Management Of Local Complications Of Peripheral Intravenous Therapy Among Staff Nurses Working In The Dr. D.y. Patil Hospital,

Pimpri, Pune. IJNER, Vol. (7), No (5), pp65-74. https://doi.org/10.52711/2454-2660.2022.00016

- **Ray, B., & Madhusoodan (2022):** Effectiveness of Protocol Based Nursing Care of Patients With Intravenous Line Cannula In Selected Hospital At Ambala City. IJARSCT,Vo(9), No.(5),pp. 102-109. https://doi.org/10.48175/ijarsct-2638
- **Ray-Barruel G, Cooke M, Mitchell M, Chopra V, & Rickard C., (2018):** Implementing the I-DECIDED clinical decision-making tool for peripheral intravenous catheter assessment and safe removal: protocol for an interrupted time-series study. BMJ Open. Vol (8), No. (6): pp.15-25.e021290. doi:10.1136/bmjopen-2017-021290
- **Ray-Barruel G, Xu H, Marsh N, Cooke M, & Rickard C., (2019):** Effectiveness of insertion and maintenance bundles in preventing peripheral intravenous catheter-related complications and bloodstream infection in hospital patients: A systematic review. Infect Dis Heal. Vol. (24), No. (3): pp.152-168. doi:10.1016/j.idh.2019.03.001
- **Rosenblad A., (2009):** Sample size calculations in clinical research (2nd ed.). Shein-Chung Chow, Jun Shao and Hansheng Wang, Chapman & Hall/CRC, Boca Raton, FL, 2008.ISBN 1-58488-982-9. Stat Med. Vol.(28), No.(2):pp.360.-370.doi:10.1002/sim.3468
- **Sou V, McManus C, Mifflin N, Frost SA, Ale J, & Alexandrou E. (2017):** clinical pathway for the management of difficult venous access. BMC Nurs., Vol. (16), No (1). pp.215-227. doi:10.1186/s12912-017-0261-z
- **Takahashi T, Murayama R, & Abe-Doi M., (2020):** Preventing peripheral intravenous catheter failure by reducing mechanical irritation. Sci Rep. Vol. (10), No. (1). pp.195-212. doi:10.1038/s41598-019-56873-2
- **The Australian Commission on Safety and Quality in Health Care Level (2021):** Management of peripheral intravenous catheter, Clinical Care standard, available at:https://www.safetyandquality.gov.au/publications-and-resources/resource-library/management-peripheral-intravenous-catheters-clinical-care-standard-highlights-infographic