

Knowledge and practices regarding prevention of peripheral intravenous catheter (PIVC) infection among registered nurses

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Abstract

Background: Peripheral intravenous catheter (PIVC) cannulation is the insertion of a vascular access device into a peripheral vein. This procedure needs manual skills, professional competency, and knowledge regarding the anatomy and physiology of the vascular system. However, the incidences of PIVC infections occur due to poor cannulation or care post-insertion practices that may lead to prolonged hospital stays. They will increase hospital costs for the patient or the hospital itself.

Purpose: To determine Registered nurses' (RN) knowledge and practices regarding PIVC care.

Method: This descriptive quantitative study used a set of online questionnaires via Google Forms. These studies aim to determine the knowledge and practice of RNs towards the care and maintenance of PIVC. A total number of 113 respondents have joined this study.

Results: Most RNs are well-versed in caring for and sustaining PIVC, while some lack knowledge and practice. Even though just 85.8% of respondents had adequate knowledge, the data revealed that 86.7% followed proper procedures. This could be a source of concern for patient safety.

Conclusion:

Keywords: Infection; Knowledge; Nurses; PIVC; Practices.

INTRODUCTION

Peripheral intravenous catheter (PIVC) is a common and necessary IV device widely used in medical settings (Catarino et al., 2022). Approximately 60% of hospital inpatients are estimated to have PIVC cannulation each year to obtain therapeutic intravenous medicines (Osti, Khadka, Wosti, Gurung, & Zhao, 2019). The procedure of PIVC cannulation involves puncturing the patient's skin with a needle to facilitate the insertion of temporary plastic tubing into a vein. The PIVC is commonly inserted into the cephalic or basilic vein in the lower arm or a metacarpal vein on the back of the hand (Osti et al., 2019). Due to the higher two density of skin flora in this area, which puts the patient at risk of infection (Lorente, Henry, Martín, Jiménez, & Mora, 2005). Although such catheters give necessary vascular access, patients are at risk for local and systemic infectious effects, including local site infection and septic phlebitis.

The placement and maintenance of PIVC by insufficiently trained personnel is one of the major causes of phlebitis (Zingg et al., 2023). Because of occlusion or leakage, phlebitis are major consequences of PIVC, and their use should be terminated. The guidelines advocate that a PIVC be withdrawn or replaced every 12 to 72 hours to avoid these complications (Mayhall, 2004). In addition, the

smallest necessary PIVC should be thoroughly noted in the patient's records, including the date, time, size, and location. One of the most important goals of IV therapy is to maintain patent, comfortable IV access that can be used to safely and reliably give the prescribed therapy. According to the Centers for Disease Control and Prevention (CDC), healthcare-related infections are illnesses acquired in a healthcare setting with no evidence that the infection was present or incubating at the time of entry into the healthcare context (Haque, Sartelli, Mckimm, & Abu Bakar, 2018).

Infection control is essential in all aspects of patient care and professional practice, and using the infection chain to assess IV treatment practice will allow for a complete examination of the risks and methods to ensure safe and competent practice. The incidences of (PIVC) infections occur due to poor practices of cannulation or care that may lead to prolonged hospital stay, morbidity, and mortality. PIVC infections will increase the hospital costs by the patient or the hospital itself. This could lead to hospital-acquired bacteraemia, as the PIVC accounts for 6.2% of such cases. PIVC is more frequently related to localized infections than systemic infections. Thrombophlebitis and infection are two of the most prevalent PIVC consequences.

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Nurses have a critical role in the prevention of such problems (Osti et al., 2019).

Insertion, monitoring, and assessment of a PIVC site are common nursing responsibilities. RNs should be well-versed in the preparation and administration of IV infusions as well as care of the intravenous (IV) devices. They should also be aware of the prevention, treatment, and management of local and systemic complications and how to use dynamic evidence-based practice guidelines. In PIVC care, only trained and competent staff should be involved, and stringent aseptic practices should be used. To prevent this complication from occurring, knowledge and good practices are essential.

Healthcare professionals must follow standard operating procedures (SOP) such as hand washing before any clinical procedure; hand washing often underperforms in the healthcare facility even though it is one of the easiest clinical tasks. Better knowledge and practices among RNs can lead to improved prevention of PIVC infection. Standardization of practice would help reduce the risk of infection for patients, and all employees, three especially RNs, must be involved and trained to ensure consistency between practice and procedures (Vaismoradi, Tella, Logan, Khakurel, & Vizcaya-Moreno, 2020).

RESEARCH METHOD

This descriptive quantitative cross-sectional was conducted in 2021 at a private hospital in Kuantan, Pahang, Malaysia. The study population was (N=161). Based on Krejcie and Morgan's (1970) table (Abdul, Bukhari, & Bukhari, 2021), since in this study, the population is 161 nursing staff (N=161), the sample for this study is 113 nursing staff (N=113). The sampling method used in this study was convenience sampling of nursing staff selected randomly based on inclusion and exclusion criteria.

An anonymous self-administered online questionnaire was adapted from a previous study (Osti et al., 2019). Self-report or self-administered with close-ended questions asked respondents to choose from a distinct set of predefined responses of Yes, No, and I do not know. The instrument used includes five sections. The first concerns socio-demographic information of the nursing staff, including gender, age, working department, position, years of work experience and educational level. The second section consists of 19 items for the knowledge of the RN towards the care and maintenance of the PIVC, and the third section consists of nursing practice on the care and maintenance of the PIVC, including 16 items.

The fourth and fifth sections were the additional sections to know the nurses' intervention if there were no signs and symptoms of complication or infection after 72 hours of PIVC (1 item) and barriers encountered for caring and maintaining PIVC (1 item). The Cronbach's Alpha value for research question one was 0.811, and for research question two was 0.818. Thus, this result suggests a good internal consistency. Due to the COVID-19 pandemic, data was collected through a Google form, and the respondent was reached via WhatsApp. Permission, explanation and informed consent were stated in the Google form. The data was analyzed by using SPSS software.

The analysis included descriptive statistics such as frequencies, percentages, means and standard deviation. The Chi-Square was used to analyze relationships between age, years of working experience and level of education. Ethical clearance was sought from the Research Management Committee (RMC) of the University affiliation and the private Specialist Hospital. The purpose of the study, informed consent, and the respondent criteria regarding privacy and confidentiality are attached and briefly explained in the Google form.

RESEARCH RESULTS

Table 1 Analysis of demographic characteristics of the sample (n=113)

Characteristics	Frequency (n)	Percentages (%)
Gender		
Female	107	94.7

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Male	6	5.3
Age		
21 – 30	35	31.0
31 – 40	60	53.1
41 - 50	18	15.9
Year of work experience		
< 1	7	6.2
1 – 5	30	26.5
6 – 10	38	33.6
> 10	38	33.6
Educational level		
Diploma in Nursing	64	56.6
Post basic	32	28.3
Bachelor in Nursing	17	15.0

Most respondents (94.7%) were female aged 21 to 30 years (31%) old. The majority of the respondents had experience working 6 to 10 and more than ten years, with a total number of 76 (67.2%). Most respondents have proper knowledge, although there was an item in which respondents had the wrong knowledge about proper care.

Table 2 Knowledge among RN regarding PIVC infection prevention (n=113)

Variables	Correct N (%)	Wrong N (%)	I Do Not Know N (%)
The cannula gauge 14-20 G is suitable in adult patient and 22-24 G in paediatric patient	112 (99.1)	1 (0.9)	0 (0)
Veins at dorsal and ventral surface of the upper extremities are used for IV cannulation	112 (99.1)	1 (0.9)	0 (0)
Peripheral IV cannula must be removed every 12-72 hours from insertion time	101 (89.4)	12 (10.6)	0 (0)
IV cannula can be used 48–72 hour if no signs and symptoms of complication	112 (99.1)	1 (0.9)	0 (0)
Phlebitis is the most identifiable infection	112 (99.1)	1 (0.9)	0 (0)
The environment sanitation influent the risk of IV infection	109 (96.5)	4 (3.5)	0 (0)
Hand hygiene before IV cannula insertion prevents	112 (99.1)	1 (0.9)	0 (0)

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infection			
Maintaining aseptic technique only during IV insertion helps to prevent infection	111 (98.2)	2 (1.8)	0 (0)
Wearing non-sterile gloves during IV cannula insertion is advisable	111 (98.2)	2 (1.8)	0 (0)
Skin preparation at insertion site is essential	112 (99.1)	1 (0.9)	0 (0)
Increase attempts for cannulation will increase the risk of infection	111 (98.2)	2 (1.8)	0 (0)
Transparent dressing will help to recognize early signs and symptoms of infection	112 (99.1)	1 (0.9)	0 (0)
Removing extra IV cannula will help to reduce risk of infection occur	111 (98.2)	2 (1.8)	0 (0)
Staphylococcus aureus is the most associated with cannula tips	111 (98.2)	2 (1.8)	0 (0)
Catheter material, size, duration, experience of the staff influences on risk of infection	106 (93.8)	7 (6.2)	0 (0)
IV therapy increases risk of PIVC infection	109 (96.5)	4 (3.5)	0 (0)
Patient with PIVC is on risk of nosocomial infection	112 (99.1)	1 (0.9)	0 (0)
Patient education on care of IV cannula is important to reduce risk of infection	110 (97.3)	3 (2.7)	0 (0)
IV cannula should be flushed by injection Normal Saline after any IV Medication	111 (98.2)	2 (1.8)	0 (0)

As shown in Table 2, 112 (99.1%) of respondents knew how to choose the correct size of PIVC and were aware that veins at the dorsal and ventral surface of the upper extremities are used for IV cannulation whilst only 1 (0.9%) are not aware of it. There were 101 (89.4%) respondents who knew that the IV cannula was to be removed or replaced every 12 to 72 hours from insertion time, whilst 12 (10.6%) did not remove it. 112 (99.1%) of total respondents know that an IV cannula can be used within 48 to 72 hours if there are no signs and symptoms of complication as the review date, which PIVC should be in situ no longer than 72 hours without appropriate risk assessment. On the other hand, 112 (99.1%) of respondents knew that phlebitis is the most identifiable infection related to PIVC.

This is a very good sign that respondents are aware of the complications of PIVC. Meanwhile, 109 (96.5%) know that environmental situations will

influence the risk of infection related to PIVC cannulation. Regarding the hand hygiene statement, 112 (99.1%) of respondents agree that it should be done before PIVC insertions, which could help prevent infection. On the other hand, 111 (98.2%) of respondents knew that maintaining the aseptic technique not only during the insertion of PIVC but also during the preparation and removal phases. Wearing non-sterile gloves during IV cannula insertion is advisable. Thus, 111 (98.2%) of respondents know practising it. It was a great response as it may reduce the risk of PIVC infection. From the study, 112 (99.1%) respondents know that skin preparation at the insertion site is essential.

As practised, most of them decontaminate skin with alcohol 70%/chlorhexidine 2% swabs and leave the site to dry for at least 30 seconds. The 'no-touch' technique for insertion after decontamination is well known. Patients admitted to the hospital are only

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allowed two attempts at peripheral cannulation by any one person, according to hospital policy, after which senior staff members are informed. Multiple attempts have been extensively documented as increasing the risk of phlebitis. For this reason, 111 (98.2%) of respondents knew that increased attempts for cannulation may increase the risk of further infection that may harm the patients. Transparent dressings are required to generate a sterile environment over the PIVC and secure the device more reliably than tape dressings, allowing for continuous visual inspection of the PIVC site. Transparent dressings should be easy to remove comfortably for patients, allowing patients to bathe and shower without wetting the dressing and requiring fewer changes than tape dressings. It can be left on PIVC without raising the risk of infection during catheter insertion. 112 (99.1%) of respondents are well-known and aware that it does help to recognize early signs and symptoms of infection.

The possible reasons for the removal of PIVC include several complications, which range from infiltration, extravasation, phlebitis, occlusion, dislodgement and migration. Once the treatment is over, the PIVC should be removed to avoid any additional complications. Remove any extra PIVC as soon as it is no longer clinically indicated had been known by 111 (98.2%) respondents. *Staphylococcus aureus* is a gram-positive bacterium that can cause several clinical diseases. This pathogen causes infections in both community-acquired and hospital-acquired settings. For the knowledge regarding *Staphylococcus Aureus*, which is the most associated with PIVC tip, 111 (98.2%) of the respondents knew about that. It was reported that 106 (93.8%) respondents agreed that catheter material, size, duration, and staff experience influence infection risk.

IV therapy is a popular and often necessary treatment for people receiving medical treatment. Although this may positively influence the patient's health, it is not without risk. Any break in the skin's integrity, such as those created by wounds, incisions, or penetrating devices like IV catheters, can act as a portal for microorganisms to access normally sterile tissues, predisposing the patient to infection. IV therapy patients are four times more likely than those who do not receive this type of treatment to develop healthcare-associated

bacteremia (Elliott, 1993). With that, 109 (96.5%) respondents agreed with this statement. Nosocomial infection occurs in a patient admitted to the healthcare setting for more than 48 hours but without evidence that the infection was present or incubating at admission.

The results of 112 (99.1%) respondents knowing patients at high risk of getting a nosocomial infection with PIVC are identified. In the research, 110 (97.3%) of respondents agreed that patients should be involved in education on the care of PIVC, which may reduce the risk of infection if they also had a basic knowledge of it. Flushing is administered in patients before and after starting IV medication drips or fluids. This ensures the lines stay clean and prevents blockages. Flushes are also commonly used between administering multiple medications to ensure the medications will not react. 111 (98.2%) of the respondents agreed that PIVC should be flushed by Normal Saline injection (Sodium Chloride 0.9%) after any IV medication was served. The mean and standard deviation score for the level of knowledge ($M=1.02$, $SD=0.071$).

The research hypotheses for the study were as indicated: H_0 : there is no association between variables, and there is no relationship between knowledge regarding the prevention of PIVC infection with socio-demographic age, years of working experience and level of education among RNs in KPJ Pahang Specialist Hospital in Kuantan. An alternative hypothesis H_1 for this would be that there is an association between variables and no relationship between knowledge regarding the prevention of PIVC infection with socio-demographic age, years of working experience and level of education among RNs in the private Specialist Hospital.

DISCUSSION

In this study, the researcher found that the experience of PIVC insertion and maintenance is frequently not pleasant for many patients, and it can be associated with severe pain, stress, and concern. According to the study, patients who had more difficult PIVC insertions and maintenance were affected by the RN's level of knowledge and expertise, which could affect patient outcomes of infection. The current study results showed that 85.8% of respondents had adequate knowledge, and 86.7% were following proper practices. Meanwhile,

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compared to the study done by Osti et al., 82.47% of respondents had proper knowledge, and 84.72% had correct practices. According to the current study's findings, promoting collaborative decision-making between the RN and the patient could improve care.

Improvements in care were also noted in conjunction with introducing a new PIVC equipment or procedure. The present study provides nurses' understanding, knowledge, and practice in caring for and maintaining peripheral intravenous cannulation at KPJ Pahang Specialist Hospital in Kuantan, Pahang. Respondents in the study were selected from various departments. A total of 113 respondents completed the questionnaires. A pilot study was done on 16 respondents in the nursing administration department.

According to the study, most nurses have a strong understanding of PIVC protocols and practice them properly. Nurses' lack of awareness about infection prevention and adequate nursing care could make following evidence-based guidelines for reducing PIVC-related infections difficult. Despite the known risks of PIVCs, there are still RNs who do not follow the standard protocols and incorrectly perform the insertion, removal, and maintenance of PIVCs.

The findings revealed that staff experience significantly impacts their knowledge and practice of caring for and maintaining PIVC, as the longer they have been in the clinical field, the more experience they've gained. Six (5.36%) of them were junior nurses who had clinical experience of less than one year, and 31 (27.4%) had 1-5 years of clinical experience. Most of them, 38 (33.6%), were from 6 to 10 and had more than ten years of clinical experience. Of their education level, 64 (56.6%) were diploma holders. A remarkable 32 (28.3%) were certified with post-basic ranges from a few disciplines, and only 17 (15%) were degree holders (Bachelor of Nursing).

In light of Florence Nightingale's (1863) statement that "...the very first requirement of a hospital is that it should do no harm to the sick," and the high risk of patients contracting a nosocomial infection while receiving IV therapy, prevention and control of peripheral intravenous cannula infection can only be sustained if all levels of healthcare institutions are committed. "Infection prevention is everyone's business," Morris and Tay (2008: S21) described it. Hand decontamination is a key to infection control practice for all practitioners since

healthcare professionals' hands are a primary source of nosocomial pathogen transmission (Pettit 2000:381; Pittet, Mourouga & Perneger 1999:126).

CONCLUSION

According to this study, practically all nurses are knowledgeable about PIVC care and maintenance. However, some nurses are unaware of the technique. This study also revealed that some RNs are not using the proper way of caring for and maintaining PIVCs since some of them are unaware of when PIVCs should be removed or changed.

Their practice of PIVC care is encouraging, but they still lack information. Some of them are having difficulty sustaining PIVC owing to several barriers, such as medications supplied by doctors that are excessively strong, causing the vein to occlude easily and increasing the danger of infection as nurses must reinsert PIVC to other extremities. As the risk of problems endangers the patient's life, RNs must be well-versed in the care and maintenance of PIVC. One strategy to improve their knowledge and confidence is to attend training or courses. Optimize new RN competency development, considering age-related characteristics; no more than two attempts per caregiver, no more than four attempts per site; an algorithm to guide optimal use of PIVC access tools, such as visualization devices, is advised.

To conclude, products and technologies, as well as knowledge and practice on PIVC care and maintenance, are a continuum. RNs should protect their patients from PIVC complications. As a result, the respective administration must take corrective action and create a new strategy so that RNs and patients get the benefit. The researcher is grateful to all the nursing staff who were involved in this research project. Not only that, the researcher very thankful to the author for giving me permission to use the questionnaire to be conducted.

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