Awareness of Peripheral Intravenous Catheters Among Nurses, Physicians, and Students

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Objectives: Peripheral intravenous catheters (PIVCs) are frequently used to meet patients' short-term health care needs. However, many PIVCs are not promptly removed at the completion of treatment, placing patients at risk of avoidable harm from serious complications including local and systemic infection. This study aims to report the proportion and accuracy of health care staff/students awareness of the presence of their patient's PIVC.

Methods: We asked staff/students to recall the presence or absence of a PIVC in a patient under their care, as well as details of the date of insertion and PIVC location. We recorded concordance of responses with direct observations. To achieve this, face-to-face interviews were conducted with clinical staff/students at 2 adult hospitals.

Results: Overall, 90% (n = 216) of staff responses (94% of nurses, 100% of nursing students, 76% of medical staff) correctly identified the presence/absence of a PIVC. Clinicians correctly identified the PIVC location 55% (n = 71) of the time.

Conclusions: Health care services must recognize the implications of this lack of awareness and implement and evaluate tailored quality improvement efforts to address this.

Key Words: catheterization, peripheral, infusions, intravenous, catheter-related infections, vascular access devices, performance monitoring

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Peripheral intravenous catheters (PIVCs) are the preferred vascular access device for short-term intravenous (IV) therapy.[1] More than 2 billion PIVCs are purchased each year, making them the world's most common invasive medical device.[2] Despite this, they are by no means innocuous, with more than one-third failing before completion of treatment.[3–6] A recent systematic review found that the most frequently occurring PIVC complications are phlebitis (irritation to the vein wall) reported in 19.3% (95% confidence interval [CI], 15.9%–22.8%) of catheters, infiltration (fluid moving into surrounding tissue) in 13.7% (95% CI, 11.1%–16.5%), occlusion (blockage) in 8% (95% CI, 5.8%–10.6%), and dislodgement in 6% (95% CI, 4.8%–7.2%) of PIVCs.[6] Peripheral intravenous catheter–related bloodstream infection rates are lower than those reported for other types of vascular access devices (0.9–0.13 per 10,000 catheter days).[7] However, with the high volume of PIVCs inserted each year, this is likely to impact large numbers of patients globally. When a PIVC fails, it can delay important IV treatment, lead to a longer hospital stay, and damage a patient's vasculature, which can in turn create challenges in meeting future vascular access needs.[6]

Although 70% of patients have a PIVC during their hospital stay, many devices are not promptly removed at the completion of IV treatment; these redundant, also called idle, devices place patients at risk of avoidable harm from serious complications such as local and systemic infection.[8–10] They are uncomfortable for patients and are known to cause anxiety and poor sleep.[11] Hospital clinical audits, including an international audit of 415 hospitals and 40,620 catheters, have shown a high prevalence of redundant PIVCs, insertion site complications, soiled and loose dressings, and poor or no documentation of the device itself.[9,12–15] This may in part be due to clinical staff being unaware that a PIVC is in place and therefore remembering when it needs to be removed. This phenomenon of lack of device awareness is not new; rather, it has been reported for other types of indwelling devices. For example, a 2013 US national survey of 381 medical staff found 57% self-reported that, on at least 1 occasion, they had forgotten their patient had a peripherally inserted central line.[16] Another survey identified 38% of attending physicians reported being unaware of a patient's indwelling urinary catheter.[17] However, clinical staff awareness of PIVCs has not previously been reported in Australia or internationally.

Over the last decade, many hospitals have had difficulty meeting the IV therapy needs of patients because of vascular access limitations caused by comorbid conditions, obesity, and extremes of age.[3,18] In Australia, improving PIVC care is a national health care priority,[19] and clinician awareness of the presence of PIVCs is essential to prompt early detection of complications and removal of catheters that are no longer necessary. This project aimed to improve patients' vascular access outcomes by determining levels of PIVC awareness among health care providers, including medical staff, nurses, and nursing students, to help guide future education programs and organizational interventions to improve PIVC care.

METHODS

Study Design

This audit of patients PIVC insertion sites involved face-to-face interviews with patients and their treating medical and nursing teams at 2 adult public hospitals in Australia. These hospitals were conveniently sampled from more than 20 public hospitals in Brisbane, Queensland, to ensure representation of both large and moderately sized metropolitan hospitals: site 1, a large teaching, referral hospital with approximately 1000 beds; and site 2, an acute-care metropolitan hospital with 175 beds. Human Research Ethics Committee (HREC) approval was obtained for the participating hospitals (HREC/18/QRBW/284) and Griffith University (2018/961).

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Research Questions

1) What proportion of health care providers are aware that their patient has a PIVC?
2) What proportion of health care providers are aware of the location site, body side, and insertion date of their patient's PIVC?

Sample and Setting

Between May and July 2019, research nurses (ReNs) screened medical, surgical, and cancer care units at both hospitals to identify patients who met the following eligibility criteria: >18 years of age and able to provide verbal consent to participate. Clinicians and students of contributing units were eligible and approached for study participation if they were attending medical physicians, registrars, residents, interns, registered nurses responsible for the patients' care, or nursing students providing supervised patient care.

Data Collection

During the recruitment period, the ReN approached patients in each clinical unit to explain the study and obtain verbal consent for study participation. Once consented, the patient was asked if he/she had a PIVC and its location. The ReN then conducted a site inspection to confirm physical location: for example, body side (left or right) and confirmed date of insertion with the patient's medical record.

Health care providers (medical, nursing) were surveyed on the same day as the patients. Similarly, they were approached and provided with a study explanation, and verbal consent for study participation was obtained. Each health care provider was asked about the presence and location of PIVCs for patients under their care. Each clinical unit was only surveyed once. Patients at site 2 who did not have a PIVC present were not surveyed. Staff were not permitted to look at the patient's medical record during the interviews.

Data Analysis

Categorical variables were summarized as frequency and percentage, whereas continuous variables (all nonnormally distributed) were described using median, interquartile range, and minimum/maximum. Sensitivity and specificity with 95% CIs were reported for staff/student assessments of whether a PIVC was present, treating assessments as independent measures ("don't know" responses excluded). This method does not account for the multiple staff/student surveys performed for the same patient (e.g., multiple comparisons). Therefore, sensitivity analyses were conducted to compare and contrast these results against the sensitivity and specificity obtained using logistic regression with clustered robust standard errors (sandwich estimator) or using a logistic mixed-effects model including patient as a random effect to account for the correlated data.

RESULTS

At site 1, 211 beds were assessed; at the time of screening, 33 were unoccupied (Fig. 1). Of the 178 surveyed beds, 133 (75%) patients provided consent for study participation. Of these 133 patients, 6 were not assessed, leaving 127 patients included for analysis; a total of 69 PIVCs were present in 61 (48%) patients, whereas 66 (52%) patients did not have a PIVC. At site 2, 166

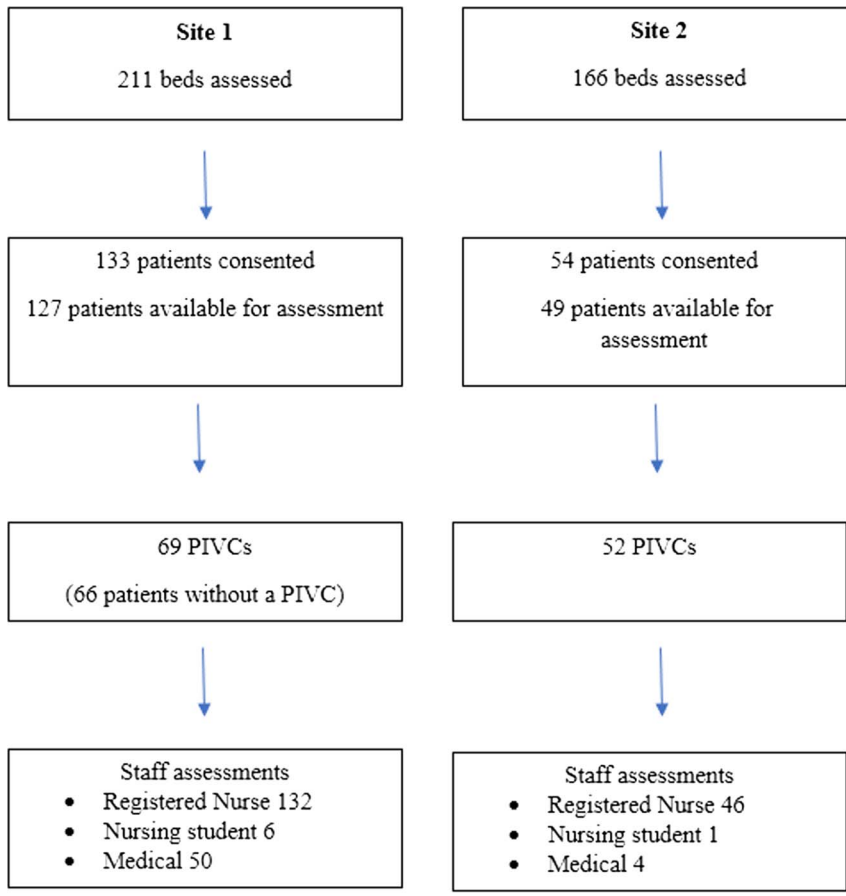

FIGURE 1. Patient flow diagram for site 1 and site 2 for patients with 0, 1, or 2 PIVCs.

beds were assessed; of these, 11 beds were empty, and 1 did not have the patient information completed and was excluded henceforth. From the 155 beds, 54 (34%) were occupied by a patient with a PIVC present and provided informed consent. Of the 54 patients, 5 were not assessed, and therefore, 52 PIVCs in 49 participants were included in analysis. For both sites combined, the total sample size was 239 staff assessments of 121 PIVCs among 176 patients.

Participant characteristics are provided in Table 1. At site 1, 61 (48%) patients had at least 1 PIVC. The most common insertion site at sites 1 and 2 for a single PIVC was at a point of flexion, either the antecubital fossa (n = 41 [41%]) or the hand/wrist (n = 34 [34%]).

Clinical staff assessments at both hospitals were predominately completed by nursing staff (n = 178 [74%]), with medical staff participating in 27% of the interviews at site 1 and 8% at site 2. Table 2 outlines the proportion of staff interview responses as to whether or not a patient had a singleton PIVC (dual PIVCs excluded). For site 1, 188 staff were surveyed, 166 correctly reported the absence (n = 86 [46%]) or presence (n = 80 [43%]) of a PIVC, 14 incorrectly recalled the absence (n = 5 [3%]) or presence (n = 9 [5%]), and 8 staff reported not knowing whether a PIVC was present or absent. The sensitivity for awareness was 94.1% (95% CI, 86.8%–98.1%), and specificity was 90.5% (95% CI, 82.8%–95.6%). Sensitivity analyses accounting for multiple staff/student surveys for the same patient (correlated data) produced very similar sensitivity and specificity results (within 1% difference). Of the 129 nurses surveyed at site 1, 3 (2%) reported the presence of a PIVC that was not observed on patient assessment, and 4 (3%) reported the absence of a PIVC that was present at patient assessment. Six (12%) medical staff reported that a PIVC was present, and 1 (2%) reported that a PIVC was absent, in direct conflict to the results of the patient assessment.

Table 3 outlines the percentage of staff interview responses that were correct for various singleton PIVC characteristics. Overall, 90% (n = 216) of staff responses (94% of nurses, 100% of nursing students, and 76% of medical staff) correctly identified the presence of a singleton PIVC in a patient under their direct care. Correct side of the body and location of the PIVC were correctly reported by 74% (n = 96) and 55% (n = 71), respectively. Peripheral intravenous catheter insertion date was correctly recalled by 70% (n = 66) of staff responses (67% of nurses, 83% of medical staff, 100% of nursing students).

At site 1, 69% (n = 55) of staff responses were correct recalls of the side of the body (left or right) of PIVC placement. This recollection was higher for nursing staff (82%) than medical staff responses (37%) but similar to results from site 2 that correctly reported side of PIVC placement by 87% (n = 39) of nurse and

TABLE 1. Patient, Device, and Staff Characteristics at Site 1 and Site 2

	Site 1 (PIVCs, n = 69), n (%)	Site 2 (PIVCs, n = 52), n (%)	Total (N = 121), n (%)
No. patients with a PIVC	61 (48)	49 (100)	110 (63)
No. patients without a PIVC	66 (52)	NC	66 (37)
Side of single PIVC			
Left	33 (62)	21 (46)	54 (55)
Right	20 (38)	25 (54)	45 (45)
Sides of dual PIVCs			
Both left	1 (13)	1 (33)	2 (18)
Both right	1 (13)	0 (0)	1 (9)
Left and right	6 (75)	2 (67)	8 (73)
Single PIVC location			
Hand	11 (21)	6 (13)	17 (17)
Wrist	9 (17)	8 (17)	17 (17)
Forearm	13 (25)	8 (17)	21 (21)
Antecubital	17 (32)	24 (52)	41 (41)
Upper arm	2 (4)	0 (0)	2 (2)
Leg/foot	1 (2)	0 (0)	1 (1)
Locations of dual PIVCs			
Both hand	1 (13)	0 (0)	1 (9)
Hand/forearm	1 (13)	0 (0)	1 (9)
Hand/antecubital	1 (13)	2 (67)	3 (27)
Hand/other	1 (13)	0 (0)	1 (9)
Wrist/hand	1 (13)	0 (0)	1 (9)
Wrist/forearm	1 (13)	0 (0)	1 (9)
Wrist/antecubital	2 (25.0)	0 (0)	2 (18)
Antecubital (left and right)	0 (0)	1 (33)	1 (9)
Single PIVC dwell time, median (IQR) [range], d	1 (1–2) [0–11]	1 (1–2) [0–5]	1 (1–2) [0–11]
No. assessments according to staff designation for 0 and 1 PIVC,			
Registered nurse	132 (70)	46 (90)	178 (74)
Student (nursing)	6 (3)	1 (2)	7 (3)
Medical	50 (27)	4 (8)	54 (23)

NC, not collected.

TABLE 2. Proportions of Correct Staff/Student Response for Absence and Presence of Singleton PIVC

	Site 1 PIVCs (n = 188)		Site 2 PIVCs (n = 51)	
Surveyed Staff Answer	**Absent, n (%)**	**Present, n (%)**	**Absent, n (%)**	**Present, n (%)**
Total				
Absent	86 (46)	5 (3)	0 (0)	0 (0)
Present	9 (5)	80 (43)	0 (0)	50 (98)
"Don't know"	4 (2)	4 (2)	0 (0)	1 (2)
Nurse				
Absent	67 (51)	4 (3)	0 (0)	0 (0)
Present	3 (2)	55 (42)	0 (0)	46 (100)
"Don't know"	2 (2)	1 (1)	0 (0)	0 (0)
Student (nursing)				
Absent	0 (0)	0 (0)	0 (0)	0 (0)
Present	0 (0)	6 (100)	0 (0)	1 (100)
"Don't know"	0 (0)	0 (0)	0 (0)	0 (0)
Medical				
Absent	19 (38)	1 (2)	0 (0)	0 (0)
Present	6 (12)	19 (38)	0 (0)	3 (75)
"Don't know"	2 (4)	3 (6)	0 (0)	1 (25)

33% (n = 1) of medical staff responses. When nursing staff were asked the anatomical site of insertion, 58% (site 1) and 61% (site 2) of responses were correct. Peripheral intravenous catheter insertion date was correct for 64% of nurse and 80% of medical staff responses at site 1, compared with 71% of nurse and 100% of medical staff responses at site 2.

LIMITATIONS

We acknowledge some study limitations. Although at site 1 patient consent was obtained before asking staff about the presence or absence of a PIVC, at site 2 patient consent was only obtained from patients with a PIVC in situ. Therefore, site 2 staff could not be asked about the presence or absence of a PIVC in patients

TABLE 3. PIVC Characteristics Correctly Identified by Staff/Students*

	Site 1		Site 2		Total	
PIVC Characteristic	**n**	**Correct, n (%)**	**n**	**Correct, n (%)†**	**n**	**Correct, n (%)**
PIVC present						
Total	188	166 (88)	51	50 (98)	239	216 (90)
Nurse	132	122 (92)	46	46 (100)	178	168 (94)
Student (nursing)	6	6 (100)	1	1 (100)	7	7 (100)
Medical	50	38 (76)	4	3 (75)	54	41 (76)
PIVC side of body						
Total	80	55 (69)	49	41 (84)	129	96 (74)
Nurse	55	45 (82)	45	39 (87)	100	84 (84)
Student (nursing)	6	3 (50)	1	1 (100)	7	4 (57)
Medical	19	7 (37)	3	1 (33)	22	8 (36)
PIVC location						
Total	80	41 (51)	50	30 (60)	130	71 (55)
Nurse	55	32 (58)	46	28 (61)	101	60 (59)
Student (nursing)	6	3 (50)	1	1 (100)	7	4 (57)
Medical	19	6 (32)	3	1 (33)	22	7 (32)
PIVC insertion date						
Total	56	38 (68)	38	28 (74)	94	66 (70)
Nurse	44	28 (64)	35	25 (71)	79	53 (67)
Student (nursing)	2	2 (100)	1	1 (100)	3	3 (100)
Medical	10	8 (80)	2	2 (100)	12	10 (83)

*Some PIVC surveys were completed by more than 1 staff/student for a patient.

†Responses of "unsure" were classified as incorrect.

without a PIVC. It is possible that some staff were surveyed more than once and therefore would have had foreknowledge of the questions, which may have increased their PIVC awareness. With the majority of PIVCs at site 2 being surgical patients, it was more difficult to obtain responses from medical staff at times, resulting in fewer medical respondents. Moreover, a limitation of the sensitivity analyses of this study is that the variance may be poorly estimated when the number of clusters or the number of patients within clusters is small, which is the case for these data. Analyses were also not able to account for staff members conducting more than 1 assessment because the staff identification number was not recorded. Therefore, only the sensitivity and specificity of the data treated as independent measures were presented, given that all 3 analyses produced very similar results (within 1% difference). Finally, both hospitals were public training hospitals, and therefore, results may have been different in another health care setting.

DISCUSSION

In this study of 176 patients with 121 PIVCs at 2 Australian hospitals, we observed from 239 staff responses that a majority of nurses (94%) were aware of the presence of a singleton PIVC for a patient under their direct care, and that nurses had higher awareness than medical staff (76%). On face value, the finding that nurses were more aware of the presence and side of a PIVC is not unexpected because nurses spend more direct time caring for patients. However, because medical staff have overall responsibility for ordering PIVC placement and IV treatment (and are ultimately responsible for the device removal), it is problematic that a quarter of medical staff were unaware of their patient's PIVC, potentially placing patients at higher risk of avoidable harm from complications including *Staphylococcus aureus* bloodstream infections.[20] A recent international point prevalence audit found higher rates of idle PIVCs in Australian/New Zealand (23%) compared with the overall global idle catheter rate (14%).[14] The results of our study suggest that a lack of awareness of the presence of PIVCs is a likely contributing factor to high local PIVC failure rates reported to occur in 32% to 54% of catheters.[3,21] Possible reasons for a lack of staff awareness of PIVCs were not explored in this study, but further qualitative research is recommended. In addition, the impact of workload and shift times will need to be considered when developing interventions to improve PIVC awareness.

On closer examination, staff awareness of PIVC characteristics was less than ideal, with only 55% of staff reporting correct PIVC location and 74% recalling the correct side of the body, suggesting that staff were possibly remembering a previous PIVC for that patient. Staff awareness of a PIVC site is important because catheters placed at points of flexion, such as the antecubital fossa or hand/wrist, have a higher association with catheter failure than those placed in the forearm and need regular assessment.[22] The date of insertion was correctly reported by 70% of staff (67% nurses, 83% medical staff). The inability to recall the actual location of the PIVC and length of dwell is perhaps not surprising, given that staff provide care for several patients each shift. However, both participating hospitals have a 72-hour routine PIVC replacement policy. A lack of adherence and possible awareness of the length of time of dwell has been reported previously in a local cohort study that observed PIVC dwells of up to 14 days.[3] The results of this study reiterate the importance of accurate PIVC documentation, which has been noted as often substandard, posing an ongoing safety concern.[12,14,23]

To our knowledge, this is the first study to focus on PIVC awareness among health care providers. Because PIVCs are the most frequently inserted medical device, most patient hospital encounters will involve at least 1 PIVC insertion.[2] Patients have the right to expect their direct health care provider to be aware of the presence of their indwelling medical device. A lack of staff awareness leads to devices being forgotten and cares being missed.[24] Of even greater concern, redundant devices put patients at unnecessary risk of health care–associated complications, including potentially deadly bloodstream infections.[10] Recent studies have demonstrated the rates of idle PIVCs between 14% and 50%.[14,25,26] Staff awareness of the presence and appropriateness of an invasive device is the first crucial step for the prompt recognition and removal of unneeded devices.[17,27]

In light of the negative consequences of forgotten devices for patients and health care services, quality improvement strategies and future studies are needed to explore systems' successes and failures in safety-related interventions and policy-related initiatives to enhance staff compliances and awareness of PIVCs. Some health systems have already made strides in this direction, with the implementation of electronic reminders and stop orders, journey boards, and proforma handover sheets with device reminders to prompt timely PIVC removal.[28] Routine prompts to identify and reassess the need for devices are often included in PIVC maintenance bundles.[23,25,29] Neither of the hospitals in this study used such prompts for PIVC awareness, but these should be considered in future quality improvement efforts. Decision aids and algorithms could play a role in improving staff awareness and decision making for PIVCs.[30–32]

In addition, we recommend that staff or patients' understanding of the reason for PIVC insertion and continuation should be collected, as it would provide valuable information about device appropriateness. A 2011 study in Ireland identified that if patients did not know the reason for their PIVC, they were 7 times more likely not to need it.[33] We recommend that further studies of this kind include staff and patient awareness of the rationale for having the PIVC.

CONCLUSIONS

Health care services must recognize the implications of lack of staff awareness of indwelling devices and implement and evaluate tailored quality improvement efforts to address this. Ongoing audits should incorporate staff awareness and monitor device appropriateness as well as dwell time and complications.

IMPLICATIONS

Education for medical staff should emphasize PIVC awareness, because a quarter surveyed were unaware that their patient had a PIVC in place. This project emphasizes a need for health systems to implement structures and processes that ensure increased PIVC monitoring and decision making to promote early removal of idle catheters. This in turn will likely reduce unnecessary PIVC complications (e.g., phlebitis, infection) and promote patients' comfort by timely removal of unnecessary devices. The methods described in this article could be adopted by health systems to routinely identify and promote the awareness of not only PIVCs but also other types of indwelling devices.

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