







Aligning peripheral intravenous catheter quality with nursing culture—A mixed method study

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Abstract

Aim: To explore barriers and facilitators that influence adherence to evidence-based guidelines for peripheral intravenous catheter care in different hospital wards.

Design: Sequential explanatory mixedmethod study design, with qualitative data used to elaborate on quantitative findings.

Method: Data were collected between March 2021 and March 2022 using the previously validated Peripheral Intravenous Catheter mini questionnaire (*PIVC-miniQ*) on each ward in a tertiary hospital in Norway. Survey completion was followed by individual interviews with nurses from selected wards. The Pillar Integration Process was used to integrate and analyse the quantitative and qualitative findings.

Results: The *PIVC-miniQ* screening assessed 566 peripheral intravenous catheters in 448 patients in 41 wards, and we found variation between wards in the quality of care. Based on the quantitative variation, we interviewed 24 nurses on wards with either *excellent* or *not as good* quality. The integration of the quantitative and qualitative findings in the

Stian Lydersen is a statistician.

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study enabled an understanding of factors that influence nurses' adherence to the care of peripheral venous catheters. One main theme and four subthemes emerged. The main finding was that ward culture affects education practice, and this was evident from four subthemes: (1) *Deviation from best practice*, (2) *Gaps in education and clinical training*, (3) *Quality variation between wards* and (4) *The importance of supportive leadership*.

Conclusion: This mixed method study is the first study to explore reasons for variability in peripheral intravenous catheter quality across hospital wards. We found that ward culture was central to catheter quality, with evidence of deviations from best practice correlating with observed catheter complications. Ward culture also impacted nursing education, with the main responsibility for learning peripheral intravenous catheter management left to students' clinical training placements. Addressing this educational gap and fostering supportive leadership, including champions, will likely improve peripheral intravenous catheter care and patient safety.

Implications for the Profession and/or Patient Care: Nurses learn good peripheral intravenous catheter care in wards with supportive leaders and champions. This implies that the quality of nursing practice and patient outcomes are situational. Nurses need a strengthened emphasis on peripheral catheter quality in the undergraduate curriculum, and nurse leaders must emphasize the quality of catheter care in their wards.

Impact: The study findings impact nurse leaders who must commit to quality and safety outcomes by appointing and supporting local ward champions for promoting peripheral intravenous catheter care. This also impacts nursing education providers, as the emphasis on catheter care must be strengthened in the undergraduate nursing curriculum and continually reinforced in the hospital environment, particularly when guidelines are updated.

Reporting Method: The study adhered to the Good Reporting of A Mixed Method Study (GRAMM).

Patient or Public Contribution: A patient representative has been involved in planning this study.

KEYWORDS

catheters, guideline adherence, mixed method design, PIVCs, quality of care, ward culture

1 | INTRODUCTION

Worldwide, peripheral intravenous catheters (PIVCs) are primarily inserted by nurses (Alexandrou et al., 2018). Further, nurses are responsible for care and monitoring of PIVCs. However, observational studies have underlined shortcomings in PIVC quality and care such as PIVC failure, idle catheters, soiled dressings and poor documentation (Aghdassi et al., 2019; Berger et al., 2021; Hovik et al., 2019; Marsh et al., 2020; Miliani et al., 2017). The risks associated with PIVCs include bloodstream infections (BSI), with incidence rates ranging from 0.5 (Maki et al., 2006) to 0.7 (Worth et al., 2018) per 1000 catheter days. Due to the widespread use of PIVCs in modern hospitals, the overall number of PIVC-related BSIs can be substantial despite a low incidence rate (Zingg et al., 2023). A longitudinal study from Spain found that BSIs associated with central venous catheters decreased over time, while BSIs associated with PIVCs increased (Badia-Cebada

What does this paper contribute to the wider global community?

- Peripheral intravenous catheter quality care, and thus patient safety outcomes, is dependent on leaders that champion evidence-based quality care in their local ward.
- Nurses expressed the need for a strengthened focus on peripheral intravenous catheter care and maintenance in the undergraduate curriculum.

et al., 2022). Despite decades of focus on such serious risks, the awareness of risks associated with PIVCs remains limited in clinical practice.

Several evidence-based guidelines for PIVC quality and care are available (Capdevila et al., 2016; Gorski et al., 2021; Loveday

et al., 2016), but adherence to these guidelines is often inadequate (Berger et al., 2021; Hovik et al., 2019; Raynak et al., 2020; Zingg et al., 2023). Nurses' substandard adherence to PIVC handling needs to be further explored, as inconsistencies between guidelines and local policy are common (Berger et al., 2021; Brors et al., 2023; Yilmaz et al., 2021). There is a known need to identify individual and institutional factors that play a role in influencing the quality of PIVC care (Blanco-Mavillard et al., 2022). Conducting mixed methods research to explore the PIVC safety culture has the potential to enhance understanding of the challenges in managing PIVCs at the ward level.

2 | BACKGROUND

PIVCs are the most common invasive devices in acute care hospitals, with up to 90% of patients needing one or more during their hospital stay (Hill & Moureau, 2019). PIVCs are preferred for short-term delivery of intravenous (IV) fluids and medications. Hence, they often are considered as low risk for patients, yet these devices are highly disposed to failure and complications and their ubiquitous appearance may altogether represent a threat to patient safety (Badia-Cebada et al., 2022). A global multicentre point prevalence study revealed widespread problems with PIVCs, including idle catheters (no indication for use), missing documentation in patient records, devices placed in non-recommended sites of flexion such as the wrist or antecubital fossa and phlebitis and other PIVC malfunctions such as extravasation and leakage (Alexandrou et al., 2018). Nearly half of the PIVCs inserted in the prehospital setting remain idle (Gonvers et al., 2020), and emergently inserted catheters in a non-aseptic environment are associated with later development of sepsis or BSI (Hughes et al., 2014). The incidence of BSIs due to PIVCs may represent 4.8%–19% of hospital-acquired bacteraemia (Mermel, 2017). Further, PIVC-related BSIs have increased during the past decade, especially in hospital wards (Badia-Cebada et al., 2022). A Norwegian observational study found that 7.5% of *Staphylococcus aureus* BSIs were due to IV catheters (Paulsen et al., 2015); however, 25% were classified as 'unknown', possibly associated with a PIVC. This is not surprising, considering the inadequate documentation in patient records, modest patient engagement in PIVC care and ongoing need, and nurses' poor awareness of potential complications (Berger et al., 2021). PIVC tips are rarely cultured, even when the patient demonstrates signs and symptoms of infection (Nickel, 2020). Thus, PIVCs as a source of bacteraemia may be overlooked by clinicians (Blanco-Mavillard et al., 2022).

3 | THIS STUDY

This study took place at St. Olav's University Hospital, in the city of Trondheim in central Norway. The hospital has a capacity of 1000 beds and serves as the local hospital for a population of approximately 300,000. Moreover, it acts as a regional hospital and provides healthcare services to over 700,000 people.

In Norway, doctors prescribe IV medications, fluids and blood products and nurses are responsible for most decision-making regarding PIVC care.

3.1 | Aims

This study aimed to identify individual and organizational factors contributing to PIVC quality of care.

The research questions were as follows:

- What is the current quality of PIVC care among different wards at a single university hospital?
- Which factors contribute to the quality of PIVC care?

4 | METHODS

4.1 | Study design

A sequential explanatory mixed method design (Creswell & Plano Clark, 2011) consisting of two phases was carried out. The first phase was a cross-sectional survey measuring PIVC quality at two separate time-points in different hospital wards with a validated tool, Peripheral Intravenous Catheter mini-questionnaire (PIVC-miniQ) (Hovik et al., 2019). After analysing the data, a semi-structured interview guide was developed, based on the quantitative findings.

The second phase aimed to explore nurses' understanding of PIVC quality and follow-up and their attitudes towards PIVC care on selected wards. This study was denoted by QUAN → QUAL, whereby the qualitative results were used to assist in explaining and interpreting the quantitative results (Creswell & Plano Clark, 2011). Figure 1 displays the model we used in the study, including phases, procedures and products for the mixed method sequential exploratory design, an overview recommended by Ivankova et al. (2006).

4.2 | Quantitative study

The objective of the quantitative phase was to measure PIVC quality in a university hospital, consisting of 12 clinics in different specialties with a total of 41 wards, to reveal differences or similarities in PIVC care. All 41 wards were included in the survey. The wards comprised medicine, surgery, oncology, birth/obstetrics, intensive care and short-term length of stay. Units for day procedures or ambulant care were excluded because of their limited use of PIVCs.

4.2.1 | Data collection

All adult patients (aged ≥18 years) with a PIVC on the sampling days were included in this survey, except patients with active COVID-19 infection, due to a lack of personal protective equipment. A machine-readable,

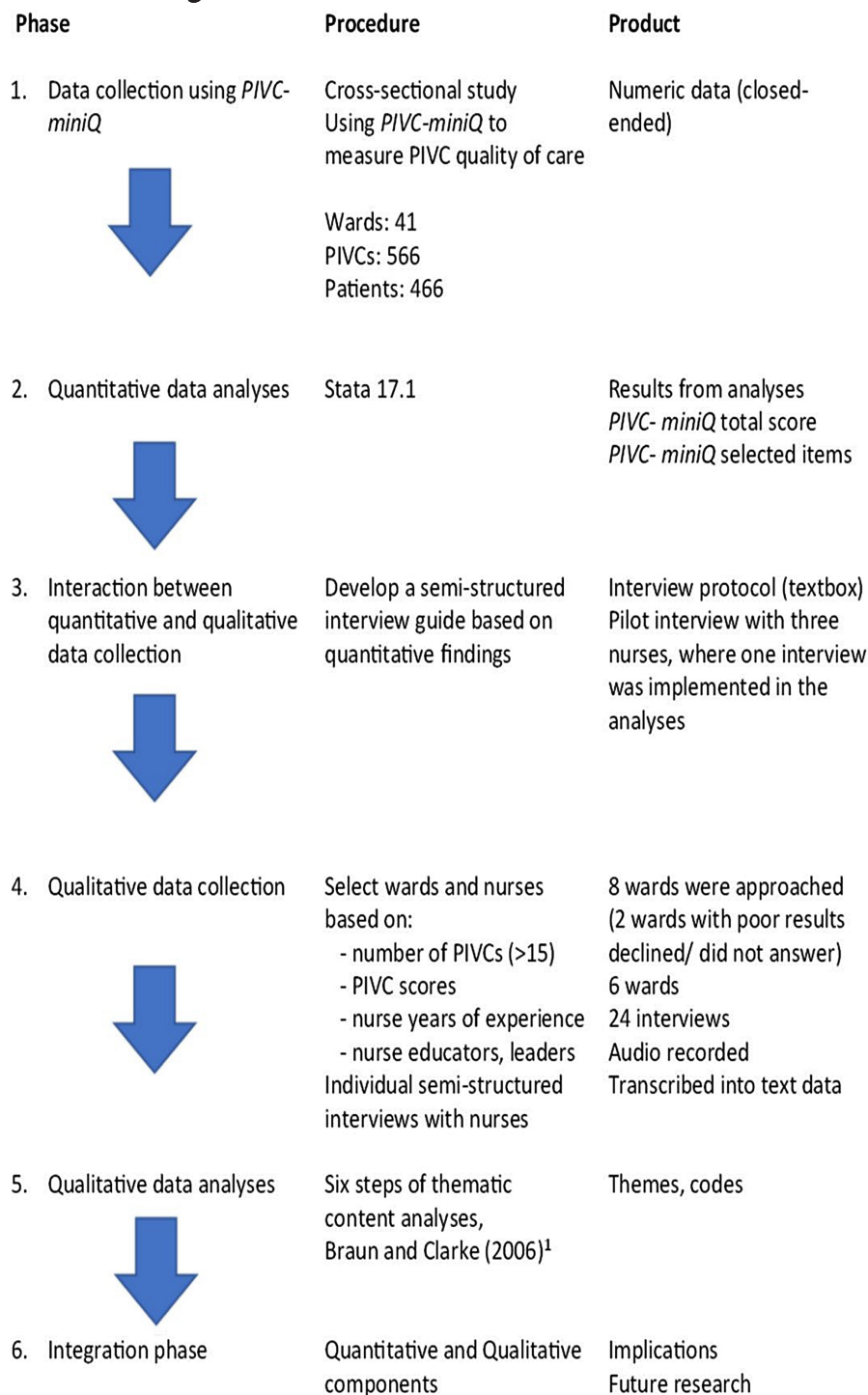


FIGURE 1 Visual model for our mixed-methods sequential explanatory design. 1 refers to Virginia Braun & Victoria Clarke (2006). The design is inspired by Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research* (2nd ed.). SAGE Publications, Inc.² PIVC, Peripheral Intravenous catheter; *PIVC-miniQ*, Peripheral Intravenous catheter–miniQuestionnaire. [Colour figure can be viewed at wileyonlinelibrary.com]

paper-based version of the *PIVC-miniQ* was used as the tool for the quantitative data collection. Study nurses not employed directly in patient care were trained in the use of the *PIVC-miniQ* and screened all available patients. Hospital wards were not notified in advance of the screening.

A standard operating procedure was developed to avoid spreading COVID-19 during data collection. Wards were screened twice: first in April/May 2021 and again in September 2021.

4.2.2 | Survey tool—The *PIVC-miniQ*

The *PIVC-miniQ* has been tested previously for feasibility and inter-rater agreement. Independent raters in two Norwegian hospitals assessed the PIVC twice, and the intraclass correlation coefficient (ICC) between raters was 0.604 (Hovik et al., 2019). The *PIVC-miniQ* consists of two sections. The first section contains background data

on hospital ward, patient sex and age, together with PIVC dwell time, size/gauge, insertion site and location of PIVC insertion (operating room, prehospital, emergency room, etc.). The second section contains 16 PIVC quality items with answer options yes/no. 'Yes' = 1 point, and 'no' = 0; every 'yes' is considered a deviation from evidence-based guidelines and can be summed up in a score from 0 to 16 deviations. The sum score is based on four quality domains. The first measures phlebitis-related signs and symptoms (nine items). The second is related to PIVC dressing and IV connection (five items). The third relates to documentation in patient records (one item), and the fourth identifies if there is an indication for PIVC use (one item).

4.2.3 | Quantitative data analysis

We used a data software solution, 'Teleform', which can extract and classify data from paper-based forms and convert data to Excel (Jorgensen & Karlslose, 1998). Completed *PIVC-miniQ* forms were scanned in dedicated scanners and the verification involved an automatic part and a manual part verified by the user. Approved data were transferred to IBM® SPSS® Statistics 29. Thereafter, all data were transformed from SPSS to Stata statistical software, release 17.

Descriptive statistics, including patient demographics, PIVCs and scores on each item, are reported as frequencies (n) and proportions (%) for categorical data and mean (SD) for continuous data. Dwell time is defined as the number of days between PIVC insertion and the screening date.

Missing values on single *PIVC-miniQ* items were imputed using the Expectation Maximization (EM) algorithm, using the 16 items on the *PIVC-miniQ* as predictors. Imputed values were thereafter rounded up to nearest integer 0 (problem does not exist) or 1 (problem exists). A summated *PIVC-miniQ* score was generated for each PIVC (theoretical range 0–16) after imputation, and mean and SD from the *PIVC-miniQ* were calculated for each ward. To assess inter-ward differences, we used a random effect linear mixed model with *PIVC-miniQ* sum score as dependent variable and ward as random effect.

4.3 | Qualitative study

In the second phase, the results and analysis from the PIVC screening were used to develop a semi-structured interview guide (Table 1). Qualitative interviews of nurses from purposively selected wards were performed based on the results from the *PIVC-miniQ* survey (mean, SD) to explore issues that influence PIVC care. In addition, we used snowball sampling when informants highlighted wards or nurses that they perceived delivered excellent PIVC care and when the survey results from the relevant ward confirmed their experiences. We hypothesized that wards with ≥ 15 PIVC observations in total during the two screenings had nurses with regular PIVC experience. These wards were subject to further investigation in the qualitative study.

TABLE 1 Semi-structured interview guide.

1. Can you tell me about your experience with insertion of PIVCs?
2. How was your education regarding insertion and follow-up on PIVCs?
3. How do you reflect on the patient's need for a PIVC?
4. Can you tell me about your knowledge of PIVC follow-up?
5. Are you aware of the existence of a PIVC hospital procedure?
6. Are PIVCs a subject that is discussed with your colleagues?
7. When you begin your shift, how do you normally identify if your patient has a PIVC?

Abbreviation: PIVC, peripheral intravenous catheter.

4.3.1 | Data collection

Two of the proposed wards declined the interview request due to heavy workloads after the COVID-19 restrictions and concurrent implementation of a new electronic health record system. A prerequisite for nurses' inclusion was regular patient contact.

Other inclusion criteria were as follows:

1. PIVC scores, wards with *excellent* or *not as good* PIVC scores.
2. Different units, that is, surgical or medical.
3. Years of nursing experience in each selected ward (Variation in experience preferred).
4. When possible, inclusion of nurse educators.

The interviews, undertaken between November 2021 and April 2022, took place during the nurse's shift in a hospital meeting room away from the clinical area. The main author, a nurse anaesthetist and PhD student, conducted the interviews. Only the interviewer and the informant were present during the interview. Participation was voluntary. The nurses were selected by the ward head nurse, and the interviews were primarily conducted after the morning care/tasks. Recruitment continued until data saturation was achieved and no new information was obtained from the participants. Three pilot interviews were conducted, which resulted in minor revisions of the interview guide, and one of the pilot interviews was included in the results as the informant was employed in one of the wards of interest. Results from the quantitative study were not presented during the interviews, as we wanted the participants to speak freely and not feel compromised by the survey results.

4.3.2 | Qualitative data analysis

The interviews were recorded, transcribed and listened to repeatedly. Transcripts were checked against the audio recording to ensure rigour.

Qualitative data were subject to thematic content analysis (Virginia & Victoria, 2006). Two researchers (LHH and LTG) independently analysed the interviews and met to discuss codes, themes and patterns in the data findings until consensus was reached.

Themes were reviewed with constant reference to the coded extracts, and initial and developed thematic maps of analyses were generated (LHH). Themes were analysed with a realist approach, with each data item given attention in the coding process. Finally, themes were defined and refined by five researchers (LHH, KHG, AWB, GRB and LTG) and organized in a consistent interpretation (Braun & Clarke, 2006).

4.4 | Mixed methods analysis

The final analyses of the collected data were achieved using the Pillar Integration Process (Johnson et al., 2019). The process consists of five stages: listing, matching, checking, matching and pillar building (Figure S1). The quantitative and qualitative analyses are first completed separately, and the joint display is finalized, working from the outside columns towards the central column for the integration of data (Johnson et al., 2019; Guidelines for reporting, Appendix S1).

The first stage consisted of listing raw data from the quantitative (i.e. numbers and percentages) and the qualitative data (selected quotes). The next step was to match the findings by listing results that related to the initial listed data. Data were cross-checked for inclusiveness.

4.5 | Ethics

As no identifiable patient information was collected during the quantitative phase, this was considered a quality prevalence survey and did not need ethical approval (Regional Ethical Committee: 79077). Therefore, the hospital's Chief Medical Officer approved the survey with informed verbal consent obtained from the participating patients in compliance with the General Data Protection Regulation (GDPR) for anonymous data. All wards were given pseudonyms to protect data privacy.

For the qualitative phase, formal informed consent was obtained from each nurse who participated in the interviews, according to the approval from the Regional Ethical Committee (266508).

5 | RESULTS/FINDINGS

5.1 | Quantitative results

We screened 566 PIVCs in 448 patients aged 18–98 years (mean: 66.8, SD: 17.97). There were 294 (51.9%) PIVCs in the first screening and 272 (48.1%) in the second screening. PIVC dwell time ranged from 0 to 12 days (mean: 2.1, SD: 1.71). A PIVC size of 18G or larger was found in 47.9% of the patients, and 41.3% of PIVCs were placed in the wrist or antecubital fossa. Further, 21.9% of PIVCs in situ were inserted in either the ambulance or emergency room.

There were 521 (92.0%) PIVC-miniQ forms with complete data collection on the 16 PIVC items, 37 (6.5%) forms had one missing

value, and eight (1.4%) forms had two or more missing values. Before imputation the observed range was 0–8 (mean: 2.29, SD: 1.40), and following imputation the range was 0–8 (mean: 2.27, SD: 1.39). Variations in PIVC quality among wards ranged from a mean (SD) of 1.13 (1.03) to 3.28 (1.99). Descriptive statistics for the PIVC-miniQ sum scores for each of the 41 wards are shown in Table 2. Based on the random effect model, the estimated mean score across the wards was 2.20 (95% CI: 2.00–2.40). The estimated SD for the variation between the wards was 0.52 (95% CI: 0.38–0.71) with a likelihood ratio test $p < 0.001$.

Nineteen wards (46.3%) had more than 15 PIVC observations and were subject to follow-up. Items with high prevalence and discrepancy between wards were 'indication unknown', 'date of PIVC insertion in patient chart is lacking' and dressings 'soiled with blood or fluid'.

The results revealed that 36.2% of PIVCs lacked documentation of insertion date, 21.2% of PIVCs were idle and 32.0% of PIVC dressings were soiled with blood or fluids.

5.2 | Qualitative results

The semi-structured, face-to-face interviews lasted from 13:44 to 46:39 min. The informants were one male and 23 female nurses from six different hospital wards and the participant characteristics are given in Table 3.

After analysing qualitative data, four main themes emerged. First, we found an inconsistency in education and clinical training, where nurses reported that their undergraduate nursing curriculum focused mostly on PIVC insertion rather than maintenance. Their learning had opportunity gaps, as nursing education related to PIVCs was situational and dependent on clinical practice placement. Second, we identified a lack of attention to guidelines; guideline knowledge follow-up was scarce because nurses thought they knew the best practices. Some stated they had been unaware of recent updates and believed that, since PIVCs were common, they were providing proper PIVC care. Third, documentation and indication inattentiveness were evident. In some wards, there was extensive use of nurse-to-nurse verbal reports regarding PIVCs that needed follow-up care, and some wards had no processes for documentation of complications. The final theme was that supportive leadership and local champions are important for good PIVC care. Some wards highlighted the importance of an enthusiastic driving force or 'champion'. These wards had nurse educators and leaders who acted as role models in the clinic, with the ability to improve the nurses' knowledge and competence with PIVC quality. They were familiar with guideline updates and acted as information providers, and they took responsibility for implementing new guidelines.

5.3 | Mixed methods findings

Finally, the quantitative and qualitative findings were analysed together. Findings of the mixed analysis are presented in Figure 2 and

TABLE 2 Results from the screening with the 16 item PIVC mini-Q of hospital wards (after imputation).

Ward	Observations N (PIVCs)	Mean PIVC-mini-Q score	Standard deviation	Minimum score	Maximum score
S1	32	3.31	1.97	0	8
S2	8	3.25	0.89	2	4
O1	14	3.21	1.12	1	5
S3	22	3.09	1.23	1	6
S4	10	3.00	1.56	1	5
M1	30	2.80	1.13	1	5
M2	20	2.75	1.83	0	6
M3	12	2.75	1.36	1	5
BO1	22	2.64	0.90	1	5
S5	21	2.62	1.28	1	6
S6	31	2.61	1.17	1	6
M4	15	2.60	1.35	0	5
S7	25	2.56	1.23	1	5
M5	15	2.53	1.35	1	6
S8	4	2.50	1.73	0	4
ICU1	15	2.47	1.68	1	7
S9	12	2.42	1.73	1	6
S10	5	2.40	1.34	1	4
S11	8	2.38	1.19	0	4
S12	7	2.29	1.38	0	4
O2	12	2.17	1.90	0	6
M6	2	2.00	1.12	1	5
M7	16	1.94	1.34	0	4
S13	10	1.90	1.60	0	4
S14	9	1.89	1.05	1	4
ICU2	13	1.85	0.99	0	3
M8	5	1.80	0.84	1	3
M9	23	1.74	1.18	0	4
M10	16	1.69	1.08	0	4
BO2	3	1.67	1.16	1	3
M11	6	1.67	1.03	0	3
M12	3	1.67	0.58	1	2
M13	8	1.63	1.19	0	4
ICU3	17	1.59	0.80	0	3
O3	7	1.57	1.40	0	3
ICU4	15	1.47	0.74	0	3
S15	20	1.40	0.50	1	2
M14	15	1.33	0.98	0	3
M15	10	1.2	0.63	0	2
M16	24	1.13	1.03	0	4
ICU5	4	1.00	0.82	0	2

Note: Theoretical range 0–16 where each point represents a deviation from best practice guidelines.

Abbreviations: BO, Birth/Obstetrics; ICU, Intensive Care Unit; M, Medicine; O, Oncology; PIVC-miniQ, Peripheral intravenous catheter mini questionnaire; S, Surgery.

TABLE 3 Characteristics of participants/informants.

Variables	(n = 24)
Gender	
Female	23
Male	1
Age (years)	
20–29	9
30–39	8
40–49	4
50–60	3
Nursing experience (years)	
0–2	8
2–5	4
>5	8
Nurse educator (>5 years of experience)	4
Area of specialty	
Medicine	8
Surgery	12
Intensive care	4

elaborated in Table 4. In the integrated findings, one main theme and four subthemes emerged: The main finding was that *Ward culture affects education and practice*. The four subthemes were: (1) *Deviation from best practice*, (2) *Gaps in education and clinical training*, (3) *PIVC quality variation between wards* and (4) *The importance of supportive leadership*.

5.3.1 | Main theme: Ward culture affects education and practice

The findings of heterogeneity in PIVC quality between wards were reinforced by the qualitative findings. The ward culture with supportive leadership was crucial for PIVC quality and affected students' clinical training and education in PIVC care.

Subtheme 1: Deviation from best practice

The quantitative results revealed that 32.0% of dressings were soiled with blood or fluids, and the interview findings showed that this was communicated and talked about in some wards. Further, the survey found that 21.9% of PIVCs had been inserted in either the ambulance or emergency room. The qualitative findings confirmed that nurses lacked awareness regarding prehospital inserted PIVCs and related risks. Prehospital-inserted PIVCs were kept in situ even though clinical guidelines strongly recommend replacement, as they were seen as useful for patient treatment and seldom regarded as a patient safety risk. If the PIVC otherwise seemed fine, soiled dressings were changed, even in wards with high numbers of emergency care patients.

Additionally, many ward nurses complained about PIVCs in the antecubital fossa (37.1%) inserted in the emergency department.

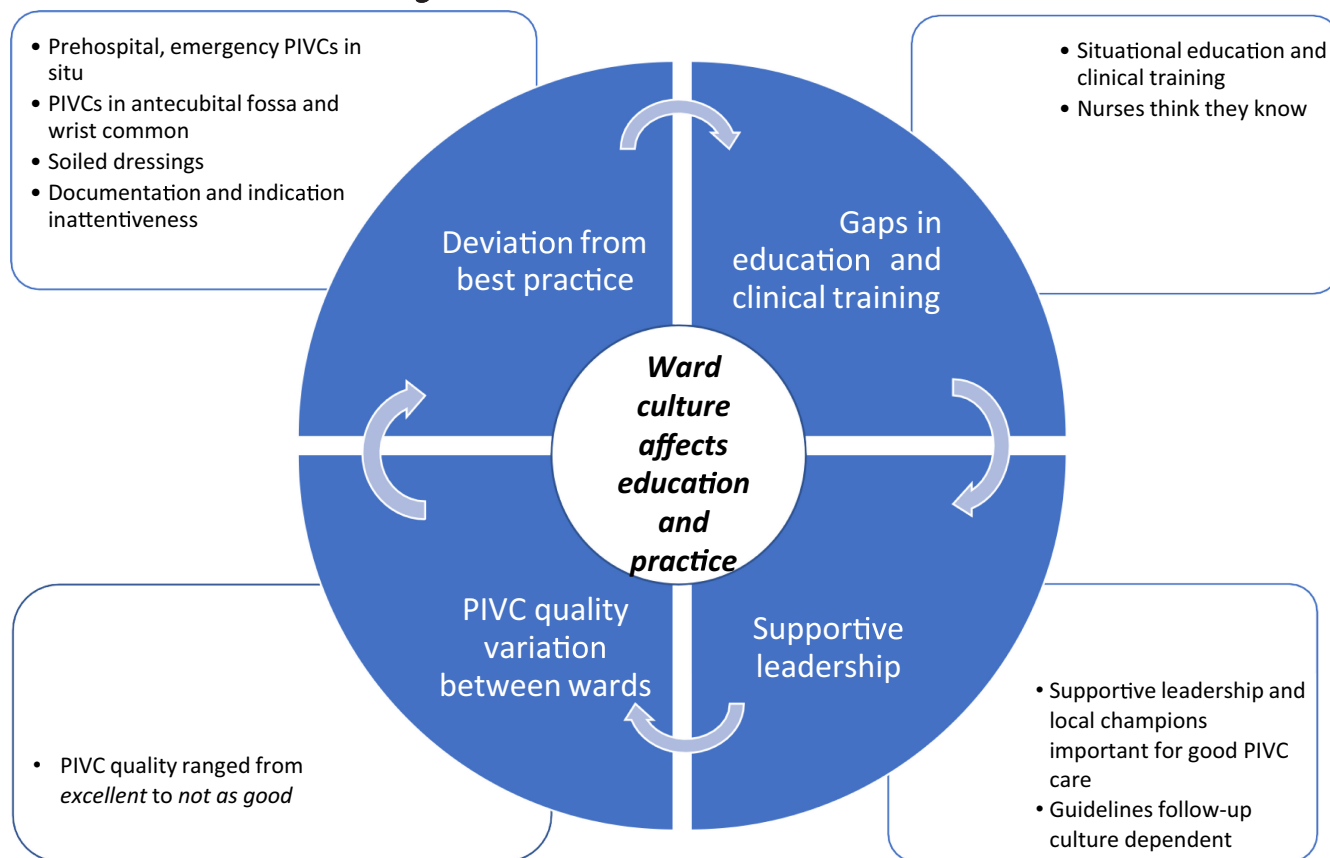


FIGURE 2 Mixed methods findings. PIVC, Peripheral intravenous catheter. [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/doi/10.1111/jocn.17179)]

Nurses reported that these PIVCs precluded the opportunity for blood sampling, infusion pumps alarmed and stopped infusing when the patient bent their arm and patients struggled with clothing. Some wards replaced such PIVCs, but others did not.

Further, 36.2% of PIVCs were not documented in patient health records, and 70.8% had no documentation on the PIVC dressing, contrary to local policy. Nurses reported routinely examining patients to check for undocumented PIVCs as they did not trust the health records. Some wards used verbal reports from nurse to nurse regarding PIVCs that needed follow-up care and examining the patient for PIVCs was part of the procedure at each shift. PIVC complications were not routinely described, and when complications occurred, the PIVC was usually replaced without written reporting.

In addition, the survey found that 21.2% of PIVCs were idle. Interview participants explained the high prevalence of idle PIVCs as due to potential need in case of emergency, difficult IV access or patients with dementia who needed a backup PIVC in case of accidental removal. Risk of bleeding, hypotension or cardiac arrest were mentioned as possible reasons for keeping a PIVC and earlier experiences of such emergency situations contributed to the nurse's judgement. One nurse expressed, 'as long as it is ok, I think we just keep it there'. The decision to remove the PIVC was mainly made by nurses; doctors were contacted only if the IV access was difficult. However, if the patient was waiting for nursing home placement, this triggered the nurses' thoughts of removing a PIVC.

Subtheme 2: Knowledge gaps in education and clinical training

This theme reflects varying and situational-dependent PIVC education, with a perceived lack of importance of PIVC management other than insertion technique. The work-integrated learning process during undergraduate education was very much dependent on each ward's clinical practice and clinical supervisors. The nurses observed a substantial variation in PIVC skills between newly educated nurses depending on where they had undergone clinical training. Some wards offered thorough follow-up on both insertion and PIVC care to their nursing students, but other wards left nursing students to self-education by reading guidelines and 'learning by doing' regarding PIVC insertion. Some nurses found the PIVC education to be a mere demonstration of guidelines, equipment and insertion techniques.

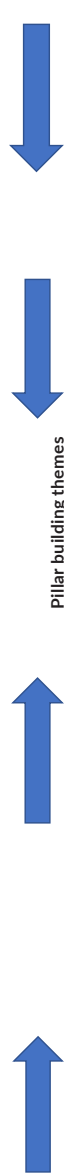
Nursing graduates and nursing students are trained by nurses who may themselves lack adequate training and education. Without supportive leaders or champions, the quality of PIVC care may suffer, leading to suboptimal patient outcomes. Many nurses do not keep informed about evidence-based guidelines, yet they still think they understand best practices. Overwhelmed with multiple other clinical guidelines, nurses reported that they often forgot the seemingly less important PIVC guidelines unless their local champions or leaders emphasized them. Nevertheless, students who had attended wards with good PIVC follow-up and care maintained positive attitudes when educated, even when they perceived that their new employment environment lacked a strong PIVC quality focus.

TABLE 4 Pillar integration process. [Colour table can be viewed at wileyonlinelibrary.com]

	↑	Pillar building themes	↓	
QUANT data	QUANT categories	Ward culture affects education and practice	QUAL categories	QUAL data verbatim
Survey findings	Heterogeneity between wards PIVC quality ranged from 'excellent' to 'not as good'		Enthusiasm and persistence are essential for maintaining good education and clinical practice	Interview findings
Prevalence on each item on the PIVC-miniQ	Do not meet PIVC guidelines regarding emergency inserted PIVCs	Deviation from best practice	Guideline inattentiveness <ul style="list-style-type: none"> • Emergency inserted PIVCs • PIVCs in sites with flexion 	<p>Prehospital/emergency PIVCs in situ</p> <p>'We don't treat (prehospital) PIVCs differently. We do not remove them if they look fine, the dressing is OK, then we keep it' (nurse >5 years, S6)</p> <p>'We have actually learned that we should replace them (prehospital PIVCs) because they possibly are not inserted aseptically. This is probably something that is not complied with, I think' (nurse 2–5 years, M16)</p> <p>PIVCs in areas of flexion</p> <p>'We don't have control on the management of the infusions (in the antecubital fossa); infusion can be slow, and I feel that the skin here is so sensitive and it (the PVC) irritates' (nurse 1–2 years, M14)</p> <p>Dressing control</p> <p>'We often talk about it, there are a lot of patients with soiled dressings, and it does not look good. I don't like it' (nurse >5 years, S15)</p> <p>Documentation</p> <p>'There are a lot of verbal reports, so (PIVCs and complications) are reported orally so we are aware of it' (nurse 2–5 years, ICU1)</p> <p>Indication</p> <p>'I have experienced a patient waiting for a place at the nursing home that had a PIVC in place for too long; no one seems to think about it' (nurse 0–2 years, S3)</p> <p>'We discuss PIVCs and if the patient needs it, but perhaps we discussed more when we had to exchange it every third day. Now we don't think about it. I don't know if it creates more infections' (nurse >5 years, S6)</p> <p>Training and education</p> <p>'... but I also think it's been like "yes, just go in and try it yourself", so actually it's a lot of self-learning, so you must have read the guidelines and ... it's sort of like ... so you master it but ... there has been too little training, together with some experienced people' (nurse 0–2 years, M16)</p> <p>'The teachers demonstrated some procedures, practical equipment needed for insertion (of PIVC), how to disinfect, and that it should dry for a certain amount of time. They also demonstrated (PIVC) insertion. That was the training, really' (nurse 2–5 years, ICU1)</p> <p>Guideline</p> <p>'I may have read it (guideline) the first summer here. I feel the newbies use it a lot and that's good. I am sure it is updated, there are some things that you don't get if you do not check. But that particular guideline, I don't think there are many people who go in and read it after you've worked for 1 year' (nurse 2–5 years, M16)</p> <p>'It's possible that it's (PIVC) just that common. You kind of assume there isn't an update on it (the PIVC guideline), in away. Regarding the students, I have not considered using a guideline for PIVCs. We have used all other guidelines, but not exactly the PIVC' (nurse >5 years, S3)</p> <p>'That's what happens when you think you know something. In that sense ... you tend not to look it up and read about things you imagine you master' (nurse >5 years, ICU1)</p> <p>'I have a feeling that when the PIVC is inserted, it's there. As long as it's ok, not much is done with it' (nurse 2–5 years, ICU1)</p>

(Continues)

TABLE 4 (Continued)



QUANT data	QUANT categories	Pillar building themes	QUAL categories	QUAL data verbatim
Pain/tenderness on palpation	13.07			
Redness >1 cm from insertion site	5.30			
Swelling >1 cm from insertion site	4.24			
Warmth	0.71			
Purulence	0.00			
Streak/red line along vein	0.71			
Induration/hardness of tissues >1 cm	0.71			
Palpable hard vein beyond IV tip	0.53			
Partial/complete dislodgement PVC	2.12		Do not meet PIVC guidelines regarding PVC sites with flexion	
Dressing soiled with blood or fluids	31.08			
Dressing with loose or lifting edges	16.96			
Fixed with tape only	0.35			
Blood in line	22.44			
PVC insertion date not documented on dressing	70.85		Do not meet PIVC guidelines regarding documentation, indication and dressing control	
Indication unknown	21.20			
Date of PVC insertion in patient chart is lacking	36.22			

TABLE 4 (Continued)

QUANT data	QUANT categories	Pillar building themes	QUAL categories	QUAL data verbatim
PIVC site (n = 559)	%			
Hand	25.76			
Wrist	9.66			
Forearm	30.05			
Antecubital fossa	31.66			
Upper arm	1.25			
Foot	1.61			
Insertion environment (n = 530)	%			
Ambulance	5.09		Inconsistency in clinical training and education	
Emergency department	16.79		<ul style="list-style-type: none"> Lack of knowledge of guidelines 	
Operating room	23.02	Gaps in education and clinical training	<ul style="list-style-type: none"> PIVCs are so common, and nurses think they know Identified need for more education and clinical training 	
General ward/unit/clinic/ICU	44.91		<ul style="list-style-type: none"> Education is mostly about inserting the PIVC Think the guideline is only about inserting the PIVC 	
Radiology/Procedure room	0.75			
Unknown	9.43			
Findings between wards				
	Heterogeneity between wards in PIVC quality of care		Supportive leadership and local champions important for good PIVC care	
PIVC-miniQ, mean (SD), range (after imputation)		PIVC quality variations between wards		
Ward S3: Mean: 3.09 (1.23), range: 1–6	Wards needing improvement on PIVC care ('not so good')		<ul style="list-style-type: none"> Challenges: Nurses have many new guidelines and the PIVC guideline is not read Lack of PIVC awareness 	'I was taught how to do it (check PIVC quality) when I was a student. At this ward, PIVC check does not have attention' (nurse 0–2 years, S3) 'We only talk about it (PIVC) when it is difficult venous access' (nurse 0–2 years, S6) 'It's just there (PIVC). I don't think we have any more thoughts about it than that the patient has it' (nurse < 5 years, ICU1)
Ward S6: Mean: 2.61 (1.17), range: 1–6				
Ward ICU1: Mean 2.47 (1.68), range 1–7				

(Continues)

TABLE 4 (Continued)

QUANT data	QUANT categories	Pillar building themes	QUAL categories	QUAL data verbatim
Ward M16: Mean: 1.13 (1.03), range: 0–4 Ward M14: Mean: 1.33 (0.98), range: 0–4 Ward S15: Mean: 1.40 (0.50), range: 1–2	Wards with good quality of care ('excellent')	Supportive leadership	Challenge: • When nurses are not reminded of PIVC updates, attention dropped Role of leader/educator Role of ward culture Influencers/ champions Leadership Ward culture PIVC awareness	'We have leaders who focus on it (PIVC) and remind us and update us to remember to do it properly' (nurse 0–2 years, M16) 'When your memory is newly refreshed, you are a bit more alert, so she (nurse educator) goes around and updates us on new guidelines, like it's big news, haha' (nurse 0–2 years, M14) 'You notice at once that when attention is dropping ... the quality declines, that's why we try to have those PIVC weeks twice a year. I have the impression that the things you focus on, you are good at in that moment ... but then quality declines before it goes up again' (nurse educator >5 years, M14) 'Many of us think that PIVC insertion is done as we always have done it. We have been talking about how we need to be aware of updates (PIVC guidelines) and that we need to read it regularly' (nurse >5 years, S15)

^aAfter imputation.

Subtheme 3: PIVC quality variations between wards

The survey exposed that PIVC quality ranged from *excellent* to *not as good*, and variations in PIVC quality among wards in the quantitative results ranged from 0 to 8 in sum score on the *PIVC-miniQ* and mean score (SD) ranged from 1.13 (1.03) to 3.28 (1.99).

Nurses in wards with poorer survey results admitted that the PIVC hospital guidelines were not in active use, neither among themselves nor by the other nurses. The PIVC guidelines were accessed by graduate nurses and students, but after they had mastered the insertion technique, use of the guidelines was sparse, with a common perception that once nurses had learned about PIVCs, no further updates were needed.

Nevertheless, several nurses had perused the PIVC guidelines just before the interview, experiencing a moment of revelation as they expressed surprise at their utility and informativeness. Some stated they had been unaware of recent updates and believed that, since PIVCs were so common, they thought they understood PIVC care: 'I read the procedure today, I have read it during clinical training, but I can see that a lot is forgotten'. The understanding of PIVCs as a possible source of infection was present, mostly among nurses who had experience with patients with PIVC-related bacteraemia.

Subtheme 4: The importance of supportive leadership

The wards with better results highlighted the importance of supportive leadership and local 'champions'. These wards had nurse educators and leaders who acted as role models and prioritized improving the nurses' knowledge and competence of PIVC care. They were familiar with guideline updates and acted as information providers, and they took responsibility for implementing new guidelines. They planned and arranged meetings, lectures and reminders to inform their colleagues about PIVC updates. Ward meetings, ward training, short educational sessions and repeated point prevalence surveys using the *PIVC-miniQ* constantly kept PIVC quality on the agenda. They also initiated regular PIVC quality audits and reported the results to their ward nurse colleagues. These nurses felt dedicated to improving patient outcomes regarding PIVCs and so managed to influence the ward culture, as well as nursing students in clinical training. These champions also delegated responsibility for guideline adherence to other ward nurses to foster greater understanding and staff engagement. They emphasized that maintaining a consistent focus on PIVCs requires persistent reminders and updates, as neglecting this aspect could lead to a decline in attention: 'You notice right away that when the focus changes, so does the quality, I think'.

6 | DISCUSSION

In this sequential explanatory mixed method study, we found that *ward culture affects practice*; the statistical variance in PIVC quality across wards identified in the survey was confirmed in the qualitative analysis. This is the first mixed method study to explore the barriers and facilitators to PIVC care between different hospital wards, and it highlights the need for supportive leaders and local PIVC

champions and a strengthened emphasis on PIVC care in the nursing curriculum as essential for PIVC quality.

The identification of *deviation from best clinical practice* was connected in some wards to lack of awareness regarding PIVC risks. A recent Australian study found that nurses felt confident with PIVC care, which was inconsistent with their knowledge scores (Massey et al., 2020). Several prevalence studies have reported on PIVC complications (Marsh et al., 2020), and many hospitals have successfully initiated care bundles and quality improvement projects (Ray-Barruel et al., 2019). However, many experienced nurses in the study felt knowledgeable about the local PIVC guideline until they read it ahead of the interview and realized they were unaware of recent updates. The discrepancy between clinical practice and evidence-based guidelines has been identified in other studies (Berger et al., 2021; Brors et al., 2023). Nurses know the insertion procedure, but they lack awareness of updates; therefore, guideline knowledge and adherence should be assessed regularly (Saliba et al., 2018).

Only 62.9% of PIVCs were correctly recorded, and documentation of removal-related complications was limited, which is in accordance with findings from other studies (Alexandrou et al., 2018; Bahl et al., 2022). Poor documentation of vein assessment and PIVC complications can affect future vein quality, and written reporting of complications can contribute to a better understanding of patient safety and vessel health (Moureau, 2019). Some wards in the study considered verbal reports as more reliable than written health records and checking patients for undocumented PIVCs was part of daily patient care. Further, PIVC failure was not documented; if it failed, the catheter was removed, and replaced if needed. Documentation of reasons for removal is crucial for understanding complications and improving PIVC care (Bahl et al., 2022). Understanding of the risks of emergently inserted PIVCs (Badia-Cebada et al., 2022) seems deficient and was an overall finding in the qualitative interviews. A case-control study found that emergently inserted PIVCs were related to sepsis development and a lack of sterile precautions was frequently overseen and not documented (Hughes et al., 2014). This is similar to our study findings, where knowledge related to the risk of prehospital inserted PIVCs was non-existent.

Several studies have reported high prevalence rates of idle catheters (Alexandrou et al., 2018; Mestre et al., 2013), with patients often unaware of the reason for their PIVC (Berger et al., 2021; Laan et al., 2020). An Irish study found an association between patient engagement and redundant PIVCs (McHugh et al., 2011), leading to a call to involve patients in the process (Ray-Barruel et al., 2020). Despite being a ubiquitous medical device, PIVCs receive little attention and both patients and staff lack awareness of the consequences of PIVC-related complications and infection risks (Nickel, 2020).

We identified that deviation from best clinical practice was directly related to *gaps in training and education*. Nursing students attended a demonstration of the PIVC equipment and the procedure, with education primarily focusing on PIVC insertion. In terms of teaching, practical demonstrations are often used to teach skills such as catheter insertion and the connection of IV fluids (Vandenhouten et al., 2020). Subsequently, students develop skills

through observation, hands-on performance and teaching others. This method enables them to acquire procedural skills without necessarily attaining a comprehensive understanding of the entire process of PIVC insertion and maintenance (Ravik et al., 2017). Gaps in education and clinical training regarding PIVC guidelines have many implications for the patient, as guidelines cover topics from insertion and maintenance to device removal. Such gaps may arise because of scarcity in education and training (Massey et al., 2020). Education is needed for all aspects of PIVC management, including maintenance, monitoring, and evaluation, ranging from the insertion site, patency and dressing integrity to the infusion pumps and IV tubing (Alexandrou et al., 2018; Gorski et al., 2021; Massey et al., 2020). However, since the responsibility to teach most aspects of PIVC management rests with individual wards or clinics, the training of nursing graduates and students depends on the PIVC culture encountered during their clinical placements. PIVC education is mostly focused on PIVC insertion, as this is a crucial skill for nurses in clinical practice, but education on daily maintenance, including quality checks of the PIVC seems lacking in many nursing schools.

PIVC education, as well as regular and systematic audits of PIVC quality, is crucial for improving care. Feedback on audit results is also important for identifying areas that need improvement and ensuring that best practices are being followed. Conducting regular audits can increase awareness of PIVC management, which can lead to better care over time.

Clinically indicated replacement of PIVCs (Rickard et al., 2012) is usually implemented in Norway, but adherence to the associated recommendations of continued close monitoring of PIVCs is inconsistent. Education about insertion skills, together with scientific knowledge about aseptic insertion technique, daily management, PIVC risks and how to audit the PIVC, can bridge the gap between performance and understanding (Ravik et al., 2017; Vandenhouten et al., 2020). The PIVC should be assessed every shift as a minimum (Gorski et al., 2021). Our findings indicate that responsibility for PIVC quality and care is left to clinical nurses who themselves may have experienced fragmented learning.

Supportive leadership and local champions are essential for good PIVC care. Creating an enthusiastic culture for PIVC care resulted in a strong learning environment for students and attentiveness to PIVC guidelines. Conversely, when supportive leadership is lacking, adherence to best practice can be poor (Blanco-Mavillard et al., 2022). Despite a common experience with PIVC guidelines and care being omitted from undergraduate curricula, some wards had champions, committed leaders or enthusiastic nurses promoting PIVC quality, which had a highly positive effect on colleagues and ward routines. Many healthcare providers do not identify PIVC complications as a serious challenge (Zingg et al., 2023), but the champions on these wards understood the consequences of PIVC inattention. Moreover, nursing students who had spent their clinical training in such wards tended to bring their learnt behaviour to new wards. Wards without such champions had poorer objective PIVC quality and their nurses seemed less aware of PIVC guidelines, procedures and related risks.

6.1 | Strength and limitations

Using a validated data collection tool and study nurses not employed in the wards increased the reliability of the findings. Investigating the quantitative results by undertaking qualitative interviews is a strength of this study, enabling interpretation of the findings.

The quantitative survey found few severe signs of infections or other complications. It has however been claimed that prospective cohort studies that follow the PIVC from insertion to removal are more reliable than prevalence studies (Chen et al., 2022), and as such, we could have missed PIVCs with signs of complications. The sampling of nurses for the interviews was decided by the head nurses, which may have biased the answers. However, including nurses with different clinical experience increased the validity of the results. All the interviewed nurses had been working on the relevant wards during the PIVC screening. The interviews were not in-depth as the issue was a clinical question, trying to increase understanding of the correlation between PIVC guideline awareness and ward culture.

There were differences between the types of wards (medical, surgical and intensive care) but this did not seem to impact PIVC quality or nurses' attentiveness. Rather, it showed that PIVC care varied widely, regardless of specialty.

As the results are from a single hospital, generalizability may not be possible, however, the quantitative findings in our study accord with a study from New Zealand (Berger et al., 2021). Furthermore, our findings reveal the need for improved clinical management of PIVCs, a finding supported by a qualitative study from Spain (Blanco-Mavillard et al., 2022). Differences between hospital settings elsewhere are likely, as we identified differences between hospital wards. As one of the first mixed method studies in this area, this research provides an in-depth understanding of the underlying factors of PIVC challenges.

7 | CONCLUSION

This mixed method study is the first to explore reasons for variability in PIVC quality. Ward culture and especially leader commitment and champions promoting good PIVC quality are important for nurses' adherence to PIVC guidelines and attentiveness towards best practice PIVC care. Further, PIVC quality must become a priority in nursing education, beginning in the undergraduate nursing curriculum and continuing throughout the continuum of patient care.

AUTHOR CONTRIBUTIONS

LHH, LTG, KHG and GR-B made substantial contributions in drafting and revising the article. Together with study nurses, LHH and ABW collected and organized the quantitative part of this study. SL contributed to the statistical analyses. LHH made all the interviews with the nurses. LHH and LTG analysed the qualitative data. All authors reviewed critically and approved the final article.

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CONFLICT OF INTEREST STATEMENT

No conflict of interest has been declared by the authors.

DATA AVAILABILITY STATEMENT

The corresponding author can provide the datasets upon reasonable request until ethical requirements necessitate data deletion in 2029.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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