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Peripheral intravenous catheter insertion, maintenance and outcomes in Indonesian paediatric hospital settings: A point prevalence study

Ferika Indarwati [a,b,e], Judy Munday [a,d], Samantha Keogh [a,c,e,*]

[a] Queensland University of Technology (QUT), School of Nursing and Centre for Healthcare Transformation, Brisbane, Queensland, Australia
[b] School of Nursing, Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia
[c] Nursing and Midwifery Research Centre, Royal Brisbane and Women's Hospital, Brisbane, Queensland, Australia
[d] Faculty of Health and Nursing Sciences, University of Agder, Grimstad, Norway
[e] Alliance of Vascular Access Teaching and Research Group, Griffith University, Queensland, Australia

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ABSTRACT

Purpose: This study aimed to assess peripheral intravenous catheter use, maintenance practices, and outcomes of paediatric patients in a developing country setting.
Design and methods: A point prevalence survey using validated checklist was conducted between March and April 2022 in ten hospitals in Indonesia. A total number of 478 participants were approached during the audit. Data were obtained from site observation and medical records.
Results: Of the 386 patients surveyed, >90% (362) had one catheter in-situ. The catheters were mostly inserted by nurses (331, 86%), primarily in the dorsum of the hand (207, 54%) with the purpose of delivering intravenous infusions and medications (367, 95%). Simple transparent dressings (176, 46%) with splint and bandage (295, 76%) were predominantly used for securement methods. Insertion sites were not visible for 182 (47%) patients, and 151 (40%) of daily care practices were poorly documented. Complications were documented in the medical record for 166 (43%) catheters. Adjusted analysis indicated that patient diagnosis, ward, catheter size, location, dressings, infusate, and flushing administration were significantly associated with complications.
Conclusions: Findings indicate that issues related to paediatric intravenous catheter complications in Indonesia are comparable to developed country settings. Ongoing surveillance is important to evaluate the management practices to benchmark against guidelines, optimise patient safety, and improve outcomes.
Practice implications: Results demonstrate low and middle-income countries face similar challenges with catheter insertion and care. The study indicates the importance of applying vascular access needs assessments, providing training for inserters, identifying optimum dressing methods, and optimising documentation.

Introduction

Peripheral intravenous catheters (PIVC) are the most common invasive medical device used in healthcare, including in paediatric settings (Chen et al., 2021). Nearly two billion PIVCs are used globally (Alexandrou et al., 2018). PIVC was commonly used to deliver intravenous therapies, including fluids and electrolytes, medications, anaesthetics, diagnostic reagents, and blood or blood product transfusions (Ullman et al., 2020). Despite the important role of PIVCs to administer intravenous drugs and fluids for patients, PIVC insertion and care in paediatric patients is challenging (Al-Awaisi et al., 2022; Ballard et al., 2022; Reigart et al., 2012; Schults et al., 2019). Varied developmental stages in children, including cognitive development, physical conditions such as small veins, stranger anxiety, potential difficulties in cooperation during insertion, and patient's clinical presentation such as poor perfusion, presence of sepsis or other circulatory conditions, complicate PIVC placement and care (Scott-Warren & Morley, 2015). The incidence of PIVC failure (any complication at catheter removal, such as, phlebitis, occlusion, infiltration, extravasation, dislodgement, leakage and infection) in paediatric patients is still relatively high (Chu et al., 2023; Kleidon, Cattanach, Mihala, & Ullman, 2019; Malyon et al., 2014; Ullman et al., 2020). A recent systematic review of 32 studies demonstrated

* Corresponding author at: Queensland University of Technology, Faculty of Health, School of Nursing, Centre for Healthcare Transformation, Victoria Park Road, Kelvin Grove, Brisbane, Queensland 4059, Australia.
E-mail addresses: ferika.indarwati@umy.ac.id, ferika.indarwati@hdr.qut.edu.au (F. Indarwati), judy.munday@qut.edu.au (J. Munday), s2.keogh@qut.edu.au (S. Keogh).

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that, on average, 34% of PIVCs in paediatric patients fail before the completion of therapies, with infiltration as the most frequent identified complication (Indarwati et al., 2020).

The burden caused by PIVC failure significantly affects patients, families, and healthcare systems. PIVC insertion is reported as a traumatic experience for paediatric patients and their families (Cooke et al., 2018; Sharp et al., 2023). Moreover, re-insertion procedures increase medical fear, anxiety, and procedural pain perceptions (Çalbayram & Altundağ, 2018). The traumatic experience of placement and re-insertion experienced by paediatric patients may affect medical care-seeking behaviours in later life (Jones et al., 2008). PIVC failures also impact healthcare system budgets: the costs per PIVC replacement in the Unites States (US) is reported approximately US$85 (Goff et al., 2013), whereas, in Australia, it was estimated at AU$69.30 (AU$80.00 2023) (Tuffaha et al., 2019). Given the ubiquitous nature of PIVC use in healthcare and the identified proportion of PIVC failure, the overall costs likely significantly affect healthcare expenditure (Lim et al., 2019; Morgan et al., 2022).

Optimising insertion practice is important for paediatric patients to minimise physical and emotional stress and trauma (Cooke et al., 2018; Hands et al., 2010; Kleidon et al., 2021; Schults et al., 2019; Sharp et al., 2023). This includes informing and preparing patients and parents/carers, patient assessment for identification of the optimal site, prophylactic analgesia, skin decontamination, insertion of the device under aseptic conditions, and adequate dressing and securement (ACSQHC, 2021). The first-time insertion success rate in the paediatric and neonatal population has been found to be between 45% (Vinograd et al., 2018) and 68% (Legemaat et al., 2016), respectively. Interventions using expert inserters and ultrasound have improved insertion practice: two paediatric studies found that time to successful cannulation was reduced, and fewer attempts were required to achieve success for patients randomised to ultrasound-guided insertion compared with the traditional method (Kleidon et al., 2021). After insertion, careful PIVC management should be implemented to prevent complications, failure, and premature removals (Kleidon, Cattanach, Mihala, & Ullman, 2019). This includes regular assessment of condition and function through observation and discussion with the patient (Rickard & Ray-Barruel, 2017). As with any invasive device, reducing the risk and rate of infection is paramount.

PIVC outcomes are influenced by patient characteristics such as age, weight, diagnosis, catheter characteristics, type of drugs or fluid administered, and the inserters' attributes (Parker et al., 2017). In terms of medication, high osmolality and vesicant drugs/infusates are common causes of PIVC infiltration and extravasation complications (Shenoy & Karunakar, 2014). Characteristics of the inserter, such as the healthcare provider's knowledge, confidence and education/training, influence the ability to perform PIVC insertion and care based on guidelines and will subsequently affect PIVC outcomes (Farrell et al., 2017). PIVC insertion and management practices such as the use of aseptic technique during insertion, flushing/locking, dressing, and site assessment practices are identified as care variables that may also influence PIVC performance and dwell time (Crowell et al., 2017; Kleidon, Cattanach, Mihala, & Ullman, 2019).

The infusion nursing standard of practice (Gorski et al., 2021) specifies interventions to prevent and decrease PIVC failure and complications in paediatric patients. These include the use of technology to assist PIVC insertion (Kleidon et al., 2021), inserter or nurse education (Keleekai et al., 2016), provision of decision-making algorithms (Hartman et al., 2018), technology-assisted PIVC care reminders, and intervention bundles (Kleidon, Cattanach, Mihala, & Ullman, 2019). In Australia, the Commission for Safety and Quality in Healthcare (ACSQHC) has also developed and launched a Clinical Care Standard for PIVCs (ACSQHC, 2021).

Given the available high-level evidence summarised in the national and international guidelines (ACSQHC, 2021; Gorski et al., 2021; Indonesian Ministry of Health, 2017; Pancho Kaslam et al., 2021), it is important to benchmark practices against the recommendations combined with regular surveillance to assess whether PIVC management meets the standard of practices (Alexandrou et al., 2018; Schults et al., 2019; Ullman et al., 2020). Furthermore, despite the growing literature regarding PIVC use and management published worldwide in the last five years, studies investigating PIVC use and practice in the paediatric population, both generally and in developing settings like Indonesia, remain scarce. Limited surveillance and studies mean the exact prevalence of use, management practice, outcomes, staff expertise, and patients' satisfaction and experience are unknown. Moreover, studies in the paediatric cohort in Indonesia are mostly conducted in neonates, have small sample sizes, and have only involved single sites, limiting generalisability (Ferdianingsih et al., 2023; Yuningsih et al., 2020; Yuningsih & Rustina, 2019).

Methods

Aim(s)

The aim of the study was to assess the PIVC use, management practices, and outcomes as well as to understand the current issues regarding PIVC service deliveries in paediatric patients. Findings from the point prevalence survey provide baseline data and enable tracking of improvements in future monitoring and evaluation of care for paediatric patients with PIVCs.

Design

A point prevalence survey was employed to investigate the variation and characteristics of current use, maintenance practice and outcomes of PIVCs in paediatric patients in Yogyakarta, Indonesia. The point prevalence design is an effective method for surveillance purposes such as to estimate the prevalence rate or incidence rate of a condition (such as PIVC use and outcomes) at one point in time (Polit & Beck, 2017) and to collect data to understand current practice from a large number of varied sites, to prevent bias represented by a single centre or geographic region (Nellis et al., 2018). The Donabedian structure – process – outcome theoretical framework (Donabedian, 2003) was used to guide the study. The use of this framework enables the researcher to identify relevant indicators, as well as to understand the relationship between dimensions of PIVC care practices in paediatric patients.

Setting and sample

The study was conducted in the paediatric wards of one provincial/tertiary hospital, five district hospitals, one specialised women and children hospital, and three private hospitals in Indonesia. The paediatric units included general paediatric, perinatology, high care, recovery unit, paediatric emergency department, Neonatal Intensive Care Unit (NICU), and Paediatric Intensive Care Unit (PICU). The point prevalence survey included data from direct observations or bedside visits and from patient clinical records in each hospital. The inclusion criteria for eligible participants included paediatric patients aged 0–18 years with PIVCs currently in situ, admitted to paediatric settings in Yogyakarta hospitals at the time of the survey. A potential number of 478 patients were approached for participation during the study period.

Research variables and instrument

Research variables consisted of elements from the national and international PIVC care standard of practices (Gorski et al., 2021; Indonesian Ministry of Health, 2017) and classified into three concepts based on the Donabedian theoretical framework namely structure, process, and outcome of the PIVC insertion and care. The structure of care variable in this study was patient characteristics (e.g., age, weight, gender, diagnosis, skin hydration, and settings/wards), inserter' discipline, and

catheter size. The process of care variables included PIVC use, insertion location, dressing and stabilisation, site assessment, type of infusate, type of drugs, and flush administration. The outcome variable was any complications documented in the medical records in the last eight hours. The survey used a questionnaire adapted for the paediatric setting in Indonesia from a published tool (New et al., 2014; Russell et al., 2014). The instrument includes 29 variables related to PIVC insertion, care, and documentation. The assessment included three main components namely patient and catheter characteristics, PIVC insertion and maintenance practices, and documentation. The patient and catheter characteristics included age, weight, gender, medical diagnosis, skin hydration, and ward settings, number of catheters and gauge. The PIVC insertion and management practices such as purpose or use of PIVC insertion, inserter' discipline, insertion location, dressings and stabilisation products, dressing conditions, skin integrity around the insertion site, visibility of the insertion site, site assessment, type fluid therapy, and type of intravenous medications. The documentation includes notation of device location, insertion or re-insertion dates, infusate ordered, intravenous medications ordered, flushing ordered, and daily maintenance care, as well as any complication documentation (New et al., 2014; Russell et al., 2014). The questionnaire has been forward and backward translated into Indonesian and checked for its validity and reliability in the Indonesian context (Indarwati et al., 2022a). The six-step forward and backward translation method was used to validate the questionnaires. The six-step forward and backward translation method adapted form Sousa and Rojjanasrirat (2011) was used to validate the questionnaires. Two translators were involved in the translation process. Three-panel experts rated the instrument' content validity using a four-point rating scale. Item and scale level content validity index and kappa index were calculated. Ten-panel members of the target population evaluated the questionnaire regarding feasibility, clarity, logical sequence, and formatting. The translation process indicated relatively low discrepancies between translators except for semantic equivalence where there were nine discrepancies found in the forward translation of the checklist. The semantic discrepancies were less prevalent in the backward translation, with only one item reported during the process. The item validity index showed relatively high agreement between experts. The face validity indicated that the instrument was easy to understand and presented logically (Indarwati et al., 2022a).

Data collection

The survey was conducted between March and April 2022. The lead researcher coordinated the survey, including the recruitment of four research assistants to collect data in the hospitals. All research assistants received training on the survey protocol and on the audit checklist prior to data collection. A schedule for data collection in each hospital was used. For example, data collection at the provincial hospital was scheduled on Monday, the survey at the district hospital was on Tuesday and so on. The key person in each hospital notified all the patients about the study one day prior to data collection. The lead researcher or research assistant met potential participants and sought written consent before conducting observation on the PIVC insertion site and accessing the patients' medical records. Data were collected in hard copy in the tertiary/provincial and district hospitals and via Research Data Capture (REDCap) (Harris et al., 2019) by the lead researcher for the private and specialist hospitals.

Ethical considerations

Ethical clearance for this study was obtained from a University in Australia and each hospital in Indonesia. The Ethics Committee declared that the study conformed to The Declaration of Helsinki, The Council for International Organisations of Medical Sciences (CIOMS), and The National Statement on Ethical Conduct in Human Research standards. The Strengthening The Reporting of Observational Studies in Epidemiology (STROBE) (von Elm et al., 2007) guideline is used for reporting.

Data analysis

Data were collated in Microsoft Excel™, checked and cleaned before exporting to IBM SPSS Statistics for Windows, Version 28. No missing data were imputed. Descriptive statistics were used to analyse each variable in the study. Results were described as frequency, percentage, mean, standard deviation (SD), median, interquartile range (IQR), and mode, as appropriate for variable type and data distribution. The Pearson' Chi-Square, *t*-test or comparable non-parametric tests were used to examine the association between potential explanatory and outcome variables. The explanatory variables included patient characteristics (e.g., age, weight, gender, diagnosis, skin hydration, and settings/wards), inserter's discipline, and catheter size, PIVC use, insertion location, dressing and stabilisation, type of infusate, type of drugs, and flush administration. The outcome variable was any complication documented in the medical records in the last eight hours. Associations between independent explanatory variables and the outcome variable were considered significant if p-value <0.05. Multivariable binomial logistic regression was used to investigate adjusted associations of the explanatory factors for the PIVC outcomes. Prior to regression analysis, multicollinearity among the independent variables were checked. Only factors meeting these criteria such as indicating association with p-value <0.10 (Bursac et al., 2008; Kirkwood, 2003), very low–weak correlation coefficient (0–0.2), correlation matrix <0.50, or variance inflation factor (VIF) ≤ 5 were included in the adjusted analysis (Field, 2018).

Results

Patients' characteristics

Of the 487 eligible patients, 386 were surveyed for their current PIVC insertion and maintenance. Ninety-two patients (19.2%) were not assessed, either because they declined or were absent from their bed during the survey. Demographic data is described in Table 1. Fifty-one percent of the cohort were male, and the median age of the total cohort was 18 months (IQR 59.50). Most patients (66%) were located on dedicated paediatric or neonatal ward.

PIVC insertion and care characteristics (Site inspection)

Site inspection results (Table 2) indicated that >90% (362/386) of respondents had one PIVC currently in-situ, inserted by nurses (331,

Table 1
Patient characteristics ($N = 386$).

Variables	n (%)
Sex (Female)	188 (49)
Age (months)[a]	18.00 (59.50)
Weight (kilograms)[a]	12.00 (16.6)
Diagnosis	
Prematurity	71 (18)
Hematology	42 (11)
Respiratory	65 (17)
Neurology	54 (14)
Gastroenterology	65 (17)
Other	89 (23)
Ward	
Paediatric general ward	148 (38)
Neonatal/infant ward	106 (28)
PICU	44 (11)
NICU	43 (11)
Other	45 (12)

Results reported as n (%) unless otherwise indicated; a = Median (IQR – interquartile range); PICU = paediatric intensive care unit; NICU = neonatal intensive care unit.

Table 2
Catheter, PIVC insertion, and care characteristics (Site inspection) (N = 386).

Variable	n (%)
Number of IVs	
One	362 (94)
Two	24 (6)
Catheter size	
20G	68 (18)
22G	124 (32)
24G	114 (30)
Undetermined	43 (11)
Other	37 (10)
Inserter discipline	
Nurse	331 (86)
Other	55 (14)
Catheter position (side)	
Right	175 (45)
Left	211 (55)
Insertion site	
Dorsum of hand	207 (54)
Forearm	90 (23)
Wrist	48 (12)
Ankle (saphenous vein)	23 (6)
Other	18 (5)
Device in use	
No	10 (3)
Intermittent	9 (2)
Continuous infusion/medication	367 (95)

IV = intravenous; G = gauge.

86%) primarily in the dorsum of the hand (207, 54%) with the purpose to deliver continuous intravenous infusion and medications (367, 95%). The primary dressing used was a simple transparent dressing (176, 46%) which were mostly clean, dry and intact. Splint and bandage used as a stabilisation method for 295 (76%) of the PIVCs surveyed. The insertion site was not visible for 182 (47%) of patients with site inspection finding that 103 (27%) had complication signs such as blisters, fluid in tissue/oedema, oozing, pain, red/inflamed and tracking. Simple transparent dressings were used for almost half of the PIVC insertions which aligns with current guidelines. However, almost half of the insertion sites were not visible due to additional add on products such as tapes and bandages. A more robust dressing might improve primary dressing integrity and reduce the need of additional dressing products.

PIVC insertion and care characteristics (Documentation)

Of 386 records, 151 (39%) did not have complete documentation as per the site inspection guideline. The medical record observation (see Table 3) identified lack of documentation was mostly found in relation to dressing change due dates, re-insertion dates and flushing practices with only 63 (16%), 121 (31%), 118 (31%) of instances documented, respectively. >40% (166/386) of PIVCs were documented in the medical record as being affected by any type of complications, but with occlusion as the most reported complication.

Bivariate analysis of the potential explanatory variables and the PIVC complication based on documentation in the patient medical records showed that age, weight, diagnosis, ward, catheter size, insertion area, type of dressings, skin hydration, type of infusate, and flushing administration were significantly associated with PIVC complications (p-value <0.05) (See Supplementary Table 1). After adjustment, only diagnosis, ward, catheter size, insertion location, type of dressings, type of infusate, and flushing administration were significantly associated with PIVC complications ($p < 0.05$). The logistic regression model was significant (χ^2 210; df 24; $p < 0.001$, Nagelkerke R^2 0.56) (Supplementary Table 2). Only variables with p-value <0.10 were included in the adjusted model. Weight and PIVC use were not included in the logistic regression due to high correlation with age and due to a small number of cases, respectively.

Table 3
Catheter, PIVC insertion, and care characteristics (Documentation) (N = 386).

Variables	n (%)
Primary dressing	
Gauze and tape	52 (14)
Simple transparent	176 (46)
Bordered transparent	74 (19)
Foam square	84 (22)
Use of splint and bandage* (yes)	297 (77)
Dressing clean* (yes)	313 (81)
Dressing dry* (yes)	358 (93)
Dressing intact* (yes)	365 (93)
Site dated*	
Insertion date (yes)	272 (71)
Last dressing change dates (yes)	111 (29)
Dressing change due date (yes)	111 (29)
Was dressing overdue for change?* (yes)	122 (30)
Insertion site visible?* (yes)	204 (53)
Complications* (based on site inspection)	
No complication (yes)	136 (35)
Any complication sign (yes) (eg, pain, red/inflamed, tracking, fluid in tissue/edema)	103 (35)
Other (yes) (could not assess/site not visible)	148 (38)
Skin integrity* (integrity and hydration)	
Good (intact and well hydrated))	358 (93)
Moderate/poor (integrity compromised or poor hydration)	28 (7)

* Binary variable; Yes or No response. Yes values reported.

Discussion

The primary purpose of this study was to investigate the use, management, documentation, and outcomes of PIVC insertion and maintenance in paediatric patients across paediatric settings (general ward, high dependency units, and critical care units) in Yogyakarta, Indonesia. Our data indicated that the majority of PIVCs (376/386, 97%) were inserted with a clear indication for delivering intravenous fluids and medications. There were limited idle devices. Simple transparent dressings were used in the majority of PIVCs surveyed, which aligns with the current guideline recommendations (Gorski et al., 2021). However, almost half of the insertion sites in the current study were not visible due to additional securement or stabilisation products. The use of a splint and bandage to help stabilise and secure the catheter was reported in three-quarters of cases, covering the transparent dressing. This finding clearly indicates a tension between ensuring adequate catheter securement and stabilisation and the need to facilitate easy visualisation, routine assessment, and early detection of PIVC complications. Nevertheless, evidence on effective securement methods in paediatric settings is inconclusive (Kleidon et al., 2020; Laudenbach et al., 2014). Thus, research on optimising dressing and securements methods in paediatric PIVCs is warranted to support early detection and timely interventions for PIVC complications (e.g., infiltration/extravasation, phlebitis). Such complications can have an immediate impact on vessel health (Ullman & Kleidon, 2019) as well as treatment schedules (Vinograd et al., 2019), negative long-term impacts on patient outcomes (Scott-Warren & Morley, 2015), and increased healthcare costs (Tuffaha et al., 2019).

Our findings show that more than a third of the PIVCs inserted were poorly documented, particularly in regard to dressing change due dates, clinically indicated re-insertion dates, and flushing. This concurs with

evidence from other studies indicating that PIVC insertion and maintenance practices are not well documented (Förberg et al., 2012; New et al., 2014). A cross-sectional point prevalence study conducted in adult patients in Australia reported that among 186 patients, only 95 of 179 PIVCs in-situ (43%) had re-insertion dates recorded (New et al., 2014). In paediatric patients, pre-intervention data from a pre-post experimental study conducted in Sweden indicated that only 31% of PIVCs had complete documentation on insertion (including date, side, site, and size), and PIVC removals documentation was notably incomplete (Förberg et al., 2012). The current infusion therapy guideline recommends accurate documentation of initial, ongoing assessment, monitoring, plan of care, patient's response, adverse events, and interventions taken to overcome the symptoms of PIVC failure (Gorski et al., 2021). This information is important to assess whether standards have been met and to give a basis for quality improvement programs to prevent potential PIVC complications, such as building user-friendly systems to support and optimise point of care documentation to facilitate bedside and ongoing PIVC surveillance (Förberg et al., 2016). Furthermore, incomplete documentation may reflect poor nurses'/clinicians' understanding or appreciation of accurate and timely documentation on quality and continuity of patient care leading to compromised patient safety (Gorski, 2018). Thus, this could form a basis for education regarding PIVC insertion and management, particularly in the Indonesian context.

More than 40% (166/386) of the PIVCs in this study demonstrated one or more types of complication (ascertained from available documentation), with occlusion as the most reported complication. Analysis of findings highlighted a mixture of modifiable and non-modifiable factors associated with PIVC condition. Non-modifiable factors included patient diagnosis and commensurate wards/settings. Modifiable aspects such as catheter size, insertion location, type of dressings, type of infusate, and flushing administration were significantly associated with PIVC complications. Similar findings have been reported in previous studies that there were significant relationships between patients' underlying disease, catheter gauge, dressing, and medications and the occurrence of PIVC complications (Ben Abdelaziz et al., 2017; Tripathi & Gladfelter, 2021; Ullman et al., 2020). While non-modifiable factors are just that, understanding patient characteristics is important for insertion preparation, as this will assist inserters in predicting the likelihood of a difficult intravenous vascular access (DIVA) and thus enable optimum preparation for best outcomes (Girotto et al., 2020; Schults et al., 2022). The accurate initial patient assessment will help inserters choose the most appropriate site, vein and catheter to meet the prescribed treatment or medication and ensure prompt escalation, reducing harm and improving patient experience (Schults et al., 2019).

In this study, patients who received flushing experienced higher complications compared to those without flushing, indicating that further research using rigorous research design and core outcome definitions in this population is needed to understand PIVC flushing practice. Based on the latest systematic review study, using sodium chloride is preferred rather than heparin to prolong peripheral intravenous catheter functions in paediatric patients (Gunes & Bramhagen, 2018).

Observational and pilot RCT studies in Australia have identified that flushing practices are poorly documented and highly variable across hospitals (Keogh et al., 2015; Kleidon, Keogh, et al., 2020). Additionally, the effectiveness of intermittent flushing and slow continuous infusion (to keep the vein open) either alone or in combination; using a single dose, pre-filled or manually prepared syringes is inconclusive (Schreiber et al., 2015; Yeung et al., 2020). Infusion Therapy Standards of Practice (Infusion Nurses Society) makes a clear recommendation about flushing solutions and processes (Gorski et al., 2021); however, it is based on limited evidence, especially in paediatric population.

Limitations

Our study provides important information related to issues on paediatric PIVC insertion and care and potential contributing factors in Indonesian contexts. The logistic regression findings demonstrated wide confidence intervals in some of the potential explanatory variables for PIVC complications; therefore, these results should be interpreted with caution because of lower precision. This may be due to the small number of cases per category in some variables. In addition, there are other important variables that can affect PIVC complications incidences, such as the inserter's training and level of experience. Although a survey on the training, experience, knowledge, and confidence of paediatric nurses conducted in the same settings two years ago indicated a lack of training and low level of maintenance knowledge of the nurse (Indarwati et al., 2022b), in the current study, these variables were not able to be assessed due to the inherent nature of the point prevalence design. This may limit the interpretation of the current study findings. Moreover, the current cross-sectional study cannot validate the causation of PIVC complications. Prospective cohort study designs with sufficient sample sizes, including all plausible factors to enable understanding of the aetiology of PIVC failure and complications in the paediatric cohort, may provide more robust evidence.

Implication to practice

The results of this study provide useful information for clinicians, healthcare providers, and education providers in identifying several areas for improvement related to PIVC insertion and care in paediatric patients. This includes developing or ensuring the application of the needs assessment checklists (e.g., Device assessment and decision tool (I-DECIDED), Paediatric peripheral venous access algorithm (PPVAA), and Difficult peripheral venous access (DIVA) (Hartman et al., 2018; Ray-Barruel et al., 2020; Schults et al., 2019), which will assist clinicians on decision-making regarding appropriate venous access devices, catheter size and insertion locations; providing ongoing training for inserters to improve documentation; identifying optimum dressing and securement methods to improve site visibility during routine site assessments; researching ideal flushing solutions and techniques to prevent PIVC complications. In addition, issues related to PIVC insertion and care in paediatric patients identified in surveillance can provide timely feedback to clinicians on current practices and outcomes and support drivers for practice improvement. This reinforces that ongoing audit is important and should be recommended to evaluate PIVC management practices and formulate evidence-based interventions to ensure patient safety and outcomes.

Conclusion

This study identified several issues related to PIVC insertion and care management practices in paediatric hospital settings in Yogyakarta, Indonesia. These were comparable to studies in other settings and countries. Specifically, poor visibility of the insertion site, uncertainty around dressing and securements methods, flushing practices, and poor documentation were identified as leading to a relatively high number of PIVC complications. The study also provided information on modifiable (e.g., catheter and location selection, dressing and securement types, and flushing administration) and non-modifiable factors (e.g., patients' diagnosis and settings) related to PIVC complications. Identifying these problems can provide useful information to inform recommendations for strategies to enhance practice and management of PIVC insertion and care in paediatric settings.

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CRediT authorship contribution statement

Ferika Indarwati: Conceptualization, Methodology, Formal analysis, Data curation, Investigation, Writing - original draft, Writing - review & editing. **Judy Munday:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Samantha Keogh:** Conceptualization, Methodology, Supervision, Investigation, Writing - review & editing.

Declaration of Competing Interest

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Appendix A. Supplementary data

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