



Artikel

Factors associated with peripheral intravenous catheter complications among hospitalised pediatric patients: a cross-sectional study

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Abstrak

Peripheral intravenous catheter (PIVC) complications are common in hospitalised children and may interrupt intravenous therapy. This study aimed to examine the associations of patient age, medical diagnosis, intravenous fluid type, and intravenous medication category with PIVC complications among hospitalised pediatric patients. This observational cross-sectional study was conducted at two teaching hospitals in Yogyakarta, Indonesia, from January to June 2025. A total of 120 pediatric patients meeting the study criteria were recruited using purposive sampling. Data were collected by trained observers using a validated observation checklist. Descriptive statistics, the Mann-Whitney U test, and Chi-square tests were used for analysis. PIVC complications were recorded in 57 of 120 patients (47.5%). Children with complications were younger than those without complications (mean age 53.9 vs 78.5 months; $p = 0.002$). Compared with respiratory diagnoses, gastrointestinal/neurological/immunological/urinary diagnoses were associated with higher unadjusted odds of complications (OR = 9.91, 95% CI: 3.16–31.07), as were musculoskeletal/integumentary diagnoses (OR = 10.13, 95% CI: 1.96–52.42). Intravenous fluid type ($p = 0.056$) and medication category ($p = 0.277$) were not significantly associated with PIVC complications. Younger age and medical diagnosis category were associated with PIVC complications in this sample. Because the estimates were derived from bivariate analyses, they should be interpreted cautiously. Prospective studies with catheter-level variables and multivariable adjustment are needed to clarify independent determinants of PIVC complications in pediatric patients.

INTRODUCTION

Hospitalised children commonly require peripheral intravenous catheters (PIVCs) to receive fluids, electrolytes, nutrients, and medications. Pediatric hospitalisation remains substantial across health systems

(Weiss et al., 2022; Steiner et al., 2023), and Indonesian health data also indicate a large number of hospitalised children (Ministry of Health, 2023). Because PIVC insertion is one of the most common procedures performed by nurses, safe insertion and maintenance are central to pediatric care

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(Kusuma & Nurhidayati, 2021; Ullman et al., 2020). Despite these benefits, PIVCs frequently fail before therapy is completed. International studies have reported pediatric PIVC failure or complications in a substantial proportion of catheters (Bisrat et al., 2026; Bulbul Maras et al., 2025; Ullman et al., 2020). In Indonesia, PIVC complications have also been reported, with infiltration and phlebitis among the most frequent events (Indarwati et al., 2023).

Previous studies have largely emphasized technical aspects of pediatric PIVC insertion and catheter maintenance (Maragani et al., 2021; Nuraidah et al., 2023; Wijaya et al., 2025). Evidence on the associations of patient characteristics, intravenous fluid type, and intravenous medications with PIVC complications remains limited in Indonesian pediatric settings (Bisrat et al., 2026; Bulbul Maras et al., 2025). Younger children may be more vulnerable because of smaller vessels, developmental differences, and greater difficulty maintaining catheter stability (Ertaş Akyüz & Turan, 2025). Underlying diagnoses may also influence hydration status and vascular condition, while the physicochemical characteristics of intravenous fluids and medications can contribute to endothelial irritation and complications such as phlebitis, infiltration, and extravasation (Annisa et al., 2024; Ertaş Akyüz & Turan, 2025). These factors are therefore clinically relevant when planning and monitoring peripheral intravenous therapy in children.

Studies from other settings have identified younger age, medical diagnosis, intravenous fluid exposure, and intravenous medications as factors associated with PIVC complications (Karaoğlu et al., 2022; Resnick et al., 2021). These exposures may be related to vascular integrity, catheter dwell conditions, and the occurrence of infiltration, phlebitis, or extravasation (Bulbul Maras et al., 2025; Ertaş Akyüz & Turan, 2025; Karaoğlu et al.,

2022). However, their relevance may differ across clinical settings and pediatric populations. Accordingly, this study aimed to examine the associations between patient age, medical diagnosis, intravenous fluid type, intravenous medication category, and PIVC complications among hospitalised pediatric patients in two teaching hospitals in Yogyakarta, Indonesia.

METHODS

This observational study used a cross-sectional approach. Data were collected from pediatric patients with peripheral intravenous catheters between January and June 2025 at two teaching hospitals in Yogyakarta, Indonesia. The study used purposive sampling. Inclusion criteria were patients aged 0–18 years who received intravenous therapy and had complete data on the infusion and recorded PIVC complications. Patients discharged before the planned complication observation could be completed were excluded. All eligible patients identified during the data-collection period who met these criteria were included. Data were recorded using an observation checklist containing patient characteristics (age and gender), medical diagnosis, intravenous therapy characteristics (fluid and medication category), and PIVC complications. The checklist had previously undergone content-validity and inter-rater reliability assessment; all items met the reported content-validity criteria (I-CVI > 0.78, S-CVI/Ave > 0.90, S-CVI/UA > 0.70), and inter-rater agreement was reported as $\kappa > 0.74$ (Indarwati et al., 2022). For the present study, two bachelor-prepared nurse researchers with at least one year of pediatric ward experience received standardized training on the study variables, checklist completion, and criteria for identifying infiltration, phlebitis, extravasation, occlusion, leakage, and accidental dislodgement. During a pilot phase, both observers independently



assessed the same patients and resolved discrepancies by consensus. Regular meetings with the principal investigator were used to maintain consistency during data collection. Data were analysed using Jamovi. Descriptive statistics summarized demographic and clinical characteristics. Age was assessed for normality using the Kolmogorov–Smirnov test; because it was not normally distributed, the Mann–Whitney U test was used to compare age between patients with and without PIVC complications. Medical diagnosis, intravenous fluid type, and medication category were summarized as frequencies and percentages and assessed using Chi-square tests. Statistical significance was defined as $p < 0.05$. The study received ethical approval from the Ethics Committee of PKU Muhammadiyah Hospital (No. 203/KEP-PKU/XII/2024).

RESULTS

Table 1 presents the characteristics of the 120 hospitalised pediatric patients included in the study. Most participants were male (63.3%). The mean age was 61.67 months (SD 48.90; range 3–192 months). Gastrointestinal, neurological, immunological, or urinary diagnoses comprised the largest diagnostic group (65.8%). Most patients received Ringer lactate (82.5%) and antibiotics (85.8%). PIVC complications were recorded in 57 patients (47.5%).

Table 2 compares age between patients with and without PIVC complications. Patients with complications were younger on average than patients without complications (53.90 vs 78.50 months), and the group difference was statistically significant ($p = 0.002$).

Table 3 presents the bivariate associations of medical diagnosis, intravenous fluid type, and medication category with PIVC complications. Medical diagnoses were

initially classified into seven categories. To reduce sparse cells, neurological, immunological, and urinary diagnoses were combined with the gastrointestinal category after consultation with a biostatistician. Compared with respiratory diagnoses, the gastrointestinal/neurological/immunological/urinary group had higher unadjusted odds of PIVC complications (OR = 9.91, 95% CI: 3.16–31.07), and the musculoskeletal/integumentary group also had higher unadjusted odds (OR = 10.13, 95% CI: 1.96–52.42). Ringer lactate was not significantly associated with complications compared with KAEN 3B or dextrose (OR = 2.66, 95% CI: 0.95–7.41; $p = 0.056$). Antibiotic administration was also not significantly associated with complications compared with analgesic/other medications (OR = 1.80, 95% CI: 0.62–5.23; $p = 0.277$).

Table 1
Demographic characteristics of the pediatric patients (n=120)

Characteristics of respondents	f	%
Gender		
– Male	76	63.3
– Female	44	36.7
Medical diagnosis		
– Respiratory	31	25.8
– Gastrointestinal, Neurology, Immunology, Urinary	79	65.8
– Musculoskeletal, Integumentary	10	8.3
Type of Fluid		
– Ringer Lactate	99	82.5
– KAEN 3B & Dextrose	21	17.5
Type of Drug		
– Antibiotics	103	85.8
– Analgesic & Other	17	14.2
Complications		
– Yes	57	47.5
– No	63	52.5

Source: Primary Data (2025)



Table 2
Association between age and PIVC complications in pediatric patients (n=120)

Patients Group	n	Mean Age	SD	MD	SE	p	95% CI
Pediatric patients with IV catheter complications	57	53.90	44.73				
Pediatric patients without IV catheter complications	63	78.50	50.64	-24.6	8.7	0.002	7.4 – 41.8

SD:Standard Deviation, SE:Standard Error, Cohen's d: 0.51(moderate effect size)

Source: Primary Data (2025)

Table 3
Association between medical diagnosis, type of intravenous fluids, type of intravenous drugs and PIVC complications in pediatric patients (n=120)

Variables	Complications		p-value	OR	95% CI
	No	Yes			
Patient Diagnosis					
– Respiratorya	27	4		-	-
– Gastrointestinal, Neurology, Immunology, Urinary	32	47	0.001	9.91	3.16 – 31.07
– Musculoskeletal, Integumentary	4	6		10.13	1.96 – 52.42
Type of IV fluid					
– Ringer lactate	48	51	0.056	2.66	0.95 – 7.41
– Kaen 3B or Dextrosea	15	6		-	-
Type of Drugs					
– Antibiotics	52	51	0.277	1.80	0.62 – 5.23
– Analgesic or othersa	11	6		-	-

a reference category; OR: unadjusted Odds Ratio; CI: Confidence Interval Source: Primary Data (2025)

reference category, OR: Odds Ratio, CI: Confidence Interval

Source: Primary Data (2025)

DISCUSSION

Relationship between Age and Intravenous Catheter Complications in pediatric patients

The study found an association between younger age and PIVC complications ($p = 0.002$). Children with complications were, on average, younger than those without complications. This pattern is consistent with previous reports that younger children experience more PIVC-related phlebitis and other catheter complications (Bunga & Widhiati, 2018; Suliman et al., 2020). Several developmental and anatomical factors may contribute: younger children generally have smaller, more fragile vessels, may move more during catheter use, and may have greater difficulty communicating early discomfort or catheter problems. These factors can complicate insertion and maintenance and may contribute to

dislodgement, leakage, or infiltration (Resnick et al., 2021). Older children may have larger vessels and greater ability to cooperate and report symptoms, which can facilitate earlier recognition of catheter-related problems (Ullman et al., 2020). These findings support age-sensitive PIVC assessment and monitoring; however, age was not adjusted for other catheter or patient-level factors in the present analysis (Bunga & Widhiati, 2018; Khotimah et al., 2023; Kusuma & Nurhidayati, 2021).

Relationship between medical diagnosis and intravenous catheter complications in pediatric patients

Medical diagnosis category was also associated with PIVC complications. Compared with respiratory diagnoses, the gastrointestinal/neurological/immunological/urinary group and the musculoskeletal/integumentary group had



higher unadjusted odds of complications, although the confidence intervals were wide. Underlying illness may influence hydration, vascular condition, treatment intensity, and the need for intravenous therapy (Annisa et al., 2024; Karaoglan et al., 2022). Gastrointestinal illness, for example, may involve dehydration and electrolyte loss requiring intravenous replacement (Schneuer et al., 2023), while children with immunological or severe respiratory conditions may require substantial supportive or intravenous treatment (Suliman et al., 2020; Ullman et al., 2020). Nevertheless, the diagnostic categories used in this analysis were broad and heterogeneous, and the estimates were not adjusted for age, catheter characteristics, treatment intensity, or hospital site. The observed odds ratios should therefore be interpreted as exploratory associations rather than independent predictors.

Relationship between Type of Infusion Fluid and Complications of Intravenous Catheter Insertion in Pediatric Patients

No statistically significant association was found between intravenous fluid category and PIVC complications ($p = 0.056$). The estimated association was imprecise, and most participants received Ringer lactate, which limited exposure variability. PIVC complications are multifactorial and may be influenced by patient characteristics, vascular integrity, catheter size and site, insertion technique, securement, and dwell time in addition to the infused solution (Karaoglan et al., 2022; Suliman et al., 2020). Accordingly, the absence of statistical significance in this sample should not be interpreted as evidence that fluid characteristics are clinically irrelevant.

Prior literature suggests that the osmolarity, concentration, and composition of intravenous solutions can influence endothelial irritation and the likelihood of

phlebitis, infiltration, or extravasation (Abubakar & Salman, 2024; Gonsalves et al., 2023; Owen et al., 2021). In the present study, however, fluids were analysed in broad categories (Ringer lactate versus KAEN 3B/dextrose), so the data do not support conclusions about specific osmolarity, concentration, infusion rate, or solution-level mechanisms. Future studies should classify intravenous solutions using clinically relevant physicochemical characteristics and measure administration rate and catheter dwell conditions (Annisa et al., 2024; Purnaningsih et al., 2020).

Relationship between Intravenous Drug Types and Complications of Infusion Installation in Pediatric Patients

The medication category was not significantly associated with PIVC complications in this study. This differs from evidence showing that some intravenously administered medications can increase phlebitis risk because of their concentration, pH, osmolarity, or other physicochemical properties (Ferraz-Torres et al., 2026). PIVC complications were also observed among patients receiving non-antibiotic medications in the present sample, but the broad grouping of antibiotics versus analgesics/other medications limits drug-specific interpretation. Medication-related risk may depend on the specific agent, dilution, infusion rate, route of administration, and catheter-management practices rather than on a broad therapeutic category alone (Brossier et al., 2024). Future studies should therefore analyse individual medications or clinically meaningful irritant/vesicant categories and account for administration practices.

Implications for Nursing Practices

These findings support comprehensive assessment and individualised vascular-access management in pediatric nursing



practice. Younger age and medical diagnosis category were associated with PIVC complications in this sample, so nurses should pay particular attention to vascular assessment, age-appropriate catheter selection, securement, and regular inspection in children who may be more vulnerable. Standard aseptic technique, appropriate site and catheter selection, and timely recognition of catheter problems remain established components of safe PIVC care. Parents can also be engaged as partners in observing the catheter site and promptly reporting swelling, pain, leakage, or other changes, particularly in infants and younger children (Bunga & Widhiati, 2018; Khotimah et al., 2023; Kusuma & Nurhidayati, 2021). These practice recommendations are based on established PIVC-care principles and should not be interpreted as interventions directly tested by the present study.

Limitations of the Study

This study has several limitations. First, the cross-sectional design limits temporal and causal inference between the examined characteristics and PIVC complications (Savitz & Wellenius, 2023). Second, participants were recruited from only two teaching hospitals using a non-probability approach, which may limit generalisability. Third, analyses were not stratified by pediatric developmental stage, although vascular anatomy and catheter-management challenges may differ among infants, toddlers, school-age children, and adolescents. Fourth, several diagnostic and treatment categories were broad and contained small numbers, resulting in wide confidence intervals. Fifth, the reported associations were bivariate and were not adjusted for potential confounders such as hospital site, catheter gauge and location, insertion attempts, securement, dwell time, inserter characteristics, and treatment intensity. Finally, the analysis focused on the presence of any PIVC complication and

did not present complication-specific estimates. Prospective catheter-level studies with standardized outcome definitions and multivariable analysis are needed to clarify independent determinants and the timing of PIVC complications.

CONCLUSION

In this sample of hospitalised pediatric patients, 47.5% experienced a PIVC complication. Younger age and medical diagnosis category were significantly associated with PIVC complications in bivariate analyses, whereas intravenous fluid type and medication category were not significantly associated. These findings indicate that patient age and clinical context warrant attention during pediatric PIVC assessment and monitoring, but the unadjusted cross-sectional estimates should not be interpreted as independent risk prediction. Future prospective studies should evaluate catheter-level insertion and maintenance factors, use clinically specific exposure and outcome definitions, stratify analyses by pediatric age group, and apply multivariable methods to identify independent determinants of PIVC complications.

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