

The Prevalence and Associated Factors of Peripheral Intravenous Complications in a Thai Hospital

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ABSTRACT

Complications of peripheral intravenous catheters (PIVCs) remain a major contributor to health care costs and are a patient safety problem. The objective of this cross-sectional descriptive study was to examine the prevalence of complications and factors associated with complications from peripheral intravenous fluid administration. The study was conducted at a tertiary care hospital in Thailand. The instruments were developed from the literature review. Data were analyzed using SPSS statistics, version 22. The study examined 441 patients with a total of 497 PIVC sites. Phlebitis (level 1 and 2 only) occurred at 2.41% of all sites; infiltration (level 1 and 2 only) occurred at 1.01% of all sites, and extravasation (mild and moderate only) occurred at 0.60% of all sites. Factors associated with the occurrence of infiltration complications included receiving intravenous (IV) crystalloids ($P = .03$) and receiving IV analgesic drugs ($P = .001$). Age was statistically significantly related to extravasation complications ($P = .001$). Nurses should be aware of possible complications from peripheral intravenous fluid administration, especially in older patients and those receiving IV crystalloids or analgesic drugs.

Key words: extravasation, infiltration, peripheral intravenous fluid, phlebitis

INTRODUCTION

Peripheral intravenous catheters (PIVCs) are widely used to maintain intravenous (IV) access in clinical practice. Up

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to 80% of all hospital patients receive peripheral IV fluid administration, and nurses are key to preventing complications from this procedure.¹ The use of peripheral intravenous catheters is associated with the risk of complications such as phlebitis, infiltration, and extravasation. Phlebitis is the irritation or inflammation of a vein wall and is categorized as mechanical (related to the action of the PIVC in the vein), chemical (related to infusate or medication), or bacterial (related to contamination at the insertion site, intravenous solution, or tubing).² Infiltration is the leakage of fluid out of the vein, and extravasation is the leakage of a vesicant drug out of the vein. Phlebitis, caused by irritation of blood vessels due to friction from the catheter tip, is a common complication from peripheral IV fluid administration. Medications themselves can also cause inflammation, as can blood clots formed at the IV catheter tip. Swelling from infiltration and extravasation are also common. These complications cause discomfort and pain and can lead to higher treatment costs and longer hospital stays.³ These complications can lead to bloodstream infections, with a mortality rate of 12% to 25%. Prevention of complications must focus on proper technique, only using IV catheters when medically

necessary and ensuring their prompt removal when no longer necessary, according to recommended guidelines.⁴ However, the magnitude of this risk is unknown.

Background

The use of PIVCs is associated with the risk of complications such as phlebitis, infiltration, and extravasation. Children are at greater risk of complications due to the smaller size of their veins and reduced blood flow around the catheter tip.⁵ The most frequent PIVC complication is phlebitis (with definition), which occurs in 19.3% of patients, based on clinical findings such as redness, swelling, tenderness, pain, warmth, palpable cord, or purulent discharge.^{5,6} Phlebitis can be classified according to the causative factors in mechanical phlebitis, bacterial phlebitis, postinfusion phlebitis, and chemical phlebitis.⁴ Phlebitis is identified and documented using a standardized phlebitis scale that utilizes a range of 1 to 4 to indicate severity (0 = no phlebitis; 1 = lowest in severity; 4 = highest in severity). The risk for phlebitis exceeds 50% by day 4 postcatheterization.⁷ Most articles (57.14%) associated phlebitis with risk factors, including patient's age, gender, current infection, catheter size, dwell time and/or anatomical area, antibiotics, and intermittent maintenance.^{8,9} An association between phlebitis and variable dwell time ≥ 72 hours resulted in higher risks for the development of phlebitis.⁹ Most previous studies reported the risk factors of PIVC complications, which comprised patient characteristics, therapy administered, practice of health care professionals, and materials used.¹⁰ Actions that promote the efficacy and safety of intravenous therapy include maintenance of venous access, infusion volume control, verification of signs of phlebitis during saline solution and medication administration, and constant monitoring through the use of transparent adhesive dressings to achieve frequent and adequate intravenous inspection of the intravenous area and reduce incidence of phlebitis.¹¹

In the studies reviewed for the current study, IV catheter failure is infiltration. With a range of 15.7% to 33.8% and a mean incidence of 23.9%, infiltration is the most common form of IV catheter failure.¹² The most frequent PIVC complication was infiltration/extravasation, which occurred in 13.7% of patients.² Infiltration leads to infusion of fluids and/or medications into the surrounding soft tissues, resulting from erosion or penetration of the catheter into or through the venous wall. Extravasation, the infiltration of a known vesicant or caustic agent, is a particular subgroup of infiltration that can lead to extensive soft tissue injury and loss with devastating results.¹²

The severity of infiltration was labeled with the infiltration scale range from grade 1 through grade 4.⁴ Data were collected from incidence of peripheral intravenous infiltration, which was assessed for several risk factors, such as age, diagnosis, comorbidities, dwell time, size of catheter use for insertion, and the number of medications being administered intravenously.^{8,13} The risk factors of infiltration for hospitalized children who received peripheral

intravenous injection therapy were lower limb (odds ratio [OR] = 1.72), phenytoin (OR = 11.03), 10% dextrose (OR = 6.55), steroids (OR = 6.21), vancomycin (OR = 4.10), high-concentration electrolytes (OR = 3.49), and ampicillin/sulbactam combination (OR = 3.37).¹⁴

Extravasation is a medication-related adverse event occurring when an irritant or vesicant injectable drug (which may cause tissue necrosis) leaks into the perivascular or subcutaneous spaces. Of all the irritant and vesicant substances that may extravasate, cytotoxic and contrast agents are already subject to a relatively well-defined management strategy in health care institutions.¹⁵ The incidence of extravasation varies between 0.01% and 7.00%, depending on the study.¹⁶ The severity of extravasation was labeled with the extravasation scale, from grade mild to moderate to severe extravasation.¹⁷ The risk factors of extravasation include infused high volume per day (≥ 1000 mL), type of medical procedure, infused agents with high osmolarity, and poor vein condition. The severity of extravasation was related to the large volumes of drug or special drugs (high-osmolarity, high-risk, low pH, etc).¹⁸ However, numerous drugs that are used on a daily basis in most general care institutions may cause patients serious harm in the case of extravasation, including hyperosmolar agents (eg, parenteral nutrition solutions, magnesium sulfate, potassium chloride, sodium bicarbonate), acidic (eg, metronidazole, vancomycin, nicardipine) and basic compounds (eg, furosemide, phenobarbital), and vasopressors (eg, norepinephrine, epinephrine, dobutamine, dopamine).¹⁵

Numerous characteristics might be included as patient considerations, including small and fragile veins, brittle skin, and age: young children and the elderly are more likely to have small rolling veins.¹⁹ Patients who are unconscious, confused, or have communication difficulties may be incapable of addressing pain or discomfort caused by the cannula position. Patients with comorbid conditions that can result in diminished feeling or poor circulation, such as peripheral vascular disease, diabetes mellitus, or obesity, may also experience diminished sensation or poor circulation. Depending on the agent, coexisting medications such as anticoagulants, analgesics, antifibrinolytics, vasodilators, hormone therapy, diuretics, steroids, antihistamines, and intravenous antibiotics may increase blood circulation, decrease inflammatory response, and decrease pain sensation, among others.¹⁶ Other risk factors associated with PIVC complications found on the prevalence surveys on PIVC complications performed in 2020 at Chiang Mai University Hospital depended on the agent, such as blood, blood component, colloid, crystalloids, and whether a sterile transparent dressing was used.²⁰

Maharaj Nakorn Chiang Mai Hospital is a 1400-bed university hospital located in the north of Thailand. It serves about 50 000 patients per year, of whom approximately 80% receive PIVCs. Prevalence surveys on phlebitis were performed in 2020 and found that 4.69% of patients with a peripheral catheter had phlebitis, and 3.35% of patients had

infiltration.²⁰ The related PIVC complications had no documentation to improve maintenance and care. Therefore, the current study proposed to examine the prevalence of complications and factors associated with complications from peripheral IV fluid administration.

METHODS

Study Design

This cross-sectional descriptive study aimed to analyze the prevalence of complications and factors associated with difficulties from peripheral IV fluid administration. Data were collected at a tertiary care hospital in Thailand on December 17, 2021.

Setting and Subjects

This cross-sectional study was conducted among the patients who received peripheral intravenous IV fluid administration at the Faculty of Medicine, Chiang Mai University. The subjects were patients who received peripheral IV fluid administration from 10 nursing sections.

Instruments

The research instruments were developed from the literature review and included the following (see Appendix 1):

1. general patient information, including ward data and diagnosis;
2. information on factors associated with complications from peripheral intravenous fluid exposure, including gender, age, diagnosis, comorbidities, level of consciousness (Glasgow Coma Scale [GCS] score), IV infusion setting, PIVC catheter size, insertion site, PIVC dressing, treatment affecting immunosuppression, receiving IV crystalloids, receiving IV colloid, receiving IV vascular regulators, receiving IV antibiotics, receiving IV hyperosmolar agents, receiving IV anticoagulant, receiving IV antiplatelet, receiving IV antifibrinolytics, receiving IV analgesic drugs, and catheter dwell time (days); and
3. PIVC complication data (phlebitis, infiltration, and extravasation) using the phlebitis scale, infiltration scale, and extravasation scale.¹⁷

To verify accuracy of the contents (content validity), validity of the instruments was checked by 3 infection control specialists, including an infection control associate professor, infection control advanced practice nurse (APN), and infusion nurse specialist. The content validity index (CVI) was calculated with a value equal to 1. To determine reliability of the tools, a complication assessment sheet was used to evaluate 10 patients. After recording complications of the PIVC, interrater reliability was calculated to 0.98. Then, the nursing action observation sheet was used to observe 10 nurses. The interrater reliability of this instrument was 0.95.

Data Collection and Analysis

The data were collected by 26 research assistants, who assessed the peripheral intravenous complications at 10 nursing sections at the Faculty of Medicine, Chiang Mai University, on December 17, 2021. These research assistants were trained in degrees of peripheral intravenous fluid complications, including phlebitis, infiltration, and extravasation, and the interrater reliability of the research assistants was tested. The CVI was 1.0 in a test of 30 items of degree of PIVC complications.

The exclusion criterion was unwillingness to participate. The participant or the parent/guardian was asked to sign a consent form. The research assistants recorded the data by using the research instruments that were developed from the literature review and included general patient information, including ward data and information on factors associated with complications from peripheral intravenous fluid exposure.

Data were analyzed using the SPSS statistics program, version 22 (IBM, Armonk, NY), by frequency and percentage. Factors associated with complications from peripheral IV fluid administration were investigated using χ^2 analysis statistics.

Ethical Approval

This study was approved by the research ethics committee of the Faculty of Medicine, Chiang Mai University (research ID: NUR-2564-08607, Certificate Code 535/64).

RESULTS

Prevalence of Complications From Peripheral Intravenous Fluid Exposure

The study included a total of 441 patients treated in 10 nursing sections, with 497 peripheral IV catheter sites. Among them, 27.8% were patients with cancer, 38.0% had comorbidities, 55.5% were men, 43.3% were over the age of 60 years, and 5.6% were younger than 1 month (Table 1). Information on complications from peripheral intravenous fluid exposure shown at Table 2. Phlebitis (level 1 and 2 only) was found at 2.41% of all sites; infiltration (level 1 and 2 only) occurred at 1.01% of all sites; and extravasation (mild and moderate only) was found at 0.60% of all sites (Table 3).

Factors Associated With Complications From Peripheral IV Fluid Exposure

The factors investigated for association with complications from peripheral IV fluid exposure included in this study can be found above, under "Instruments." The study found that IV infusion setting ($P = .03$), receiving IV crystalloids ($P = .04$), and receiving IV analgesic drugs ($P = .01$) were statistically significantly associated with overall IV complications (phlebitis, infiltration, and extravasation). Statistically significant factors associated with infiltration were receiving IV crystalloids ($P = .04$) and receiving IV analgesic drugs ($P = .01$). Age was statistically significantly related to the occurrence of extravasation complications ($P = .001$; Table 4).

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TABLE 1
Characteristics of Study Participants and Factors Associated with Complications from Peripheral IV Fluid Exposure (n = 497)

Characteristics/factors	Number	Percent
Gender		
Male	276	55.5
Female	221	44.5
Age group		
<1 mo	28	5.6
>1 mo to 1 y	4	0.8
>1 y to 15 y	28	5.6
>15 y to 30 y	91	18.3
>30 y to 60 y	131	26.4
>60 y	215	43.3
Bacterial sepsis		
Yes	0	0
No	497	100
Comorbidities		
Yes	189	38.0
No	308	62.0
Treatment affecting immunosuppression		
Yes	117	23.5
No	380	76.5
Level of consciousness (GCS score)		
Score 1-5	156	31.4
Score 6-10	35	7.0
Score 11-15	306	61.6
IV infusion setting		
Continuous	270	54.3
Intermittent	227	45.7
PIVC catheter size		
Unknown	8	1.6
18 gauge	28	5.6
20 gauge	68	13.7
22 gauge	290	58.4
24 gauge	103	20.7
Insertion site		
Arm	262	52.7
Hand	159	32.0
Arm crook	29	5.8
Leg	27	5.4
Instep	11	2.2
Head	7	1.4
Ankle	2	0.4
PIVC dressing		
Sterile transparent	483	97.2
Nonsterile transparent	14	2.8

(continues)

TABLE 1
Characteristics of Study Participants and Factors Associated with Complications from Peripheral IV Fluid Exposure (n = 497)
(Continued)

Characteristics/factors	Number	Percent
Receiving IV crystalloids		
Yes	234	47.1
No	263	52.9
Receiving IV colloid		
Yes	9	1.8
No	488	98.2
Receiving IV vascular regulators		
Yes	6	1.2
No	491	98.8
Receiving IV antibiotics		
Yes	263	52.9
No	234	47.1
Receiving IV hyperosmolar agents		
Yes	10	2.0
No	487	98.0
Receiving IV anticoagulant		
Yes	29	5.8
No	468	no
Receiving IV antiplatelet		
Yes	13	2.6
No	484	97.4
Receiving IV antifibrinolytics		
Yes	3	0.6
No	494	99.4
Receiving IV analgesic drugs		
Yes	66	13.3
No	431	86.7
Catheter dwell time, d		
<4	474	95.4
>4	16	3.2
Unknown	7	1.4

Abbreviations: GCS, Glasgow Coma Scale/Score; IV, intravenous; PIVC, peripheral intravenous catheter.

DISCUSSION

The study found phlebitis (level 1 and 2 only) in 2.41% of the 497 peripheral IV sites investigated. This was significantly less than the Centers for Disease Control and Prevention.²¹ In comparison, the One Million Global study reports an overall prevalence of 10%, with the highest prevalence seen in Asia, at 16%.²² Infiltration (level 1 and 2 only) was found at 1.01% of all sites, which is much less than that reported

TABLE 2**Information on Complications from Peripheral Intravenous Fluid Exposure (n = 497)**

IV Complications Prevalence	Number	Percent
Phlebitis scale grade		
0	485	97.6
1	10	2.0
2	2	0.4
3	0	0
4	0	0
Infiltration scale grade		
0	492	99.0
1	1	0.2
2	4	0.8
3	0	0
4	0	0
Extravasation scale grade		
Normal	494	99.4
Mild	1	0.2
Moderate	2	0.4
Severe	0	0

in a Serbian study of 1428 IV cannula insertions in a tertiary care hospital, which found a 16.30% rate of infiltration, and less than a previous study in a Thai university hospital, which found a rate of 6.20%.^{8,23} The extravasation rate of 0.6% found in this study was much less than that in a study from Thammasat Chalermprakiat Hospital in Thailand²⁴ and slightly higher than the 0.5% rate found in the previous study.^{24,25}

The relatively low complication rates found in this study could be attributed to active promotion, support, monitoring, and evaluation of the quality of peripheral IV fluid administration and using updated practices, which had increased the list of drugs and fluid agents that could cause extravasation.²⁶ The new organizational guidelines

were published in January 2021, media and educational materials were created, and the use of the guidelines was promoted.²⁶ An online knowledge test was conducted in August 2021, with the assessment passing the threshold at 100%, which increased compliance with the guidelines. In September 2021, more than 80% of the IV assessments met the criteria, showing that nursing staff were knowledgeable and able to assess extravasation.

This study found that IV infusion setting was statistically related to complications ($P = .03$), which was consistent with studies on infusion therapy, in which rapid hydration increases the risk factors of leakage.²⁷ It was also in line with the study of Norrasarn,²⁸ showing that high osmolarity increases the risk of phlebitis. It was shown that osmolarity values >290 mOsm/L cause high osmotic pressure, causing fluid to move from inside the cells, which makes the cells lose their function.

Crystalloid exposure was also statistically significantly related to complications from overall IV fluid administration. Isotonic, hypotonic, and hypertonic solutions all require control of infiltration volume and infusion rate, thus increasing the pressure of the drug in the vein. In most cases, fluid administration uses infusion therapy, which provides rapid and continuous hydration, which increases the risk factors of fluid leakage and the risk of venous injury.^{2,11} The hypertonic solution was reported to damage the vascular endothelium and cause phlebitis because it is a chemical substance and its osmolarity is higher than the osmolarity of blood.⁴ There are studies indicating that the type of infusion fluid is important in the development of phlebitis, particularly the use of hyperosmolar solutions, antibiotics, and fluid with potassium chloride (KCl), which increase the risk for phlebitis.²⁹

This study also found that exposure to analgesic drugs was statistically significantly related to complications from overall IV fluid administration ($P = .01$), which corresponds to studies in England where extravasation occurred in patients receiving analgesic drugs (Table 4).⁴ As analgesics reduce the pain response, when a drug or fluid leak occurs, severe extravasation can occur.³⁰ Finally, this study found that age was statistically significantly related to the occurrence of extravasation complications from IV fluid administration ($P = .001$; Table 4). This was consistent with a study by Pathomjaruwat,²⁴ which found that patient age was a risk factor for drug leakage or extravasation. It found that young children and the elderly were at greater risk, as they were less associated with skin strength and stiffness.³¹ Infants and young children have relatively thin blood vessels, thus, making it difficult to perform venipuncture and more likely to damage blood vessels.³² Moreover, infants and young children are more likely to move and have poor compliance; thus, it is difficult to properly stabilize the infusion site during infusion. Elderly patients have decreased body functions; decreased skin elasticity, which is prone to needle displacement; atherosclerosis of the blood vessels causing diminished blood flow; and reduced blood fluidity. Consequently, the risk of extravasation in older adults is greatly increased.

TABLE 3**Data on the Prevalence of Complications from Peripheral Intravenous Fluid Exposure (n = 497)**

Complications encountered	No. (times)	Prevalence of complications (per 100 peripheral intravenous catheter sites)
Phlebitis	12	2.41
Infiltration	5	1.01
Extravasation	3	0.60
Total	20	4.02

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TABLE 4

Analysis of the Factors Associated with PIVC Complications

Factors/IV complications	Phlebitis (P value)	Infiltration (P value)	Extravasation (P value)	Complications included (P value)
Gender	.12	.27	.70	.61
Age range	.60	.81	.001**	.37
Diagnosis	.43	.55	.99	.45
Comorbidities	.35	.40	.17	.90
Level of consciousness (GCS score)	.29	.21	.89	.45
IV infusion setting	.37	.12	.06	.03*
PIVC catheter size	.78	.46	.92	.93
Insertion site	.21	.87	.85	.65
PIVC dressing	.71	.87	.77	.44
Treatment affecting immunosuppression	.90	.21	.67	.70
Receiving IV crystalloids	.33	.03*	.63	.04*
Receiving IV colloid	.63	.76	.81	.53
Receiving IV vascular regulators	.70	.22	.63	.27
Receiving IV antibiotics	.70	.22	.63	.27
Receiving IV hyperosmolar agents	.11	.75	.80	.33
Receiving IV anticoagulant	.38	.58	.67	.26
Receiving IV antiplatelet	.57	.71	.78	.45
Receiving IV antifibrinolytics	.79	.86	.89	.72
Receiving IV analgesic drugs	.92	<.001**	.20	.01*
Catheter dwell time, d	.10	.59	.93	.28

Abbreviations: GCS, Glasgow Coma Scale/Score; IV, intravenous; PIVC, peripheral intravenous catheter.

χ² test.

*Significant P < .05.

**Significant P < .001.

Study Limitations

Limitations of this study are that, although data were representative of the population surveyed, the sample size was relatively small, and the survey was only conducted in 1 tertiary care university hospital at 1 point in time.

CONCLUSIONS

Nurses are important workers in the care and monitoring of complications from peripheral IV fluid administration. Nurses should be aware and develop guidelines for preventing complications from peripheral IV fluid administration. This survey has identified priority areas for improvement related to PIVC insertion and management, which are key to preventing PIVC failure and associated complications in the future for patients.

REFERENCES

1. Mermel LA. Short-term peripheral venous catheter-related bloodstream infections: a systematic review. *Clin Infect Dis*. 2017;65(10):1757-1762. doi:10.1093/cid/cix562

2. Marsh N, Webster J, Flynn J, et al. Securement methods for peripheral venous catheters to prevent failure: a randomized controlled pilot trial. *J Vasc Access*. 2015;16(3):237-244. doi:10.5301/jva.5000348

3. Dychter SS, Gold DA, Carson D, Haller H. Intravenous therapy: a review of complications and economic considerations of peripheral access. *J Infus Nurs*. 2012;35(2):84-91. doi:10.1097/NAN.0b013e31824237ce

4. Gorski LA, Hadaway L, Hagle ME, et al. Infusion therapy standards of practice. *J Infus Nurs*. 2021;44(1S suppl 1):S1-S224. doi:10.1097/NAN.0000000000000396

5. Marsh N, Webster J, Ullman A, et al. Peripheral intravenous catheter non-infectious complications in adults: a systematic review and meta-analysis. *J Adv Nurs*. 2020;76(12):3346-3362. doi:10.1111/jan.14565

6. Zingg W, Pittet D. Peripheral venous catheters: an under-evaluated problem. *Int J Antimicrob Agents*. 2009;34(Suppl 4):S38-S42. doi:10.1016/S0924-8579(09)70565-5

7. Cicolini G, Manzoli L, Simonetti V, et al. Phlebitis risk varies by peripheral venous catheter site and increases after 96 hours: a large multi-center prospective study. *J Adv Nurs*. 2014;70(11):2539-2549. doi:10.1111/jan.12403

8. Simin D, Milutinović D, Turkulov V, Brkić S. Incidence, severity and risk factors of peripheral intravenous cannula-induced complications: an observational prospective study. *J Clin Nurs*. 2019;28(9-10):1585-1599. doi:10.1111/jocn.14760

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9. Urbanetto JS, Freitas APC, Oliveira APR, et al. Risk factors for the development of phlebitis: an integrative review of literature [in Portuguese, English]. *Rev Gaucha Enferm.* 2018;38(4):e57489. doi:10.1590/1983-1447.2017.04.57489
10. Lee WL, Chen HL, Tsai TY, et al. Risk factors for peripheral intravenous catheter infection in hospitalized patients: a prospective study of 3165 patients. *Am J Infect Control.* 2009;37(8):683-686. doi:10.1016/j.ajic.2009.02.009
11. Guanche-Sicilia A, Sánchez-Gómez MB, Castro-Peraza ME, Rodríguez-Gómez JÁ, Gómez-Salgado J, Duarte-Clímets G. Prevention and treatment of phlebitis secondary to perspective. *Healthcare (Basel).* 2021;9(5):611. doi:10.3390/healthcare9050611
12. Helm RE, Klausner JD, Klemperer JD, Flint LM, Huang E. Accepted but unacceptable: peripheral IV catheter failure. *J Infus Nurs.* 2015;38(3):189-203. doi:10.1097/NAN.0000000000000100
13. Banks JM. Identifying risks for high incidence of peripheral intravenous catheter complications: reducing infiltration rate within the hospital. *Walden Dissertations and Doctoral Studies.* 2015. Accessed January 2, 2024. <https://scholarworks.waldenu.edu/dissertations/1615>
14. Park SM, Jeong IS, Jun SS. Identification of risk factor for intravenous infiltration among hospitalized children: a retrospective study. *PLoS One.* 2016;11(6):e0158045. doi:10.1371/journal.pone.0158045
15. David V, Christou N, Etienne P, et al. Extravasation of noncytotoxic drugs. *Ann Pharmacother.* 2020;54(8):804-814. doi:10.1177/1060028020903406
16. Hassan DS, Hasary HJ. Chemotherapy-induced extravasation injury: classification and management. *Al-Rafidain J Med Sci.* 2022;2:81-92. doi:10.54133/ajms.v2i.64
17. Infusion Nurse Network of Thailand. *Peripheral Intravenous Nursing Guideline.* Pre-One Company; 2018:1-50.
18. Yan Y-M, Gong M, Chen J-L, et al. Incidence, risk factors and treatment outcomes of drug extravasation in pediatric patients in China. *Turk J Pediatr.* 2017;59(2):162-168. doi:10.24953/turkped.2017.02.008
19. Utlu Z, Bilen H. Evaluation of cutaneous side-effects associated with chemotherapeutic use in oncological patients. *Postepy Dermatol Alergol.* 2021;38(6):1078-1085. doi:10.5114/ada.2020.99943.
20. The Prevention and Infection Control Unit. *Prevalence Report.* Chiang Mai University Hospital. 2020;1:1-34.
21. O'Grady NP, Alexander M, Burns LA, et al. Guidelines for the prevention of intravascular catheter-related infections. *Clin Infect Dis.* 2011;52(9):e162-e193. doi:10.1093/cid/cir257
22. Alexandrou E, Ray-Barruel G, Carr PJ, et al. Use of short peripheral intravenous catheters: characteristics, management, and outcomes worldwide. *J Hosp Med.* 2018;13(5). doi:10.12788/jhm.3039
23. Pichensathian W, Dumrongkullachart D, Wongsan R, Kaveevan T, Koonna A, Netsawang P. Promoting evidence-based practice among nurses in the management of peripheral intravascular devices. *Nurs J.* 2014;41:71-87. Accessed January 2, 2024. <https://www.tci-thaijo.org/index.php/cmunnursing/article/download/32702/27868/0>
24. Pathomjaruwat T. Impact of a nursing care guideline on prevention and management of extravasation. *TJNC.* 2016;31(2):81-95. Accessed January 2, 2024. <https://he02.tci-thaijo.org/index.php/TJONC/article/view/47539>
25. Abolfotouth MA, Salam M, Bani-Mustafa A, White D, Balkhy HH. Prospective study of incidence and predictors of peripheral intravenous catheter-induced complication. *Ther Clin Risk Manag.* 2014;10:993-1001. doi:10.2147/TCRM.S74685
26. Nursing Department. *Peripheral Intravenous Infusion Guideline.* Maharaj Nakhon Chiang Mai Hospital. 2020;2:1-25.
27. Doellman D, Hadaway L, Bowe-Geddes LA, et al. Infiltration and extravasation: update on prevention and management. *J Infus Nurs.* 2009;32(4):203-211. doi:10.1097/NAN.0b013e3181aac042
28. Norrasarn S. Phlebitis: clinical risks prevention. *Rama Nurs J.* 2006;12(2):167-179. Accessed January 2, 2024. https://www.rama.mahidol.ac.th/nursing/sites/default/files/public/journal/2549/issue_02/05.pdf
29. Al-Benna S, O'Boyle C, Holley C. Extravasation Injuries in Adults. *ISRN Dermatol.* 2013;856541. doi:10.1155/2013/856541.
30. Sauerland C, Engelking C, Wickman R, Corbi D. Vesicant extravasation part I: mechanisms, pathogenesis, and nursing care to reduce risk. *Oncol Nurs Forum.* 2006;33(6):1134-1141. doi:10.1188/06.ONF.1134-1141
31. Gong Z, Zhang J, Hou J, et al. Drug extravasation in a large general hospital in Hunan, China: a retrospective survey. *Risk Manag Healthc Policy.* 2021;14:4931-4938. doi:10.2147/RMHP.S318832
32. Atay S, Sen S, Cukurlu D. Incidence of infiltration/extravasation in newborns using peripheral venous catheter and affecting factors. *Rev Esc Enferm USP.* 2018;52:e03360. doi:10.1590/s1980-220X2017040103360

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Collecting data form

The Prevalence and Associated Factors of Peripheral Intravenous Complications in Thailand
Nursing Service Organization, Faculty of Medicine Chiangmai University

Sticker ID

Part 1 Demographics date

Ward..... Nursing Section

Diagnosis.....

Part 2 Risk factor associated of PIV complications (phlebitis, infiltration, extravasation)

1. Gender Male Female
2. Age (Focus on year, month, day).....
3. Bacteria sepsis No Yes
 - Skin infection from Fungus Skin infection from bacteria septicemia
 - other (specific type of sepsis).....
4. Comorbidities cancer vascular disease DM
 - hypertension skin kidney failure
 - other (specific type of comorbidities).....
5. Level of conscious Level: GCS score =.....
6. Treatment affecting immunosuppression
 - No
 - Yes cytotoxic agent steroid radiotherapy other.....
7. IV infusion setting continuous intermittent
8. Type of catheter Butterfly IV Canula /Cather No.....
 - IV catheter with 3 way IV catheter with injection plug
9. Insertion site arm hand arm crook leg instep Head
 - ankle other
10. PVC dressing sterile Transparent Plaster / fixomull Gauze & tape
11. Receiving IV crystalloids no yes
 - Hypotonic (0.45% NSS, 1/3 NSS, 1/4 NSS)
 - Hypertonic (5% D/S, 5%D/S/2, 10% D/S, 10%D/W. 20%D/W)
 - Isotonic (0.9% NSS, 5% D/W, LRS. Acetate ringer)

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12. Receiving IV colloids no
 yes (type) Heamaccel, Plasma, Gelifundol, Dextran.....
13. Receiving IV vascular regulators no yes (type) Dopamine, Norepinephrine, Dobutamine, Adrenaline,.....
14. Receiving IV antibiotics (Potentially damaging; alkaline & acid) no yes (type)
 Genta, Penicillin, Vancomycin, Amphotericin B, Ceftriaxone, Acyclovir, Erythromycin, Co-trimoxazole, Gancyclovir
15. Receiving IV Hyperosmolar agents no yes (type)
 TPN, 20% lipid,.....
16. Receiving IV anticoagulant no yes (type)
17. Receiving IV antiplatelet no yes (type)
18. Receiving IV antifibrinolytics no yes (type) Aspirin, Warfarin.....
19. Receiving IV analgesics drug no yes (type and route)
 Paracetamol (oral/ IV). MO..... , Fentanyl,.....other (type).....
20. Catheter dwelling time (days).....
 in hospital (ward)..... out hospital (name of hospital).....
21. Other (type) Blood/blood component, Potassium chloride (KCl), Nicardipine, Diuretic, Ca. gluconate, NaHPO4, Antihistamine ,.....

Part 3 The data of IV complications

1. phlebitis scale 0 1 2 3 4
2. infiltration scale 0 1 2 3 4
3. extravasation scale no mild moderate severe

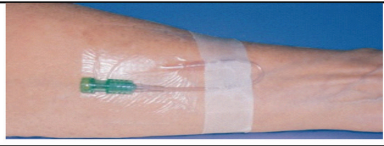
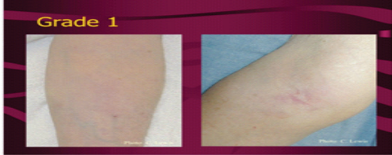



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Phlebitis scale

Scale	Signs & Symptoms	Nursing care	Picture
0	No symptoms	Observe IV site Monitor & Record	
1	Erythema at access site with or without pain	-Resite the cannula -Monitor & Record -Report incidence	
2	Pain at access site with erythema and/or edema	- Resite the cannula -Cold or hot pack, depending on fluid -Monitor & Record - Report incidence	
3	-Pain at access site with erythema -Streak formation -Palpable venous cord	- Resite the cannula - Cold or hot pack, depending on fluid - Report to the doctor - Monitor & Record -Report incidence	
4	- Pain at access site with erythema -Streak formation -Palpable venous cord > 1 inch in length	- Resite the cannula - Cold or hot pack, depending on fluid - Report to the doctor - Consider treatment - Monitor & Record every shift - Report incidence	





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Infiltration scale

Scale	Signs & Symptoms	Nursing care	Picture
0	No symptom	Monitor & Record	
1	Skin blanched - Edema < 1 inch in any direction - Cool to the touch - With or without pain	- stop IV infusion - Resite the cannula - Incidence Report	
2	Skin blanched - Edema 1-6 inches in any direction - Cool to the touch - With or without pain	- stop IV infusion - Resite the cannula - Elevate the extremity - Inform Physician - Incidence Report	
3	Skin blanched - Gross edema > 6 inches in any direction - Cool to the touch - Mild to moderate Pain - Possible numbness (per resident)	- stop IV infusion - Resite the cannula - Elevate the extremity - Inform Physician - Incidence Report	
4	-Skin blanched, translucent - Skin tight, leaking -Skin discolored, bruised, swollen - Gross edema > 6 inches in any direction - Deep pitting tissue edema - Circulatory impairment - Moderate to severe pain - Possible numbness (per resident)	- stop IV infusion - Resite the cannula - Elevate the extremity - Inform Physician - Incidence Report - consult plastic surgery - Consider treatment - Monitor & photograph site	

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Extravasation scale

Scale	Signs & Symptoms	Nursing care	Picture
Normal	No pain	<ul style="list-style-type: none"> - Monitor & Record * Monitor every 1 hour in Vesicant drug 	
Mild	<ul style="list-style-type: none"> - Redness at site - Cool to the touch / warm skin - Swelling - No skin blanching - Mild Pain (score 1-3) - Normal capillary refill and peripheral pulsation - Normal temperature (36.5-37.5°c) 	<ul style="list-style-type: none"> - Stop IV infusion immediately - Give antidote - Apply thermal therapy according to the drug - Elevate the extremity - Monitor & Record - Inform Physician - Consider treatment - Monitor & photograph site - Incidence- Report 	
Moderate	<ul style="list-style-type: none"> - Bruised - Cool blanched area - moderate swelling - Normal capillary refill and peripheral pulsation - Moderate Pain (score 3-5) - Fever (BT>37.5°c) 	<ul style="list-style-type: none"> - Stop IV infusion immediately - Give antidote - Apply thermal therapy according to the drug - Elevate the extremity - Monitor & Record - Inform Physician - Consider treatment - Monitor & photograph site - Incidence- Report - Consider treatment - Monitor & photograph site 	
Severe	<ul style="list-style-type: none"> - Skin blanching - Skin breakdown or necrosis - Cool blanched area - severe swelling - Edema - Severe Pain (score 5-10) - Reduced capillary refill - Fever (BT>37.5°c) 	<ul style="list-style-type: none"> - Stop IV infusion immediately - Give antidote - Apply thermal therapy according to the drug - Elevate the extremity - Monitor & Record - Inform Physician - Consider treatment - Monitor & photograph site - Incidence- Report - Consider treatment - Monitor & photograph site 	

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