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The Risk Factors of Phlebitis in The Installation of Intravent Catalysts

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ABSTRACT

Background: A hospital is a health service facility that allows nosocomial infections, namely phlebitis. Phlebitis is a complication of intravenous catheter placement that is characterized by redness, pain, swelling, and fever. The high rate of phlebitis in various countries is due to the risk factors that predispose to the incidence of phlebitis due to intravenous catheter placement.
Objective: This study aims to determine the risk factors for phlebitis in intravenous catheter placement.
Methodology: This study uses an observational analytic method with a cohort design. The study was conducted on 27 February - 14 March 2020 with 22 samples taken using purposive accidental sampling in the inward and RST surgery Dr. Soedjono Magelang. The instrument used was an observation sheet designed by researchers that had been tested by experts and a standard operational checklist for infusion. Data analysis uses a chi-square test and multiple logistic regression.
Results: The incidence of phlebitis was 7 respondents (31.8%) and the associated risk factors were the type of infusion fluid (RR = 4.37 CI 95% 1.09-17.58; p-value 0.020). While the factors of age, sex, nutritional status, chronic diseases, types of injection drugs, insertion location, duration of installation, nurse skills, installation techniques, and catheter size were not related to the incidence of phlebitis (p-value> 0.05).
Conclusion: Although several factors are not related to the incidence of phlebitis, these factors can be a support for the incidence of phlebitis.

Keyword : phlebitis; intravenous catheter; risk factors

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Background. The hospital is a health institution that serves the community by providing inpatient, outpatient, and emergency services (President, 2009). Various hospital services from health checks, treatments, and even medication can improve the degree of public health. However, there are risk factors that need to be considered in health care, namely nosocomial infections.

Nosocomial infection or iatrogenic infection is an infection obtained after entering a health care facility. This is due to the high intensity of the patient's illness or frequent invasive actions that reduce immunity (Astle et al., 2019). The incidence of nosocomial infection is used as a standard of service in the accreditation system that is ≤1.5% (Rizky, 2016). One contributor to nosocomial infections in hospitals is phlebitis. Phlebitis is inflammation of venous blood vessels due to trauma to the vessel wall, infection, immobilization, and duration of IV placement (Astle et al., 2019). According to Vidhya (2017), phlebitis has signs or symptoms such as pain, swelling, redness, and warmth in the area of infusion.

The prevalence of phlebitis is still high in some countries. Research in Brazil by Urbanetto, Peixoto, & May (2016) explains the incidence of phlebitis when a venous catheter is 1.25% installed, whereas after an IV has been removed 1.38%. Besides, higher phlebitis rates occur in the UK reaching 20-80% (Mohammed & James, 2018). In Southeast Asian countries, the incidence of phlebitis is also still high. Research conducted by Gargar, Cutamora, & Abocejo (2017) states that the incidence of phlebitis in the Philippines is 12.12% to 23.19%, seen from the time of infusion replacement. Whereas in Thailand as much as 20% with predictive factors such as cancer, smoking, glucose use, and drugs (Yeesin, Rojanaworarit, & Chansatitporn,

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2017). Indonesia, there are no specific data regarding phlebitis. However, a study by Sumara (2017) at the Husada Utama Hospital in Surabaya stated that 56.25% of patients who were installed intravenously had phlebitis. While the incidence of phlebitis in the installation of infusion in Tugurejo Regional Hospital Semarang was 55% (Pradini, 2016).

According to Salgueiro-Oliveira, Parreira, & Veiga (2012), risk factors for phlebitis are divided into 4 main parts, namely patient characteristics, administration of therapy, the practice of health professionals, and use of materials. On patient characteristic factors there are age, sex, nutritional status, illnesses suffered by patients (Akbar & Isfiandiari, 2018; Rizky & Supriyatiningsih, 2014; Yeesin et al., 2017). In the age factor, elderly people are more at risk of developing phlebitis than children so that the incidence of phlebitis in pediatric wards is lower (Nadhova, Irasanti, & Fitriyana, 2019; Rizky & Supriyatiningsih, 2014). Factors that include administration of therapy are the type of fluid, type of drug injected, location of insertion, and length of time of installation (Anggita, 2018; Aziz, Hafid, & Alip, 2016; Budiarti, Subagja, & Ratnasari, 2018; Putri, 2016; Sumara, 2017). Practical factors of professional health workers include nurses 'skills in installation, installation techniques, and nurses' knowledge (Milutinović, Simin, & Zec, 2015; Nadhova et al., 2019), while the factor of material used is the type and size of the IV catheter (Milutinović et al., 2015). If these factors are not considered by nurses in the management of infection prevention, the incidence of phlebitis in hospitals remains high and even increases.

The incidence of phlebitis in RST dr. Soedjono Magelang Bougenvile, Cempaka, and Seruni wards in September to December 2019 were still quite high, from 2597 patients who had infusion as many as 32 patients experienced phlebitis and when tested, a value of 1.2% was obtained, a number close to the hospital nosocomial infection standard (≤1.5%).

Therefore the need to know the most dominant risk factors in supporting phlebitis in RST dr. Soedjono Magelang so that prevention and control of phlebitis can be minimized so that the quality of health services in hospitals increases.

Methods. This type of research is an observational analytic cohort design. The sample in this study was inpatients in the Bougenvile, Cempaka, and Seruni Wards which were infused and fulfilled the researchers' inclusion and exclusion criteria. This is with the consideration that the three wards have almost the same socio-economic conditions that affect the lifestyle of patients who support phlebitis. Also, the ward's health care form when compared to class 1 or VIP wards is slightly different. The sampling technique used by researchers is purposive accidental sampling, where respondents are taken based on the criteria and patient inpatient times determined by the researcher. The instrument used was an observation sheet designed by researchers that had been tested by experts and a standard operational checklist for infusion. Data analysis uses a chi-square test and multiple logistic regression.

Result and Discussion. Characteristics of respondents attached intravenous catheters based on age, sex, nutritional status, chronic disease, type of infusion fluid, type of drug injected, insertion location, duration of installation, nurse skills, installation technique, size of catheter IV, and incidence of phlebitis in the following table 1

Table 1 Distribution of Characteristics of Respondents with Intravenous Catheters

Variable	Frequency	%
Age		
≥ 40 years	13	59,1
< 40 years	9	40,9
Gender		
Female	12	54,5
Male	10	45,5
Nutritional Status		
< 18,5 kg	6	27,3
≥ 18,5 kg	16	72,7
Chronic Disease		
Predisposition	8	36,4
Not a Predisposition	14	63,6

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Types of Infusion Fluids		
Risk	8	36,4
Not a risk	14	63,6
Types of Injection Medications	11	50,0
Diluted	11	50,0
Not Diluted		
Insertion Location		
Joint	7	31,8
Not a joint	15	68,2
Duration of Infusion		
>3 days	1	4,5
≤ 3 days	21	95,5
Nurse Skills		
≤ 3 years	5	22,7
>3 years	17	77,3
Infusion Installation Techniques	13	59,1
Not By SOP	9	40,9
By SOP		
Catheter Size		
>20 G	18	81,8
≤ 20G	4	18,2
Phlebitis incident		
Yes	7	31,8
No	15	68,2

Based on the table the difference in age of respondents ≥ 40 years with <40 years by 4 (18.18%), the sex of women with men as much as 2 (9.09%), nutritional status <18.5 kg with ≥ 18.5 kg as much as 10 (45.45), chronic disease predisposing to non-predisposing by 6 (27.27%), type of infusion fluid with risk not risk 6 (27.27%), location of joint insertion with non-joint 8 (36.36 %), duration of infusion installation> 3 days with ≤ 3 days was 20 (90.90), nurse skills ≤ 3 years with> 3 years was 8 (36.36%), infusion technique was 4 (18.18%), catheter size> 20 G with ≤ 20G as much as 14 (63.63%), and phlebitis occur without 8 (36.36%).

Table 2 Relationship and Estimation of Risk of Phlebitis

Variable	Phlebitis		p-value	OR (CI 95% Min-Max)	RR (CI 95% Min-Max)
	Yes (N=7) f (%)	No (N=15) f (%)			
Age					
≥ 40 years	6 (46)	7 (54)	0,083	6,85 (0,66 - 71,72)	4,15 (0,59 - 28,87)
<40 years	1 (11)	8 (89)			
Gender					
Female	2 (17)	10 (83)	0,095	0,20 (0,02 - 1,42)	0,33 (0,08 - 1,36)
Male	5 (50)	5 (50)			
Nutritional Status					
< 18,5 kg	3 (50)	3 (50)	0,262	3,00 (0,42-21,29)	2,00 (0,62-6,42)
≥ 18,5 kg	4 (25)	12 (75)			
Chronic Disease Predisposition	4 (50)	4 (50)	0,166	3,66 (0,55-24,13)	2,33 (0,69-7,89)
Not a Predisposition	3 (21)	11 (79)			
Types of Infusion Fluids					
Risk	5 (63)	3 (27)	0,020	10,0 (1,26-79,34)	4,37 (1,09-17,58)
Not a risk	2 (14)	12 (86)			
Types of Injection Medications					
Diluted	5 (45)	6 (55)	0,170	3,75 (0,54-26,04)	2,50 (0,61-10,25)
Not Diluted	2 (12)	9 (82)			
Insertion Location					
Joint	2 (29)	5 (71)	0,823	0,80 (0,11-5,68)	0,85 (0,21-3,38)
Not a joint	5 (33)	10 (67)			
Duration of Infusion					
>3 days	0 (0)	1 (100)	0,484	-	-
≤ 3 days	7 (33)	14 (67)			
Nurse Skills					
≤3 years	2 (40)	3 (60)	0,655	1,60 (0,20-12,69)	1,36 (0,37-4,99)
>3 years	5 (29)	12 (71)			
Infusion Installation Techniques					
Not By SOP	6 (46)	7 (54)	0,083	6,85 (0,65-71,72)	4,15 (0,59-28,87)
By SOP	1 (11)	8 (89)			
Catheter Size					
>20 G	6 (33)	12 (67)	0,746	1,50 (0,12-17,66)	1,33 (0,21-8,21)
≤ 20G	1 (25)	3 (75)			

Based on the table, infusion fluid type factors influence the incidence of phlebitis with a p-value of 0.020 (p-value <0.05), while age, sex, nutritional status, chronic diseases, types of injection drugs, insertion location, duration of infusion, nurse skills, infusion installation techniques, and catheter size did not affect the incidence of phlebitis with each p-value 0.083; 0.095; 0.262; 0,166; 0.170; 0.823; 0.484; 0.655; 0.083; and 0.746 (p-value> 0.05). Even so, these factors can predispose to phlebitis by looking at the value of Odds Ratio (OR) and Relative Risk (RR) in table 2.

Table 3: Multivariate Analysis Results 3 Major Risk Factors

Risk Factor	Coefficient	S. E	Wald	df	Value	OR
Type of Infusion Liquid	2,303	1,057	4,748	1	0,029	10,000
Age	1,731	1,305	1,760	1	0,185	5,647
Gender	-1,362	1,249	1,190	1	0,275	0,256

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Based on the table, the most influential variable on the incidence of phlebitis is the type of infusion fluid with a value of 0.029 with a strength of the relationship (OR) of 10.00.

Research "Risk Factors for Phlebitis" in RST Intravenous Catheter dr. Soedjono Magelang was held on 27 February 2020 - 14 March 2020 in the IGD Unit, Bougenvile Ward, Cempaka, and Seruni. Researchers could not conduct the study within the allotted time (February 24 - March 31, 2020) because of the covid19 pandemic and RST dr. Soedjono became a referral for a hospital that treats covid patients19 in Central Java. Samples were taken using observation sheets and SOP checklists that researchers developed themselves with a purposive accidental sampling technique.

Samples that researchers took were patients aged 18-70 years who were hospitalized for at least 2 days and installed intravenous catheters, patients treated in the Bougenvile, Cempaka, and Seruni wards in February-March 2020, the patient had a history of previous illnesses, was not diagnosed as having a vascular infection and willing to be a respondent.

Age. The results showed that most phlebitis occurred in samples aged ≥ 40 years, 6 respondents (46%) out of 13 respondents (100%). This is due to increasing age, more fragile blood vessels, decreased cell, and tissue regeneration, easy to experience increased coagulation, and less effective immune system (Fitriyanti, 2015; Putri, 2016; Rahmadani, 2018; Rizky & Supriyatiningsih, 2014). Even so, the results of the chi-square test showed that there was no relationship between age and phlebitis (p-value 0.083> α 0.05). This is the same as research conducted by Erdogan & Denat (2016); Nito, Setiawati, & Murtiningsih (2017); Pradini (2016); Salgueiro-Oliveira et al. (2012); and Urbanetto et al. (2016) which states that age has no relationship with the incidence of phlebitis (p-value> 0.05).

The results of this study contrast with the research of Akbar & Isfiandiari (2018); Fitriyanti (2015); Rizky (2016); and Rojas-sánchez, Parra, & Camargo-figuera (2015). The study revealed that age affects the incidence of phlebitis.

The amount of risk obtained is 6.85 with 95% CI 0.66-71.72, which means that the age factor of 6.85 is at risk of phlebitis. Meanwhile, the results of the relative risk analysis used in this cohort study were 4.15 (RR value> 1), so patients aged ≥ 40 years had a greater risk of developing phlebitis compared to patients aged <40 years. This is consistent with the expression of Carlos and Furtado (2011) in Rahmadani (2018), namely the higher the age, the higher the incidence of phlebitis.

Gender. Based on the results of bivariate calculations, it was found that phlebitis was mostly experienced by someone who was male as many as 5 respondents (50%) from 10 respondents compared to women 2 respondents (17%) from 12 respondents. These results are the same as the research of Abdul-Hak & Barros (2014); Nurinda (2017); Uslusoy & Cashew (2008); and Zavareh M & Ghorbani (2007) which states that the incidence of phlebitis is more common in men than women with a percentage of more than 50%. The reason according to Darmawan (2008) in Nurinda (2017) is due to the low level of men in paying attention to patterns or lifestyles so that they are susceptible to disease, besides, the presence of the hormone estrogen in a woman's body so that it strengthens the immune system.

Therefore, seen from the p-value of 0.095 which is greater than α 0.05, it can be concluded that the sex factor has no relationship with the incidence of phlebitis. The results of this study are the same as researchers Anand et al. (2020); Erdogan & Denat (2016); Lee, Kim, & Kim (2019); and Nito et al. (2017) which revealed that gender did not have a significant relationship with phlebitis. In contrast, the results of this study differ from those examined by Akbar & Isfiandiari (2018); Pattola, Rachmat, & Basri (2013); and Rizky & Supriyatiningsih (2014) the study explained that there is a sexual related to the incidence of phlebitis ie female sex is more risky than male. The reason is high mobility, the immunity that often decreases after the menstrual cycle, and lower muscle mass when compared to men.

The amount of risk obtained is 0.20 with 95% CI 0.02-1.42, which means that the sex factor is 0.2 times the risk of phlebitis. Meanwhile, the results of the relative risk analysis used in this cohort study were 0.33 (RR value <1), so male patients had a greater risk of phlebitis than women.

Nutrition Status. The results showed that phlebitis was more common in patients with a Body Mass Index ≥ of 18.5 kg, with 4

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respondents (25%) out of 16 respondents (100%). The p- value from the chi-square test also shows the number 0.262 which means that nutritional status does not affect the incidence of phlebitis. (p-value 0.262> α 0.05). This is in line with Pradini's research (2016) conducted at Tugurejo District Public Hospital Semarang which states that nutritional status is not related to phlebitis with a p-value of 0.100.

These results are different from the research of Akbar & Isfiandiari (2018); and Prastika F, Susilaningsih, & Amir A (2011). The research explains that nutritional status influences the occurrence of phlebitis with a p-value of 0.007; 0.001, which means the p-value < α 0.05 Ha is accepted.

The amount of risk obtained is 3.0 with 95% CI 0.04-2.36, which means that the nutritional status factor is 3.0 times the risk of phlebitis. Meanwhile, the results of the relative risk analysis used in this cohort study were 2.00 (RR value> 1), so patients who have a Body Mass Index (BMI) <18.5 kg are at greater risk of developing phlebitis than patients having an IMT ≥ 18.5 kg That is because the body's lack of nutrition will reduce endurance so it is susceptible to infection (Prastika F et al., 2011).

Chronic Disease. The results showed that phlebitis often occurs in patients with chronic diseases predisposing to 4 respondents (50%) of 8 respondents (100%). This is same a research by Salma, Sarker, Zafrin, & Ahamed (2019) which states that phlebitis mostly occurs in patients who have a history of Diabetes Mellitus and Hypertension with a percentage of 32.89% and 25%, respectively. The reason is the low flow of blood vessels in the peripheral tissues so that the immune system decreases, the regeneration of the body's cells slows down, and the endothelium wall is easily injured (Akbar & Isfiandiari, 2018; Fitriyanti, 2015; Jirkovsky, Hlavacova, Nikodemova, & Tomova, 2014; Salma et al. al., 2019).

Even so, p-value 0.166> α 0.05 which means that chronic disease does not affect phlebitis. These results are in line with research by Gargar et al. (2017); Rizky (2016); Rojas-sánchez et al. (2015) which states that there is no relationship of disease to the incidence of phlebitis with p values of 0.524 each; 0.643; and 1.494 (p-value> α 0.05).

In contrast, the results of this study are inversely related to research conducted at Thailand's Public Hospital by Yeesin et al., (2017), the study revealed that there is a relationship between cancer and phlebitis with a p-value <0.001. Besides, Akbar & Isfiandiari (2018) also stated that a history of hypertension and diabetes mellitus influenced the occurrence of phlebitis with p values 0.01 and the magnitude of OR respectively 6.18 and 17.88.

The amount of risk obtained is 3.66 with 95% CI 0.55-24.13 which means that the chronic disease factor is 3.66 times the risk of phlebitis. Meanwhile, the results of the relative risk analysis used in this cohort study were 2.33 (RR value> 1), so patients who have predisposing chronic diseases such as Diabetes Mellitus, Hypertension, Cancer, Autoimmune, and Kidney Failure are at greater risk of developing phlebitis than patients the chronic disease is not a predisposition.

Types of Infusion Fluids. The results showed that phlebitis often occurs in patients who get intravenous fluids that fall into the category of risk (hypertonic such as mannitol; drugs in the form of infusion preparations such as moxifloxacin, metronidazole, levofloxacin; drugs mixed in the infusion such as neuron) as many as 5 respondents (63%) from 8 respondents (100%). Also, the results of the bivariate analysis showed a p-value of 0.020 which meant that there was a relationship between the types of infusion fluids and phlebitis.

This is line a cohort study by Yeesin et al., (2017) conducted at Ratchaphipat Hospital in Bangkok, Thailand. The study states that the type of infusion fluid affects the incidence of phlebitis with a p-value of 0.014 <α 0.05 with the highest incidence of phlebitis occurring in patients receiving 30% hypertonic fluid. The reason is that hypertonic fluids and liquids that have acidic pH irritate the venous wall so that it is easily damaged and causes phlebitis.

In contrast, research by Pradini (2016) at Tugurejo District Public Hospital Semarang concluded that the type of infusion fluid was not related to the incidence of phlebitis with p values of 0.269> α 0.05.

The amount of risk obtained is 10.00 with 95% CI 1.26 to 79.34 which means that the type of infusion fluid is 10.00 times the risk of phlebitis. Meanwhile, the results of the relative risk analysis used in this cohort study were 4.37 (RR value> 1), so patients who were given a type of infusion fluid such as hypertonic and/or had a greater acidic pH occurred phlebitis than patients who were given infusion

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fluid therapy instead risk**.**

Types of Injection Medications. The results showed that phlebitis was more common in patients who were given a type of diluted injection drug that is as many as 5 respondents (45%) of 11 respondents (100%). While the p-value generated by bivariate analysis is 0.170 which means there is no relationship between the types of injection drugs and the incidence of phlebitis.

In contrast, research conducted by Yeesin et al., (2017) and Anand et al., (2020) states that there is a relationship between injection drugs and phlebitis with p-values of 0.003 and 0.00, respectively. This is because drugs such as antibiotics or acidic pH are at risk of causing phlebitis (Salgueiro-Oliveira et al., 2012; Urbanetto et al., 2016).

The amount of risk obtained is 3.75 with 95% CI 0.54-26.04 which means that the type of injection drug factor is 3.75 times the risk of phlebitis. Meanwhile, the results of the relative risk analysis used in this cohort study were 2.50 (RR value> 1), so patients who were given a diluted injection drug type such as omeprazole, cefotaxime, ceftriaxone, and vinculin belonging to the antibiotic drug were at greater risk of developing antibiotics. phlebitis compared to non-diluted injection drugs such as norages, ranitidine, ondansetron. This is because these drugs that are classified as antibiotics choose an acidic pH that can irritate the walls of blood vessels.

Location of the Insertion. The results showed that phlebitis was more common in patients whose insertion sites were not in the joints, namely the metacarpal vein of 5 respondents (33%) out of 15 respondents (100%). Besides, based on the bivariate analysis p-value was 0.823 which means that the insertion location had no relationship with phlebitis (p-value> α 0.05). The results of this study are in line with research conducted by Nito et al., (2017); Lee et al., (2019) and Anand et al., (2020) which stated that the location of insertion did not have a significant relationship with the incidence of phlebitis, evidenced by p-values of 0.164; 0.202 and 0.082.

In contrast, the results of research conducted by Uslusoy & Cashew (2008) at University Hospital Turkey and Sumara (2017) at the Husada Utama Hospital stated that there was a relationship between the insertion location and the p-value values of 0.049 and 0.02, respectively. The study revealed that phlebitis mostly occurred at the insertion site in the forearm vein area (56.9%) and the metacarpal vein (25%).

The amount of risk obtained is 1.25 with 95% CI 0.17-8.87, which means that the insertion location factor is 1.25 times the risk of phlebitis. Meanwhile, the results of the relative risk analysis used in this cohort study were 0.85 (RR value <1), so patients who had intravenous catheters installed in non-joint areas, namely metacarpal veins, had a greater risk of phlebitis than patients in joint locations. This is possible because the metacarpal vein has inadequate tissue and thin skin in the area (Alexander, 2014).

Duration of Installation. The results showed that phlebitis often occurs in patients who are infused for ≤ 3 days, namely 7 respondents (33%) of 21 respondents (100%). Many respondents experienced phlebitis on day 2 and day 3 of installation. This is the same as research by Pattola et al., (2013) which explains that phlebitis mostly occurs on the third day of infusion (36.7%). The reason is that the risk of phlebitis is 35% to 65% after 48 hours of installation (Alexander, 2014; Budiarti et al., 2018)

Bivariate analysis results obtained a p-value of 0.484 which means that the length of infusion was not related to the incidence of phlebitis. This is in line with research by Enes, Opitz, Faro, & Pedreira, (2016). Research conducted at the Hospital in the Western Brazilian Amazon which stated that the length of infusion was not significantly related to the incidence of phlebitis was evidenced by the results of a p-value of 0.796.

In contrast to research conducted by Urbanetto et al., (2016) at the University Hospital in The City of Porto Alegre stated that the p-value is 0.016, which means the length of infusion affects on phlebitis.

Nurse Skills. The results of the analysis found that phlebitis mostly occurs in patients who are infused by nurses who have worked longer than 3 years, amounting to 5 respondents (29%) out of 17 respondents (100%). The bivariate analysis results obtained a p-value of 0.655 which means that the nurses' skills seen from the length of time working have no relationship with the occurrence of phlebitis.

The results of this study differ from studies conducted by Lee et al., (2019) which states that the period of experience of nurses

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influences the incidence of phlebitis with p <0.001. The study explained the long period of experience of nurses ≥1 to <3 years caused more phlebitis which was 43.3%. The reason is that if nurses do not have experience in performing difficult catheter infusion let alone the patient's poor vein condition, will make mistakes more than once during an incision so that the risk of phlebitis is increased.

The magnitude of the risk obtained is 1.60 with 95% CI 0.20-12.69 which means that the nurses' skills factor is 1.60 times the risk of phlebitis. Meanwhile, the results of the relative risk analysis used in this cohort study were 1.36 (RR value> 1), so nurses' skills ≤ 3 years are at greater risk of phlebitis compared to> 3 years.

Installation Techniques. The results showed that phlebitis was more common in patients who did infusion not according to SOP, namely 6 respondents (46%) out of 13 respondents (100%) whereas in installation according to SOP the only phlebitis occurred in 1 respondent. That is because improper infusion techniques such as poor hand hygiene, not using handscoon or aseptic principles that are not applied will increase the risk of infection, especially phlebitis.

Although the results of the p-value analysis did not indicate an association between the infusion technique and phlebitis (p-value 0.083> α0.05). However, research conducted by Fitriyanti, (2015) states that the installation technique affects the incidence of phlebitis with a p-value of 0,000.

The amount of risk obtained is 6.85 with 95% CI 0.65 to 71.72, which means that the installation technique is 6.85 times the risk of phlebitis. Meanwhile, the results of the relative risk analysis used in this cohort study were 4.15 (RR value> 1), so patients who were fitted with an SOP-fitting technique were at greater risk of developing phlebitis than according to the SOP.

Catheter size. The results showed that phlebitis was more common in patients with catheter sizes> 20G, 6 respondents (33%) out of 18 respondents (100%). These results are the same as the study of Yeesin et al., (2017) who explained that the incidence of phlebitis occurred more at the catheter size of 22G-24G with 14.16%. While the results of bivariate calculations of researchers amounted to 0.746 which means there is no relationship between the size of the catheter with phlebitis (p-value> α0.05). These results are similar to cohort studies conducted by Yeesin et al., (2017) and Nito et al., (2017) with p values of 1,000 and 0.118, respectively.

Inversely with the research of Anand et al., (2020) at the Hospital of North-Eastern India. The study states that there is an effect between the size of the catheter on the incidence of phlebitis with a p-value of 0.00. Also, the RR value in the study was greater at 18G and 20G catheter sizes (RR: 2.46 CI 95% 1.48-4.08).

The amount of risk obtained is 1.50 (95% CI 0.12-17.66) which means that the catheter size factor is 1.50 times the risk of phlebitis. Meanwhile, the results of the relative risk analysis used in this cohort study were 1.33 (RR value> 1), so patients who had an intravenous catheter> 20 G had a greater risk of developing phlebitis than a size ≤ 20 G.

The results of multivariate analysis on the joint test produced that each variable has a value that is not much different, this means that the risk factors studied remain a predisposition to phlebitis even though there is no most prominent value. As for the multivariate analysis on 3 risk factors with a value of p <0.25, it was found that the type of infusion fluid type was the most dominant risk factor supporting the incidence of phlebitis 0.029 with a strength of the relationship (OR) of 10.00.

Conclusion and Suggestions. Risk factors that have a relationship or influence on the incidence of phlebitis in this study are the types of infusion fluids classified as therapeutic administration factors (p-value 0.020 <α 0.05) with Odds Ratio (OR) values of 10.00 CI 95% 1,26-79.36 and Risk Relative (RR) value 4.37 (95% CI 1.09-17.58). Risk factors for age, sex, nutritional status, chronic diseases, types of injection drugs, insertion location, duration of installation, nurse skills, installation techniques, and catheter size do not affect the incidence of phlebitis due to p-value> 0.05. Even so, these factors can be supporting the incidence of phlebitis. The most dominant risk factor in supporting the occurrence of phlebitis is the type of infusion fluid with a value of 0.029 and OR 10,000.

Suggestions for Medical Officers : It is expected to apply and pay attention to the technique of infusion installation by Operational Standards (SOPs) that have been set in the hospital. It is expected to increase the supervision of patients undergoing infusion in areas of the body that are infused so that the

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risk of phlebitis or other complications can be minimized by early detection.

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