Phlebitis, Infiltration, and Localized Site Infection Among Patients With Peripheral Intravenous Catheters

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doi: 10.19044/esj.2017.v13n18p148 URL:http://dx.doi.org/10.19044/esj.2017.v13n18p148

Abstract

This study examined the occurrence of phlebitis, infiltration, and localized site infection between standard replacement (control group) and clinically indicated replacement (experimental group) among patients with peripheral IV catheters. We utilized a two-group, post-test only, randomized experimental design in a level 4 tertiary hospital in Cebu for a period of 30 days. A total of 80 participants who passed the selection criteria were chosen and equally divided into 2 groups of 40 members each using randomization. The control group had their peripheral IV catheters changed every 3 days while the experimental group had their peripheral IV catheters replaced only in the presence of complications. The outcome variables for the study were phlebitis, infiltration, and localized site infection. Findings revealed that the standard replacement group had a higher prevalence rate of complications compared to the clinically indicated replacement group. Moreover, patients who stayed for 7-14 days had an increased likelihood of developing phlebitis and infiltration compared to those who remained for 4-6 days. Remarkably, peripheral IV catheters inserted by physicians had a higher rate of infiltration compared to nurses. Furthermore, nurses who had 2 years of experience were found to have lower incidence of phlebitis compared to those who had 3 years of experience. In conclusion, the risk of developing phlebitis and infiltration was not increased when peripheral IV catheters were replaced on a clinical-need rather than on a routine basis. Hospitals should consider

adopting new guidelines wherein peripheral IV catheters are changed only in the presence of complications.

Keywords: Peripheral intravenous catheters, standard replacement, clinically indicated replacement, phlebitis, infiltration, localized site infection

Introduction

Intravenous (IV) therapy involves the administration of medications through a catheter inserted either peripherally or centrally. Indications for intravenous therapy include administration of intravenous medications and fluids, giving of parenteral nutrition, and provision of blood and blood products during acute, perioperative, and emergency situations (Waitt, Waitt, & Pirmohamed, 2004; Dychter, Gold, Carson, & Haller, 2012).

By the 1990s, greater than 85 percent of inpatients in the US received IV therapy (Dychter et al., 2012). Today, approximately 200 million peripheral IV catheters are used yearly in the US alone (Maki, 2008). Since intravenous cannulation is an invasive procedure, it may serve as a port for pathogens to enter into the local tissues or bloodstream. Although the percentage of bloodstream infections linked with peripheral IV catheters is generally small, with its increased usage, serious infectious complications could result in morbidity. Common complications arising from the presence of peripheral IV catheters include: phlebitis, infiltration, extravasation (Dougherty & Lister, 2005), and localized site infection if left in place for >72 hours (O'Grady, 2002). To minimize the complications, the Center for Disease Control and Prevention (CDC) endorses in its 2011 recommendations, the routine change of peripheral IV catheters every 3-4 days in adults (CDC, 2011). Conversely, the Infusion Nurses Society (INS) recommends the rotation of peripheral IV catheters on a clinical need basis in its 2011 standards (INS, 2011). Thus, the issue of when to change the peripheral IV catheters remains unresolved as of today.

Furthermore, it is important to note that new punctures not only cause inconvenience for the patient but also add to the hospital expenses. A recent study revealed that clinically indicated catheter changes is more economical compared with routine replacement (Tuffaha et al., 2014). Likewise, Rickard et al (2012) showed the possibility of replacing peripheral IV catheters only in the presence of complications.

In the Philippines, the Association of Nursing Service Administrators of the Philippines (ANSAP) is the recognized body of the Professional Regulation Commission (PRC) to conduct the training on intravenous therapy. Since ANSAP is a member of the INS, it is only but natural that ANSAP follows the 2011 INS standards. In spite of that, there are still practices in both private and public hospitals in the country that advocates

routine or standard peripheral IV catheter changes every 3 days or 72 hours. Thus, there is a need to investigate the unsettled matter of the ideal time to change the peripheral IV catheters in adults.

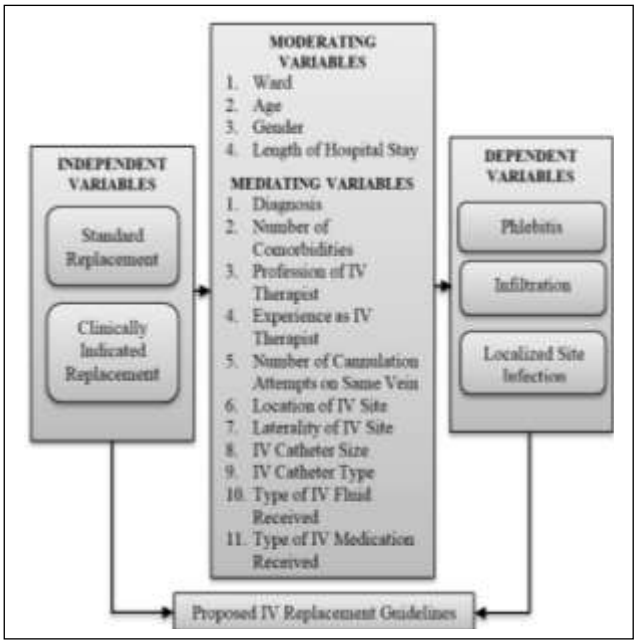

Figure 1 shows the framework of the study and the relationship between the independent and dependent variables. The research participants were equally distributed into two (2) groups – the standard replacement (control) and the clinically indicated replacement (experimental) – and were subjected to a two-group, post-test only, randomized experimental design. The four (4) moderating and eleven (11) mediating variables were taken into consideration and were measured according to the degree of influence they exert on the independent and dependent variables. Outcome or dependent variables for the study are phlebitis, infiltration, and localized site infection. Findings of the research would be used to propose new intravenous (IV) replacement guidelines.

Study Objectives

This study examined the occurrence of phlebitis, infiltration, and localized site infection between standard replacement and clinically indicated replacement groups among patients with peripheral IV catheters. Specifically, it endeavored to determine (1) the prevalence rates of phlebitis, infiltration, and localized site infection in both groups, (2) which of the following factors relate with the outcome variables (ward, age, gender,

length of hospital stay, diagnosis, number of comorbidities, profession and experience as IV therapist, number of cannulation attempts on same vein; location and laterality of IV site, IV catheter size and type, type of IV fluid and medication received), (3) whether significant difference existed in the occurrence of outcome variables (phlebitis, infiltration, and localized site infection) between standard replacement and clinically indicated replacement groups. Finally, a new IV replacement guideline is proposed for adoption and implementation based on the study findings.

In this research, we tested the null hypothesis of no significant difference in the occurrence of phlebitis, infiltration, and localized site infection between standard (control) and clinically indicated (experimental) replacement groups.

Significance of the Study

The research findings provide insight on the possibility of extending the peripheral IV catheter beyond 72 hours or 3 days. After being deemed viable, hospitals need to re-examine their current policy on routine replacement of catheters every 3 days. Furthermore, the significant results of the study sheds new light on which IV cannulation policy should be adopted – CDC or INS. For healthcare professionals, replacing peripheral IV catheters on a clinical need basis saves them a lot of time lost in the reinsertion process – most especially if it involves a difficult IV site. Nurses and physicians alike can then convert that to more patient interaction and care. New puncture sites spell increased costs for patients. Changing peripheral IV catheters only when clinically indicated allows patients to allocate their savings to more important expenditures (i.e. medications, room accommodations, and hospital equipment rentals). In addition, unnecessary pain associated with reinserting peripheral IV catheters, even without complications, can be avoided.

In the same manner, future studies can use the research outcomes to explore more benefits or find disadvantages of choosing clinically indicated changes over routine reinsertion when it comes to replacement of peripheral IV catheters. Moreover, the study encourages other research enthusiasts to review other hospital policies with the ultimate goal of improving patient care. On a different note, lesser frequency in changing peripheral IV catheters means fewer medical wastes; thus, reduced consumption of these materials result in better waste management in the community and the country as a whole.

Scope and Limitation

Even with time constraints and limited funding, we were able to cover a period of one month in a tertiary hospital located in Cebu City,

Central Philippines. Participants were screened if they were: (a) admitted in the Medical or Surgical Ward, (b) 18 years old and above, and (c) projected to have a peripheral IV catheter in place for a minimum of 96 hours. Those who passed the inclusion criteria were initially counted for the study. After which, the participants were assessed if they: (a) were immunocompromised, (b) had an IV in place for more than 48 hours, (c) had a planned removal of IV in less than 24 hours, (d) underwent blood transfusion using the same IV catheter, and (e) had hypersensitivity to the IV catheter. If they had any of the 5 exclusion criteria, they were automatically omitted from the study. A total of 80 patients who passed the comprehensive selection criteria were considered for the study.

Routine blood and device cultures were ideally recommended to link the incidence of localized site infection to the presence of a peripheral IV device. However, these were not possible due to budgetary constraints; hence, they were eliminated from the study.

Literature Review

The first known documented use of intravenous (IV) therapy dates back as early as 1942 where a physician attempted to give blood transfusion to Pope Innocent VIII from three adolescent boys. However, the result was dismal since all the donors and the recipient died. It was in the mid-1600s that Christopher Wren created the first functional IV infusion apparatus. Using a pig's bladder and a plume, he was able to successfully infuse a unique mixture of different elements into the veins of a dog (Rivera, Strauss, van Zundert, & Mortier, 2005). When Wren left Oxford to begin his work as an architect of churches, his colleague – Richard Lower, took over the transfusion studies and made a breakthrough by successfully transfusing blood from one dog to another (Felts, 2000). He was later dubbed as the Father of IV Therapy.

Back in the olden times, there were several attempts of using IV therapy to infuse humans with animal blood (Corrigan, 2001). The first known successful attempt at human blood transfusion was carried out by Dr. James Blundell in 1818 using a syringe (Rivera et al., 2005). However, the use of plastics in IV therapy did not come until 1950 when Dr. David Massa, a resident in anesthesiology, created the first over-the-needle IV cannula which later became the famous "Rochester plastic needle" (Rivera et al., 2005).

The landmark discovery of the over-the-needle IV cannula design sparked an instant revolution in IV therapy. However, it was only the doctors who were allowed to perform IV cannulation in extremely high standards. It was not until 1973 when Plumer became the first nurse to administer IV

therapy (Rivera et al., 2005). From then on, the evolution of IV catheters underwent numerous improvements.

Presently, IV therapy is used for hydration, blood transfusion, parenteral nutrition, and medication administration. More than 90 percent of inpatients undergo IV therapy (Corrigan, 2010). IV catheters are often needed for at least a week or so; however, they frequently fail before the treatment is completed because of phlebitis (Rickard et al., 2009). CDC endorses the routine replacement of IV catheters in adults to not more than every 3-4 days to lessen the possibility of developing phlebitis and infection (CDC, 2011). Remarkably, CDC does not recommend the routine replacement of IV catheters in high-risk devices (arterial, hemodialysis, and central venous catheters) or in kids since this does not avert infection (O'Grady et al., 2011). Although there is evidence from observational studies linking the increasing length of catheter dwell time with the incidence of phlebitis (Mestre Roca et al., 2012; Malach et al., 2006; Powell, Tarnow, & Perucca, 2008), other studies do not coincide with this finding (Sterba, 2001; Idvall & Gunningberg, 2006; Ho & Cheung, 2012; Webster, Osborne, Rickard, & Hall, 2010).

If the area of catheter insertion was taken into consideration as a determining factor for phlebitis, several studies showed different results. One research in particular showed there was no statistically significant difference between peripheral IV catheters inserted in the ward and in the emergency room in terms of phlebitis rates (Salgueiro-Oliveira, Veiga, & Parreira, 2012). In contrast to the previous study, a study in Nepal found that the incidence of phlebitis rates in the hospital were higher in the medical ward, surgical ward, emergency room, operation theater, and OB-GYNE area compared with the rest of the hospital areas (Sing, Bhandary, & Pun, 2008). Another study compared the population between the medical and surgical outpatient departments (OPD) in India and showed that the medical OPD had higher phlebitis rates while the surgical OPD had higher infiltration rates (Saini, Agnihotri, Gupta, & Walia, 2011).

Gender and age were also considered and showed that women and older patients were more likely to develop peripheral IV complications (Kagel & Rayan, 2004; Ascoli, De Guzman, & Rowlands, 2012). Other studies linked the presence of IV complications with an increased length of hospital stay (Waitt, Waitt, & Pirmohamed, 2004; Marschall et al., 2014).

White (2001) reported that adults showed that 40 percent of the phlebitis cases occurred in patients with orthopedic and respiratory diagnoses. Even if the sample was small, it was sufficient to demonstrate a significant correlation between phlebitis and the patients' diagnoses. Rickard et al. (2012) conducted a study involving diagnoses and comorbidities as

factors but there were no conclusions made on the relationship between the variables and phlebitis.

Katsogridakis, Seshadri, Sullivan, & Waltzman (2008) determined the success rates of multiple cannulations in children inserted by physicians, nurses, and IV clinicians at a range 23 percent, 44 percent, and 98 percent respectively. It was also found out that nurses who are older and have more experience in IV insertions had significantly greater success at cannulation than the younger and less-experienced ones (Jacobson & Winslow, 2005). Data on successful cannulation in children showed 53 percent success on the first attempt up to 91 percent on the fourth attempt on different IV sites (Lininger, 2003). The results of that study led to a standard of practice in that hospital with nurses having no more than four attempts at insertion. There is, however, one noteworthy study that linked the nursing profession with phlebitis and infiltration rates as high as 85 percent (Saini, Agnihotri, Gupta, & Walia, 2011).

The most common sites identified with peripheral IV complications are the forearm, hand, wrist, antecubital fossa (Kagel & Rayan, 2004), and joint (Sing, Bhandary, & Pun, 2008). Currently, CDC (2011) recommends the use of the upper-extremity for catheter insertion in grownups. In the event that an IV catheter is in the lower extremity, it must be transferred to an upper extremity in the earliest possible time to decrease complications. It is also suggested that the non-dominant hand be used to diminish accidental damage to the IV site (Dougherty & Lister, 2005), starting with the most distal area and moving up as needed (Hadaway & Millam, 2005). In addition, INS (2000) advocates that each succeeding IV cannula should be inserted in a site close to the last one.

With regard to catheter gauge, several studies involved their differentiation as part of the characteristics of an IV catheter (Webster, Lloyd, Hopkins, Osborne, & Yaxley, 2007; Van Donk, Rickard, McGrail, & Doolan, 2009; Rickard et al., 2012). There are a few researches though who found out that catheter gauge has no influence on the development of phlebitis (Abbas, de Vries, Shaw, & Abbas, 2007; Salgueiro-Oliveira, Veiga, & Parreira, 2012; Uslusoy & Mete, 2008). The current recommendation, however, is that the patient's status and the type of infusate should be considered before selecting a catheter gauge (Hadaway & Millam, 2005).

The material used for the creation of IV catheters also exert influence on the incidence of phlebitis. Polyurethane catheters, also known as "Teflon", were associated with a decreased likelihood of infection compared with polyvinyl chloride or polyethylene catheters (O'Grady et al., 2002). Although steel needles have similar rates of infectious complications with Teflon, CDC (2011) recommends the use of the latter in peripheral IV cannulations because it has lower incidences of infiltration. Newer versions

of the polyurethane in the market, however, have been associated with a 30-45 percent drop in the incidence of peripheral vein thrombophlebitis when compared with the previous type of Teflon (Tagalakis, Kahn, Libman, & Blostein, 2002).

INS (2011) acknowledges the role of the infusate in the development of infiltration or extravasation. Salgueiro-Oliveira, Veiga, and Parreira (2012) found out that potassium chloride and antibiotics increased the likelihood of phlebitis by 1.95 and 1.92 times respectively. Blood, however, was not found to be statistically significant in increasing the incidence of phlebitis as found out by Singh, Bhandary, and Pun (2008). As for the number of drug administrations, Uslusoy and Mete (2008) showed that medications given at least four times daily doubled the risk of phlebitis compared with medications given one to three times daily.

An exhaustive review of the current literature on the comparison between routine and clinically indicated change of peripheral intravenous catheters revealed several studies. Six (6) of the studies were randomized controlled trials with population sizes ranging between 47 and 1,885. Four (4) of the researches were run in single-center, acute inpatient locales (Barker, Anderson, & Macfie, 2004; Webster et al., 2007; Webster et al., 2008; Rickard, McCann, Munnings, & McGrail, 2010). One was done in a residential setup (Van Donk et al., 2009) while the other one was a multi-center study of three hospitals (Rickard et al., 2012). Three trials compared routine catheter changes (every 3-4 days) with clinically indicated changes (Van Donk et al., 2009; Rickard et al., 2010; Rickard et al., 2012) but only one trial had 48 hour changes compared with clinical indications (Barker et al., 2004). All of the results were strikingly similar in that they found no evidence of benefit for routine peripheral catheter changes over clinical indication changes. These findings coincide with earlier studies which showed that extending the duration of peripheral intravenous catheterization did not increase the risk for phlebitis (White, 2001) and lowered the cost and clinician time consumed (Catney et al., 2001; O'Grady et al., 2002).

Data suggests the possibility and benefit of extending peripheral intravenous sites for more than 72 hours; however, all of the researches were conducted outside of the country – mostly Australia (Webster et al., 2007; Webster et al., 2008; Van Donk et al., 2009; Rickard et al., 2010; Rickard et al., 2012). Thus, it is essential to find out if the findings of the previous studies will be replicated in the present research locale. Furthermore, pursuing this research will not only improve evidence for clinical practice but also evaluate the current practice of replacing peripheral IV catheters every 3 days. With the addition of more variables, this research aims to add new knowledge to the current literature on IV catheter replacement.

Research Methodology

Research Design.

This research employed a two-group, post-test only, randomized experimental design wherein research participants were equally but randomly assigned to the standard replacement or control group and the clinically indicated replacement or experimental group. The control group had their peripheral IV catheters changed on a standard basis (every 72 hours or 3 days) while the experimental group had their peripheral IV catheters replaced on a clinical need basis (presence of phlebitis, infiltration, and localized site infection).

The randomization ensured that the two groups were the identical in terms of attributes thereby making a pretest unlikely necessary. Since the two groups were equivalent from the start, any difference between them in terms of dependent variables is most likely attributed to the effect of the independent variable (Trochim, 2000).

Research Locale.

The study was conducted in Hospital A – a level 4, tertiary hospital situated in Cebu City, Central Philippines. Although the medical institution consisted of several wards, the foci of the study was placed on the Medical and Surgical Wards.

Research Participants.

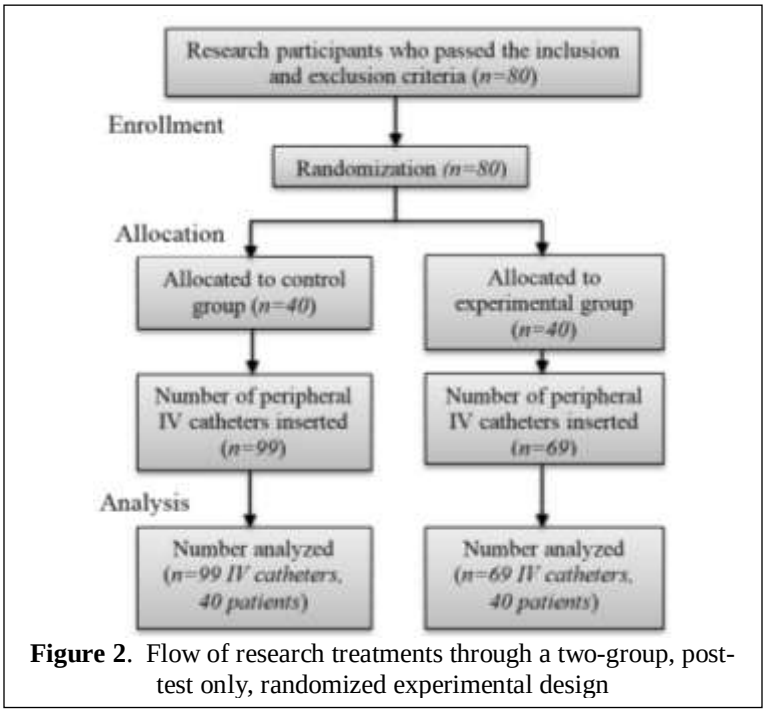

Figure 2. Flow of research treatments through a two-group, post-test only, randomized experimental design

Figure 2 illustrates the flow in how actual research participants were randomized and selected. There were 80 patients who qualified based on the selection criteria and all of them were considered as research participants. In essence, a complete enumeration was resorted to; thereby no randomization was employed for the choice of the research participants.

The research was implemented for a period of 30 days. The inclusion criteria drafted patients who were: (a) admitted in the Medical or Surgical Ward, (b) 18 years old and above, and (c) projected to have a peripheral IV catheter in place for a minimum of 96 hours. On the other hand, the exclusion standards disregarded patients who: (a) were immunocompromised, (b) had an IV in place for more than 48 hours, (c) had a planned removal of IV in less than 24 hours, (d) underwent blood transfusion using the same IV catheter, and (e) had hypersensitivity to the IV catheter. The participants who passed both criteria were then divided equally into two groups with 40 members each using randomization. A total of 99 peripheral IV catheters were inserted in the control group while only 69 were inserted in the experimental group.

Research Instrument

A structured outcome assessment form was employed for this study adapted from the Peripheral IV Assessment Form of North York General Hospital (NYGH). We modified it to capture all data related to the variables under study. The said adapted research instrument was available online free of charge.

Data Gathering Procedure

After consent was obtained, data involving the patient's peripheral IV catheter was collected at least once daily, through an exhaustive chart review using the Modified Peripheral IV Assessment Form. Any member of the healthcare staff (nurse, physician, or intern) was responsible for all the IV cannulations. We had no involvement in the manner of inserting, securing, or removing the IV catheters; hence, a cannulation protocol could not be established.

The peripheral IV catheter was removed only in the presence of a clinical complication (phlebitis, infiltration, and localized site infection) and reinserted if required by the physician. During the course of the study, as researchers, we made ourselves available to the participants and the healthcare staff through mobile phone contacts.

Data Analysis

To determine the prevalence rate of phlebitis, infiltration, and localized site infection between both groups, a descriptive analysis was used.

On another note, the Chi-square test of independence was utilized to assess the degree of influence the moderating and mediating variables have on the outcome variables – phlebitis and infiltration.

On the other hand, the T-test of two independent samples was used to determine if there was a significant difference between the standard replacement group and the clinically indicated replacement group with regard to age, length of hospital stay, and experience of nurse as IV therapist. The same statistical test was employed in determining the significant difference between the two groups with regard to the first onset of infiltration and phlebitis. Statistical treatments were carried out using MS Excel for Windows and the Minitab (Version 17, Free Trial) software.

Method of Verification

Every step of the research underwent rigorous steps to ensure that it was the actual representation of what transpired. First, we reviewed the chart and obtained the necessary data using the Modified Peripheral IV Assessment Form. The information obtained from the chart review was then verified by the patient if correct. After the initial confirmation, a second verification was done by the nurses of the unit. They certified that the data recorded on the patients' charts were true and accurate to the best of their knowledge. The third and last verification was performed by the charge nurse or the head nurses of the unit through validation of the nurses' documentation to ensure that no data manipulation took place.

Ethical Considerations

To ensure that a patient's right to accept or refuse participation in a research was protected, a consent was obtained within 24 hours prior to the subject's enrollment in the study. Confidentiality was also regarded as equally important; hence we took careful steps to guarantee that no name or identity was disclosed to the public without the patient's consent. Moreover, care was exercised when naming brands of the peripheral IV catheters during the course of the research to avoid bias and unintentional marketing. Finally, safety of the research participants was our topmost priority; thus, any form of clinical complication (phlebitis, infiltration, and localized site infection) arising from the presence of a peripheral IV device warranted the need for its termination. Reinsertion of a new IV catheter was only done if clinically required by the physician.

Results and Discussion

In this chapter, we present the outcomes of the study by discussing the findings substantiated with interpretations and implications, then linking them to the literature reviews.

Prevalence Rates of Phlebitis, Infiltration, and Localized Site Infection between Control and Experimental Groups

Table 1 shows that a total of 168 peripheral IV catheters were inserted to 80 research participants; 99 of which belonged to the control group while the remaining 69 were part of the experimental group. Peripheral IV catheters in the control group were changed every 3 days, thus explaining why there were more catheters inserted in the control group compared with the experimental group. Of the four possible outcomes (*normal*, *phlebitis*, *infiltration,* and *localized site infection*), the outcome with the highest count was "normal" covering 83 percent of the control group and 58 percent of the experimental group. This suggests that more than half of the time, a peripheral IV catheter inserted into a patient will not develop any complications. On the contrary, the outcome with the lowest count was "localized site infection" with only a single case in each group. Based on the data, we can assume that localized site infection is a rare complication of intravenous therapy unlike phlebitis and infiltration. These findings coincide with the results of similar studies involving peripheral IV catheters (Webster et al., 2008; Rickard et al., 2010).

Table 1. Prevalence rates of phlebitis, infiltration and localized site infection between control and experimental groups

Area	Outcome variables	Standard replacement (control group)	Percent (%)	Clinical replacement (experimental group)	Percent (%)
Surgical Ward (Male)	Normal	32	88.89	11	52.38
	Phlebitis	4	11.11	5	23.81
	Infiltration	-	-	5	23.81
	Localized Site Infection	-	-	-	-
	Subtotal	36	100.00	21	100.00
Surgical Ward (Female)	Normal	18	69.23	13	52.00
	Phlebitis	3	11.54	8	32.00
	Infiltration	4	15.38	4	16.00
	Localized Site Infection	1	3.85	-	-
	Subtotal	26	100.00	25	100.00
Medical Ward (Male & Female)	Normal	32	86.49	16	69.57
	Phlebitis	5	13.51	3	13.04
	Infiltration	-	-	3	13.04
	Localized Site Infection	-	-	1	4.35
	Subtotal	37	100.00	23	100.00
All Wards	Normal	82	82.83	40	57.97
	Phlebitis	12	12.12	16	23.19

	Infiltration	4	4.04	12	17.39
	Localized Site Infection	1	1.01	1	1.45
	Total	99	100.00	69	100.00

Further investigation reveals that the experimental group had the highest number of "Phlebitis" and "Infiltra-tion" with corresponding rates of 23.19 percent (16) and 17.39 percent (12) compared with the control group who only had 12.12 percent (12) and 4.04 percent (4). Adding up all the rates of complications in both groups would reveal that the experimental group had a higher incidence of complication at 42.03 percent, compared with the control group who only had rate of 17.17 percent. This suggests that changing peripheral IV sites every 72 hours or 3 days were associated with lesser chances of developing phlebitis, infiltration, and localized site infection. This result agrees with the assertion of CDC (2011) that routine replacement of IV catheters reduces the risk of infection and phlebitis.

Frequency of Phlebitis and Infiltration With Regard to Moderating and Mediating Variables

Table 2 illustrates the results of the Chi-square analysis between the moderating and mediating variables, and frequency counts of phlebitis and infiltration. The other complication – localized site infection, was excluded from the table because it could not be statistically treated for having values less than the minimum number required by the test. The outcome variables – Phlebitis and Infiltration, were further subdivided into 2 groups ("With" and "Without") to clearly delineate the occurrence of the complications. Furthermore, all data were dichotomized to give the readers a better grasp of the variables under study. A total of 168 peripheral IV catheters were inserted in 80 patients for a period of 30 days.

Table 2 further reveals that only 3 out of the 15 identified moderating and mediating variables were found to have statistically significant results. The first significant variable on the list is the length of hospital stay, expressed in either 4-6 days or 7-14 days. It was found out that patients who stayed for 7-14 days had a higher rate of phlebitis (18 out of 77 cases or 23.38 percent) and infiltration (12 out of 77 cases or 15.58 percent) compared with those who only remained for 4-6 days. This suggests that the longer a patient stays in the hospital, the higher is the likelihood of developing peripheral IV complications. The findings are similar with previous researches which showed that an increased length of hospital stay is associated with the presence of more IV complications (Waitt, Waitt, & Pirmohamed, 2004; Marschall et al., 2014).

Table 2. Frequency of phlebitis and infiltration with regard to moderating and mediating variables

MODERATING & MEDIATING VARIABLES		Phlebitis (n = 168)		CHI-SQUARE TEST (α = 0.05)			Infiltration (n = 168)		CHI-SQUARE TEST (α = 0.05)		
		With	Without	X^2-Value	df	P-Value	With	Without	X^2-Value	df	P-Value
Ward	Medical	8	53	0.870^{ns}	1	0.351	3	58	2.358^{ns}	1	0.125
	Surgical	20	87				13	94			
Age	45 and below	16	70	0.476^{ns}	1	0.490	10	76	0.905^{ns}	1	0.341
	46 and above	12	70				6	76			
Gender	Male	11	78	2.528^{ns}	1	0.112	7	82	0.604^{ns}	1	0.437
	Female	17	62				9	70			
Length of Hospital Stay	4-6 days	10	81	4.608*	1	0.032	4	87	6.060*	1	0.014
	7-14 days	18	59				12	65			
Diagnosis	Medical	8	53	0.870^{ns}	1	0.351	3	58	2.358^{ns}	1	0.125
	Surgical	20	87				13	94			
Number of Comorbidities	None	22	118	1.494^{ns}	1	0.222	15	125	0.904^{ns}	1	0.342
	One	6	17				1	22			
Profession of IV Therapist	Nurse	25	122	0.004^{ns}	1	0.947	12	135	4.087*	1	0.043
	Physician	3	14				4	13			
Experience as IV Therapist (Nurse)	2 years	14	93	4.301*	1	0.038	10	97	0.099^{ns}	1	0.753
	3 years	8	19				2	25			
Number of Cannulation Attempts on Same Vein	One Attempt	28	132	1.680^{ns}	1	0.195	15	145	0.086^{ns}	1	0.769
	Two Attempts	0	8				1	7			
Location of IV Site	Cephalic	11	45	0.800^{ns}	1	0.371	5	51	0.184^{ns}	1	0.668
	Dorsal Metacarpal	14	85				11	88			
Laterality of IV Site	Right	15	72	0.043^{ns}	1	0.836	8	79	0.023^{ns}	1	0.881
	Left	13	68				8	73			
IV Catheter Size	G20	14	62	0.183^{ns}	1	0.668	4	72	1.705^{ns}	1	0.192
	G18	13	69				9	73			
IV Catheter Type	Polyurethane	13	71	0.171^{ns}	1	0.679	9	75	0.276^{ns}	1	0.599
	Teflon	15	69				7	77			
Type of IV Fluid	PNSS	15	64	0.797^{ns}	1	0.372	6	73	1.057^{ns}	1	0.304
	PLR	11	69				10	70			
Type of IV Medication	Antibiotic	19	96	0.078^{ns}	1	0.781	11	104	0.209^{ns}	1	0.648
	Anti-ulcer	22	101				14	109			

df – degree of freedom, ns - not significant, * - significant at α = 0.05

The second salient variable in the table is the profession of the IV therapist. While there is no significant relationship found between profession and the occurrence of phlebitis, the opposite is seen in infiltration. Data

reveal that peripheral IV catheters inserted by physicians had a higher rate of infiltration (4 out of 17 cases or 23.53 percent) compared with those inserted by nurses (12 out of 147 cases or 8.16 percent). One possible reason for this is that nurses undergo formal classes on IV therapy training delivered by ANSAP before they could care for patients with IV devices, whereas physicians learn it from actual on-the-job training. As a result, nurses are more inclined to follow established principles of asepsis compared with other healthcare providers who do not have any formal IV therapy training. This finding is reassuring in a sense that it refutes the result of a previous study by Saini, Agnihotri, Gupta, and Walia (2011) wherein nurses were accounted for phlebitis and infiltration rates as high as 85 percent.

The last variable which shows significant result is the experience of the IV therapist. In this category, only the nurses' experience was considered since values belonging to the physicians were well below the minimum frequency count required for Chi-square test. On closer assessment, data show that nurses who had 2 years of experience were found to have lower incidence of phlebitis (14 out of 107 cases or 13.08 percent) compared with those who had 3 years of experience (8 out of 27 cases or 29.63 percent). A tentative explanation for this is that nurses who have 3 or more years of experience might have already forgotten the policies and procedures that were taught to them during their IV therapy training. This strengthens the mandatory requirement of ANSAP to have nurses undergo refresher courses on IV therapy training every 3 years. The remaining variables did not yield any significant influence on the occurrence of phlebitis and infiltration (P-Value > 0.05).

Difference between Control and Experimental Groups on Phlebitis With Regard to Moderating and Mediating Variables

Table 3. Difference between control and experimental groups on phlebitis with regard to moderating and mediating variables

Variable	Group	n	Mean	SD	T-Value	df	P-Value
Age (Years)	Control	12	48.75	21.00	1.250^{ns}	18	0.227
	Experimental	16	39.94	14.28			
Length of Hospital Stay (Days)	Control	12	6.92	2.11	1.160^{ns}	22	0.259
	Experimental	16	7.81	1.87			
Experience of Nurse as IV Therapist (Years)	Control	11	2.27	0.65	0.490^{ns}	21	0.627
	Experimental	14	2.14	0.66			

Table 3 depicts the results of the T-test of mean difference between the standard replacement group and the clinically indicated replacement group with regard to age, length of hospital stay, and experience of nurses as

IV therapist. Only the 3 abovementioned variables were included since the rest of the moderating and mediating variables were nominal in nature and could not be subjected to the statistical test. In addition, the table excluded the outcome variables – infiltration and localized site infection, because they each had counts that do not yield a Standard Deviation (SD) value.

From the entire 168 peripheral IV catheters that were inserted in 80 research participants for a period of 30 days, 28 cases of phlebitis were taken into consideration. 12 out of the 28 cases belonged to the control group while the remaining 16 cases were under the experimental group. The mediating variable "experience of nurse as IV therapist" has a different count since only 25 out of the 28 phlebitis cases were inserted by the nurses. 11 out of the 25 cases belonged to the control group while the remaining 14 cases were under the experimental group. The remaining 3 phlebitis cases inserted by the physicians were omitted since the figures were not sufficient to generate an SD value.

Based on the tabulated data, it can be seen that there is no significant difference between the control and experimental groups with regard to age, length of hospital stay, and experience of nurse as IV therapist (P-Values > 0.05). This suggests that both groups have an equal chance of developing phlebitis regardless of age, length of hospital stay, and experience of nurse as IV therapist.

Difference between Control and Experimental Groups on the First

Table 4. Difference between control and experimental groups on the first onset of outcome variables

Outcome Variable	Group	n	Mean	SD	T-Value	df	P-Value
Phlebitis (Days)	Control	10	2.34	0.73	0.430^{ns}	17	0.673
	Experimental	10	2.21	0.62			
Infiltration (Days)	Control	2	2.25	1.34	0.040^{ns}	1	0.974
	Experimental	9	2.21	0.63			

Onset of Outcome Variables

Table 4 illustrates the T-test of mean difference between the standard replacement group and the clinically indicated replacement group on the first onset of phlebitis and infiltration. The last outcome variable – Localized Site Infection, was not included because it had numerical data that were not adequate to yield an SD value. Only the first instance of complication was taken into consideration so as to determine the average length of time it took one peripheral IV site to develop phlebitis or infiltration without the biases that may occur if the subject had previous similar cases.

Out of the 168 peripheral IV catheters that were inserted in 80 research participants over a course of 30 days, 20 developed into phlebitis while 11 advanced to infiltration – both of which developed on the first occasion. The 20 cases of phlebitis were equally divided between the control and experimental groups with 10 counts each. On the other hand, 2 out of the 11 infiltration cases belonged to the control group while the remaining 9 were under the experimental group.

Analysis of the data show that the average number of days to develop phlebitis was 2.34 for the standard replacement group and 2.21 for the clinically indicated replacement group. Although both groups have similar values, there is no significant difference between them. Likewise, the same insignificant relationship can be found for infiltration between both groups (2.25 days for the control group versus 2.21 days for the experimental group).

Although the average time it took for phlebitis or infiltration to occur was less than 3 days, the findings suggest that standard replacement of peripheral IV catheters every 3 days has no benefit over clinically indicated changes (P-Values > 0.05). This outcome reinforces several studies which revealed that there was no significant difference between standard and clinically indicated changes with regard to phlebitis and infiltration (Webster et al., 2007; Webster et al., 2008; Van Donk et al., 2009; Rickard et al., 2010; Rickard et al., 2012).

Proposed New IV Replacement Guidelines

Based on the results gathered from the study, we propose the following new IV replacement guidelines to be adopted by hospitals:

1. Replacing peripheral IV catheters on a clinical-need, rather than a routine basis to lessen the possibility of developing phlebitis and infiltration in adults is a viable option (Webster et al., 2007; Webster et al., 2008; Van Donk et al., 2009; Rickard et al., 2010; Rickard et al., 2012).
2. When rotating sites of peripheral IV catheters based on clinical indications is followed, routine IV site assessment should be done to minimally include the following factors: patient's subjective data, visual evaluation, and palpation of the IV site (INS, 2011).
3. The frequency of site assessment should be:

a. No less than every 4 hours for patients receiving non-blistering or non-irritating solutions (INS, 2011);

b. At best every 1-2 hours for severely ill patients (INS, 2011); and

c. At least every 5-10 minutes for patients receiving intermittent vesicant solutions and vasoconstrictor agents (INS, 2011).

4. Each organization should adopt a standardized scale in assessing phlebitis (Gallant & Schultz, 2006) and infiltration (INS, 2006b).

5. For cases involving infusion-related infections, culture should be done on blood specimens, the tip of the IV catheter, and the IV site using aseptic technique (INS, 2006c).
6. Appropriate documentation should be done to include patient assessment, complications, and side-effects associated with infusion therapy (INS, 2006c).
7. Each organization should establish protocols in the care of vascular access devices (i.e. peripheral IV catheters) to avoid complications (2006c).

Conclusions and Recommendations

In light of the research findings, we conclude that the risk of developing phlebitis and infiltration is not increased when peripheral IV catheters are replaced on a clinical-need rather than on a routine basis among adult patients. Length of hospital stay has bearing on the development of phlebitis and infiltration; whereby the longer a patient stays in the hospital with a peripheral IV catheter, the higher is the likelihood of developing phlebitis and infiltration. Moreover, when peripheral IV catheters are inserted by a physician, there is an increased chance of developing infiltration. Arguably, the length of experiences among nurses is associated with the development of phlebitis. Other variables considered in the study (ward, age, gender, diagnosis, comorbidities, cannulation attempt, location and laterality of IV site, IV catheter size, IV catheter type, and type of IV fluid and medication) have no relevance on the development of phlebitis or infiltration.

Hospitals should consider adopting new guidelines wherein peripheral IV catheters are replaced only in the presence of complications – phlebitis and infiltration. Consequently, unnecessary pain would be avoided and potential savings may be promoted for patients with peripheral IV catheters changed on a clinical need basis.

Similar studies may be conducted involving larger population samples for a prolonged duration of time to eliminate the insufficiency of values in certain data subsets such as the case of the outcome variable "localized site infection." Moreover, the study should include blood and device cultures if they wish to develop an accurate connection between the presence of a peripheral IV catheter and the development of localized site infection. Finally, it would be a welcome addition if cost, pain level, and patient satisfaction could be measured as one of the outcome variables in the study. This would greatly help evaluate the patient's response in relation to the application of the hospital IV replacement policy.

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