

## ORIGINAL ARTICLE

### Peripheral Intravenous Catheter Complication Rates between those Indwelling > 96 Hours to those Indwelling 72 – 96 Hours: A Retrospective Correlational Study

Ascoli GB<sup>\*a</sup>, DeGuzman PB<sup>b</sup>, Rowlands A<sup>c</sup>



Ascoli GB

a. Infusion Center, Martha Jefferson Hospital, Charlottesville, Virginia, USA.  
b Assistant Professor, University of Virginia School of Nursing.  
c Assistant Professor, West Virginia University School of Nursing

## ABSTRACT

**Background:** Care of peripheral intravenous catheters (PIVs) is a major component of hospital nursing practice, yet little published evidence exists to help nurses determine the maximum time PIVs can remain indwelling to minimize the risk of complications. This study sought to determine if PIVs that remained in place for > 96 hours would have the same complication rate as those that remained in place for 72-96 hours.

**Population:** Hospitalized adults with a peripheral intravenous catheter indwelling at least 72 hours.

**Methods:** A retrospective correlational design explored the relationship between complication rates with respect to these dwell times.

**Results:** Of all charts reviewed, 490 met inclusion criteria, of which 110 were discontinued due to a complication. The most common complication was infiltration. The study found that there was no difference in complication rate between those PIVs dwelling for 72-96 hours and those for greater than 96 hours.

**Conclusion:** This research supports the current Infusion Nurses Society recommendation to remove PIVs based on clinical indication rather than standard interval.

**Keywords:** *Peripheral intravenous catheter; phlebitis; dwell times; infiltration; evidence-based practice; occlusion; intravenous complication.*

#### \*Corresponding Author

Infusion Center, Martha Jefferson Hospital, 500 Martha Jefferson Drive,  
Charlottesville, Virginia 22911, USA. E-mail: [Gloria.Ascoli@mjh.org](mailto:Gloria.Ascoli@mjh.org)

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## **Introduction:**

### **Background:**

Care of peripheral intravenous catheters (PIVs) is a major component of hospital nursing practice, yet little published evidence exists to help nurses determine the maximum time PIVs can remain indwelling to minimize occurrence of complications. Bregenzer, Cohen, Sakmann, and Widmer (1998) found prolonged catheterization did not lead to higher complications, and suggested that the practice of routine replacement should be re-examined. Despite this finding, as recently as 2006, the Infusion Nurses Society (INS) Infusion Nursing Standards of Practice recommended a scheduled replacement of PIVs every 72 hours. Optimal dwell time for PIVs is unclear, and may be individual to the patient. Reflecting this, the updated 2011 Infusion Nursing Standards of Practice recommend considering “replacement of the short peripheral catheter when clinically indicated.” (Infusion Nurses Society, 2011, pS57).

Researchers have examined the difference between phlebitis rates for PIVs with dwell times of less than and longer than 72 hours. Lai (1996) compared phlebitis rates for patients with a 72- hour indwelling catheter to patients with a 96- hour indwelling catheter, and observed no difference between the groups. More recently, Powell, Tarnow and Perucca (2008) compared rates of phlebitis among PIV catheters left dwelling for different amounts of time. They found a positive correlation between indwell time and phlebitis, but this relationship was weaker for catheters indwelling for at least three days (Powell, Tarnow & Perucca, 2008).

While evidence suggests phlebitis and infection rates may not increase with longer dwell times, little published evidence exists demonstrating the relationship between occurrence of other complications (e.g. leaks, infiltration and occlusion) with higher dwell times. The purpose of this study was to determine if a PIV that remained in place for > 96 hours would have the same complication rate as one that remained in place for 72-96 hours.

### **Methods**

This study used a retrospective, correlational design to explore the relationship between complication rates in 72- 96 hour PIVs, and those indwelling for more than 96 hours. Institutional Review Board approval was granted for this study.

The study was conducted in a 176-bed, Magnet-designated, South-eastern U.S. community hospital using data collected in a chart review. The hospital has no IV team; all hospital-placed PIVs are started by nurses or emergency department technicians. The sample included all hospitalized patients over the age of 18 who were admitted to any of three medical -surgical units between August 2009 and May 2010. These units specialized in orthopaedics, telemetry and oncology patient populations. To be included in the study, patients must have had a PIV that remained in place for at least 72 hours during their hospital stay, and nursing documentation had to include PIV start and stop time, and reason for discontinuation.

A computerized report was generated from identifying patients whose PIV had remained in place for at least 72 hours. Demographic data was collected on each patient who met inclusion criteria. Characteristics of each PIV were collected, including start and end time, origin, site, and reason for removal. The PIV origin was classified as either outside the hospital or within the hospital. Catheter sites included the antecubital space, forearm, wrist and hand. The reason for removing a catheter was classified as either complication (infiltration, leak, occlusion or phlebitis), or non-complication (accidental dislodgement, completed therapy, central line placement, routine site change or patient request).

All statistical analyses were performed using SPSS 18.0 (SPSS Inc., Chicago, Illinois), and the level of significance was set at 0.05 (two-tailed) throughout. Demographic characteristics of the sample were calculated by complication rate, and chi-squared analysis was used to determine if demographics differed between those people who experienced a PIV complication and those who did not. Univariate analysis was run using chi-square to determine if the complication rate varied by dwell time, and to determine other factors that were related to a higher complication rate.

### **Results**

Of all charts reviewed during this period, 490 met inclusion criteria. Of note, several thousand charts were reviewed, but due to inclusion criteria requiring complete documentation of PIV start and stop time, and reason for discontinuation, less than 500 qualified for inclusion in the analysis. The majority of patients sampled were male (51.8%) and Caucasian (86.5%), and approximately two-thirds were over 65 years old.

Table 1: Demographic Characteristics of Study Sample by Complication Occurrence (n=490)

Variable	Complication (n=110) n (%)	No complication (n=380) n (%)	p-value
<b>Gender</b>			
Male (n = 254)	47 (18.5)	207 (81.5)	0,03
Female (n = 236)	63 (26.7)	173 (73.3)	
<b>Race</b>			
Caucasian (n=424)	98 (23.1)	326 (76.9)	0.37
Non – Caucasian (n = 66)	12 (18.2)	54 (81.8)	
<b>Age</b>			
< 65 years old (n = 159)	29 (18.2)	130 (81.8)	0.05
65 – 74 years old (n = 120)	24 (20.0)	96 (80.0)	
75 – 84 years old (n = 131)	30 (22.9)	101 (77.1)	
≥ 85 years old (n = 80)	27 (33.8)	53 (66.3)	

Table 1 shows demographic characteristics of the sample, by occurrence of complications. Although men made up the majority of the sample, they were less likely to experience a PIV complication (p=.03). Also, older patients were more likely to have

experienced a PIV complication, with 33.8% of patients 85 years old or more experiencing a PIV complication compared with only 18.2% of patients younger than 65 years old.

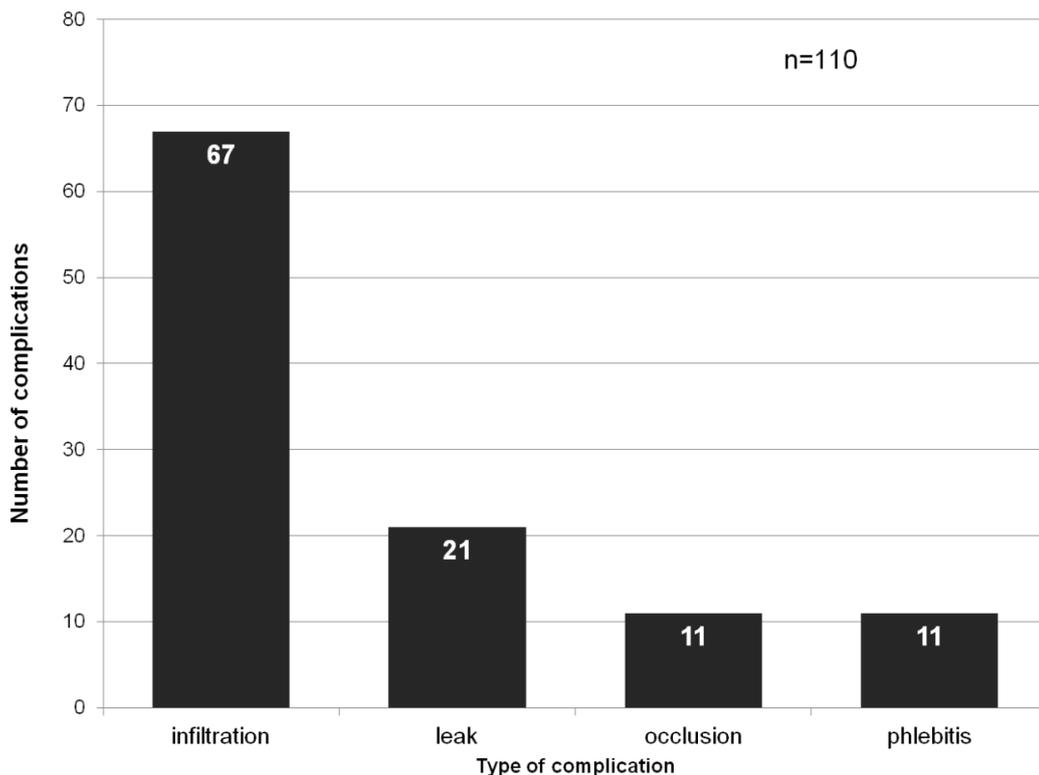


Figure 1: Complications of Peripheral Intravenous Catheters, by Type of Complication

Overall, of 490 PIVs, 110 (22.4%) were discontinued due to a complication. The most common complication was infiltration (67/110, [60.9%]). Figure 1 shows the breakdown of all

complications. Of those PIVs that were discontinued for reasons other than a complication, the most common reason was that the therapy was complete (86.3%).

Table 2: PIV Characteristics

Variable (n=162)	n (%)
<b>Insertion side</b>	
Left	201 (41.0)
Right	288 (58.8)
Missing data	1 ( 0.2)
<b>Site</b>	
Antecubital	150 (30.6)
Forearm	183 (37.3)
Hand	111 (22.7)
Wrist	46 ( 9.4)
<b>Dwell Time (hours)</b>	
72-96	314 (69.1)
96 or more	176 (30.9)
<b>Origin</b>	
Inside hospital	457 (93.3)
Outside hospital	33 ( 6.7)

PIV – Peripheral Intravenous Catheter

Table 2 shows characteristics of PIVs. The most common site was the patient's forearm (n=183/490), followed by the antecubital space (n=150). Nearly one-third of all PIVs sampled were left indwelling for more than 96 hours (n=176/490).

Table 3 contains the results of the univariate analysis. To answer the main research questions we found no significant difference in complication occurrences between catheters left indwelling for 72 to 96 hours, and those left indwelling greater than 96 hours (p=0.14). Forearm placement of the PIV appeared to be associated with a higher complication rate when compared with all other sites (29.0% vs. 18.6%, p<.01), while those placed in the hand or wrist were associated with a lower rate compared with other sites (16.6% vs. 25.2%, p=.03). No other PIV characteristics were found to be associated with a higher occurrence of complications. Of note, there was no significant difference in complication occurrences between those PIVs originating inside the hospital compared with those started in the hospital.

## Discussion

Our analysis of the data supports the hypothesis that PIVs indwelling for more than 96 hours do not have a higher complication rate than those that are indwelling for 72-96 hours. The inclusion criteria limited analysis to those PIVs that were still indwelling after 72 hours, thus excluding PIVs that already had failed. Prior studies have found the risk of phlebitis in PIVs increases over the first 48 hours, but then decreases. (Homer & Holmes, 1998; Gallant & Schultz, 2006; Powell, Tarnow & Perucca, 2008). Our data appears to support these findings, as well as the recommendation that PIVs that last more than 3 days should be left indwelling until removal is clinically indicated, because the risks associated with them are lower once they surpass the three-day period. Regular site rotation may be unnecessary to prevent complications, and as elimination of this extra task would save time, resources and patient pain, regular PIV site rotation should be avoided when not clinically indicated.

If regular site rotation is eliminated from nursing practice, extra care must be given to regular PIV site assessment, in particular for groups who may be at higher risk for complications. Patients in our study who were older and female were more likely to have experienced PIV complications, a finding that is consistent with the literature (Dychter, Gold, Carson, & Haller, 2012). In our study, nearly one-third of patients 85 years old or older experienced a PIV complication compared with 18.2% of patients younger than 65. While this study supports longer PIV dwell times, nurses should exercise increased vigilance when caring for females and the elderly patients, who are at higher risk for PIV complications. As people age, skin becomes more fragile, placing the elderly at a higher risk for injury due to complications (U.S. National Library of Medicine, 2012). The pressure placed on elderly skin during the placement of PIVs can cause skin to tear and blood vessels to break, making each new PIV insertion also additionally risky. Little research exists investigating the effect of longer dwell times on these higher risk groups. Further study may be warranted to determine how the risk of PIV complications compares to the benefit of minimizing PIV insertions for elderly patients.

In our study, the forearm site had a higher complication rate than other PIV sites, while PIVs in the hand or wrist had far a lower rate than other sites. These were unexpected findings; prior research suggests sites over a joint are more likely to develop phlebitis (Furtado, 2011). However; most prior research has just looked at incidence of phlebitis.

Complications in our study were not limited to phlebitis, but also included common local complications such as leak, occlusion and infiltration. Inclusion of these complications may have led to a different result than in prior research. Nurses have a tendency to choose the forearm as a PIV site, because of the belief that this is preferable. Lundgren & Ek (2007) found this preference for forearm PIVs was due to nurses' desire to avoid a joint and for patient comfort. Little research has been done investigating PIV site placement in its relationship to complication rates during longer dwell times. Researchers should consider investigation of complication rates of PIVs placed in the hand and wrist compared with other sites.

Another unexpected finding was that PIVs started outside the hospital did not have a higher complication rate, despite possibly being started in a less aseptic environment. The current INS standard states that "VADs [vascular access devices] placed in an emergency situation should be removed as soon as possible, and not later than 48 hours" (Infusion Nurses Society, 2011, P S57). Because we only included data for PIVs lasting longer than 72 hours, patients who developed complications earlier are not included in our data collection. Additionally, it is possible that aseptic technique has improved outside the hospital in recent years, and this may need to be examined in further research.

Table 3: Factors associated with PIV complication occurrence

Variable	Complication n(%)	No complication n(%)	p-value
<b>Dwell Time (hours)</b>			
72-96, (n=314)	64 (20.4)	250 (79.6)	.14
96 or more, (n = 176)	46 (26.1)	130 (73.9)	
<b>Site</b>			
Forearm Site, (n=183)	53 (29.0)	130 (71.0)	<.01
Other site, (n=307)	57 (18.6)	250 (81.4)	
Hand or Wrist, (n=157)	26 (16.6)	131 (83.4)	.03
Other site, (n=333)	84 (25.2)	249 (74.8)	
<b>PIV origin</b>			
Inside hospital, (n=457)	104 (22.8)	353 (77.2)	.54
Outside hospital, (n=33)	6 (18.1)	27 (81.9)	

### Limitations

Our sample was limited to three inpatient units in a mid-sized community hospital in the Southeast and may not be generalizable to patients in other settings. Over 85% of patients sampled were Caucasian, representing the hospital's demographic mix, thus findings might not be generalizable to patients from other racial and ethnic backgrounds. Because we used a retrospective data collection method, our independent variables were limited to those we could reliably find documented in the medical record. We did not collect data on vein

fragility, patient condition, use of stabilization devices, and type of infusate or nurses skills in venous access; thus, any of these factors could have influenced these findings. Future studies looking at common complications should include these variables in data collection. Finally, we were limited in our ability to find patient charts to include in our sample, due to the lack of complete nursing documentation in many records. This limitation may have restricted our chart review to certain nurses, or nurses with certain work characteristics, both of which could be related to nursing skills, and could have affected our results.

## Conclusion

This study adds to the body of nursing research supporting the current INS recommendation to remove PIVs based on clinical indication, rather than a standard time interval. Future studies using retrospective data should be aware of limitations due to incomplete nursing documentation. To advance patient care and nursing research, complete documentation should include PIV start and stop time, site, condition, signs and symptoms of complications and specific reason for removal.

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