

## ORIGINAL RESEARCH

# Hospitalist Experiences, Practice, Opinions, and Knowledge Regarding Peripherally Inserted Central Catheters: A Michigan Survey

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**BACKGROUND:** Peripherally inserted central catheters (PICCs) are commonly inserted during hospitalization for a variety of clinical indications.

**OBJECTIVE:** To understand hospitalist experience, practice, knowledge, and opinions as they relate to PICCs.

**DESIGN AND SETTING:** Web-based survey of hospitalists in 5 healthcare systems (representing a total of 10 hospitals) across Michigan.

**RESULTS:** The overall response rate was 63% (227 hospitalists received invitations; 144 responded). Compared with central venous catheters, hospitalists felt that PICCs were safer to insert (81%) and preferred by patients (74%). Although 84% of respondents reported that placing a PICC solely to obtain venous access was appropriate, 47% also indicated that 10%–25% of PICCs inserted in their hospitals might represent inappropriate placement. Hospitalist knowledge regarding PICC-related venous thromboembolism

was poor, with only 4% recognizing that PICC-tip verification was performed principally to prevent thrombosis. Furthermore, several potential practice-related concerns were identified: one-third of hospitalists indicated that they never examine PICCs for externally evident problems, such as exit-site infection; 48% responded that once inserted, they did not remove PICCs until a patient was ready for discharge; and 51% admitted that, at least once, they had “forgotten” that their patient had a PICC.

**CONCLUSIONS:** Hospitalist experiences, practice, opinions, and knowledge related to PICCs appear to be variable. Because PICC use is growing and is often associated with complications, examining the impact of such variation is necessary. Hospitals and health systems should consider developing and implementing mechanisms to monitor PICC use and adverse events. *Journal of Hospital Medicine* 2013;8:309–314. © 2013 Society of Hospital Medicine.

Peripherally inserted central catheters (PICCs) have become among the most common central venous catheters (CVCs) used in contemporary medical practice.<sup>1</sup> Although they were originally developed for delivery of parenteral nutrition, the use of PICCs has expanded to include chemotherapy administration, long-term intravenous (IV) antibiotic treatment, and venous access when obtaining peripheral veins is difficult (eg, occluded peripheral veins, unusual venous anatomies).<sup>2</sup> Despite these roles, little is known about PICC use in hospitalized patients. This knowledge gap is important, as PICCs are placed in inpatient settings for a variety of reasons. Some of these reasons may not be appropriate, and inappropriate PICC use may worsen outcomes and increase healthcare costs.<sup>3</sup> In addition,

PICCs are not innocuous and are frequently associated with important complications including thrombophlebitis, central-line-associated bloodstream infection and venous thromboembolism.<sup>4–6</sup> Therefore, understanding patterns and knowledge associated with PICC use is also an important patient safety concern.

As the main providers of inpatient care, hospitalists frequently order the insertion of PICCs and treat PICC-related complications. Unfortunately, to date, no study has surveyed hospitalists regarding management or use of PICCs. Understanding hospitalist experiences, practice, opinions, and knowledge related to PICCs is therefore of significant interest when examining present-day PICC use. To bridge this important knowledge gap and better understand these practices, we conducted a Web-based survey of hospitalists in 5 healthcare systems in the state of Michigan.

## METHODS

A convenience sample of hospitalists (N = 227) was assembled from 5 large healthcare systems (representing 10 hospitals) that participate in the Hospital Medicine Safety (HMS) Consortium, a Blue Cross/Blue Shield of Michigan-funded statewide collaborative quality initiative. Individuals engaged in research, quality improvement, or leadership at HMS sites were

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**TABLE 1.** Characteristics of Participating Sites

Survey Site	No. of Hospitals	No. of Inpatient Beds	No. of Annual Inpatient Encounters	No. of Hospitalists	Full-Time Hospitalists, %	Avg. No. Weeks/Year on Service	Avg. Years of Experience	No. PICCs/Week, 2012	Modality of PICC Insertion Available
University of Michigan Health System	1	900+	5,775	46	100	25	6	42	Vascular access nurse
Ann Arbor VA Medical Center	1	135	825	16	50	17.6	5.1	12	Vascular access nurse
Spectrum Health System	2	800	14,000	47	80	34	3.75	56	Interventional radiology
Trinity Health System	3	634	2,300	67	80	24	4	31	Interventional radiology and hospitalists
Henry Ford Health System	3	1,150	1,450	51	100	20.4	5.6	15	Vascular access nurse

NOTE: Abbreviations: Avg., average; PICC, peripherally inserted central catheter; VA, Veterans Affairs.

invited to serve as site principal investigators (site PIs). Site PIs were responsible for obtaining regulatory approval at their parent facilities and disseminating the survey to providers in their group. Participation in the survey was solicited via e-mail invitations from site PIs to hospitalists within their provider group. To encourage participation, a \$10 electronic gift card was offered to respondents who successfully completed the survey. Reminder e-mails were also sent each week by site PIs to augment participation. To enhance study recruitment, all responses were collected anonymously. The survey was administered between August 2012 and September 2012; data collection occurred for 5 weeks during this interval.

Survey questions were derived from our published, evidence-based conceptual framework of PICC-related complications. Briefly, this model identifies complications related to PICCs as arising from domains related to patient-, provider-, and device-related characteristics based on existing evidence.<sup>2</sup> For our survey, questions were sourced from each of these domains so as to improve understanding of hospitalist experience, practice, opinions, and knowledge regarding PICC use. To ensure clarity of the survey questions, all questions were first pilot-tested with a group of randomly selected hospitalist respondents at the University of Michigan Health System. Direct feedback obtained from these respondents was then used to iteratively improve each question. In order to generate holistic responses, questions were designed to generate a response reflective of the participants "typical" PICC use/scenario. We used SurveyMonkey to collect and manage survey data.

### Statistical Analyses

Variation in hospitalist experience, reported practice, opinions, and knowledge regarding PICCs was assessed by hospitalist type (full time vs part time), years of practice (<1, 1–5, >5), and care-delivery model (direct care vs learner-based care). Bivariate comparisons were made using the  $\chi^2$  or Fisher exact tests as appropriate; 2-sided  $\alpha$  with a  $P$  value <0.05 was considered statistically significant. All analyses were conducted using Stata version 11 (StataCorp, College Station, TX). Local institutional review board approval was obtained at each site participating in the survey.

## RESULTS

A total of 227 surveys were administered and 144 responses collected, for a survey response rate of 63%. Each participating site had unique characteristics including size, number of hospitalists, and modality of PICC insertion (Table 1). Of the hospitalists who completed the survey, 81% held full-time clinical positions and had been in practice an average of 5.6 years. Surveyed hospitalists reported caring for an average of 40.6 patients per week and ordering a mean of 2.9 (range, 0–15) PICCs per week of clinical service. Among survey respondents, 36% provided direct patient care, 34% provided care either directly or through mid-level providers and housestaff, and 9% delivered care exclusively through mid-level providers or housestaff (Table 2). As our survey was conducted anonymously, potential identifying information such as age, race, and sex of those responding was not collected.

### Hospitalist Experiences and Practice Related to Peripherally Inserted Central Catheters

According to responding hospitalists, the most common indications for PICC placement were long-term IV antibiotic treatment (64%), followed by inability to obtain peripheral venous access (24%). Hospitalists reported an average duration of PICC placement of 17 days (range, 3–42 days). A significant percentage of hospitalists (93%) stated that they had cared for patients where a PICC was placed only for use during hospitalization, with the most common reason for such insertion being difficulty in otherwise securing venous access (67%). Respondents also reported caring for patients who had both PICCs and peripheral IV catheters in place at the same time; 49% stated that they had experienced this <5 times, whereas 33% stated they had experienced this 5–10 times. Furthermore, 87% of respondents indicated having admitted a patient who specifically requested a PICC due to prior difficulties with venous access. More than half of surveyed hospitalists (63%) admitted to having been contacted by a PICC nurse enquiring as to whether their patient might benefit from PICC insertion.

The majority of hospitalists (66%) reported that they specified the number of lumens when ordering

**TABLE 2.** Descriptive Characteristics of Study Population

Characteristic	Total (N = 144)
Hospitalist type, n (%)	
Full time	117 (81)
Part time	19 (13)
Unknown	8 (6)
Weeks/year on a clinical service, n (%)	
<20	24 (17)
≥20	107 (74)
Unknown	13 (9)
Mean (SD)	25.5 (10.7)
Median	26
Type of patients treated, n (%)	
Adults only	129 (90)
Adults and children	7 (5)
Unknown	8 (6)
Years in practice as a hospitalist, n (%)	
≤5	81 (56)
>5	54 (38)
Unknown	9 (6)
Model of care delivery, n (%)	
Direct	52 (36)
Some midlevel or housestaff providers (<50% of all encounters)	49 (34)
Mostly midlevel or housestaff providers (>50% of all encounters)	22 (15)
Only midlevel or housestaff providers	13 (9)
Unknown	8 (6)
Location of practice	
Trinity Health System	39 (27)
University of Michigan Health System	37 (26)
Henry Ford Health System	28 (19)
Spectrum Health System	21 (15)
Ann Arbor VA Medical Center	11 (8)
Unknown	8 (6)

NOTE: Abbreviations: SD, standard deviation; VA, Veterans Affairs.

PICCs. Thirty-eight percent indicated that this decision was based on type of medication, whereas 35% selected the lowest number of lumens possible. A power PICC (specialized PICCs that are designed to withstand high-pressure contrast injections), was specifically requested for radiographic studies (56%), infusion of large volume of fluids (10%), or was the default PICC type at their facility (34%).

A majority (74%) of survey respondents also reported that once inserted, PICCs were always used to obtain blood for routine laboratory testing. Moreover, 41% indicated that PICCs were also always used to obtain blood for microbiological cultures. The 3 most frequently encountered PICC-related complications reported by hospitalists in our survey were blockage of a PICC lumen, bloodstream infection, and venous thromboembolism (VTE; Table 3).

### Hospitalist Opinions Regarding Peripherally Inserted Central Catheters

Compared with CVCs, 69% of hospitalists felt that PICCs were safer and more efficient because they could stay in place longer and were less likely to cause infection. Most (65%) also agreed that PICCs were more convenient than CVCs because they were

inserted by PICC teams. Additionally, 74% of hospitalists felt that their patients preferred PICCs because they minimize pain from routine peripheral IV changes and phlebotomy. A majority of respondents (84%) indicated that it was appropriate to place a PICC if other forms of peripheral venous access could not be obtained. However, when specifically questioned, 47% of hospitalists indicated that at least 10%–25% of PICCs placed in their hospitals might represent inappropriate use. A majority (78%) agreed with the statement that the increase in numbers of vascular nurses had influenced use of PICCs in

**TABLE 3.** Key Hospitalist Experience and Opinions Regarding PICCs

Hospitalist Experiences With PICCs	Total (N = 144)
Primary indication for PICC placement*	
Long-term IV antibiotics	64
Venous access in a patient with poor peripheral veins	24
Parenteral nutrition	5
Chemotherapy	4
Patient specifically requested a PICC	1
Unknown/other	2
PICC placed only for venous access, n (%)	
Yes	135 (94)
No	9 (6)
PICC placed only during hospitalization, n (%)	
Yes	134 (93)
No	10 (7)
Notified by a PICC nurse (or other provider) that patient may need or benefit from a PICC, n (%)	
Yes	91 (63)
No	53 (37)
How frequently PICCs are used to obtain blood for routine laboratory testing, n (%)	
Always	106 (74)
Unknown/other	38 (26)
How frequently PICCs are used to obtain blood for blood cultures, n (%)	
Always	59 (41)
Unknown/other	85 (59)
Hospitalist Opinions on PICCs	Total (N = 144)
In your opinion, is it appropriate to place a vascular in a hospitalized patient if other forms of peripheral access cannot be obtained? n (%)	
Yes	121 (84)
No	21 (15)
Unknown	2 (1)
In your opinion, should hospitalists be trained to insert PICCs? n (%)	
No	57 (40)
Yes, this is an important skill set for hospitalists	46 (32)
Unsure	39 (27)
Unknown/other	2 (1)
Do you think the increasing number of vascular nurses and PICC nursing teams has influenced the use of PICCs in hospitalized patients? n (%)	
Yes	112 (78)
No	30 (21)
Unknown	2 (1)
What % of PICC insertions do you think may represent inappropriate use in your hospital? n (%)	
<10	53 (37)
10–25	68 (47)
25–50	18 (13)
>50	3 (2)
Unknown/other	2 (1)

NOTE: Abbreviations: IV, intravenous; PICC, peripherally inserted central catheter.

\*Mean response values are reflected.

**TABLE 4.** Key Knowledge Gaps and Variation Regarding PICC-Related VTE

	Total (N = 144)
Why is the position of the PICC tip checked after bedside PICC insertion? n (%)	
To decrease the risk of arrhythmia related to right-atrial positioning	108 (75)
To minimize the risk of VTE*	6 (4)
To ensure it is not accidentally placed into an artery	16 (11)
For documentation purposes (to reduce the risk of lawsuits related to line-insertion complications)	6 (4)
Unsure/Unknown	8 (6)
According to the 2012 ACCP Guidelines on VTE prevention, is pharmacologic prophylaxis for DVT recommended in patients who receive long-term PICCs? n (%)	
No; no anticoagulant prophylaxis is recommended for patients who receive long-term PICCs*	107 (74)
Yes, but the choice and duration of anticoagulant is at the discretion of the provider	23 (16)
Yes; aspirin is recommended for $\geq 3$ months	4 (3)
Yes; anticoagulation with warfarin or enoxaparin is recommended for 3 months	3 (2)
Yes; anticoagulation with warfarin or enoxaparin is recommended for 6 months	2 (1)
Unknown	5 (4)
Assuming no contraindications exist, do you anticoagulate patients who develop a PICC-associated DVT (with any therapeutic anticoagulant)? n (%)	
Yes*	122 (85)
No	16 (11)
Unknown	6 (4)
How long do you usually prescribe anticoagulation for patients who develop PICC-associated DVT? n (%)	
I don't prescribe anticoagulation	12 (8)
1 month	4 (3)
3 months*	84 (58)
6 months	8 (6)
As long as the line remains in place; I stop anticoagulation once the PICC comes out	3 (2)
As long as the line remains in place and for an additional specified period of time after line removal, such as 2 or 4 weeks	27 (19)
Unknown	6 (4)
As part of the treatment of PICC-related DVT, do you routinely remove the PICC?† n (%)	
Yes	102 (71)
No	36 (25)
Unknown	6 (4)

NOTE: Abbreviations: ACCP, American College of Chest Physicians; DVT, deep venous thrombosis; PICC, peripherally inserted central catheter; VTE, venous thromboembolism.

\*Correct answer.

†This represents an unresolved issue; thus, there is no correct guideline recommended answer.

hospitalized patients, but most (45%) were neutral when asked if PICCs were more cost-effective than traditional CVCs.

### Hospitalist Knowledge Regarding Risk of Peripherally Inserted Central Catheter-Related Venous Thromboembolism and Bloodstream Infection

Although 65% of responding hospitalists disagreed with the statement that PICCs were less likely to lead to VTE, important knowledge gaps regarding PICCs and VTE were identified (Table 4). For instance, only 4% of hospitalists were correctly aware that the PICC-tip position is checked to reduce risk of PICC-related VTE, and only 12% knew that the site of PICC insertion has also been associated with VTE risk. Although 85% of respondents stated they would

prescribe a therapeutic dose of an anticoagulant in the case of PICC-associated VTE, deviations from the guideline-recommended 3-month treatment period were noted. For example, 6% of hospitalists reported treating with anticoagulation for 6 months, and 19% stated they would treat as long as the PICC remained in place, plus an additional period of time (eg, 2–4 weeks) after removal. With respect to bloodstream infection, 92% of responding hospitalists correctly identified PICC duration and prompt removal as factors promoting PICC-related bloodstream infection and 78% accurately identified components of the catheter-associated bloodstream infection bundle. When specifically asked about factors associated with risk of PICC-related bloodstream infection, only half of respondents recognized the number of PICC lumens as being associated with this outcome.

### Variation in Hospitalist Knowledge, Experience, or Opinions

We assessed whether any of our findings varied according to hospitalist type (full time versus part time), years of practice (<1, 1–5, >5), and model of care delivery (direct care vs learner-based care). Our analyses suggested that part-time hospitalists were more likely to select “rarely” when it came to finding patients with a PICC and a working peripheral IV at the same time (74% vs 45%,  $P = 0.02$ ). Interestingly, a higher percentage of those in practice <5 years indicated that 10%–25% of PICCs represented inappropriate placement (58% vs 33%,  $P < 0.01$ ) and that vascular nurses had influenced the use of PICCs in hospitalized patients (88% vs 69%,  $P = 0.01$ ). Lastly, a higher percentage of hospitalists who provided direct patient care reported that PICCs were always used to obtain blood for microbiological culture (54% vs 37%,  $P = 0.05$ ).

### DISCUSSION

In this survey of hospitalists practicing at 5 large healthcare systems in Michigan, we observed significant variation in experience, reported practice, opinions, and knowledge related to PICCs. Our findings highlight important concerns related to inpatient PICC use and suggest a need for greater scrutiny related to these devices in these settings.

The use of PICCs in hospitalized patients has risen dramatically over the past decade. Though such growth is multifactorial and relates in part to increasing inpatient volume and complexity, hospitalists have increasingly turned to PICCs as a convenient and reliable tool to obtain venous access.<sup>7</sup> Indeed, in our survey, PICCs that were only used during hospitalization were most likely to be placed for this very reason. Because PICCs are safer to insert than CVCs and the original evidence regarding PICC-related VTE or bloodstream infection suggested low rates of these events,<sup>8–14</sup> many hospitalists may not perceive these

devices as being associated with significant risks. In fact, some have suggested that hospitalists be specifically trained to insert these devices, given their safety compared with traditional CVCs.<sup>7</sup>

However, accumulating evidence suggests that PICCs are associated with important complications.<sup>5,15,16</sup> In studies examining risk of bloodstream infection, PICCs were associated with significant risk of this outcome.<sup>6,17,18</sup> Recently, the presence of a PICC was identified as an independent predictor of VTE in hospitalized patients.<sup>19</sup> Several studies and systematic reviews have repeatedly demonstrated these findings.<sup>19–22</sup> A recent systematic review examining nonpharmacologic methods to prevent catheter-related thrombosis specifically called for avoidance of PICC insertion to prevent thrombosis in hospitalized patients.<sup>23</sup> Despite this growing evidence base, the use of PICCs in the inpatient setting is likely to rise, and our survey highlights several practices that may contribute to adverse outcomes. For instance, hospitalists in our survey were unlikely to remove a PICC until a patient was discharged, irrespective of the need for this device. As each day with a PICC increases the risk of complications, such practice poses potential patient safety concerns. Similarly, many hospitalists believe that PICCs are safer than CVCs, a viewpoint that does not stand up to increasing scrutiny and highlights important knowledge gaps. The risk of PICC-related complications appears not to be a stationary target, but rather a dynamic balance that is influenced by patient-, provider-, and device-specific characteristics.<sup>2</sup> Increasing discretionary use (especially for patients with poor peripheral venous access), forgetting at times that a patient has a PICC, and the finding that up to 25% of PICCs placed in their hospitals may be unnecessary underscore concerns regarding the safety of current practice trends. Interestingly, the viewpoints of hospitalists in practice <5 years and those providing direct patient care were more likely to reflect concerns regarding inappropriate placement, influence of vascular nurses, and use of PICCs for blood culture. This finding may reflect that these nuances are more recent phenomena or perhaps most apparent when care is delivered directly.

Our study must be interpreted in the context of several limitations. First, as this was a survey-based study of a small, convenience sample of hospitalists in a single state, recall, respondent, and systematic biases remain threats to our findings. However, all site PIs encouraged survey participation and (through local dialogue) none were aware of material differences between those who did or did not participate in the study. Similarly, Michigan is a diverse and relatively large state, and our results should be generalizable to other settings; however, national studies are necessary to confirm our findings. Second, our response rate may be perceived as low; however, our rates are in accordance with, and, in fact, superior to those of many

existing physician surveys.<sup>24</sup> Finally, only 1 federal facility was included in this study; thus, this care-delivery model is underrepresented, limiting generalization of findings to other such sites.

However, our study also has important strengths. First, this is the only survey that specifically examines hospitalist viewpoints when it comes to PICCs. As hospitalists frequently order and/or insert these devices, their perspectives are highly pertinent to discussions regarding current PICC use. Second, our survey highlights several instances that may be associated with preventable patient harm and identifies areas where interventions may be valuable. For example, forgetting the presence of a device, keeping PICCs in place throughout hospitalization, and rendering treatment for PICC-related VTE not in accordance with accepted guidelines are remediable practices that may lead to poor outcomes. Interventions such as device-reminder alerts, provider education regarding complications from PICCs, and systematic efforts to identify and remove unnecessary PICCs may mitigate these problems. Finally, our findings highlight the need for data repositories that track PICC use and hospitalist practice on a national scale. Given the risk and significance of the complications associated with these devices, understanding the epidemiology, use, and potential misuse of PICCs are important areas for hospitalist research.

In conclusion, our study of hospitalist experience, practice, opinions, and knowledge related to PICCs suggests important gaps between available evidence and current practice. There is growing need for the development of appropriateness criteria to guide vascular access in inpatient settings.<sup>25,26</sup> Such criteria should consider not only type of venous access device, but granular details including rationale for venous access, nature of the infusate, optimal number of lumens, and safest gauge when recommending devices. Until such criteria and comparative studies become available, hospitals should consider instituting policies to monitor PICC use with specific attention to indication for insertion, duration of placement, and complications. These interventions represent a first and necessary step in improving patient safety when it comes to preventing PICC-related complications.

## Disclosures

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