

Peripherally Inserted Central Catheter Use in Skilled Nursing Facilities: A Pilot Study

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OBJECTIVES: To describe patterns of use, care practices, and outcomes related to peripherally inserted central catheter (PICC) use in skilled nursing facilities (SNFs).

DESIGN: Prospective cohort study.

SETTING: Two community SNFs.

PARTICIPANTS: Adult SNF residents with PICCs (N = 56).

MEASUREMENTS: Information on indication for PICC use, device characteristics (e.g., lumens, gauge), and participant data (comorbidities, medications) were obtained from medical records. Care practices (e.g., frequency of flushing, dressing care) and problems related to PICCs were recorded. Major (central line–associated bloodstream infection, venous thromboembolism, catheter dislodgement) and minor (migration, dressing disruption, lumen occlusion, exit site infection) complications and process measures (flushing of PICC, assessment of necessity) were recorded. Bivariate analyses with *t*-tests, chi-square tests, or Fischer exact tests were used for continuous and categorical data.

RESULTS: Participants were enrolled from two SNFs. The most common indication for PICC use was intravenous antibiotic delivery. The average PICC dwell time was 43 days, and most devices were single-lumen PICCs. Major and minor complications were common and occurred in 11 (20%) and 18 (32%) participants, respectively. Occlusion (23%, n = 13), accidental dislodgement (12%, n = 7), and dressing disruption (11%, n = 6) were the commonest complications observed. Documentation regarding catheter care practices occurred in 41% of cases.

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CONCLUSION: Quality improvement efforts that seek to benchmark practice, identify gaps, and institute efforts to improve PICC care and practice in SNFs appear necessary. *J Am Geriatr Soc* 63:1894–1899, 2015.

Key words: skilled nursing facility; peripherally inserted central catheter; venous thromboembolism; deep vein thrombosis; central line–associated bloodstream infection

Acute care in hospitalized settings is often fraught with peril for older adults. Complications such as delirium, falls, pressure ulcers, infections, and adverse drug events are not only common, but also disproportionately affect older adults in acute care.^{1–4} One approach to mitigating such harm includes transitioning people from acute to alternative care settings. This shift has led to a number of new problems, including coordination and the need to provide care to people with acute needs in skilled nursing facilities (SNFs).^{5–7}

Although several innovations have helped foster such transitions, peripherally inserted central catheters (PICCs) are of particular relevance in this context for at least two reasons.^{8,9} First, PICC use has grown substantially because of increasing availability through hospital-based vascular access nursing teams that offer convenient and cost-effective bedside insertion.^{10,11} Second, PICCs provide durable yet nonpermanent means through which to continue long-term intravenous treatments; thus, they serve as ideal “bridge” devices for transitions of care.

Nevertheless, accumulating evidence suggests that PICCs are also associated with important complications, including central line–associated bloodstream infection (CLABSI) and venous thromboembolism (VTE).^{12–15} Catheter dislodgement, tip migration, and superficial phlebitis also occur frequently with these devices.¹⁶ Because older adults are at greater risk of complications such as CLABSI and VTE,^{17–19} the question of whether SNFs are prepared

to care for individuals at risk of experiencing these events is highly relevant, but no studies were found regarding PICC use or outcomes in this setting.

To bridge this knowledge gap, a pilot study was conducted to evaluate PICC use in two local SNFs. It was hypothesized that PICC use would be common in SNFs and that complications related to these devices would also be frequent. It was further postulated that there would be variations in processes of care related to PICCs in SNFs.

METHODS

Design, Setting, and Participants

Between December 2013 and September 2014, an observational, prospective cohort study of residents and healthcare providers was conducted at two SNFs. Members of the study team (VC, CB, AB, JC) visited each site weekly to identify and recruit residents for participation. Residents were eligible for inclusion if they could provide written informed consent and had a PICC (inserted after hospitalization or during the course of their care at the SNF) for any reason. Because perceptions regarding PICC care and personal experiences with this device were of particular interest, individuals with dementia or cognitive impairment documented in medical records were excluded, because baseline and follow-up data may not be reliably obtainable in such individuals.

Once participants were identified, written informed consent was obtained. Upon enrollment, baseline clinical data for reason for SNF admission, indication for PICC, device characteristics (e.g., number of lumens, gauge, vein and arm of insertion), location of PICC placement (hospital vs SNF), comorbidities, and medications were obtained from hospital and SNF medical records. Next, brief structured interviews were conducted in which residents were asked whether their PICC posed problems with activities of daily living (e.g., showering, bathing, sleeping) or rehabilitation. Symptoms such as arm pain, swelling, and tenderness were also asked about. These questions were then posed to participants' nurses, and congruence of replies was examined. The PICC site was evaluated, and date of dressing change, condition of the dressing (e.g., loose, soiled, intact), presence of erythema or exudate at the insertion site, and centimeters of catheter visible so as to track external migration were recorded.

Participants and nurse providers were followed weekly until a major complication, PICC removal, or discharge from the SNF occurred. At each follow-up, participants were asked whether difficulties with activities, medical problems, or symptoms related to the PICC had developed. In tandem, interviews with nurses for problems related to the device were performed. SNF records were reviewed to determine whether providers from other shifts had documented PICC concerns and whether flushing and dressing changes were being performed. During weekly visits, the PICC site, dressing condition and catheter exit on the skin were also examined and evaluated to determine interval changes. All baseline and follow-up data were collected using a standardized data collection form.

Definitions and Ascertainment of Outcomes

Major complications were defined as the occurrence of symptomatic DVT, CLABSI, catheter dislodgement (e.g., accidental removal by participant or provider), and readmission or emergency department visit for reasons attributable to the PICC. CLABSI was identified when the treating physician at the SNF or hospital documented this diagnosis or when microbiologic data supported the diagnosis according to Centers for Disease Control and Prevention definitions.²⁰ Similarly, VTE was defined when radiographic testing (Doppler ultrasound or computed tomography scan) showed thrombosis in the axillary, brachial, or subclavian veins.²¹ Catheter dislodgement was defined as unintentional removal of the PICC by a participant or provider at any point during the study.

Minor complications included PICC migration, dressing disruption or concerns, lumen occlusion, and exit site infection. PICC migration was defined in accordance with existing standards as unintentional external migration of the PICC.²² Dressing disruption and concerns were recorded when dressings were found to be loose, soiled, wet, or only partially covering the catheter site. Exit site infections were recorded when redness, swelling, or discharge was noted at the site of catheter entry without systemic symptoms. Lumen occlusion was recorded when a nurse stated that a lumen was not working or when medications (e.g., tissue-plasminogen activator) were used to "declot" a lumen. Process measures such as lack of catheter use (e.g., <2 times per week), adherence to flushing protocols, catheter site evaluations, and assessment of line necessity by a nurse or physician at the SNF were also tracked. All complications were verified independently and in duplicate through review of records and examination of participants by at least two investigators, who worked in pairs.

Statistical Analysis

Variation in indications for PICC use, device characteristics, and major and minor complications were examined using *t*-tests, chi-square tests, or Fisher exact tests, based on the underlying distribution of continuous and categorical data. Stata MP SE version 13.0 (Stata Corp., College Station, TX) was used for all statistical analysis; all statistical tests were two-tailed, with $P < .05$ considered statistically significant.

Ethical Approval

The University of Michigan Medical School institutional review board provided regulatory oversight for study consent (HUM079723), and the two participating SNFs reviewed and approved the protocol for the study.

RESULTS

Between January and August 2014, 69 residents at two SNFs were approached, and 56 (81%) were successfully recruited. Both SNFs were located in Ann Arbor, Michigan, but had important differences with respect to participant case-mix and occupancy. Therefore, more residents

were recruited from one site than the other (Table 1). The mean age of residents was 66, and 46% ($n = 26$) were male. Major comorbidities, including hypertension (66%, $n = 37$), diabetes mellitus (46%, $n = 26$), and cancer (25%, $n = 14$), were common, as was use of cardiac and vasoactive medications (80%, $n = 45$), antiplatelet therapy (66%, $n = 37$), and diabetes mellitus medications, including insulin (32%, $n = 18$). No statistically significant differences in participant characteristics were noted between SNFs.

The most common indications for PICC use were long-term antibiotic therapy (64%, $n = 36$), other indications (e.g., intermittent blood draws and intravenous fluid administration; 21%, $n = 12$), and parenteral nutrition (14%, $n = 8$). The majority of PICCs were single-lumen devices (61%, $n = 34$), and 91% ($n = 51$) were power-injection capable (able to withstand the pressure of contrast injectors). Use of double-lumen PICCs was more common at one site (37% vs 7%, $P = .04$). The average dwell time of PICCs was 40.5 days (Table 1).

Adverse Events

Major complications occurred in 11 residents (20%). One CLABSI and three DVTs occurred in four residents; two of these residents were sent to the emergency department and were subsequently hospitalized. Catheter dislodgement was the most common major complication and occurred in seven participants. Minor complications included luminal occlusion ($n = 13$) and dressing disruption ($n = 6$). Catheter migration occurred in three participants. Exit site infection occurred in one participant (Table 2).

When examining process measures for catheter use and care from nursing and participant perspectives, it was observed that 30% of PICCs were not regularly used during the study period and that assessment of line necessity was not documented in 15 (27%) participants. Similarly, catheter site evaluations were documented in only 23 (41%) participants, with significant between-site variation in this practice (32% vs 67%, $P = .02$). Although nurses reported problems related to the use of PICCs in 25% of participants ($n = 14$), participants often complained about limitations in activities of daily living and rehabilitation due to the PICC (46%, $n = 26$). For example, one participant stated, "I don't sleep on this side as I fear it may come out," and another stated, "I cannot shower comfortably or do any pool therapy because of the PICC."

DISCUSSION

With more elderly adults receiving care in hospital settings, a silent yet growing movement to transition people to alternative levels of care has emerged.²³ In many such cases, whether to continue or initiate intravenous therapy underlies such decisions, with PICCs often facilitating such transitions. Despite this trend, data related to PICC use and outcomes in SNFs is scant. This study is among the first to report indications, complications, and process measures related to PICC use in SNFs, finding that these devices are commonly associated with adverse events in this setting. Furthermore, the results suggest that PICC use in SNFs is more prevalent in a postacute care cohort than

a long-term care population, reflecting how these facilities have evolved as niche discharge destination across U.S. hospitals.²⁴ Collectively, these pilot data highlight the need for larger-scale studies that define epidemiology, risks, benefits, and outcomes related to PICC use in individuals receiving care in SNFs.

PICC use has many advantages in hospitalized individuals. Especially in older adults, PICCs provide a new path to reducing length of hospital stay and costs related to intravenous treatments, but PICC-associated complications may offset such benefits, and little is known about the risk of these events in SNF residents. Catheter migration, catheter dislodgement, and dressing disruption were commonly observed adverse events in SNF residents with PICCs. Major complications such as CLABSI and VTE, although present, were less frequent. These observations suggest that SNFs may wish to develop efforts to improve benchmarking, feedback, and implementation of interventions (e.g., how best to secure and care for PICCs) to prevent such problems. It was also found that lumen occlusion occurred more frequently in SNFs than rates reported in hospitalized settings. Because lumen occlusion may result when flushing and maintenance are inadequate,^{25,26} these complications reflect opportunities to improve PICC outcomes through better training and education of front-line staff.

Age and associated functional decline are associated with greater risk of infectious and thrombotic complications. For instance, the prevalence of DVT in older adults hospitalized in subacute care facilities has been reported to be as high as 15.8% (95% confidence interval=13.4–18.5%), compared with 0.5% to 1% in general hospitalized individuals.²⁷ Greater dependence and higher Timed Up and Go Test scores are also associated with greater odds of DVT in older adults.²⁸ Although PICC-associated CLABSI and DVT occur in as many as 15% to 20% of older hospitalized adults,^{29,30} only three SNF residents experienced such events in the current study. While preliminary, these findings suggest that patterns of PICC complications (and, consequently, methods to prevent them) may vary between SNFs and hospitals. Because infection and colonization with antibiotic-resistant organisms is common in elderly adults with indwelling devices, and healthcare worker knowledge is known to be highly variable in SNFs,^{31,32} studies dedicated to better understanding PICC outcomes in this unique setting are needed.

During the course of the study, a number of interesting observations were made that are pertinent to the findings. First, at both SNFs, participants more frequently reported PICC problems than did the staff caring for them. Such problems were often related to activities of daily living, such as bathing and mobility. One potential reason for this discrepancy may be that attitudes toward PICCs varied between sites. For example, some nurses felt that PICCs were no different from peripheral intravenous catheters, whereas others expressed how care and management of PICCs required more of their already-limited time. These opposing views may lead to lower awareness or limited time to focus on individual-centric PICC concerns. Second, process of care measures varied across sites. Although flushing of devices was well documented, care measures such as clinical necessity of the device and condition of the catheter dressing or site were infre-

Table 1. Participant Demographic and Peripherally Inserted Central Catheter (PICC) Characteristics

Characteristic	Site A, n = 41	Site B, n = 15	Total, N = 56	P-Value
Demographic				
Age, mean	65	68	66	.55
Male, n (%)	21 (51)	5 (33)	26 (46)	.24
White, n (%)	33 (81)	13 (87)	46 (82)	.71
Comorbidities, n (%)				
Hypertension	29 (71)	8 (53)	37 (66)	.22
Diabetes mellitus type 2	21 (51)	5 (33)	26 (46)	.24
Coronary artery disease	9 (22)	6 (40)	15 (27)	.19
Cancer	12 (29)	2 (13)	14 (25)	.31
Chronic kidney disease	5 (12)	4 (27)	9 (16)	.23
Chronic obstructive pulmonary disease	5 (12)	4 (27)	9 (16)	.23
Reason for hospitalization, n (%)				
Infectious disease (e.g., wound, cellulitis, osteomyelitis, endocarditis)	23 (56)	11 (73)	34 (61)	.24
Cancer-related diagnosis	5 (12)	2 (13)	7 (13)	>.99
Orthopedic surgery (e.g., total hip arthroplasty)	2 (5)	2 (13)	4 (7)	.29
Abdominal or general surgery	3 (7)	0 (0)	3 (5)	.56
Other (e.g., dehydration, weakness, failure to thrive, congestive heart failure)	8 (20)	0 (0)	8 (14)	.09
Reason for SNF admission, n (%)				
Long-term antibiotics	25 (61)	11 (73)	36 (64)	.39
Rehabilitation	8 (20)	3 (20)	11 (20)	1.00
Both	8 (20)	1 (7)	9 (16)	.42
Medications, n (%)				
Cardiac	34 (83)	11 (73)	45 (80)	.46
Antiplatelet	26 (63)	11 (73)	37 (66)	.49
Anticoagulant	19 (46)	7 (47)	26 (46)	.98
Diabetes mellitus including insulin	13 (32)	5 (33)	18 (32)	1.00
Antibiotics through PICC or midline	12 (29)	3 (20)	15 (27)	.74
Oral or intravenous corticosteroids	4 (10)	2 (13)	6 (11)	.65
Erythropoietin-stimulating agent	1 (2)	0 (0)	1 (2)	>.99
PICC characteristics				
Indication for placement, n (%)				
Long-term antibiotics	27 (66)	9 (60)	36 (64)	.69
Total parenteral nutrition	7 (17)	1 (7)	8 (14)	.43
Chemotherapy	1 (2)	0 (0)	1 (2)	>.99
Other	8 (20)	4 (27)	12 (21)	.72
Inserted by, n (%)				
Vascular nursing	31 (76)	11 (73)	42 (75)	>.99
Interventional radiology	6 (15)	0 (0)	6 (11)	.18
Other or unknown	4 (10)	4 (27)	8 (14)	.19
Arm of insertion, n (%)				
Right	33 (80)	11 (73)	44 (79)	.25
Left	7 (17)	2 (13)	9 (16)	.25
Unknown	1 (2)	2 (13)	3 (5)	.17
Vein of insertion, n (%)				
Basilic	16 (39)	11 (73)	27 (48)	.10
Brachial	8 (20)	1 (7)	9 (16)	.10
Other or unknown	17 (42)	3 (20)	20 (36)	.14
Dwell time, days, mean \pm SD (range)	43.0 \pm 54.0 (7–310)	33.1 \pm 16.0 (12–55)	40.5 \pm 47.4 (7–310)	.56
Number of lumens, n (%)				
One	25 (61)	9 (60)	34 (61)	.95
Two	15 (37)	1 (7)	16 (29)	.04
Three	1 (2)	1 (7)	2 (4)	.47
Unknown	0 (0)	4 (27)	4 (7)	>.99
Power PICC, n (%)				
Placed in hospital, n (%)	22 (54)	11 (73)	33 (59)	.19
Placed in SNF, n (%)	14 (34)	3 (20)	17 (30)	.51
Facility characteristics^a				
Certified beds, n	180	161	341	N/A
Registered nurses who left the position, n	31	28	N/A	N/A
Licensed practical nurses who left the position, n	23	25	N/A	N/A
Four-quarter mean case-mix index	2.545	2.155	N/A	N/A

SNF = skilled nursing facility; SD = standard deviation.

Site A was a for-profit facility, and Site B was a nonprofit facility.

^aData from a number of sources, including publicly available datasets (nursinghomecompare.gov), the 2012 American Health Care Association Report, and personal communication from sites.

Table 2. Complications and Outcomes According to Site

Variable	Site A, n = 41	Site B, n = 15	Total, N = 56	P-Value
Major complications				
Central line-associated bloodstream infection	1 (2)	0 (0)	1 (2)	1.00
Venous thromboembolism (deep vein thrombosis, pulmonary embolism)	1 (2)	2 (13)	3 (5)	.17
Accidental removal or dislodgement	7 (17)	0 (0)	7 (12)	.17
Readmission or emergency department visit related to PICC	1 (2)	1 (7)	2 (4)	.47
Minor complications				
Catheter migration	3 (7)	0 (0)	3 (5)	.56
Dressing disruption	3 (7)	3 (20)	6 (11)	.33
Lumen occlusion	10 (24)	3 (20)	13 (23)	>.99
Exit site infection	0 (0)	1 (7)	1 (2)	.27
Care-specific questions				
Catheter not being used regularly	10 (25)	7 (47)	17 (30)	.19
Nurse-reported PICC problems ^a	10 (24)	4 (27)	14 (25)	>.99
Participant-reported PICC problems ^b	20 (49)	6 (40)	26 (46)	.56
Research staff noted problems upon examination of site ^c	24 (58)	5 (33)	29 (52)	.10
Flushing protocol in place	38 (93)	12 (80)	50 (89)	.33
Documentation of adherence to flushing protocol	36 (95)	10 (83)	46 (92)	.24
Catheter site evaluations documented	13 (32)	10 (67)	23 (41)	.02
Assessment of line necessity by nurse or physician	31 (76)	10 (67)	41 (73)	.51
Line appropriate in reviewer's opinion	32 (78)	10 (67)	42 (75)	.49

P-values were determined from Fisher exact test.

^aTrouble using catheter, swelling or redness, migration and irritation at exit site, inability to flush peripherally inserted central catheter (PICC), inability to use PICC.

^bDifficulty using arm in which catheter was inserted for daily activities, arm swelling, pain, redness, tenderness, itching or irritation, crusting at exit site, occlusion, migration, dislodgment, dressing concerns, inability to flush PICC, inability to use PICC,

^cRedness, swelling, leaking, infusion running, blood or crusting at exit site, dressing concerns (wet, soiled, loose).

quently performed. This discrepancy may relate to a perceived lack of adequate training related to PICCs and ambiguity regarding how to evaluate line necessity, comments that nursing staff often voiced. Nurses at both sites welcomed further training and information on care and maintenance of PICCs from the study team. Finally, several nurses identified lack of documentation regarding rationale, proposed duration, and care instructions for the PICC during transitions from the hospital as a problem. Observations were consistent in this regard and suggest that improving the quality of documentation regarding PICCs at the time of hospital discharge would help improve the safety of these devices.

This study has important limitations. First, only two SNFs were included, with different volumes and patterns of PICC use. Thus, generalizability of the findings remains limited owing to small sample size. Second, because residents who were cognitively impaired were excluded, the safety or benefits of PICC use in such populations is unknown. This limitation was necessary given the exploratory and longitudinal approach of the study, which was centered on participant engagement and views. Future studies that incorporate these populations would be important. Third, information was not collected on mobility; these factors may have influenced the findings and would also be important to assess in future studies.

These limitations notwithstanding, this study has important strengths. First, to the knowledge of the authors, this is the first study to explore patterns of use, complications, and care practices associated with PICCs in SNFs. The findings suggest that PICC use is common and associated with adverse events. Second, because participant and provider perspectives related to these devices were included, this study shines new light on the contextual aspects of living with and caring for PICCs in these settings. Finally, the data suggest that larger studies of PICC use across multiple SNFs are likely to be important. The valuable insights gained through this work will help inform such efforts.

In conclusion, patterns of PICC use and outcomes related to these devices are variable in SNFs. Because PICCs affect participant experiences, lifestyle, and safety, studies related to improving outcomes in this setting would be welcomed.

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Author Contributions: All authors: study concept and design, acquisition of subjects and data, analysis and interpretation of data, preparation of manuscript.

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