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Preparation of Patients for Central Venous Catheter Care in the Home: Perspectives from Health Care Personnel

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Abstract

Patients managing central venous catheters (CVCs) outside of hospitals need training in CVC care. Using three focus groups, the study identified themes in how health care personnel (HCP) prepare patients and their caregivers for CVC care at home. Four major themes and 25 nested subthemes were identified: (1) providing the right amount of education at the right time, (2) tailoring education to patient needs, (3) developing patient education tools, and (4) managing differences in recommendations to patients. HCPs in the study ensured patients and caregivers learn what they need to know when they need to know it, using appropriate patient education tools. Patients and caregivers are largely responsible for CVC care and central line-associated bloodstream infection (CLABSI) prevention outside of acute care hospitals and long-term care settings, and HCP take seriously their obligation to provide them with appropriate education and tools to best enhance their ability to keep themselves safe.

INTRODUCTION

With a push to improve patient experience and reduce costs, central venous catheters (CVCs) are increasingly maintained outside the hospital, such as in skilled nursing facilities (SNF), hemodialysis centers, outpatient infusion clinics, oncology clinics, and homes.¹ While some patients may require a CVC for a period of weeks, others require lifelong CVCs for conditions such as intestinal failure requiring parenteral nutrition (PN), inotropic therapies, or hemodialysis where an arteriovenous fistula or graft is not feasible. The National Home Infusion Association estimates that over 3 million patients

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received home or specialty infusion therapy in 2019—a 300% increase over the prior decade.^{1,2} For example, 80% of chemotherapy is provided in ambulatory settings (e.g., oncology clinics and the home), including parenteral chemotherapy via CVCs.^{3,4} The majority (71%) of patients initiating hemodialysis initiate hemodialysis via a CVC,^{5,6} despite major initiatives promoting arteriovenous fistulae and grafts for hemodialysis.⁷ Outpatient parenteral antimicrobial therapy (OPAT) allows stable patients to receive long-term antimicrobial therapy in the home, SNF, hemodialysis, or infusion centers.⁸ Other patients may require CVCs for intermittent infusions (e.g., iron, factor, immunoglobulin, etc.) at home or in infusion centers, or even life-sustaining home-based inotropic therapies.

Similar to patients with CVCs in acute care hospitals, patients with CVCs outside of acute care hospitals are at risk of central line-associated bloodstream infection (CLABSI). Over one year, more people were admitted to a tertiary academic medical center with CLABSI than developed CLABSI in the hospital.⁹ In home infusion therapy, CLABSI occurs at a rate of 0.2–0.24/1000 CVC-days.¹⁰ Meanwhile, most activities directed towards preventing CLABSI through ensuring best practices around insertion and maintenance of CVCs focus on acute care hospitals,¹¹ including initiatives through the Centers for Disease Control and Prevention and the Centers for Medicare and Medicaid Services.^{12,13}

Unlike in acute care hospitals, CLABSI prevention in community settings requires involvement of patients and their caregivers. Patients and caregivers must perform day-to-day CVC care and (in home care) infusions using sterile technique. Therefore, CLABSI prevention tools and educational initiatives in community settings must be tailored for patients and their caregivers.^{14–18} In particular, CVC maintenance training for patients and caregivers is necessary for CLABSI prevention, but it is unclear how health care personnel (HCP; e.g., home health nurses, home infusion nurses, acute care oncology nurses, ambulatory oncology nurses) caring for patients maintaining CVCs in the home may approach training patients and caregivers.

In this study, focus groups of HCP who provide training to patients and caregivers about CVC care to patients and caregivers were convened. The intent was to learn about how HCPs teach CVC care to patients and caregivers, and how they might use newly developed tools (e.g., videos, short and long instructional manuals, handouts)^{17,18} to teach CVC care to patients and caregivers.

METHODS

Overall approach.

Focus groups were convened to discuss patient education tools and strategies for CLABSI prevention in community settings. Guided by the reach, efficacy, adoption, implementation, and maintenance (RE-AIM) framework,¹⁹ a focus group guide and analytic approach were developed, with additional items focusing on acceptability, appropriateness, and feasibility^{20,21} of patient education tools and strategies. Focus groups were conducted among HCPs most involved in teaching patients and caregivers how to perform CVC maintenance in community settings (i.e., home care and home infusion nurses, and ambulatory and acute care oncology nurses). The focus groups occurred in a non-profit mid-

Atlantic academic health system with an internal home health and home infusion agency, and a for-profit home infusion agency. The study was approved by the Johns Hopkins University School of Medicine Institutional Review Board.

Recruitment.

Recruitment of study participants used a combination of convenience and snowball sampling.²² We focused our recruitment around HCP who were closely involved in educating patients and caregivers about CVC care in the home, particularly home infusion and oncology staff. Recruitment information solicited interest in participating in a focus group that would discuss training patients and caregivers with CVCs in the home, CLABSI prevention, and CLABSI prevention tools. Recruitment information was emailed to home infusion and oncology staff members involved in educating patients and caregivers around CVC maintenance at the academic health system as well as at an unaffiliated for-profit home infusion agency.

Focus group procedures.

Based on the RE-AIM framework,¹⁹ a focus group guide was developed (Appendix) with additional items focusing on acceptability, appropriateness, and feasibility of current and in-development patient education tools, and how patients are educated about CVC maintenance.^{20,21} Focus group members were provided with the tools for review during the focus groups. Focus groups were facilitated by three team members (SCK, TH, OOS), including a physician trained in qualitative research methods and two research staff. After obtaining written consent, focus groups were conducted via videoconferencing and lasted between 40 and 60 minutes. Three focus groups were convened.²³ Participants were asked to not use any identifying information when referring to themselves, patients or families, other HCP, or others in the focus groups. Focus groups were audio-recorded for professional transcription.

Data management and analyses.

A professional company transcribed the focus group recordings and removed any identifiers that may have been mentioned by participants. Both deductive and inductive coding was used in analyses. First, six substantive deductive parent codes were applied for how patients were taught in the past, prior use of patient education tools, perceptions of patient education tools, characteristics of patient education tools, and perceptions of a patient education toolkit independently to one focus group transcript (OOS, SCK, TH). An additional parent code around how to manage when patients may be exposed to different tools or equipment in different healthcare settings, or if patients may be exposed to different protocols or processes in self-maintaining their CVCs, arose from this first focus group transcript. The team then inductively coded 44 sub-codes instrumental in identifying perceptions around approaches to patient education. Disagreements in coding were discussed throughout the codebook development phase and rectified to coder agreement.²⁴ Thereafter, the three researchers coded together the remaining transcripts and re-coded the first transcript using the established codebook. Thematic saturation was achieved.²⁵

RESULTS

Three focus groups were conducted between January 2023 and February 2023. There were two to three members in each focus group, with eight total participants. Half worked in home infusion, a quarter worked in inpatient oncology, and a quarter worked in outpatient oncology. All were nurses (Table 1).

Four major themes and 25 subthemes were identified (Table 2). First, participants identified the importance of providing the right amount of education at the right time. Second, participants identified the importance of tailoring education to patient or caregiver needs. Third, participants identified the importance of patient education tools, including those proposed. Fourth, participants identified the importance of managing differences in protocols or equipment.

Theme One: Right Amount of Education at the Right Time

Participants focused on the importance of providing *the right amount of education at the right time*. Participants spoke about the importance of information repetition and providing ongoing access to information. As an oncology nurse explained, “I have had times where the patient and then the spouse want to come back [for a refresher].” To facilitate this, participants advised starting training early, as soon as it is determined that a patient may require a CVC. As an oncology nurse explained, education often needs to be in stages: “So when we say we give education by stages, that means ... before they start treatment, we give them pre-education regarding central line care.” Participants recommended treating each encounter with a patient as an opportunity to provide information, as a home infusion nurse explained, “So we look at it as ... not just a one-time and then you’re done with your teaching. Every encounter is an opportunity.” Teach-back, or having the patient or caregiver explain the task in their own words after receiving instructions, was also considered key.

Participants suggested ensuring an appropriate location for education with minimal distractions. Similarly, they advised discharging patients early in the day, as a home infusion nurse explained: “... when patients get home at 9:00, 10:00, 11:00 at night, that’s just not the best ... time to learn.”

A significant part of providing the right amount of education was providing what participants believed was just the right amount of information. While patients and caregivers needed to receive enough information to know what to do, participants were concerned that too much information at once could lead to confusion and anxiety. Instead, they prioritized what to focus on, such as general CVC maintenance, the details of the medication, or specific instructions for infusing. All focused on when and how to reach out to staff, as an oncology nurse explained: “And then we do give them numbers that they ... can actually call in case they have ... issues with their lines once they’re home.”

Theme Two: Tailoring Teaching to a Patient’s or Caregiver’s Needs

A second theme was *the importance of tailoring teaching to a patient’s or caregiver’s needs*. Participants discussed the need to assess whether a patient was prepared to learn—whether they were awake, alert, focused, and without distractions. Participants also assessed patient

and caregiver preferences for different education tools, as an oncology nurse explained, "... every person has their own learning preference... So if they're more ... visual [learners], or they do actually really [prefer written material]." It was particularly important to ensure that the education was provided in the patient or caregiver's preferred language, and at an appropriate health literacy level.

Participants described how they tailored the education to specific patient and caregiver skills or needs, such as ease with technology. One home infusion nurse used computers when first meeting a patient to test their comfort level with electronic resources and to determine whether electronic resources would be appropriate for that patient. However, participants also warned of relying too much on a patient's skill set. In particular, patients who worked in health care but whom lacked specific experiences in home infusion therapy still required training, as a home infusion nurse said: "never assume because someone has a knowledge base that they don't need that education and support."

Ensuring patient and caregiver comfort and relieving their anxiety was noted to be important to facilitate learning, as a home infusion nurse explained: "if you can find a way to reduce the anxiety that's involved with the patient and a caregiver as they're learning to administer, they're going to do so much better because anxiety and intellect, ... they just don't coexist very well."

Theme Three: Importance of Tools in Teaching Patients and Caregivers

A third theme was *the importance of tools in teaching patients and caregivers*. Cognitive aids were discussed. A "SAS" mat (saline-administer-saline) was a laminated placemat-sized tool intended for patients and caregivers to have a clean surface to set out their supplies in order to reduce the likelihood of errors. Internal and external home infusion nurses used a SAS mat in teaching patients and caregivers: "I've always had the patient take it out every single time as part of their setup. They set it up the exact same. That way they don't miss a step." Participants provided advice about how to improve tools. Suggestions included more color, more pictures, and the ability to skip to the most relevant portions of a tool. They described the importance of making the tools available where patients and caregivers might seek information, such as through search engines, e-mail, mail, physical handouts, electronic health record system messages, or text messaging.

Mitigate Differences in Protocols or Equipment

The fourth theme was *the need to mitigate differences in protocols or equipment*. Participants noted that due to changes in guidelines, guidance, or equipment, there were sometimes differences in versions of instructions provided to patients. Having the same versions of instructions on patient-facing materials was important as an oncology nurse explained: "You always want to make sure the written material and the recordings have the same information... that maybe one of them didn't get updated before the other one."

Participants discussed the importance of managing differences in supplies, tools, or guidance. Equipment used often looked different from those pictured in materials or videos depending on external suppliers or differences in protocols. Patient education tools needed to provide instructions but not to be overly specific to avoid confusion if supplies suddenly

changed, as a home infusion nurse explained: “It is more confusing to a patient if you have a picture of a blue cap and then all of a sudden they have a white cap.”

Participants struggled to manage when protocols varied according to providers. Managing differences in protocols regarding the use of heparin flushes, for example, resulted in some groups modifying available cognitive aids.

Participants reported inconsistent instructions caused confusion and anxiety in patients, and sometimes even led to patients avoiding tasks. Consistency in tools helps mitigate differences in instructions that patients and caregivers may receive, as an oncology nurse explained: “And it also keeps... that idea that there’s a couple different ways of doing something, ... but this way the patient is seeing consistency, less risk for misinterpretation.” As a final sub-theme, participants noted that having consistent instructions could help other HCPs understand what processes a patient should follow.

DISCUSSION

Four major themes in teaching patients and caregivers about CVC care and CLABSI prevention in the home were identified. HCP focused on providing the right amount of patient or caregiver education at the right time, and tailoring education to patient or caregiver needs. HCP reported that differences in guidance, tools, or approaches to tasks are confusing to patients, so it is important to develop ways to manage or explain these differences. The data from this study can be used to design CVC care educational materials to help patients and caregivers properly care for CVCs in the ambulatory setting.

HCP focused on providing the right amount of information to patients and caregivers, at the right time, and in a place with few distractions, to ensure patients had acquired the appropriate skills, knowledge, and behaviors²⁶ to perform CVC maintenance without being overwhelmed. Providing the right amount of information at the right time is a way of managing information hazards, in particular, avoiding information overload.²⁷ Information overload occurs when the volume of data exceed the ability of an individual to organize or act on the data.²⁷ Participants described mitigating information overload by focusing on the most important things a patient or caregiver needs to learn, repeating the teaching, teaching in stages, and performing teaching away from distractions at a time where the patient can absorb the information. Similarly, reducing distractions for HCP when performing important tasks (e.g., operating room tasks, handoffs, verifying high-risk medications, etc.) improves patient safety.²⁸ Patient education should be performed without distractions using a similar “sterile cockpit” methodology.²⁸

Participants reported tailoring education towards patient and caregiver needs. They focused on performing an individualized assessment for the patient or caregiver’s preparation for learning, learning style, and skillset. For example, some studies have shown that older adults may prefer written information that is provided by health professionals or downloaded online.²⁹ In other studies, face-to-face information supplemented by videos may be preferred.³⁰ Providing education to patients in a format most relevant to the patients’ preferred style of learning is important in this setting. They also discussed

skipping unnecessary portions of teaching tools. Future research could investigate how HCP choose when to vary from a teaching protocol, and when teaching protocols can be more streamlined.

Patient education tools were considered to be particularly important. As described above, some patients and caregivers preferred written while others preferred verbal or audiovisual information. However, a cognitive aid was also recommended. A laminated (and easily cleanable) paper, approximately the size of a placemat, that allowed patients to set out their flushes, alcohol or chlorhexidine wipes, and medications in order so that they would not forget steps was one example of such a cognitive aid.³⁰ In human factors engineering, cognitive aids are tools that are intended for use during the completion of a task, and are designed to help users complete a task³¹ and that decrease errors in health care.³² Simulation studies show an association between cognitive aids and improved performance.³³ Cognitive aids are sometimes used in presenting information to patients,³⁴ but more work should be done to create cognitive aids to help patients prevent health care associated infections (HAIs) such as CLABSI.

Participants also discussed the need to mitigate inconsistencies in tools, procedures, and protocols. Inconsistencies came from differences in devices used (for example, when a hospital system changes brands of peripherally-inserted central catheters, or an oncology clinic and home infusion agency used different brands of antiseptic end caps). These differences sometimes led to patient and caregiver confusion.²⁷ Inconsistencies also came from differences in protocols, for example, where there was ambiguity about the best way to perform a task and different approaches may both have been appropriate.³⁵ Information conflict, another information hazard, can also lead to errors. To mitigate differences, patient education tools should streamline instructions but also show where differences in approaches may be appropriate based on patient or caregiver needs.

In general, transitions between health care settings—and particularly the hospital-to-home transition—are a high-risk period for patient safety events.³⁶ Patient and caregiver education is key in reducing patient safety events at transitions. While most patient education interventions targeting patients going home focus on medication management, HAI prevention—and in particular, CLABSI prevention—should also be targeted. Interventions engaging patients in reducing surgical site infections have led to decreases in healthcare-associated infections.³⁷ Understanding how to best support patients and caregivers in CLABSI prevention in the community is an important step.

This study was subject to several limitations. First, the number of participants was low, which limited generalizability. However, thematic saturation was achieved. In addition, the purpose of qualitative work is not generalizability, but rather to develop a deeper understanding of a process. Further research is necessary to validate these findings in different settings. Second, participants were nurses, some of whom worked in oncology clinics or an oncology floor affiliated with a large academic health care system, and some of whom worked in home infusion agencies not affiliated with a large academic health care system. It is possible that perceptions would differ if other HCP or staff working in other outpatient infusion centers, oncology clinics or hospitals, or other home infusion or home

health organizations were included. Third, the focus group members were shown examples of tools during the focus group, and were provided the opportunity to view these before, but did not view the tools in advance for the most part. If they had more time to review the tools, the comments on the tools may have differed. Fourth, patients and caregivers themselves were not included in these focus groups. Future work should engage patients and caregivers in the review of these tools.

This study is one of the first to focus on patient education for CLABSI prevention outside of acute care or long-term care settings. A broader sample is needed to determine whether everyone responsible for patient and caregiver education are using best practices such as providing the right amount of education at the right time, targeted towards their needs and preferences, using tools, and mitigate potential differences in instructions. Researchers should also work to increase the evidence base for CLABSI prevention in outpatient or ambulatory settings, to ensure appropriate evidence to mitigate differences in instructions. Patients and caregivers are largely responsible for CVC care and CLABSI prevention outside of acute care hospitals and long-term care settings. They have to keep the CVC dressing dry and intact while going about their everyday activities including bathing, they frequently have to access the CVC themselves, and in some cases, they may need to reconstitute medications. They must perform all of these activities consistently and carefully to reduce the risk of CLABSI. HCP have an obligation to provide them with appropriate education and tools to best enhance their ability to keep themselves safe. These qualitative data should be confirmed in other settings and with quantitative data.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. NHIF Infusion Industry Trends Report. 2020. (Accessed May 2, 2024, 2024, at https://www.nhia.org/nhif_infusion_industry_trends_report/.)
2. Kramer N, Santaromita K, Shelton J. NHIA Industry-Wide Data Initiative Phase I 2010 NHIA Provider Survey Comprehensive Aggregate Analysis Report. Alexandria, VA: National Home Infusion Association; 2011.
3. Ardura MI, Bibart MJ, Mayer LC, et al. Impact of a Best Practice Prevention Bundle on Central Line-associated Bloodstream Infection (CLABSI) Rates and Outcomes in Pediatric Hematology, Oncology, and Hematopoietic Cell Transplantation Patients in Inpatient and Ambulatory Settings. *J Pediatr Hematol Oncol* 2021;43:e64–e72. [PubMed: 32960848]

4. Kelada AS, Foster TB, Gagliano GC, et al. Central-line-associated bloodstream infections and central-line-associated non-CLABSI complications among pediatric oncology patients. *Infect Control Hosp Epidemiol* 2023;44:377–83. [PubMed: 35475427]
5. Allon M, Zhang Y, Thamer M, Crews DC, Lee T. Trends in Vascular Access Among Patients Initiating Hemodialysis in the US. *JAMA Netw Open* 2023;6:e2326458. [PubMed: 37526939]
6. Goel N, Kwon C, Zachariah TP, et al. Vascular access placement in patients with chronic kidney disease Stages 4 and 5 attending an inner city nephrology clinic: a cohort study and survey of providers. *BMC Nephrol* 2017;18:28. [PubMed: 28095805]
7. Quality Payment Program. Quality ID #482: Hemodialysis Vascular Access: Practitioner Level Long-term Catheter Rate. In: Centers for Medicare and Medicaid Services, ed. Baltimore, MD2022.
8. Norris AH, Shrestha NK, Allison GM, et al. 2018 Infectious Diseases Society of America Clinical Practice Guideline for the Management of Outpatient Parenteral Antimicrobial Therapy. *Clin Infect Dis* 2019;68:e1–e35.
9. Leeman H, Cosgrove SE, Williams D, Keller SC. Assessing burden of central line-associated bloodstream infections present on hospital admission. *Am J Infect Control* 2020;48:216–8. [PubMed: 31515099]
10. Keller SC, Hannum SM, Weems K, et al. Implementing and validating a home-infusion central-line-associated bloodstream infection surveillance definition. *Infect Control Hosp Epidemiol* 2023;44:1748–59. [PubMed: 37078467]
11. Buetti N, Marschall J, Drees M, et al. Strategies to prevent central line-associated bloodstream infections in acute-care hospitals: 2022 Update. *Infect Control Hosp Epidemiol* 2022;43:553–69. [PubMed: 35437133]
12. Hospital Inpatient Quality Reporting Program. 2023. (Accessed January 12, 2024, 2024, at <https://www.cms.gov/medicare/quality-initiatives-patient-assessment-instruments/hospitalqualityinits/hospitalrhqdapu.html>.)
13. Acute care hospital surveillance for central line-associated bloodstream infections. 2023. (Accessed January 12, 2024, 2024, at <http://www.cdc.gov/nhsn/acute-care-hospital/clabsi/index.html>.)
14. Keller SC, Cosgrove SE, Arbaje AI, et al. It's Complicated: Patient and Informal Caregiver Performance of Outpatient Parenteral Antimicrobial Therapy-Related Tasks. *Am J Med Qual* 2020;35:133–46. [PubMed: 31161769]
15. Keller SC, Cosgrove SE, Kohut M, et al. Hazards from physical attributes of the home environment among patients on outpatient parenteral antimicrobial therapy. *Am J Infect Control* 2019;47:425–30. [PubMed: 30471975]
16. Keller SC, Cosgrove SE, Arbaje AI, et al. Roles and Role Ambiguity in Patient- and Caregiver-Performed Outpatient Parenteral Antimicrobial Therapy. *Jt Comm J Qual Patient Saf* 2019.
17. Keller SC, Tamma P, Salinas A, Williams D, Cosgrove SE, Gurses AP. Engaging Patients and Caregivers in a Transdisciplinary Effort to Improve Outpatient Parenteral Antimicrobial Therapy. *Open Forum Infect Dis* 2020;7:ofaa188. [PubMed: 32617369]
18. Keller SC, Salinas A, Gurses AP, et al. Implementing a Toolkit to Improve the Education of Patients on Home-Based Outpatient Parenteral Antimicrobial Therapy (OPAT). *Jt Comm J Qual Patient Saf* 2022;48:468–74. [PubMed: 35850954]
19. Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: the RE-AIM framework. *Am J Public Health* 1999;89:1322–7. [PubMed: 10474547]
20. Proctor E, Silmere H, Raghavan R, et al. Outcomes for implementation research: conceptual distinctions, measurement challenges, and research agenda. *Adm Policy Ment Health* 2011;38:65–76. [PubMed: 20957426]
21. Proctor EK, Landsverk J, Aarons G, Chambers D, Glisson C, Mittman B. Implementation research in mental health services: an emerging science with conceptual, methodological, and training challenges. *Adm Policy Ment Health* 2009;36:24–34. [PubMed: 19104929]
22. Miles MB, Huberman AM, Saldana J. *Qualitative data analysis: a methods sourcebook*. New York: Sage Publications; 2013.
23. Hennink MM, Kaiser BN, Weber MB. What Influences Saturation? Estimating Sample Sizes in Focus Group Research. *Qual Health Res* 2019;29:1483–96. [PubMed: 30628545]

24. Saldana J The coding manual for qualitative researchers, Fourth Edition. Thousand Oaks, CA: Sage Publications; 2021.
25. Glaser B, Strauss A. The Discovery of Grounded Theory: Strategies for Qualitative Research. New York: Aldine; 1967.
26. Eckles RE, Meslin EM, Gaffney M, Helft PR. Medical ethics education: where are we? Where should we be going? A review. *Acad Med* 2005;80:1143–52. [PubMed: 16306292]
27. Beasley JW, Wetterneck TB, Temte J, et al. Information chaos in primary care: implications for physician performance and patient safety. *J Am Board Fam Med* 2011;24:745–51. [PubMed: 22086819]
28. Mesa AK, Wiseman SM. The sterile cockpit: Reducing distractions in the operating room. *Am J Surg* 2023.
29. Goodman C, Lambert K. Scoping review of the preferences of older adults for patient education materials. *Patient Educ Couns* 2023;108:107591. [PubMed: 36584555]
30. Popoola VO, Lau BD, Shihab HM, et al. Patient Preferences for Receiving Education on Venous Thromboembolism Prevention - A Survey of Stakeholder Organizations. *PLoS One* 2016;11:e0152084. [PubMed: 27031330]
31. Marshall S The use of cognitive aids during emergencies in anesthesia: a review of the literature. *Anesth Analg* 2013;117:1162–71. [PubMed: 24029855]
32. Harrison TK, Manser T, Howard SK, Gaba DM. Use of cognitive aids in a simulated anesthetic crisis. *Anesth Analg* 2006;103:551–6. [PubMed: 16931660]
33. Daly Guris RJ, Lane-Fall MB. Checklists and cognitive aids: underutilized and under-researched tools to promote patient safety and optimize clinician performance. *Curr Opin Anaesthesiol* 2022;35:723–7. [PubMed: 36302211]
34. Menichetti J, Lie HC, Mellblom AV, et al. Tested communication strategies for providing information to patients in medical consultations: A scoping review and quality assessment of the literature. *Patient Educ Couns* 2021;104:1891–903. [PubMed: 33516591]
35. Gurses AP, Seidl KL, Vaidya V, et al. Systems ambiguity and guideline compliance: a qualitative study of how intensive care units follow evidence-based guidelines to reduce healthcare-associated infections. *Qual Saf Health Care* 2008;17:351–9. [PubMed: 18842974]
36. Keita-Fakeye M, Sharma R, Greyson S, et al. Systems barriers to medication management during hospital to home transitions of older adults with dementia. *Innovation in Agency* 2021;5:227.
37. Cox J, Douglas L, Wemmer V, Kaminsky K. The Role of Patient Engagement in Surgical Site Infection Reduction: A Process Improvement Project. *Adv Skin Wound Care* 2023;36:599–603. [PubMed: 37861664]

Table 1:

Characteristics of focus group participants

Characteristic	Number (Percentage of 8 Participants)
Nursing Background	8 (100%)
Works Primarily in Home Infusion	4 (50%)
Works Primarily in Ambulatory Oncology	2 (25%)
Works Primarily in Inpatient Oncology	2 (25%)
Based at large health system	4 (50%)
Based at unaffiliated home infusion company	4 (50%)
Gender: Female	7 (87.5%)
Male	1 (12.5%)
Race: White	5 (62.5%)
Asian-American	2 (25%)
Unknown	1 (12.5%)
Ethnicity: Hispanic	1 (12.5%)
Non-Hispanic	6 (75%)
Unknown	1 (12.5%)

Table 2:
Approaches to Teaching Patients with Central Venous Catheters

Theme	Subtheme	Exemplar Quote
Importance of providing the right amount of education at the right time.	Repeat training and allow patients and caregivers ongoing access to training.	"We know that it's going to take [patients] a few times to get used to it... and ... they might not be in the best place for learning in the hospital setting, so having that [training] later on for them to be able to view again with everything in front of them or to... refresh their memory." (Oncology nurse, FG 1)
	Start training early, and piece by piece.	"If the expectation is that there is going to be the patient or a caregiver that's going to be involved once the patient transitions to home, I would start [training] as early as possible." (Home infusion nurse, FG 1)
	Treat each encounter as an opportunity for training.	"You give information every time you treat somebody with a central line." (Home infusion nurse, FG 2)
	Ensure teach-backs.	"And a lot of teach-backs They get the teaching in the hospital, they come home, they're doing the first one on their own, you tell me what you've learned, and then you ... work from there with their knowledge base and what they've remembered and how to ... augment what they've been taught already." (Home infusion nurse, FG 1)
	Importance of teaching location.	"I guess the challenge for us is just to make sure that we have an appropriate area where they can really hear and focus on the education." (Oncology nurse, FG 2)
	Importance of discharging early in the day.	"...you should not be teaching someone that's been trying to get out of the hospital all day and already doesn't feel well, because not only was I sick, my caregiver is exhausted." (Home infusion nurse, FG 3)
	Prevent information overload.	"We don't want to give [patients] everything [information] [at once] because then that's really overwhelming." (Home infusion manager, FG 3)
	Choose what to focus on: --Dressing and line maintenance.	"And then ... we would ... run down all the things that they actually have to do, like how to protect them from getting wet during shower, how they would actually ... flush their lines, ... in order to prevent infections." (Oncology nurse, FG 2)
	--Details on medication --Who to call with problems	"I always would write ... what their actual drug name... It just was that extra reminder" (Home infusion nurse, FG 1) "And one of the things we reinforce at the end of the teaching, ... as we're bringing everything to a close..., if you remember nothing else, ... here's our phone number, you're never by yourself." (Home infusion nurse, FG 3)
Importance of tailoring teaching to a patient's needs.	Assess preparation for learning.	"... just start the conversation so that way [the patients] have the idea [of] "I need to ...start to prepare for this ... mentally." (Oncology nurse, FG 1)
	Address language barriers.	"...we tailor the resources to what they need, whether it be a different language ... or ... something like that. ... We also have a language line available 24/7, so if we have someone with a language barrier we have that resource." (Home infusion nurse, FG 3)
	Ensure appropriate health literacy.	"We've recently worked on redesigning our patient education material and really including plain language ... and trying to remove as many of those big words that we don't need ... and making it very straightforward." (Home infusion nurse, FG 3)
	Focus on communication and learning preferences.	"Having the written instructions as well as ... some sort of visual opportunity for learning, knowing that there's different learners." (Oncology nurse, FG 1)
	Focus on specific skills or challenges the patient may have.	"[Patients] might not be, you know, very tech savvy or familiar, so we have specific-to-the-pump information for each patient." (Home infusion nurse, FG 1)
	Focus on caregiver's needs or challenges.	"...and then we would actually ... plan out when we would ... call in a caregiver ... to instruct ... them how they would actually ... be part of taking care of the line once the patient ... goes home." (Oncology nurse, FG 2)
	Ensuring comfort and relieving anxiety.	"... just try to make sure they feel comfortable and that they ... feel confident in their skills. They don't feel nervous going home... nervous about infection risk, any of that stuff." (Home infusion nurse, FG 1)
Importance of patient education tools.	Use of cognitive aids.	"[We are] reinforcing the... teaching with every encounter, having them utilize those [cognitive aids]... that way they're doing the same thing every single time, that repeated model, so that way it becomes a little bit more routine ..." (Home infusion nurse, FG 1)

Theme	Subtheme	Exemplar Quote
	Use of written information.	"I think that it's definitely helpful to have it written out... I think it's just a need for this style of learning to be done when working with patients." (Oncology nurse, FG 1)
	Use of videos.	"... I think [videos are] the tool that I've found [to] make patients the most successful, and [patients have] said ... I actually just used this, the video, and what you taught me." (Home infusion nurse, FG 3)
	Suggestions for improved tools. --Use color.	"We also incorporated color, so when there's something that's a hard stop or something ... it's in a really bright color to catch their attention." (Home infusion nurse, FG 3)
	--Skip to relevant portions.	"It'd be nice if it had like a little... time stamp of where those spots are so that they could just click on it and jump to that section." (Oncology nurse, FG 1)
	--Laminated cognitive aids	"It's easy, and it also creates a surface for them to work from, ... because ... laminated, so they can clean that off and that is their surface, and so it's a really helpful." (Home infusion nurse, FG 3)
Managing differences.	Preferences for dissemination.	"If there's an interactive platform ... for them to access a video ... then I think that that's a good landing spot for it.... Some people e-mail, with text messaging, I mean, there's just a lot of different options." (Oncology nurse, FG 1)
	Differences in versions of training tools.	"...but despite that we want to [update educational materials], we've always been told that it should always be ... the same as the hospital standards, so we always have... a limitation in creating one." (Oncology nurse, FG 2)
	Managing differences in supplies, tools, or guidance.	"If it's a central line, it's a central line, and the principles are still the same, but sometimes patients [need to have] that idea that even though this is specific to a port, the flushing principles are the same as a PICC or any other central vascular access device." (Home infusion nurse, FG 1)
	Need for consistency in instructions.	"I think it's nice having something concrete, consistent, because ... every nurse has their own way of doing something and I've had patients that come and say, oh, well, so-and-so told me to do it this way, and so then they get worried, it's like, oh, well, should they not have been doing it that way, and then you've got to be like, no, no, no, everyone does it a different way." (Oncology nurse, FG 1)
	Impact of differing instructions on patients.	"And so some patients, unfortunately, ... if they get overwhelmed like that they just won't do it." (Home infusion manager, FG 3)
	Standard instructions help teach other health care workers.	"Well, I would say wherever you can offer consistency and a single, repeatable process for anybody involved is helpful, and then I think other disciplines, ... having ... an idea of how the patient proceeds helps them to ... have [an] understanding of the process." (Home infusion nurse, FG 1)

FG: Focus group