The Art and Science of Infusion Nursing

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## A Community Collaborative to Develop Consensus Guidelines to Standardize Out-of-Hospital Maintenance Care of Central Venous Catheters

#### ABSTRACT

Central venous catheter (CVC) maintenance is integral to preventing complications and improving outcomes. This process is made more challenging when patients transition from hospital to home care or to an outpatient infusion setting, because different CVC maintenance practices and care parameters confuse patients and care providers alike. Through collaboration and consensus building, a group of metropolitan home health and home infusion agencies developed a standardized

neffective central venous catheter (CVC) access is a main factor in preventing reliable and safe medication delivery and leads to increased health care costs and potential harm to patients. Therefore, it is important to maintain the integrity of a CVC to allow for safe medication administration

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approach to CVC maintenance care. This article discusses the multiagency collaborative and resulting guideline and other educational materials that better enable providers, patients, and families to maintain CVC integrity and achieve optimal outcomes.

**Key words:** central venous catheter, central lineassociated bloodstream infection, home health care, central venous catheter occlusion, care standardization, quality improvement, patientcentered care, evidence-based care

and clinical treatment across the continuum of care when a patient transitions from the hospital setting to home and/or outpatient infusion therapy. This project established evidence-based, standardized CVC maintenance care guidelines through collaboration and consensus building among a broad group of Omaha, Nebraska-area care providers to ensure safety of medication administration.

#### BACKGROUND AND SIGNIFICANCE

Medication administration safety demands reliable intravenous (IV) access. When complications with CVC access occur—such as with infection, thrombosis, or occlusion—medication administration safety is compromised. Needed medications and/or treatments might be halted completely, or patients may be placed on less effective oral alternatives during the interval when IV access is being reestablished. Additionally, thrombosis results in the need for declotting agents, which are not without potential clinical repercussions or economic implications.

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With an emphasis on reducing hospital length of stay and providing care in home and ambulatory care settings, there has been a significant increase in the incidence of patients being discharged from the hospital to home with a CVC. It is common for patients to receive continued treatment, such as chemotherapy, parenteral nutrition, and antibiotic therapy, in out-of-hospital settings.

CVC-associated complications result in a great deal of morbidity and mortality of their own accord. Seventy-eight thousand central line-associated bloodstream infections (CLABSIs) are estimated to occur each year in US hospitals and dialysis units.<sup>1</sup> Rates of CLABSI that occur in the home setting range from 0.77 to 6.7 per 1000 central line device days.<sup>2,3</sup> CLABSIs are associated with an estimated mortality rate of 12.3%<sup>4</sup> and excess health care costs between \$7288 and \$29 156 per episode.<sup>5</sup> The unadjusted median and mean lengths of stay for such infections are 6.0 and 7.7 days.<sup>6</sup> Catheter thrombosis also impedes safe medication administration and is probably an underappreciated entity. Rates of CVC thrombosis have been identified as ranging from 0.067 to 1.358 per 1000 CVC days in pediatric and adolescent populations; the incidence in adults has been found to be as high as 9.3 per 1000 device days.9

Receiving care from different providers in a variety of settings as an outpatient places patients at increased risk because of variation in maintenance care practices. Tokars et al<sup>3</sup> were the first to report that receiving infusion therapy outside the home in settings such as clinics or physician offices increased patients' risk for CLABSI. The authors surmised it might be related to increased line manipulation and access and/or poor infection control practices by care providers in these settings.<sup>3</sup>

It is imperative that ambulatory and home care providers develop ways to ensure the safe and seamless transition from hospital to home for patients with CVCs by standardizing maintenance care practices and processes. Standardizing CVC care and educating health care personnel of evidence-based practices<sup>10</sup> and examining insertion procedures and use of technologic improvements<sup>11</sup> have been shown to be effective in reducing CLABSI in the acute care setting. However, a more difficult issue to address is the routine care of CVC sites and procedures associated with accessing CVCs after patients leave the hospital. There is a paucity of research examining CVC-related outcomes in out-of-hospital settings, as well standardized outpatient care and its association with reduction of CVC complications. Moreover, with a lack of surveillance of CVCrelated outcomes in outpatient settings, the influence on outcomes that standardizing practices might affect cannot be measured.

Attempts with measuring and monitoring devicerelated infections in out-of-hospital settings have been made during the past several decades.<sup>12-14</sup> Measuring and influencing the incidence of CVC-associated adverse events in the outpatient setting is challenging for several reasons. First, there is no mandate to report CVCassociated adverse events from regulatory agencies or third-party payers, so home health companies and infusion centers have not been required to develop surveillance systems. Although the Centers for Disease Control and Prevention (CDC) launched the National Healthcare Safety Network, an Internet-based surveillance system that monitors health care-associated infections, its use in out-of-hospital settings is limited to ambulatory surgical and outpatient dialysis centers.<sup>15</sup> Second, there is no consensus on what are the most meaningful indicators or standard definitions of outpatient CVC-associated adverse events, although recommendations for these have been supported by the CDC.<sup>16</sup> Disparity may exist between electronic patient records from 1 health care agency to another and between the inpatient and outpatient settings, making capture of administrative data more difficult. Finally, linking administrative and patient care data from both settings reveals additional challenges that add to the complexity of accurate measurement of adverse outcomes. Coding errors may result in discrepant billing claims; minor procedures, such as CVC insertions carried out during other procedures, may not generate a billing code; and the inability to readily identify the CVC insertion and removal dates prohibits accuracy of surveillance for CVC-related outcomes during the period of catheterization.17

A great deal of attention has been given to national initiatives aimed at improving quality and increasing transparency of health care outcomes. The Institute for Healthcare Improvement Map emphasizes improvements in care coordination to improve safety and quality, with particular emphasis placed on prevention of health care-associated infections and hospital readmissions.<sup>18</sup> The US Department of Health and Human Services disseminated the National Action Plan to Prevent Healthcare Associated Infections in 2009, with Phase I focusing on acute care settings. Phase II and Phase III extend efforts to ambulatory care, including home health care and long-term care settings.<sup>19</sup> A critical need for evidence-based, standardized guidelines to prevent CVC complications, such as thrombosis and bloodstream infection in the outpatient setting, has been identified.20

#### COMMUNITY-BASED COLLABORATION TO STANDARDIZE CVC CARE

In 2011, a community-based initiative was launched to address deficiencies in patient safety as they related to medication administration through CVCs across settings

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of care. The project had 3 aims related to ensuring reliable IV access and safe medication administration for patients who are discharged from the hospital with a CVC: (1) to establish evidence-based, standardized CVC maintenance care guidelines; (2) to develop patient educational materials; and (3) to develop a surveillance mechanism by which CVC-related adverse events could be monitored in home health/home infusion settings. Because the work occurred in the Omaha, Nebraska, area and was focused on standardizing CVC care in the region, the project was assigned the title Standardizing Central Venous Catheter Care in the Omaha Region: Care From Hospital to Home (SCORCH). The project lead contacted the administrators of home health and home infusion agencies to which patients were frequently referred when discharged from the hospital. Partnering agencies and clinical entities included 6 Omaha-area home health and home infusion agencies and hospital-based outpatient infusion centers. Participants in the collaborative included infusion and vascular access nurses, infection prevention specialists, clinical educators, clinical nurse specialists, infectious diseases physicians, and agency leaders representing pediatric and adult care provision.

Over a 6-month period in 2011, stakeholders attended a series of 10 two-hour working sessions during which they discussed their respective agency CVC carerelated policies, procedures, and protocols. Using evidence-based resources developed by authoritative groups (eg, the CDC,<sup>21</sup> the Infusion Nurses Society,<sup>22</sup> the Oncology Nursing Society<sup>23</sup>) and other sources of evidence<sup>24</sup> helped the group establish consensus on the emerging community-based practice standards. Sessions focused on specific issues related to maintaining safe medication administration via a CVC, including dressing changes (interval and technique), access issues (scrub time, disinfectant), flush solution (composition, volume, frequency, syringe size), and supplies and equipment (ie, cap change frequency, connector valves to be used/avoided). Additional content focused on heparin use, drawing blood for laboratory testing and cultures, and problem-solving common barriers to successfully accessing the line. In the absence of definitive evidence, the group reached consensus through their clinical expertise.

The SCORCH guidelines were completed and disseminated to all licensed home health and home infusion agencies across Nebraska and Iowa in January 2012 (Figure 1). The guidelines were also submitted to the Agency for Healthcare Research and Quality for publication at the National Guideline Clearinghouse (NGC) (www.guideline.gov). The authors were directed by NGC project personnel to provide more clarity in the guidelines around the use of heparin. As a result, partnering stakeholders met over a 4-month period to revise the guideline content related to heparin use. Additional



Standardizing Central Venous Catheter Care: Hospital to Home

Figure 1 SCORCH guideline title page. C2012 The Nebraska Medical Center.

sources of evidence were gathered, critiqued, and incorporated into the second edition of the guidelines, which was completed in September 2012.<sup>25-27</sup> Figure 2 displays maintenance care-related content addressed in the guidelines.

This community-based collaborative resulted in a practical and sustainable approach to achieving optimal medication administration in patients discharged from the hospital to home with a CVC. The CVC standardized care guidelines were published on the NGC Web site on February 8, 2013; they were also made publicly available at the Nebraska Medical Center's (TNMC's) Web sites focusing on central line care (http://www.nebraskamed.com/central-line-care) and antimicrobial stewardship (http://www.nebraskamed.com/careers/ education-programs/asp).<sup>28</sup>

#### EDUCATING PATIENTS AND FAMILIES ABOUT THEIR ROLE IN MAINTAINING INTEGRITY OF A CVC

In an effort to educate and empower patients and their family members and other caregivers in taking an active role in ensuring the integrity of the patient's CVC, the authors developed patient education materials aligned with the standardized care guidelines. Three patient education DVDs were produced each in English and in Spanish: (1) *Living at Home with a* 

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Central Vascular Access Device Maintenance Care Content Area	Page Number
Accessing a CVAD	3
Flushing	3
Drawing blood for laboratory testing	4
Drawing blood cultures	4
Dressing change	5
Troubleshooting access barriers	6
Other information	6
Flushing frequencies and use of heparin	7

Figure 2 SCORCH guideline table of contents. Abbreviations: CVAD, central venous access device; SCORCH, Standardizing Central Venous Catheter Care in the Omaha Region: Care From Hospital to Home.

Peripherally Inserted Central Venous Catheter, (2) Living at Home with a Tunneled Central Venous Catheter, and (3) Living at Home with an Implanted Port. Partnering with patients and their families seen at the TNMC outpatient infusion clinic enabled inclusion of real patients and the CVC-related nursing care they received while being filmed. Each video educates the viewer about the benefits and potential complications of having a CVC in place. Basic principles of maintenance care, such as hand hygiene, are provided, along with detailed information about how the CVC will be accessed and how dressings and caps, where applicable, will be changed. Finally, the patient's role in monitoring the integrity of the CVC on a daily basis is emphasized, especially with regard to when to notify the care provider if the patient suspects complications. The videos are available to the public at the TNMC Web site focusing on central line care through the link Resources for Patients.

#### **Measuring Outcomes**

Measuring the effects of the initiative was challenging because the majority of SCORCH agencies had no CVC-related outcomes measurement processes in place before developing and implementing SCORCH guidelines. However, the authors have completed preliminary work on a robust surveillance system that involved the SCORCH partners. A database has been constructed and is being used to store information about CVCrelated outcomes, including CLABSI and occlusion rates per 1000 device days and the use of fibrinolytic agents. SCORCH agencies began participating in the database in January 2012. Participating agencies use standardized definitions of CLABSI (adapted to outpatient use from CDC definitions)<sup>15</sup> and occlusion events and submit monthly data.

Tables 1-3 display CVC-related outcomes pre- and postimplementation of the SCORCH guidelines in

# Agency CLABSI Rates Pre- and Post-SCORCH Guidelines Implementation

	Central Line-Associated Bloodstream Rate per 1000 Device Days			
SCORCH Agency	2011	2012 Four-Quarter Average	2013 Four-Quarter Average	
Agency A	Did not measure or monitor CLABSI rates	0.42	0.45	
Agency B	Quarterly BSI rates ranged from 0 to 2.96	0.00	No data <sup>a</sup>	
Agency C	Did not measure or monitor device days or complications	0.20	0.00	
Agency D	Quarterly BSI rates ranged from 0 to 4.5	0.59	1.03 <sup>b</sup>	
Agency E	Did not measure or monitor complication rates	0.27	0.00 <sup>c</sup>	
Agency F	Did not measure or monitor CLABSI rates	0.12	0.07 <sup>d</sup>	
2				

<sup>a</sup>Agency left database December 2012.

<sup>b</sup> Two-quarter average; agency left database Quarter 2, 2013.

<sup>c</sup> Two-quarter average; agency converted new IT system. No data Quarter 2 and Quarter 3, 2013.

<sup>d</sup>*Three-quarter average; agency left database Quarter 3, 2013.* 

Abbreviations: CLABSI, central line-associated bloodstream infection; SCORCH, Standardizing Central Venous Catheter Care in the Omaha Region: Care From Hospital to Home; BSI, bloodstream infection; IT, information technology.

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#### TABLE 2

### Agency Occlusion Rates Pre- and Post-SCORCH Guidelines Implementation

	Occlusion Rate per 1000 Device Days		
SCORCH Agency	2011	2012 Four-Quarter Average	2013 Four-Quarter Average
Agency A	Did not measure or monitor occlusion rates	1.96	2.58
Agency B	37.78	28.73	No data <sup>a</sup>
Agency C	Did not measure or monitor device days or complications	16.31	6.83
Agency D	Did not measure or monitor noninfection complications	0.93	1.93 <sup>b</sup>
Agency E	Did not measure or monitor complication rates	0.46	1.57 <sup>c</sup>
Agency F	Did not measure or monitor occlusion rates	1.53	1.51 <sup>d</sup>
<sup>a</sup> Agency left database Dec <sup>b</sup> Two-quarter average; age	rember 2012. ency left database Quarter 2, 2013.		

<sup>C</sup> Two-quarter average; agency converted new IT system. No data Quarter 2 and Quarter 3, 2013.

<sup>d</sup>Three-quarter average; agency left database Quarter 3, 2013.

Abbreviations: SCORCH, Standardizing Central Venous Catheter Care in the Omaha Region: Care From Hospital to Home; IT, information technology.

which baseline data were available, as well as those achieved during 2012 and 2013. Table 1 reveals little difference in CLABSI rates; however, participating agencies acknowledge difficulties receiving accurate and/or complete data related to CLABSI events that may occur with patients on their service.

Several agencies have realized an improvement in occlusion rates, as illustrated in Table 2. Agency B, in

particular, achieved a significant reduction in occlusion events after implementation of the SCORCH guidelines; however, because of the labor involved in the data collection processes, it elected to withdraw from the database at the end of 2012.

Table 3 shows that several agencies reduced the average number of patients receiving fibrinolytic agents throughout 2012 and 2013, indicating improvements in

# TABLE 3 Mean Number of Patients Receiving Fibrinolytic Agent per Month Pre- and Post-SCORCH Guidelines Implementation

	Mean Number of Patients Receiving Fibrinolytic Agent per Month			
SCORCH Agency	2011	2012 Four-Quarter Average	2013 Four-Quarter Average	
Agency A	Did not measure or monitor fibrinolytic use	1.33	1.17	
Agency B	Did not measure or monitor fibrinolytic use	7.17	No data <sup>a</sup>	
Agency C	Did not measure or monitor fibrinolytic use	1.85	1.86	
Agency D	Did not measure or monitor fibrinolytic use	1.00	2.00 <sup>b</sup>	
Agency E	Average of 12 patients per quarter received fibrinolytic agent	1.33	1.13 <sup>c</sup>	
Agency F	Did not measure or monitor fibrinolytic use	1.26	1.10 <sup>d</sup>	
0				

<sup>a</sup>Agency left database December 2012.

<sup>b</sup>Two-quarter average; agency left database Quarter 2, 2013.

<sup>c</sup>Two-quarter average; agency converted new IT system. No data Quarter 2 and Quarter 3, 2013.

<sup>d</sup>*Three-quarter average; agency left database Quarter 3, 2013.* 

Abbreviations: SCORCH, Standardizing Central Venous Catheter Care in the Omaha Region: Care From Hospital to Home; IT, information technology.

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maintaining line patency, possibly as a result of standardizing practices across their infusion providers.

#### **Implications for Practice and Research**

Although measuring the effects of this initiative on patient care and outcomes is challenging, data from several participating agencies have demonstrated that improved outcomes have been achieved after standardized maintenance care processes were implemented. The authors believe that this community-based collaborative will continue to benefit thousands of patients discharged from the hospital with CVCs in place for continued therapies, not only through care provided by partnering agencies who contributed to and implemented these guidelines but also as a result of care providers who have accessed the guidelines through the NGC Web site and have implemented them in their settings.

The authors recommend implementing a similar approach as the one taken in this initiative, to bring networks of home and outpatient infusion providers together to adopt and implement these standardized CVC maintenance care processes in their communities. Standardizing the care of CVCs in the home and in outpatient settings will better ensure safe medication administration and continued therapies across transitions of care for patients and families. Additional community-based initiatives could focus on implementing the evidence-based consensus guidelines for use with nursing staff in settings such as subacute and long-term care facilities.

Efforts will continue to focus on examining methods to intervene and measure the effect of standardized central line maintenance care practices. The surveillance database has expanded and now involves agencies from several states across the country. Our goal is to continue to develop this outcomes surveillance mechanism by increasing the number of participating agencies and documenting the impact of quality improvement efforts in out-of-hospital settings. Although implementing the SCORCH guidelines is not requisite to an agency's participation, partnering agencies are provided links to the guidelines, as well as to related patient education materials.

At present, there is no method in place for measuring patient and family perceptions of the helpfulness of the information in the central line education DVDs. Although tracking the number of times the Web pages have been viewed and the amount of time viewers spend on them provides a measure of their use, it's not substantive or optimal. Options for embedding a brief evaluation survey into the online infrastructure are currently being explored.

Partnering agencies and clinical entities have indicated a desire to maintain a CVC care task force to provide an ongoing venue for discussing changes in CVC-related practices and standards of care that undoubtedly will occur over time. In addition, brainstorming sessions have identified several ideas for collaborative research studies, including examining how and by whom patients and families are taught CVCrelated self-care and measuring their competence with these skills. Particular interest also has been drawn to examining in what settings, by whom, and for what reasons patients' central lines are accessed in out-ofhospital settings once they are discharged from the hospital in an effort to understand better the potential practice inconsistencies and risks they encounter with maintaining the integrity of the line and avoiding adverse outcomes.

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#### REFERENCES

- 1. Centers for Disease Control and Prevention (CDC). Vital signs: central line-associated blood stream infections, United States, 2001, 2008, and 2009. *MMWR Morb Mortal Wkly Rep.* 2011; 60(8):243-248.
- 2. Gorski LA. Central venous access device outcomes in a homecare agency: a 7-year study. J Infus Nurs. 2004;27(2):104-111.
- Tokars JI, Cookson ST, McArthur MA, Boyer CL, McGeer AJ, Jarvis WR. Prospective evaluation of risk factors for bloodstream infection in patients receiving home infusion therapy. *Ann Intern Med.* 1999;131(5):340-347.
- 4. Umscheid CA, Mitchell MD, Doshi JA, Agarwal R, Williams K, Brennan PJ. Estimating the proportion of healthcare-associated infections that are reasonably preventable and the related mortality and costs. *Infect Control Hosp Epidemiol.* 2011;32(2):101-114.
- Scott RD. The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospitals and the Benefits of Prevention. Atlanta, GA: Centers for Disease Control and Prevention. http:// www.cdc.gov/HAI/pdfs/hai/Scott\_CostPaper.pdf. Published March 2009. Accessed October 15, 2014.
- 6. Shorr AF, Tabak YP, Killian AD, Gupta V, Liu LZ, Kollef MH. Healthcare-associated bloodstream infections: a distinct entity? Insights from a large U.S database. *Crit Care Med.* 2006;34(10): 2588-2595.
- 7. Pinon M, Bezzio S, Tovo PA, et al. A prospective 7-year survey on central venous catheter-related complications at a single pediatric hospital. *Eur J Pediatr.* 2009;168(12):1505-1512.
- 8. Revel-Villk S, Yacobovich J, Tamary H, et al. Risk factors for central venous catheter thrombotic complications in children and adolescents with cancer. *Cancer*. 2010;116(17):4197-4205.
- 9. Beckers MM, Ruven HJ, Seldenrijk CA, Prins MH, Biesma DH. Risk of thrombosis and infections of central venous catheters and totally implanted access ports in patients treated for cancer. *Thromb Res.* 2009;125(4):318-321.
- 10. Sawyer M, Weeks K, Goeschel CA, et al. Using evidence, rigorous measurement, and collaboration to eliminate central catheter-

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associated bloodstream infections. *Crit Care Med*. 2010;38(suppl 8): S292-S298.

- Marschall J, Mermel LA, Classen D, et al. Strategies to prevent central line-associated bloodstream infections in acute care hospitals. *Infect Control Hosp Epidemiol.* 2008;29(suppl 1):S23-S30.
- White MC, Ragland KE. Surveillance of intravenous catheterrelated infections among home care clients. *Am J Infect Control*. 1994;22(4):231-235.
- Rosenheimer L, Embry FC, Sanford J, Silver SR. Infection surveillance in home care: device-related incidence rates. *Am J Infect Control*. 1998;26(3):359-363.
- 14. Clark P. Emergence of infection control surveillance in alternative health care settings. J Infus Nurs. 2010;33(6):363-370.
- Tokars JI, Richards C, Andrus M, et al. The changing face of surveillance for health care-associated infections. *Clin Infect Dis.* 2004;39(9):1347-1352.
- 16. Embry FC, Chinnes LF. Association for Professionals in Infection Control and Epidemiology, Centers for Disease Prevention and Control Healthcare Infection Control Practices Advisory Committee. APIC-HICPAC surveillance definitions for home health care and home hospice infections. http://nosobase.chulyon.fr/recommandations/cdc/2008\_HAD\_APIC\_HICPAC.pdf. Published February 2008. Accessed October 15, 2014.
- Wright SB, Huskins WC, Dokholyan RS, Goldmann DA, Platt R. Administrative databases provide inaccurate data for surveillance of long-term central venous catheter-associated infections. *Infect Control Hosp Epidemiol.* 2003;24(12):946-949.
- 18. Institute for Healthcare Improvement. *IHI Improvement Map.* http://app.ihi.org/imap/tool/. Accessed October 16, 2014.

- US Department of Health and Human Services. National Action Plan to Prevent Health Care-Associated Infections: Road Map to Elimination. http://www.hhs.gov/ash/initiatives/hai/actionplan/. Published 2009. Revised April 2013. Accessed October 15, 2014.
- 20. Nakazawa N. Infectious and thrombotic complications of central venous catheters. *Semin Oncol Nurs.* 2010;26(2):121-131.
- O'Grady NP, Alexander M, Burns LA, et al. Summary of recommendations: guidelines for the prevention of intravascular catheter-related infections. *Clin Infect Dis.* 2011;52(9):e162-e193.
- 22. Infusion Nurses Society. Infusion nursing standards of practice. *J Infus Nurs*. 2011;34(suppl 1):S1-S80.
- Cope DG, Ezzone SA, Gerber DL, et al. Vascular access devices (VADs). In: Camp-Sorrell D, ed. Access Device Guidelines: Recommendations for Nursing Practice and Education. 3rd ed. Pittsburgh, PA: Oncology Nursing Society; 2011:5-52.
- Rupp M, Yu S, Huerta T, et al. Adequate disinfection of a splitseptum needleless intravascular connector with a 5-second alcohol scrub. *Infect Cont Hosp Epidemiol*. 2012;33(7):661-665.
- Chernecky C, Macklin D, Casella L, Jarvis E. Caring for patients with cancer through nursing knowledge of IV connectors. *Clin* J Oncol Nurs. 2009;13(6):630-633.
- Hadaway L, Richardson D. Needleless connectors: a primer on terminology. J Infus Nurs. 2010;33(1):22-31.
- Infusion Nurses Society. Flushing Protocols Card Deck. Norwood, MA: INS; 2011.
- 28. Nailon RE, Rupp ME, O'Neill S, et al. Standardizing Central Venous Catheter Care: Hospital to Home. Omaha, NE: Nebraska Medical Center; 2012. http://www.guideline.gov/content.aspx?id =38459&search=central+line. Accessed October 16, 2014.