

Strategies in Implementing a Bundle Approach for Addressing Catheter Complications

CENTRAL LINE CATHETER
CARE AND MAINTENANCE

DATE: 4/17/19

PRESENTER: ILEANA GUZMAN, BSN, RN, VA-BC

Objectives

Current standard and guidelines related to catheter complication management

Recognize potential catheter complications

Impacts of HAI and CLABSI on patient populations

Review pathophysiology of CLABSI

Key strategies to minimize catheter complications

Managing Central Line Complications

It is important for the clinician inserting and caring for these devices to be educated regarding complications and methods to prevent and manage their occurrence.

Complications can vary from mild to life threatening.

The primary goal is to prevent complications when possible.

Potential Complications¹

- Air Embolism
- Bleeding
- Cardiac Arrhythmia
- Cardiac Tamponade
- Brachial Plexus Injury
- Catheter Erosion through the skin
- Catheter Embolism
- Catheter Occlusion
- Catheter Related Sepsis
- Endocarditis
- Exit Site Infection
- Exit Site Necrosis
- Extravasation
- Fibrin Sheath Formation
- Intolerance Reaction to Implanted Device
- Laceration of Vessels or Viscus
- Myocardial Erosion
- Perforation of Vessels or Viscus
- Phlebitis
- Spontaneous Catheter Tip Malposition or Retraction
- Thromboembolism
- Vessel Thrombosis
- Vessel Erosion
- Risks Normally Associated with Local or General anesthetics

Complications may occur either at the time of insertion or at any point during the length of dwell

Vessel Thrombosis

Definition

- The formation of blood clots within the blood vessel²

Signs of Thrombosis

- May be clinically silent³
- Swelling in neck, arms, or supraclavicular area²
- Dilated/prominent veins over the arm, neck, or chest²
- Arm pain or discoloration²

Prevention

- Selection of a central line with the smallest gauge and least number of lumens to manage the patients prescribed therapy³
- Tip location at or near the right atrium/SVC junction²
- Encourage gentle exercise or normal activities, stay hydrated³

Catheter Occlusion

Definition

- Thrombolytic-deposits of fibrin or blood components within and around the CVC/PICC, intraluminal blood clot⁴
- Nonthrombolytic-crystallization of TPN admixtures and drug-drug or drug-solution incompatibilities⁴
- Catheter occlusion can be partial or complete and may limit the functionality of the device for blood draws, flushing, and/or administration of medications.⁴

Signs of Occlusion⁴

- Inability to aspirate blood
- Resistance to flushing
- Sluggish infusion
- Complete inability to flush or infuse
- Increasing occlusion alarm activation with the use of electronic infusion devices

Prevention

- Catheter flushing is the primary nursing intervention used to prevent lumen occlusion from thrombotic and precipitate causes⁵

Catheter Related Infection and/or Sepsis

Definition

- Central line-associated blood stream infection is a laboratory-confirmed bloodstream infection (LCBI) where the central line (CL) was in place for >2 calendar days (48 hours) on the date of event **AND** a CL was in place on the date of event or the day before⁶
- The goal is a 0% rate

Signs of infection²

- Chills
- Fever
- Tachycardia
- Headache
- Nausea and vomiting
- Positive blood culture results

How does CLABSI occur?

Contamination Sources-Obvious?



Prevention Strategies

Skin Organisms

Endogenous
Skin flora

Extrinsic
HCW hands
Contaminated
disinfectant

1

Contaminated Catheter Hub

Endogenous
Skin Flora
Extrinsic
HCW Hands

2

Contaminated Infusate

Extrinsic
Fluid Medication

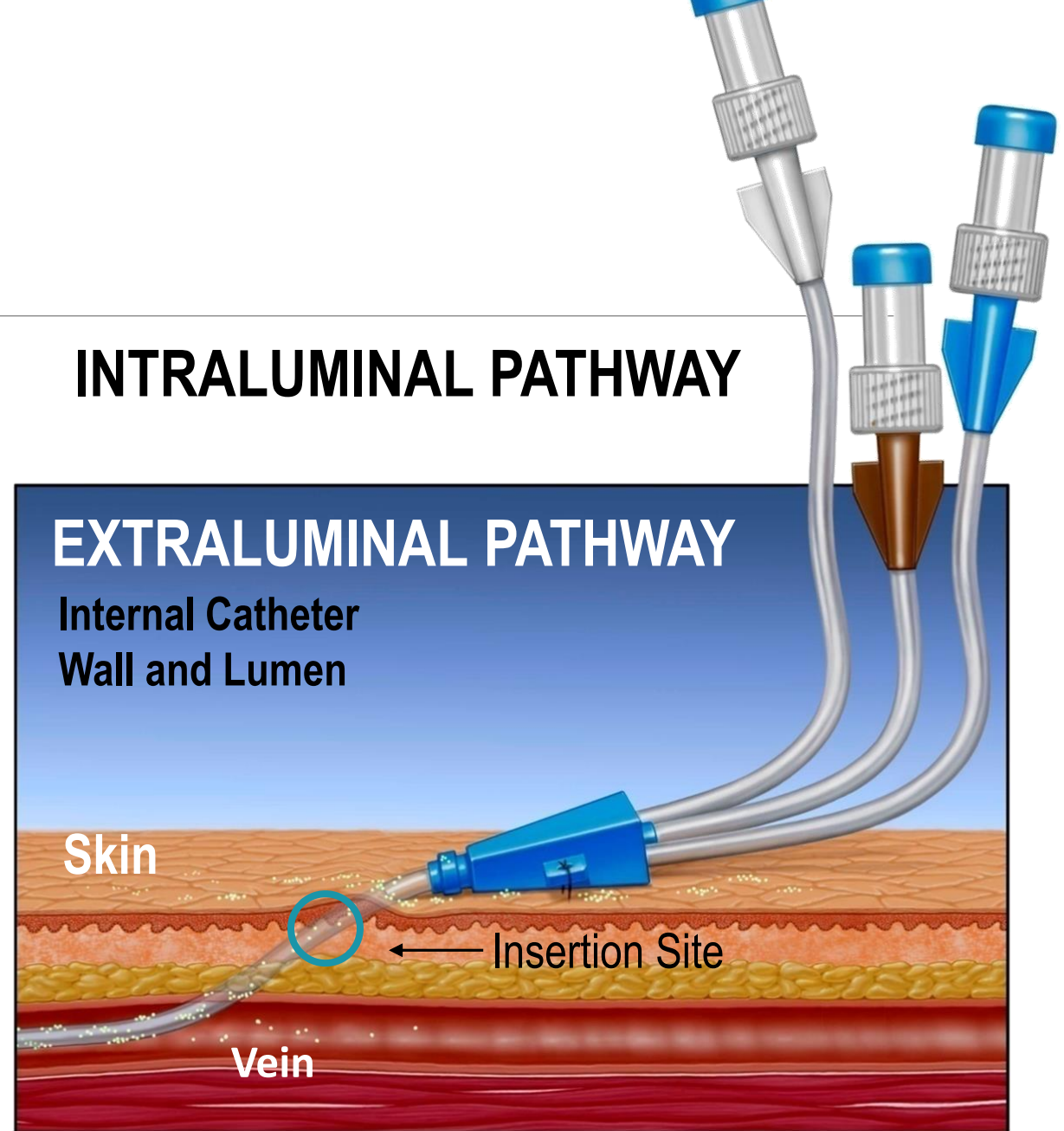
Intrinsic
Manufacturer

3

INTRALUMINAL PATHWAY

EXTRALUMINAL PATHWAY

Internal Catheter
Wall and Lumen



Contamination Pathways-Extraluminal

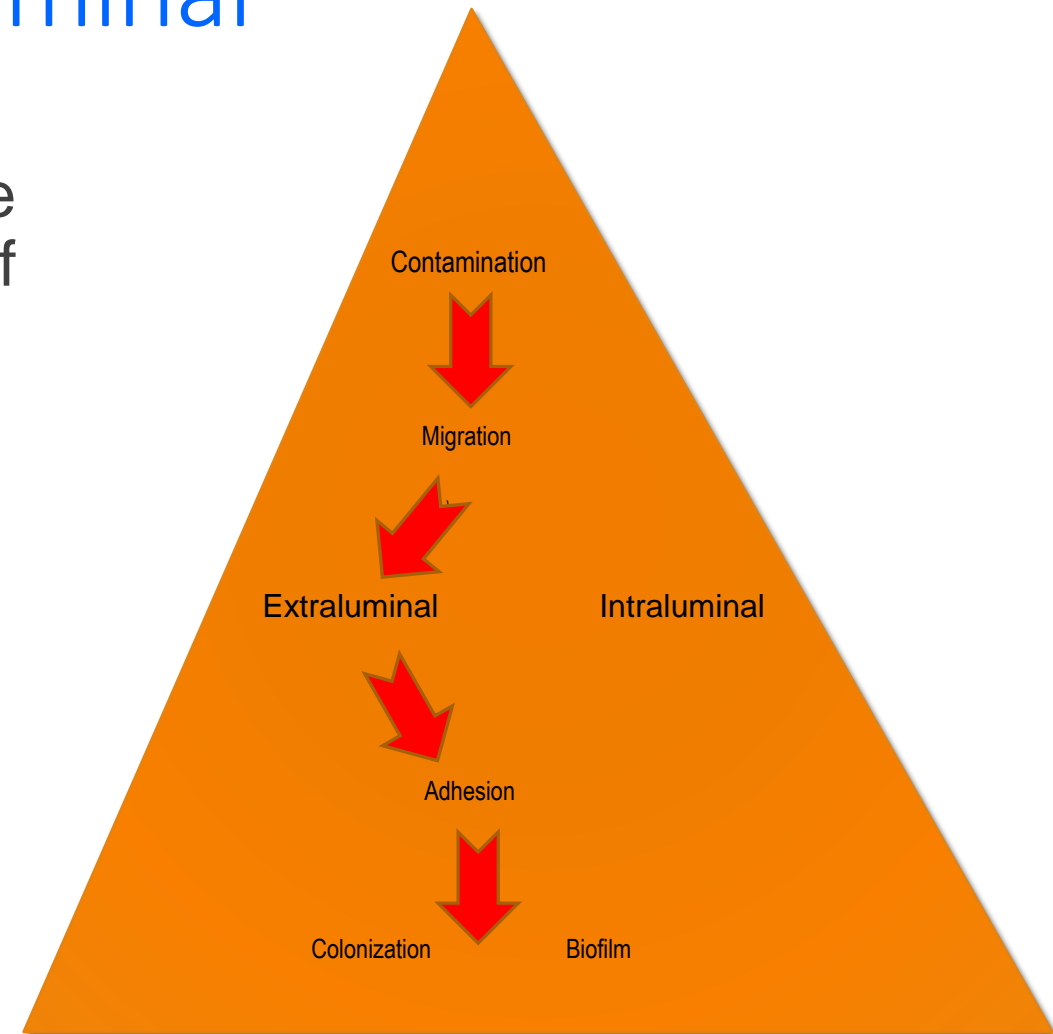
External mechanism occurs with pathogen migration from skin into the catheter tract along the external surface of the catheter with colonization of the catheter tip

May occur with any Touch

- Passive - Migration Under Dressing
- Active - Migration with Catheter Pistoning

Physiological response forms a fibrin sheath on external catheter surface

Most commonly occurs with **shorter dwell times**



Contamination Pathways-Intraluminal

Internal mechanism of infection occurs with direct contamination of catheter or catheter hub by contact with hands, or contaminated devices or fluids, causing intraluminal colonization

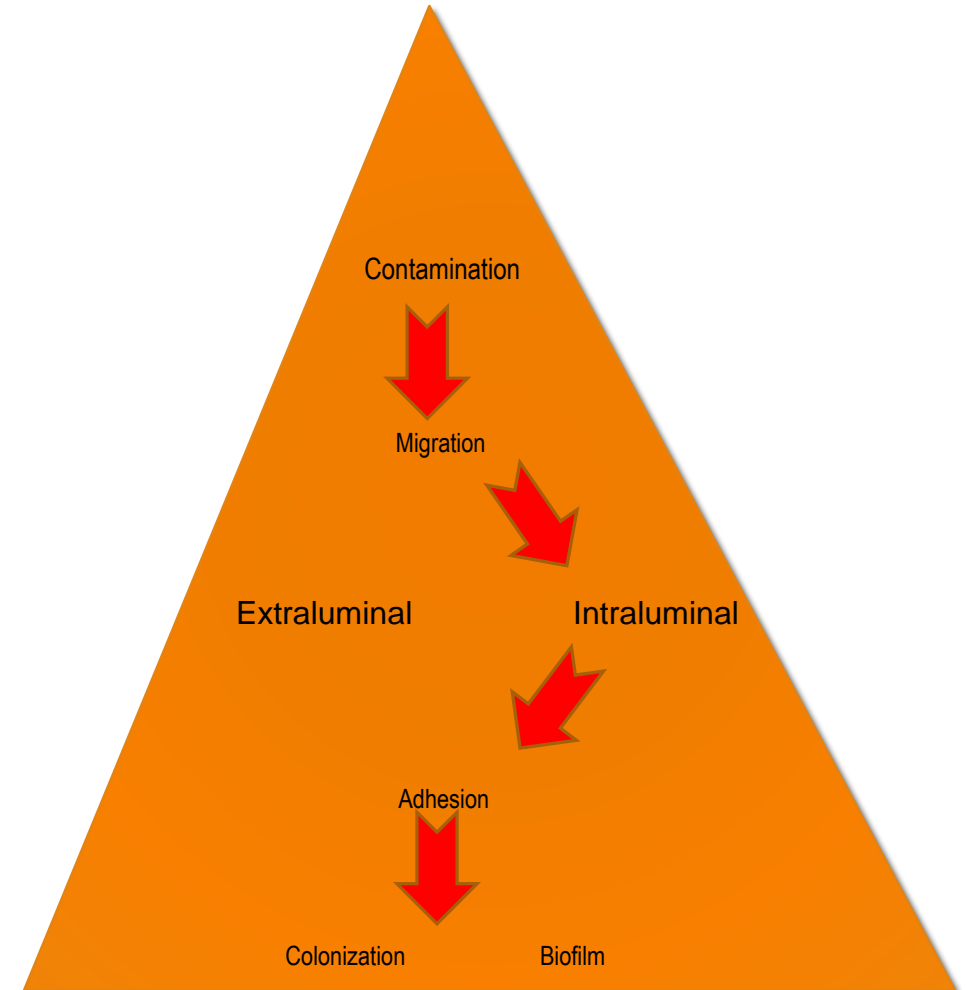
Active and Passive Micro-organism entry with each access into device

Fluid pathway design/dead space

Fibrin building block for micro-organism colonization

Colonization Occurs as Early as 24 Hours

Most commonly occurs **with prolonged dwell times**



Biofilm: The Root Cause of Infection⁸



According to the NIH, over 80% of microbial infections are caused by biofilms⁹

Biofilms are both tenacious and highly resistant to antimicrobial treatment¹⁰;

- Bacteria within biofilms have increased (up to 1000-fold higher) resistance to antimicrobial compounds⁹

Rates of Intravascular Device-Related Bloodstream Infection¹²

By Type of Devices *

					Per 1,000 IVD-days
Device	# of studies	# of catheters	# of IV days	# of BSIs	Pooled Mean
Peripheral IV catheters	110	10,910	28,720	13	0.5
PICCs (Inpatient & OP)	15	3566	105,839	112	1.1
Short term non-tunneled catheters with CHG/silver	18	3367	54,054	89	1.6
Tunneled CVC	29	4512	622,535	1013	1.6
Implanted port	14	3007	983,480	81	0.1
Dialysis catheters					
Temporary	16	3066	51,840	246	4.8
Long-term	16	2806	373,563	596	1.6

*An analysis of 200 published studies. Data collected from 1966 - 2005

HAI Progress Report⁷

HAI TYPE	# OF U.S. HOSPITALS THAT REPORTED DATA TO CDC'S NHSN, 2013 ⁺	2013 NAT'L SIR vs. 2012 Nat'l SIR [‡]	2013 NAT'L SIR vs. Nat'l Baseline [‡]	2013 NAT'L SIR
CLABSI Nat'l Baseline: 2008	3,578	↓ 4%	↓ 46%	0.54
CAUTI Nat'l Baseline: 2009	3,640	↑ 3%	↑ 6%	1.06
SSI, Abdominal Hysterectomy Nat'l Baseline: 2008	3,182	↓ 4%	↓ 14%	0.86
SSI, Colon Surgery Nat'l Baseline: 2008	3,348	↑ 14%	↓ 8%	0.92
MRSA Bacteremia Nat'l Baseline: 2011	3,827	↓ 5%	↓ 8%	0.92
C. difficile Infections Nat'l Baseline: 2011	3,924	↓ 6%	↓ 10%	0.90

⁺The number of hospitals reporting for each HAI type may differ because some hospitals do not use central lines or urinary catheters, or do not perform colon or abdominal hysterectomy surgeries.

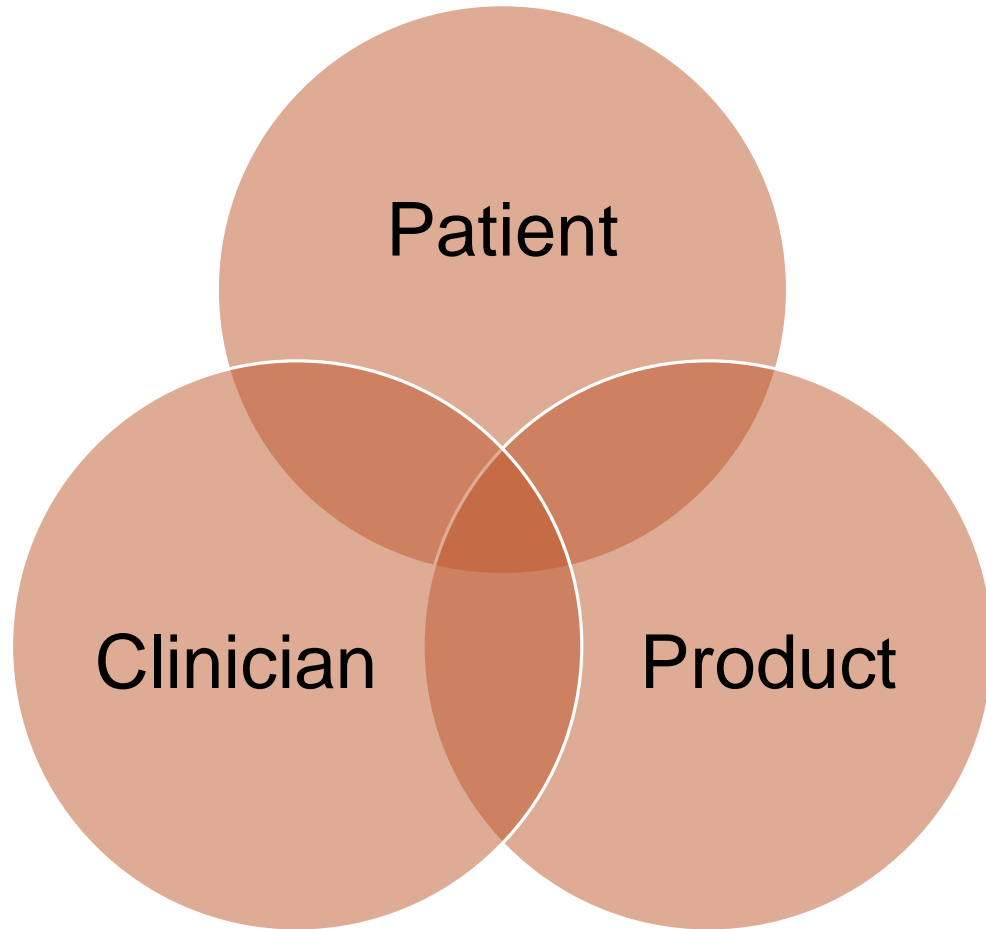
[‡]The 2012 Nat'l SIRs can be found in the data tables of this report.

[‡]Nat'l baseline time period varies by infection type. See first column of this table for specifics.

Key Strategies for Minimizing CLABSIs

- Standardization of clinical processes where practice variation may lead to increased risk of CLABSIs¹³
- Specialized teams for consistent high quality clinical outcomes (ex. Vascular Access Team)¹⁴
- A process in place to identify/assess patients with indwelling central lines¹⁵
- Bundling practices³

Developing a Bundle



A central line insertion and maintenance bundle is a group of evidence-based preventive practices and technologies that produce better outcomes when implemented collectively than when implemented individually.

A bundle will only be effective to the degree that it addresses the actual origins of CLABSI. It must include efforts to combat the formation of biofilm, because it is now well established that CLABSI develop as a result of bacteria colonizing on catheter walls.

When Can Central Line Bundles Succeed?

Dedicated, specially trained teams to conduct and/or oversee all line insertions & maintenance^{16*}

Standardized, Evidence Based Protocols (Bundle) including:¹⁷

- Insertion Checklist
- Central Line Cart Inventory
- Hand Hygiene
- Maximal Barrier
- Daily Necessity Checks (early line removal)
- Site preparation with Chlorhexidine
- Site Selection (avoiding femoral lines)

* Single-Centered Data. Not representative.

What is missing?

Older CVC bundles such as the one recommended by IHI focus on behavioral practices and address primarily the insertion phase (first 48 to 72 hours) of catheter care.

Could there be additional emphasis on care-and-maintenance?

CVCs may be in place for a week or longer, and will be accessed by nurses numerous times.

Lines left in place more than 1-2 weeks have a longer care-and-maintenance phase which may present numerous opportunities for infection.

It was recently reported that almost 72% of all CLABSIs reported to the NHSN by Pennsylvania acute care hospitals in 2010 occurred more than five days after insertion, suggesting that infection prevention lapses likely occurred in the postinsertion care and maintenance of the CVCs¹⁸

What is missing?

A comprehensive bundle should address care and maintenance as thoroughly as it does catheter insertion.

Compliance to guidelines can be challenging...¹⁹

Central Line Bundle Initiative	Presence of a Policy	Adherence to Policy
Insertion Checklist	92%	52%
Hand Hygiene Monitoring	94%	62%
Maximal Barrier for Insertion	96%	62%
Chlorhexidine	97%	71%
Selecting optimal site	91%	46%
Daily necessity checks	87%	37%

Recommendations & Guidelines for Complication Prevention

Engage both hospital frontline staff and senior leadership in the process of an outcome improvement plan.²²

Focus on a culture of safety including teamwork, technical process and promotion of accountability. Work to make the problem real to all those involved.²²

Educate healthcare personnel involved in the insertion and care of central lines.⁶

Execute best practices by standardizing the care process to help increase staff compliance. Consider using quality improvement methodologies.²²

Evaluate the impact of strategies. Multidisciplinary strategies, using quality improvement collaboratives, should be used to set goals/identify key factors to be measured.²²

Feedback should be given to all personnel with goal improvement clearly and frequently articulated.²²

Why Standardize the Process of Care?

Variation in processes of care is problematic because it leads to increased rates of error.²³

When standardized care is used, quality increases, variation decreases, and cost decreases.²³

Protocols and checklists have been shown to reduce patient harm through improved standardization and communication.²³

Review of Care and Maintenance Bundle Components

Nursing Interventions

SITE CARE

Hand hygiene **ALWAYS** - Hand hygiene should be a cornerstone of CLABSI prevention efforts⁶

- For both insertion and maintenance

For non-tunneled central lines in adults, change transparent dressings and perform site care with CHG-based antiseptic every five to seven days or immediately if dressing is soiled, loose, or damp²²

- change gauze dressings every two days or sooner if dressing is soiled, loose, or damp

Perform catheter site care with chlorhexidine at dressing changes¹⁴

- Technique for cutaneous antisepsis: "the manufacturer of ChloroPrep (CareFusion, Inc.) recommends using a back-and-forth motion for 30 seconds for skin cleansing."²⁴

Use securement device as opposed to sutures, and change whenever dressing is changed⁶

Nursing Interventions

HUB MAINTENANCE

Disinfect catheter hubs, needleless connectors, and injection ports before accessing catheter by vigorously applying mechanical friction with an alcoholic chlorhexidine preparation, 70 percent alcohol, or povidone-iodine (CDC,SHEA)

- Monitor compliance with hub/connector/port disinfection.²²

Scrub the hub using friction for a minimum of 5 seconds prior to accessing (SHEA)²²

Change caps no more often than 72 hours (or according to manufacturer's recommendations and whenever the administration set is changed)¹⁴

- After removing the cap, the hub should be wiped with CHG, alcohol, or povidone-iodine. (APIC)
- Allow hub to dry (Joint Commission)

Aseptic manipulation during all access attempts²⁵

Nursing Interventions

BLOOD DRAW AND FLUSHING

Aseptic manipulation during all access attempts²⁵

Scrub the hub using friction prior to accessing and between syringes, allow to dry⁶

Use disinfecting swab only once²⁶

Verify blood return prior to flush³

Flush vigorously using pulsatile technique²⁷

Appropriate syringe size and flush amount^{27,3}

Single use syringe – do not reuse even on same lumen²⁷

Nursing Interventions

Remove nonessential catheters. Assess need for continued intravascular access on daily basis during multidisciplinary rounds. Remove catheters not required for patient care.²²

- Use of audits to determine whether central lines are routinely removed after intended use may be helpful

Perform CLABSI surveillance in ICU and non-ICU settings. Measure unit-specific incidence of CLABSI (CLABSIs per 1,000 catheter-days) and report data on a regular basis to the units, physicians, nursing leadership, and hospital administrators.²²

Compare CLABSI incidence with historical data for individual units and with national rates.²²

Education/ competency/ product training for ALL staff inserting and maintaining central lines.²²

Team Collaboration

Communication, Cooperation, Commitment

Organizational commitment to patient safety:²⁹

- Visibility, support, and involvement of senior leadership
- Recognition that all clinicians might not be vascular access experts but have a role to play in complication prevention
- Identify super-user's, multidisciplinary champions, expert facilitator, and leaders (possibly one from each discipline)
- Feedback should be given to all personnel with goal improvement clearly and frequently articulated.

Key Points

- A central line bundle should be both evidence-based and comprehensive so that multiple sources of bacterial contamination are addressed
- Technologies/practices required of nurses should be easy, user friendly, and as fail-safe as possible
- A key step towards ensuring that CLABSI prevention steps are being done consistently on your unit is through regular audits, observations, and assessments²²
- Evidence based medicine and the guidelines are only as effective as the clinicians' consistent compliance to them¹⁹
- Collect DATA, evidenced-based studies, and patient information to support change

REFERENCES

1. Bard Access Systems, *PowerPicc Solo Instructions for Use*, 2007.
2. Phillips, L. D., & Gorski, L. A. (2014). *Manual of I.V. Therapeutics* (6th ed.). Philadelphia: F.A. Davis.
3. Infusion Nurses Society, A.M., *Infusion nursing standards of practice. 1S ed. 2011*, Norwood, MA: Infusion Nurses Society
4. Mary Alexander, A.C., ed. *Infusion Nursing: An Evidence Based Approach. 3rd ed. Infusion Nurses Society. 2010*, Saunders Elsevier: St. Louis, Missouri.
5. L. Hadaway, Technology of Flushing Vascular Access Devices.
6. CDC Centers for Disease Control. (2011) Guidelines for the prevention of intravascular catheter-related infections: Centers for Disease Control and Prevention.
7. Centers for Disease Control and Prevention. 2013 National and State Healthcare-Associated Infections Progress Report. Published January 2015. Available at <http://www.cdc.gov/hai/progress-report/index.html>
8. Retrieved September 27, 2015, from Geistlich: <http://www.geistlich-pharma.com/en/pharmaceutical/products/taurosept/taurosept-crbsi/>
9. United States of America. Department of Health and Human Services. National Institutes of Health. *NIH Guide: Research on Microbial Biofilms*. National Institutes of Health, Dec. 2002.
10. Donlan, R. (2001). Biofilms and Device-Associated Infections. *Emerging Infectious Diseases* , 7 (2), 277-281.

REFERENCES

11. Edmond MB, et al. *Clin Infect Dis*. 1999;29(2):239-244.
12. Maki DG, Kluger DM, Crnich CJ. The risk of bloodstream infection in adults with different intravascular devices: a systematic review of 200 published prospective studies. *Mayo Clin Proc* 2006; 81:1159–71
13. Loftus, K., Tilley, T., Hoffman, J. et al. Use of Six Sigma strategies to pull the line on central line-associated blood stream infections in a Neurotrauma intensive care unit. (2015). *Journal of Trauma Nursing* , 22 (2), 78-86.
14. The Joint Commission. *Preventing central line-associated bloodstream infections a global challenge, a global perspective*. 2012 [cited 2013 January 9,]; Available from: www.jointcommission.org/topics/hai_clabsi.aspx.
15. Chopra, V., Ratz, D., Kuhn, L., Lopus, T., & Chenoweth, C. (2014). PICC-associated blood stream infections: Prevalence, patterns, and predictors. *The American Journal of Medicine* , 127 (4), 319-328.
16. S. Silow-Carroll, and J. N. Edwards, Eliminating Central Line Infections and Spreading Success at High-Performing Hospitals, The Commonwealth Fund, December 2011.
17. How-to Guide: *Prevent Central Line-Associated Bloodstream Infections (CLABSI)*. Cambridge, MA: Institute for Healthcare Improvement; 2012. (Available at www.ihc.org)
18. Pennsylvania Safety Authority. Central-Line-Associated Bloodstream Infection: Comprehensive, Data-Driven Prevention. Pennsylvania Patient Safety Advisory. Sep 2011. Accessed Mar 19, 2012. [http://www.patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2011/sep8\(3\)/Pages/100.aspx](http://www.patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2011/sep8(3)/Pages/100.aspx).
19. Stone, Patricia W., et al. "State of infection prevention in US hospitals enrolled in the National Health and Safety Network." *American journal of infection control* 42.2 (2014): 94-99.

REFERENCES

20. Journey to Zero. Innovations in Reducing Hospital Acquired infections. Clinical Operations Board.2011 The Advisory Board Company. Washington D.C.
21. *Do No Harm* Edited Video. https://www.bardaccess.com/media_library/ms/bbd2482b/DoNoHarmEdit.wmv
22. Infection Control and Hospital Epidemiology, Vol. 35, No. 7 (July 2014), pp. 753-771
23. Standardization of practice to improve outcomes. Committee Opinion No. 526. American College of Obstetricians and Gynecologists. *Obstet Gynecol* 2012; 119:1081-2.
24. Carefusion. (2015). Chloraprep One Step Chloraprep with Tint. *Package Insert* .
25. Basic Infection Control And Prevention Plan for Outpatient Oncology Settings. http://www.cdc.gov/HAI/prevent/prevent_pubs.html. December, 2011
26. The Joint Commission. (2013). Preventing central line–associated bloodstream infections: Useful tools, an international perspective. <http://www.jointcommission.org/CLABSIToolkit>
27. Nebraska Medical Center. (2012). *Standardizing Central Venous Catheter Care: Hospital to Home, Second Edition*.
28. Cherry M, Brown J, Neal T, Ben Shaw N. What features of educational interventions lead to competence in aseptic insertion and maintenance of CV catheters in acute care? BEME Guide No. 15. *Medical Teacher* [serial online]. March 2010;32(3):198-218.
29. Harnage, S. (2012). Seven years of zero central line bloodstream infections. *British Journal of Nursing* , 21 (21).