NURSING MANAGEMENT OF VENOUS ACCESS DEVICES: AN OVERVIEW OF CENTRAL VENOUS ACCESS DEVICES

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Central Venous Access Devices (CVADs)

- Peripherally-inserted Central Catheters (PICCs)
- Non-tunneled catheters: subclavian / jugular / femoral lines
- Tunneled catheters: Hickman / Broviac / Groshong / Small-bore (Hohn, Powerline)
- Implanted ports: Port-a-caths / Passports

Central VADs

- "…first line of defense, not a device of last resort"
- Candidates:
  - Long-term therapies (> one week)
  - TPN
  - Chemotherapy / vesicants
  - Drugs with pH <5 or >9
  - Hypertonic solutions (osmolality > 600mOsm/L), such as 3% saline
  - Limited venous access

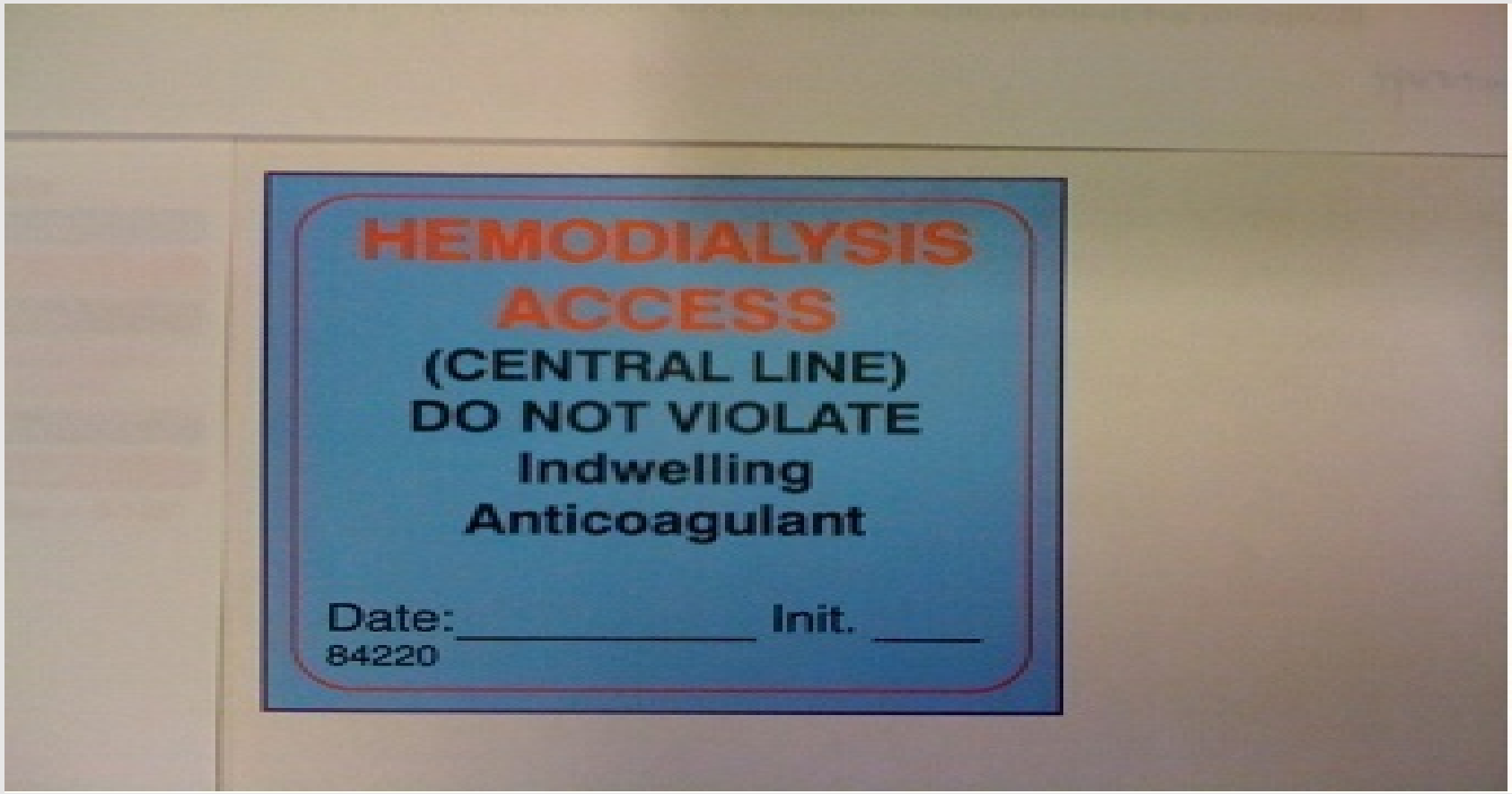
Verification of Central Lines

- Confirmation of type of central line and line placement MUST be verified before use
- Until verification is complete, the catheter must be marked with a red "unconfirmed catheter" sticker (see policy in Ellucid)
- The catheter is not to be used until this confirmation and verification of catheter tip has taken place.
- As soon as the type of catheter is confirmed and the placement of the catheter tip has been verified, the MD/NP/PA will write specific order "line ok to use"
- Pheresis and dialysis catheters will have a specific label attached to the dressing
- Refer to Nursing Policies and Procedures in MGH Ellucid


UNCONFIRMED
CATHETER
DO NOT USE
VERIFY PLACEMENT
DATE
INITIALS

Pheresis Dressing Label

Hemodialysis Dressing Label



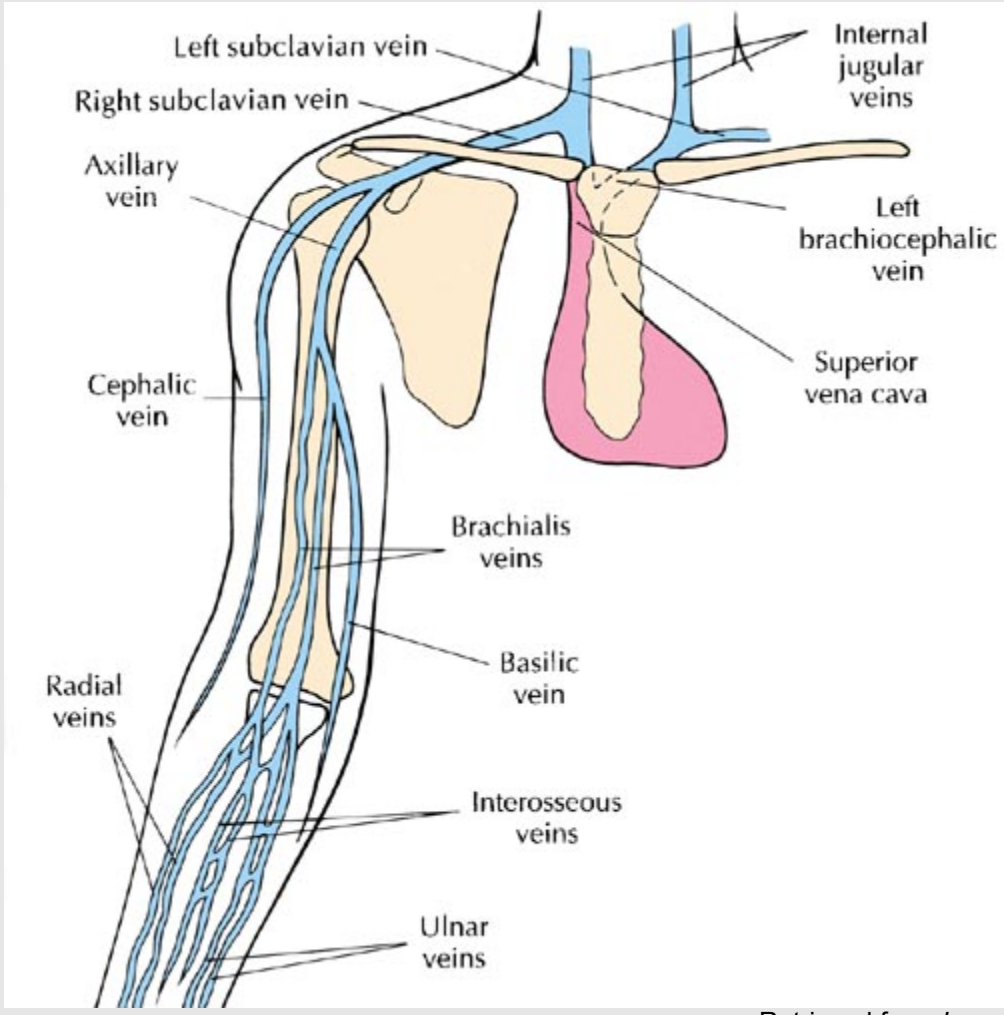
Sources to Use for Central Line Identification

- Chest x-ray (preferred) or CT scan
- Interventional Radiology report
- Operative note
- Discharge summary
- Referring MD note
- Outside hospital transfer note
- Patient-provided documentation

Central VAD: Catheter Tip Placement

- Chest x-ray mandatory before initial use (except for PICCs inserted using EKG tip positioning system [3CG] during that admission)
- Chest x-ray mandatory when patient admitted/readmitted to MGH with an existing PICC or undocumented VAD regardless of whether 3CG was used on initial placement of PICC
- MUST be "central"…Optimal central line tip placement is the distal one-third of the SVC or the cavo-atrial junction, you may see the following on reports:
  - *Superior vena cava (SVC)*
  - *Cavo-atrial junction (superior vena cava/right atrial junction). Also known as SVC/RA junction, Cajxn*
  - *Right atrium (RA); exception is PICCs*
- Femoral lines: tip in thoracic inferior vena cava (IVC) above level of diaphragm
- There is some variability, so consult with IR/radiology if needed

Venous anatomy of upper extremity veins



Retrieved from *Images.MD* at *Treadwell Library 12/11/09*

Central VADs: Malpositioned catheters

- Catheter should not be used as a central VAD until it is repositioned and tip is confirmed to be in a central location
- Interventions for PICCs:
  - Malpositioned PICCs are not automatically removed.
  - Pull-back: if tip in right atrium, right ventricle, some contralateral PICCs, or patient is experiencing cardiac irritability, the PICC may be pulled back by the IV nurse or Interventional Radiology.
  - Other tip locations may be exchanged by IV nurse or Interventional Radiology (IR).

Central VADs: Malpositioned catheters

- Interventions for PICCs (cont.):
  - Catheter exchange is considered if:
    - Tip is in the jugular, contra-lateral vein, coiled or looped. Most coiled or looped PICCs are managed by IR.
    - Patient needs more lumens for therapy or patient needs a non-violated line for TPN initiation.
- Individual patient anatomy or disease may not allow centrally-placed lines and need is determined on an individual patient case basis.

Vein Measurements

	Length	Diameter	Flow Rate
Cephalic	38cm	6mm	40-90ml/min
Basilic	24cm	8mm	90-150 ml/min
Axillary	13cm	16mm	150-350ml/min
Subclavian	6cm	19mm	350-800ml/min
Innominate	2.5cm	19mm	800-1500ml/min
SVC	7cm	20mm	2000ml/min

Central VAD Care and Maintenance: Flushing

- Always use a 10ml or larger syringe to flush. Smaller syringes have increased flushing pressure that can cause catheter rupture.
  - *Note: some pre-filled syringes smaller than 10ml have syringe barrel equal to a 10 ml syringe and are acceptable to use*
- NO heparin for heparin-induced thrombocytopenia (HIT) positive patients: flush with 0.9% preservative-free saline 10-20ml
- Use of 0.9% normal saline is sufficient for flushing of most accessed CVADs. Refer to CVAD flush chart in Ellucid for specific information
- Heparin NOT needed for 'saline only/valved' devices
- Flush IMMEDIATELY post-infusion and after blood drawing
- Use push-pause/pulsatile flush method

  (see module 1 for description)

Central VAD Care & Maintenance: Heparin

- For those patients requiring heparin, to minimize risk of unintended systemic anticoagulation from frequent flushing, consider a maintenance line for patients receiving multiple intermittent infusions
  - *Adult 'guideline': recommended maximum per 24 hours for intermittent flushes should not exceed 2,000 unit heparin*
  - *Pediatrics: maximum heparin per 24 hours should not exceed 75 units/kg. in 24 hours*
  - *Obtain order for VAD heparin flush to enable EMAR documentation*
- "Fun fact": heparin does NOT dissolve existing clots; it helps prevent future clots

Adult Heparinization (per lumen): Ports

- When in use:
  - 10-20ml of 0.9% preservative-free saline after an infusion
  - 20-30ml of 0.9% preservative-free saline after a blood draw or transfusion
  - Should be flushed *at least* every 24 hours
- When not in use; i.e., de-accessing/maintenance flush
  - Heparin 5ml of(100 units/ml)= 500 units of heparin
  - Port should be flushed every four to eight weeks

Pediatric Heparinization (per lumen): Ports

- When in use:
  - Adolescent: 10ml of 0.9% preservative-free saline, followed by heparin 5ml of (100 units/ml)= 500 units heparin after completion of any infusion or blood sampling
  - Toddler/Infant: 10ml of 0.9% preservative-free saline, followed by heparin 3-5ml of (10 units/ml)= 30-50 units heparin if used more than once a day
- When being de-accessed/maintenance flush:
  - Adolescents: 10ml of 0.9% preservative-free saline, followed by heparin 5ml of (100 units/ml)= 500 units of heparin. Monthly maintenance flush.
  - Toddlers/Infants: 10ml of 0.9% preservative-free saline, followed by heparin 3-5 ml of (100 units/ml)= 300-500 units of heparin. Monthly maintenance flush

Adult Heparinization (per lumen): Tunneled catheters

- Includes: Hickman, Broviac, and small-bore tunneled catheters (such as Hohn, Bard Powerline)
- Groshong catheters are valved and do not require heparin; use saline only
- When in use:
  - Use 10-20ml of 0.9% preservative-free saline after infusions
  - Use 20-30ml of 0.9% preservative-free saline after blood draws or transfusions
  - Should be flushed *at least* every 24 hours
- When not in use:
  - Use 5 ml of (10 units/ml) = 50 units of heparin
  - Should be flushed one to two times per week for maintenance

Pediatric Heparinization (per lumen): Tunneled catheters

- Includes Hickman and Broviac catheters
- Groshong catheters not normally used in pediatrics
- When not in use:
  - Adolescents: 5 ml of (10 units/ml) = 50 units of heparin, and should be flushed one to two times per week for maintenance
  - Toddler/infant: 2 ml of (10 units/ml) = 20 units of heparin, and should be flushed once daily for maintenance
  - Neonate/NICU: 1 ml of (10 units/ml) = 10 units of heparin, and should be flushed every 12 hours for maintenance

Pediatric Heparinization (per lumen): small-bore tunneled catheters

- Adolescents:
  - Use 5 ml of (10 units/ml) = 50 units of heparin
  - Flush *at least* once every 24 hours
- 2.6Fr or larger catheters:
  - Use 2-3 ml of (10 units/ml) = 20-30 units of heparin
  - Flush *at least* every 12 hours
- 2Fr catheters:
  - Use 1 ml of (10 units/ml) = 10 units of heparin
  - Flush *at least* every 6 hours

Adult Heparinization (per lumen): Pheresis catheters

- Pheresis catheters are large-bore catheters used in bone marrow transplant and in Blood Transfusion Service (BTS) apheresis procedures. They are managed by BTS nursing and oncology unit staff.
- Pheresis catheters may be confused with a Hickman or dialysis catheter. Certain pheresis catheters may be used for hemodialysis (HD).
- Caution: concentrated anticoagulant used in pheresis catheters must be withdrawn prior to catheter use
- When in use:
  - Use 10-20ml of 0.9% preservative-free saline following an infusion
  - Use 20-30ml of 0.9% preservative-free saline after a blood draw or transfusion
  - Should be flushed *at least* every 24 hours

Adult Heparinization (per lumen): Pheresis catheters

- When not in use:
  - Heparin 1000 units/ml or Anticoagulant Citrate Dextrose (ACD) may be used for anticoagulation in pheresis catheters
  - ACD: Pharmacy supplies Omnicell with prefilled ACD syringe
  - Refer to the Provider order for anticoagulation directions
  - To avoid excess or inadvertent anticoagulation, heparin or ACD **must** be withdrawn from the lumen prior to flushing or infusing
  - Instill volume of the catheter (printed on each lumen) plus volume of needleless connector (currently 0.2ml for the Max Plus)
  - If the catheter volume is not legible, contact CNS, BTS, or Interventional Radiology for guidance
  - Flush Monday-Wednesday-Friday and PRN

Pediatric Heparinization (per lumen): Pheresis catheters

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- Pheresis catheters may be confused with a Hickman or dialysis catheter. Certain pheresis catheters may be used for hemodialysis (HD).
- Heparin 1000 units/ml or ACD may be used for anticoagulation in pheresis catheters, and **MUST** be withdrawn prior to catheter use.
- Pharmacy supplies Omnicell with prefilled ACD syringes.

Pediatric Heparinization (per lumen): Pheresis catheters

- Adolescents:
  - Refer to the Provider order for anticoagulation directions
  - Heparin 1000 units/ml
  - Instill volume of the catheter (printed on each lumen) plus volume of needleless connector (currently 0.2ml for the Max Plus)
  - If the catheter volume is not legible, contact CNS, BTS, or Interventional Radiology for guidance
  - Flushed after completion of any infusion or blood sampling
  - Flush Monday-Wednesday-Friday and PRN
- Toddlers/infants:
  - Please refer to the provider order.

Adult Heparinization (per lumen): Non-tunneled catheters

- When in use:
  - Use 10-20ml of 0.9% preservative-free saline after infusions
  - Use 20-30ml of 0.9% preservative-free saline after blood draws or transfusions
  - Should be flushed *at least* every 24 hours
- When not in use:
  - Consider removal of line

Pediatric Heparinization (per lumen): Non-tunneled catheters

- Adolescents:
  - 5 ml of (10 units/ml)= 50 units of heparin
  - Flush after completion of any infusion or blood sampling
  - Flush *at least* once a day
- Toddler/infant:
  - 2 ml of (10 units/ml) = 20 units of heparin
  - Flush after completion of any infusion or blood sampling
  - Flush *at least* once a day
- Neonate/NICU:
  - 1 ml of (10 units/ml) = 10 units of heparin
  - Flush after completion of any infusion or blood sampling
  - Flush *at least* every six hours

Adult Heparinization (per lumen): PICCs

- Includes PICCs and Power PICCs
- Use 10-20ml of 0.9% preservative-free saline after infusions
- Use 20-30ml of 0.9% preservative-free saline after blood draws or transfusions
- Should be flushed *at least* every 24 hours

Pediatric Heparinization (per lumen): PICCs

- Includes PICCs and Power PICCs
- Adolescents:
  - 5 ml of (10 units/ml) = 50 units of heparin after completion of any infusion or blood sampling
  - Should be flushed *at least* once every 24 hours if not in use
- Pediatrics 2.6Fr catheter or larger:
  - 2-3 mls of (10 units/ml) = 20-30 units of heparin after completion of any infusion or blood sampling
  - Should be flushed *at least* 12 hours if not in use

Pediatric Heparinization (per lumen): PICCs

- Pediatrics 2FR catheter:
  - 1 ml of (10 units/ml) = 10 units of heparin after completion of any infusion or blood sampling
  - Should be flushed *at least* every six hours if not in use
- Neonates/NICU:
  - Unused lumens of multi-lumen PICCs may be heplocked in certain situations such as fluid restrictions
  - Single lumen (SL) PICCs are not heplocked
  - All infusions via PICC, including flushes, should be administered via pump to reduce the risk of catheter fracture
  - 1 ml of (10 units/ml) = 10 units of heparin after completion of any infusion or blood sampling
  - Should be flushed every six hours

Adult/Adolescent Heparinization (per lumen): Valved PICCs

- Includes, for example, Bard Solo, Vaxcel
- Heparin is not necessary
- Use 10-20ml of 0.9% preservative-free saline after infusions
- Use 20-30ml of 0.9% preservative-free saline after blood draws or transfusions
- Rarely used in pediatrics
- Flush after each use or *at least* every seven days

Adult Heparinization (per lumen): Trialysis catheters

- A hemodialysis (HD) catheter with three lumens. The "pigtail" lumen is treated as a small-bore tunneled catheter.
- The dialysis lumens are labeled and managed by HD. If there are questions, please contact Dialysis at x63700.
- When in use:
  - Use 10-20ml of 0.9% preservative-free saline following an infusion
  - Use 20-30ml of 0.9% preservative-free saline after a blood draw or transfusion
  - Should be flushed *at least* every 24 hours
- When not in use:
  - Use 5 ml of (10 units/ml) = 50 units of heparin
  - Should be flushed *at least* one to two times per week

Pediatric Heparinization: Umbilical vein catheters

- Neonates: 1 ml of (10 units/ml) = 10 units of heparin
- Flush after completion of any infusion or blood sampling
- Should be flushed *at least* every six hours

To Clamp or Not to Clamp?

- Needleless connectors should be **primed** and changed every 96 hrs (usually 2 x week, once when dressing is changed) and PRN when cap is compromised.
- **Positive displacement needleless connectors (Maxplus):** flush using a pulsatile or "push-pause" technique. Remove syringe and ONLY then, may you clamp the catheter. Let the needleless connector do its job!
- Clamps should NOT be used on PICCs or midlines while patient is "in-house"
- **Neutral displacement needleless connectors (micro-clave or q-syte) or direct connect:** flush using a pulsatile or "push-pause" technique. Maintain positive pressure by clamping line while injecting last ml of fluid, or disconnect syringe while still flushing forward

Flushing Techniques

Type of catheter cap	**Flushing technique**
Needleless system cap **with** positive pressure feature (e.g. Max-Plus). Note: These are required for all central lines at MGH.	Flush using push-pause technique. Remove syringe, and ***only then*** may you clamp the catheter.
Needleless system cap **without** positive pressure feature (e.g. blue MicroClave)	Flush using push-pause technique. Maintain positive pressure by clamping line while injecting last ml of fluid.
None- Flushing when using a direct connection (e.g. during monthly maintenance flush of port).	Flush using push-pause technique. Maintain positive pressure by clamping line while injecting last ml of fluid.

Central VADs Care and Maintenance: Blood Drawing

- GENEROUSLY flush with 20-30ml saline post blood draw or checking for blood return
- Valved VADs require slightly different withdrawal procedure
  - *Pull back slightly, pause and then continue withdrawing blood sample. Pause allows valve to open.*

Discard Amounts

- ‘Discard’ amounts:
  - *adults - 6ml of blood*
  - *pediatrics:*
    - adolescents and older children - 3ml for tunneled catheter; 3 to 5ml for implanted port
    - child - 5 to 10ml maximum
    - Infant - 2ml maximum
    - neonate - 1ml maximum
- Refer to MGH Nursing Procedures in Ellucid

Central VADs: Dressing Protocol

- Chlorhexidine gluconate 2% is the preferred, CDC recommended method of site disinfection
- Transparent semipermeable membrane [TSM] dressings (without gauze) are changed routinely **every seven days**
- Gauze dressings that obscure the catheter or port needle site are changed every 48 hours. This includes Covaderm® dressings.
- Change dressing PRN when non-occlusive, soiled, bloody, or not dated.
- Protect dressing when patient showers
- Assess skin for signs and symptoms of infection or tape reaction.
  - Assess need for alternate dressing (Sorbaview, Covaderm)
- NICU PICC dressings are only changed PRN, not routinely, and only by the Nurse Practitioner that inserted the PICC.
- Refer to MGH Nursing Procedures in Ellucid

Please note….

All information provided is subject to review and revision. Please continue to refer to MGH Policies and Procedures in Ellucid as your primary resource.

References

- Original power point, 2011: Bartholomay, Dreher, Theresa Evans, Susan Finn, Deb Guthrie, Hannah Lyons, Janet Mulligan, Carol Tyksienski
- Guthrie, D., Dreher, D., Munson, M. PICC Overview – Parts I and II, NURSING 2007, August and September 2007
- Infusion Nurses Society (INS) Infusion Nursing Standards of Practice, 2016
- MGH Ellucid
- O'Grady, NP; Alexander, M; Dellinger, EP; et al. Guidelines for the prevention of intravascular catheter-related infections. Centers for Disease Control and Prevention. MMWR Morb Mortal Wkly Rep 2002; 51(RR-10)
- O'Grady, NP; Gerberding, JL; Weinstein, RA; Masur H. Patient Safety and the science of prevention: the time for implementing the guidelines for the prevention of intravascular catheter-related infections is now. SOCrit Care Med 2003 Jan; 31(1):291-2
- Preventing complications of central venous catheterization. McGee, DC; Gould, MK SON Engl J Med 2003 Mar 20; 348(12):1123-33
- Terry, et al. Intravenous Therapy: Clinical Principles and Practice. INS. WB Saunders, 2001
- Warren, DK; Quadir, WW; Hollenbeak, CS; Elward, AM; Cox, MJ; Fraser, VJ. Attributable cost of catheter-associated blood stream infections among intensive care patients in a nonteaching hospital. SOCrit Care Med. 2006 Aug; 34(8):2084-9