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COURSE TIMELINE

Timeline

- Print post QSEs
The Instructor Guide contains four sections: Course Overview, Didactic, Course Tools, and Appendix. A brief description of each section is listed below.

**Course Overview**

The Course Overview contains course information such as the course description, course objectives, participant and instructor requirements, and pertinent class information.

**Didactic**

The Didactic section is divided into Participant Content and Instructor Actions. The Participant Content is on the Instructor CD (located inside the front cover of the Instructor Guide) to display during class. The Instructor Actions are only in the Instructor Guide for use by the instructor.

- **Participant Content:** This information is provided on the Instructor CD to display during class.

- **Icon References:** Refer to page 7 of the Instructor Guide for a description of all icons used in the course material.

- **Instructor Actions:** This section is for instructor use and is only available in the Instructor Guide. The Instructor Actions provide detailed information to discuss with participants regarding the material on the corresponding page.

**Course Tools**

The Course Tools section contains the pre-class and post-class quizzes, surveys, and course evaluations.

**Appendix**

The Appendix contains a glossary of terms and useful information for successfully integrating simulation into your training curriculum.
Instructor Guide
Course Overview

ICON EXPLANATION

Organization Reference
This icon represents the opportunity to tailor the course per organizational policy, protocol, or individual site needs.

Additional Information Alert
This icon indicates important information, tips, or notes.

Caution Awareness Alert
This icon warrants the need for safety measures to be invoked when performing the indicated action.

Ring of Knowledge (ROK) Card Icon
When this icon is displayed, refer to the corresponding ROK card for quick reference while in the clinical environment.
Description of SimsSimple...
The Central Venous Cannulation Training (CVCT) course focuses on proper central venous catheter placement, including the use of ultrasound and manometry for locating and verifying venous access sites. The course includes participant and instructor material emphasizing central venous cannulation (CVC) indications, contraindications, recognition of complications along with treatment and prevention, site anatomy, alternatives to CVC, adjuncts to CVC, patient preparation, sterile preparation and technique. A hands-on practical component is incorporated using task trainers to develop psychomotor skills for the placement of internal jugular, subclavian, and femoral catheters. The course has a strong focus on ultrasound use and the five barrier sterile technique. Patient safety is emphasized at every opportunity.
Course Overview

Upon completion of this course, participants will be able to:

1. Describe the indications and contraindications of central venous cannulation (CVC)
2. Recognize potential complications of CVC along with treatment and prevention
3. Describe the different sites for CVC, including inherent risks, benefits, and anatomy
4. Discuss alternatives to CVC
5. Utilize adjuncts to CVC, such as ultrasound and manometry
6. Demonstrate the use of the five protective barriers and proper sterile preparation for insertion of central venous catheters
7. Insert a central venous catheter into the internal jugular, subclavian, and femoral veins

The primary objective of this course is to provide participants with the necessary knowledge and skills to effectively and efficiently gain central venous access in patients.
Before attending class, participants will be required to:

1. Review the online material*
2. Complete the pre-class quiz*
3. Complete the pre-class survey*

* The participant material, quiz, and survey can be accessed via SimsSimple. Please follow the instructions on page 9 of the Instructor Guide to learn more about SimsSimple.

It is recommended for participants to wear scrubs or older clothes to class. The dyed liquid used as blood may stain.
Instructor Guide

Course Overview

CLASS INFORMATION

The recommended participant to instructor ratio is 3 to 1.

The recommended class length is four to five hours. This will vary based on participants’ prior exposure to central venous cannulation training and experience. The times in the Suggested Class Agenda are approximations and may be adjusted to accommodate your organization. Breaks can be added if needed. The suggested class agenda would take approximately 4 hours and 25 minutes.

SUGGESTED CLASS AGENDA

1. Course Introduction (5 minutes)
2. Review Pre-class Quiz (10 minutes)
3. Review Didactic Material (30 minutes)
4. Skill Station 1 – Sterile Technique (20 minutes)
5. Skill Station 2 – Internal Jugular (45 minutes)
6. Skill Station 3 – Subclavian (45 minutes)
7. Skill Station 4 – Femoral (45 minutes)
8. Skill Station 5 – Ultrasound Guidance (45 minutes)
9. Post-class Quiz (10 minutes)
10. Post-class Survey (5 minutes)
11. Course Evaluation (5 minutes)
Dr. Romeo began his career in medicine as a graduate of the Pennsylvania State University School of Medicine. After finishing his medical internship at the Milton S. Hershey Medical Center, Dr. Romeo completed a three year anesthesiology residency at the University of Pittsburgh. He is a board certified anesthesiologist and has been on faculty at the University of Pittsburgh, Department of Anesthesiology since 1999.

Dr. Romeo has been involved with simulation education and research throughout his entire career. He is the Director of the Central Venous Cannulation Training (CVCT) course at the Peter M. Winter Institute for Simulation Education and Research (WISER).
ACKNOWLEDGMENTS

The following reviewers should be acknowledged for their expert and valuable contributions to the Central Venous Cannulation Training course:

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Medical Director, UPMC Prehospital Care

Adam S. Akers, MD
Chief, Division of Hospital Medicine
Department of Critical Care Medicine
University of Pittsburgh Medical Center

Karen Smith, RN
Suggested Class Agenda

PARTICIPANT CONTENT

1. Course Introduction (5 minutes)
2. Review Pre-class Quiz* (10 minutes)
3. Review Didactic Material† (30 minutes)
4. Skill Station 1 – Sterile Technique (20 minutes)
5. Skill Station 2 – Internal Jugular (45 minutes)
6. Skill Station 3 – Subclavian (45 minutes)
7. Skill Station 4 – Femoral (45 minutes)
8. Skill Station 5 – Ultrasound Guidance (45 minutes)
9. Post-class Quiz‡ (10 minutes)
10. Post-class Survey‡ (5 minutes)
11. Course Evaluation‡ (5 minutes)

INSTRUCTOR ACTIONS

• Review the above (or modified) agenda with participants. The agenda is only a recommendation and can be modified to accommodate your organization.
• Distribute ROK cards to participants at the beginning of the class.
• If any participants did not complete the pre-class quiz and pre-class survey prior to class, instruct participants to log on to SimsSimple and complete the missing material. To access the assessments, refer to page 9 of the Instructor Guide.

* Use the SimsSimple features to review the pre-class quiz. For more information, refer to page 9 in the Instructor Guide.
† Use the Instructor CD to review the Didactic Material. The CD is located on the inside cover of the Instructor Guide.
‡ Distribute the post-class quiz, post-class survey, and course evaluation. These assessments can be printed from SimsSimple. To access the assessments, refer to page 9 of the Instructor Guide.
Course Objectives

PARTICIPANT CONTENT

Primary Course Objective
The primary objective of this course is to provide participants with the necessary knowledge and skills to effectively and efficiently gain central venous access in patients.

Educational Objectives
Upon completion of this course, participants will be able to:
1. Describe the indications and contraindications of central venous cannulation (CVC)
2. Recognize potential complications of CVC along with treatment and prevention
3. Describe the different sites for CVC, including inherent risks, benefits, and anatomy
4. Discuss alternatives to CVC
5. Utilize adjuncts to CVC, such as ultrasound and manometry
6. Demonstrate the use of the five protective barriers and proper sterile preparation for insertion of central venous catheters
7. Insert a central venous catheter into the internal jugular, subclavian, and femoral veins

INSTRUCTOR ACTIONS

Review the above material with participants.
CVC Indications and Contraindications

**PARTICIPANT CONTENT**

**Indications**
- Administration of fluids, medications, and/or blood
- Central venous pressure (CVP) monitoring
- Blood sampling
- Hemodialysis
- Temporary cardiac pacemaker access
- Poor intravenous (IV) access
- Rapid infusion
- Total parenteral nutrition (TPN)
- Chemotherapy

**Contraindications (absolute)**
- Site infection, dermatitis, loss of skin integrity
- Central vein thrombosis or occlusion
- Arteriovenous fistula
- Allergies to catheter coatings

**Contraindications (relative)**
- Anatomic abnormalities
- Coagulopathies
- Inexperienced practitioner
- Pre-existing catheter at site or in pathway (Example: peripherally inserted central catheter [PICC] line)
- Inability to provide sterile technique, except in emergencies, and with appropriate clinical judgment

**INSTRUCTOR ACTIONS**

Review the above material with participants.

*Discussion Points:*
- Stress the absolute contraindications.
Complications: General

PARTICIPANT CONTENT

• Infection
  - Most common complication with an incidence approximately 3% to 20%1
  - Most are related to microbial migration at the site
• Arterial puncture
  - American Society of Anesthesiologists (ASA) closed claim study documented that inadvertent cannulation of the carotid artery resulted in substantial morbidity2
• Occlusion of catheter tip
  - Most common non-infectious complication
  - Occlusion secondary to
    ○ Fibrin sleeve formation
    ○ Thrombus
    ○ Drug precipitation
    ○ Kinking
    ○ Knotting
• Pneumothorax
  - Second most common non-infectious complication
  - Other complications include
    ○ Hemothorax
    ○ Hydrothorax
    ○ Chylothorax
    ○ Tension pneumothorax

References:

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:
  • Stress that infection, arterial punctures, and pneumothorax are the complications that have the highest morbidity and mortality.
Complications: General (continued)

**PARTICIPANT CONTENT**

- **Arrhythmias**
  - Atrial (most common)
  - Ventricular
- **Venous air embolism (VAE)**
- **Cardiac tamponade**
  - Most common fatality
- **Nerve injury**
- **Thoracic duct injury**
  - Injury occurs during left internal jugular (IJ) cannulation
- **Hematoma**
- **Hemorrhage**
- **Plaque embolization**
  - Can lead to cerebrovascular accident (CVA)

**INSTRUCTOR ACTIONS**

Review the above material with participants.

*Discussion Points:*

- Arterial puncture, pneumothorax, arrhythmia, and VAE will be discussed later in the course. If participants do not understand the remaining complications listed above, explain in more detail.
Complications: Catheter

PARTICIPANT CONTENT

Catheter shearing
- The subclavian catheter can pinch and shear at the costoclavicular ligament between the clavicle and first rib
- Signs and symptoms
  - Catheter pinching on chest x-ray
  - Chest wall swelling or pain
  - Shoulder pain
  - Cough

Catheter embolization
- Nearly half occur while catheter is retracted through the needle
- Use of Seldinger technique decreases this incidence
- Signs and symptoms
  - Dyspnea
  - Arrhythmias
  - Pulmonary infarction

Catheter knotting, looping, coiling, and/or kinking
- Predisposed by softer catheter material
- Introducers can kink
- Diagnosis via imaging
- Fluoroscopy can be used for the removal or reduction of the catheter

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:
- The Seldinger technique is simply placing a wire through a needle into a vessel or other hollow organ.
Complications: During Catheter Removal or Exchange

PARTICIPANT CONTENT

Catheter removal considerations
- Catheters should be removed during inspiration
- If spontaneously breathing, remove catheter during Valsalva or forced expiration
- Ensure catheter tip is intact
- If any resistance, stop and reassess

Catheter exchange complications
- Infection
- Embolization
- Loss of wire
- Loss of catheter tip
- Wire-induced arrhythmia

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:
- If any resistance is met during removal of catheter, stop immediately and reassess. Do not forcefully pull the catheter out. This can lead to breakage of the catheter.
Complications: Wire

PARTICIPANT CONTENT

- Puncture of vessels or heart
- Arrhythmia secondary to right ventricular irritation
- Special vigilance needed if pre-existing left bundle branch block (LBBB)
- Wire embolization if sheared by needle, usually caused by retracting the wire back through the needle
- Loss of wire

INSTRUCTOR ACTIONS

Review the above material with participants.
Complications: Arterial Injury

PARTICIPANT CONTENT

Recognition: signs and symptoms
- Local swelling and compression of airway
- Cardiac tamponade
- Hemothorax
- Neurologic injury or changes
- Hypotension secondary to hemorrhage
- Tachycardia
- Pallor
- Decreased hematocrit
- Pulsatile needle motion

Diagnosis
- Pulsatile, bright red blood
- Rapid reflux of blood into syringe or manometry tubing
- High pressure, arterial wave tracing (view image)
- Arterial blood gas (ABG) analysis
- Verification with chest x-ray, ultrasound, transesophageal echocardiogram (TEE), or computed tomography (CT) scan

Treatment
- For a small bore needle puncture of the carotid artery, apply direct pressure for 5 to 15 minutes and monitor heart rate for sinus bradycardia.
- If the subclavian artery is punctured, direct pressure cannot be applied due to the location of the clavicle. Review chest x-ray for hemothorax, and watch patient closely for swelling in the area.
- If an artery is cannulated by the catheter, suture the line in place to prevent exsanguination. Immediately consult vascular surgeon (or follow organizational policy) for repair. Gently flush the catheter with heparin to prevent clotting. Clamp the catheter to prevent accidental injection.

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:
- Show the arterial wave tracing by clicking the “view image” link on the Instructor CD.
- Consult organizational policy for arterial punctures.
Complications: Pneumothorax

PARTICIPANT CONTENT

Recognition: signs and symptoms
- Chest pain
- Shortness of breath
- Hypotension*
- Tachycardia
- Tachypnea
- Increased anxiety
- Tracheal deviation*
- Cough
- Hypoxemia
- Cyanosis

- Asymmetrical lung sounds or chest movement
- Decreased lung sounds
- Subcutaneous emphysema
- Increased CVP
- Hyperresonance
- Increased peak inspiratory pressure (PIP)
- Hypercarbia
- Mediastinal shift*

* These signs and symptoms are seen in a tension pneumothorax.

Diagnosis
- Always check an upright chest x-ray (a supine film is not adequate).

Treatment
- Treat if symptomatic or if pneumothorax is greater than 10%.
- May require one of the following:
  - Needle decompression at the 2nd intercostal space, mid-clavicular line
  - Chest tube or pigtail catheter at the 4th intercostal space, mid-axillary line
- For a tension pneumothorax, intervention must be immediate (view image).

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:
- A supine chest x-ray is not adequate because the outline of the pneumothorax may not be visible.
- Show the tension pneumothorax chest x-ray by clicking the “view image” link on the Instructor CD.
Complications: Malposition of Catheter

**PARTICIPANT CONTENT**

**Causes**
- Incorrect anatomical placement
- Migration secondary to poor fixation, forceful flushing, coughing, vomiting, or vigorous upper extremity movements

**Recognition: signs and symptoms**
- Pain or gurgling sounds in ipsilateral ear
- Discomfort upon insertion
- Swelling
- If catheter is malpositioned in the vein, a flat or elevated CVP wave tracing may be seen
- If catheter is malpositioned in the artery, an arterial wave tracing may be seen
- Decreased infusion rates
- Back flow into central venous tubing

**Diagnosis**
- Chest x-ray
- Fluoroscopy
- Ultrasound
- CT scan

**Treatment**
- Repositioning or removal of catheter
- Change the catheter over a wire
- Fluoroscopic or surgical repair

**INSTRUCTOR ACTIONS**

Review the above material with participants.
Complications: Arrhythmias

PARTICIPANT CONTENT

Recognition
- Typically atrial arrhythmias

Diagnosis
- ECG monitoring

Treatment
- Immediate withdrawal of wire or catheter

INSTRUCTOR ACTIONS

Review the above material with participants.
INSTRUCTOR NOTES
Complications: Venous Air Embolism (VAE)

PARTICIPANT CONTENT

Causes
- Results when venous pressure is lower than ambient pressure, typically during spontaneous inspiration while sitting or hypovolemic
- Amount of air entry, speed of entry, and body position are determinants
- Air entrapment develops in right heart or pulmonary artery

Recognition: signs and symptoms
- Headache
- Light headedness
- Focal deficits
- Mental status changes
- Coma
- Hypotension
- Tachycardia
- Increased CVP
- ECG changes
- Arrhythmias
- Cardiovascular collapse
- Mill wheel murmur
- Pulmonary hypertension
- Decreased cardiac output
- Pulmonary edema
- Rales
- Wheezes
- Bronchoconstriction

Diagnosis
- Precordial Doppler
- TEE (5 to 10 times more sensitive than precordial Doppler)
- Decreased cardiac output and increased CVP are non-specific for a VAE diagnosis
- Decreased mean arterial pressure (MAP) secondary to pulmonary hypertension and right heart failure
- ABG may show a ventilation/perfusion mismatch
- Decreased end tidal CO₂ or appearance of nitrogen on a capnography monitor (intraoperative)
- Increased PIP secondary to bronchoconstriction

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:
- A mill wheel murmur is a churning-like sound produced by air in the heart and is best detected with precordial Doppler.
Complications: Venous Air Embolism (continued)

**PARTICIPANT CONTENT**

**Treatment**
- Identify and occlude source of entry (flood surgical field with sterile saline)
- Place patient in left lateral position
- Increase CVP with change in position (Trendelenburg), or via the addition of positive end expiratory pressure (PEEP)
- Attempt to remove air from the right heart by aspirating on the catheter
- Discontinue nitrous oxide (N₂O)

**INSTRUCTOR ACTIONS**

Review the above material with participants.

**Discussion Points:**
- Flooding the surgical field with sterile saline helps to prevent air from entering.
- Placing the patient in the left lateral position allows air to collect in the right apex of the heart rather than in the outflow tract of the heart.
CVC Complication Prevention

PARTICIPANT CONTENT

To prevent central venous cannulation complications:

- Limit needle insertions to five attempts
- Use ultrasound guidance technique for central line placement
- Use proper sterile technique
- Minimize guide wire length
- Avoid bilateral subclavian attempts
- Insert dilator only deep enough to reach vessel

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:

- Success is unlikely after attempting to insert the needle five times.
- Using the ultrasound guidance technique can improve the success rate for central line placement.
- Minimize guide wire length to avoid arrhythmias.
- Avoid bilateral subclavian attempts as this can lead to pneumothoraces on both sides.
- Insert dilator only deep enough to reach vessel to avoid puncturing through the vessel.
Site Anatomy: Internal Jugular

PARTICIPANT CONTENT

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:
- Review the internal jugular vein, carotid artery, and vagus nerve.
Site Anatomy: Subclavian

**PARTICIPANT CONTENT**

- Subclavian artery
- Subclavian vein

**INSTRUCTOR ACTIONS**

Review the above material with participants.

**Discussion Points:**

- Review the subclavian vein and artery with their proximity to the apex of the lung.
- This proximity leads to a greater risk of pneumothorax.
Site Anatomy: Femoral

PARTICIPANT CONTENT

- Femoral nerve
- Femoral artery
- Femoral vein

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:

- Review the structures in the femoral triangle, which include the femoral nerve, artery, vein, and lymphatics (refer to the mnemonic N-A-V-L, from lateral to medial).
## Sites: Risks and Benefits

<table>
<thead>
<tr>
<th>Site</th>
<th>Risks</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Jugular (IJ)</td>
<td><em>Left Internal Jugular:</em>&lt;br&gt;• More tortuous path of vein to the right atrium&lt;br&gt;• Cupula of the left lung is more superior than the right lung, increasing the risk of pneumothorax&lt;br&gt;• Potential for thoracic duct injury&lt;br&gt;• Longer path: 18 to 21 cm</td>
<td><em>Right Internal Jugular:</em>&lt;br&gt;• Less tortuous path of vein to the right atrium&lt;br&gt;• Cupula of the right lung is more inferior than the left lung, decreasing the risk of pneumothorax&lt;br&gt;• Impingement of the catheter tip on the lateral wall of inferior vena cava is less likely (catheter tends to stay parallel to the vessel wall)&lt;br&gt;• Shorter path: 16 cm</td>
</tr>
<tr>
<td>Subclavian (SC)</td>
<td>• Intraclavicular approach has an increased risk of the catheter pinching off&lt;br&gt;• Slight catheter movement can be experienced with patient movement&lt;br&gt;• Increased hematoma risk- difficulty applying pressure to the vessel due to the location of the clavicle&lt;br&gt;• Longer path: 18 to 21 cm</td>
<td>• Right subclavian approach is preferred to the left subclavian approach, secondary to the more inferior cupula of lung (decreased risk of pneumothorax)&lt;br&gt;• Decreased infection risk compared to IJ or FEM approaches</td>
</tr>
<tr>
<td>Femoral (FEM)</td>
<td>• Increased risk of thrombosis&lt;br&gt;• Greatest risk of infection (compared to the IJ and SC approaches)</td>
<td>• More favorable approach in patients with coagulopathies&lt;br&gt;• Potentially the easiest access in acute resuscitation</td>
</tr>
</tbody>
</table>

**Discussion Points:**

- General risks exist for all approaches, on both left and right sides. The above table emphasizes some of the risks and benefits of using one side versus the other.
- Femoral approach may be the easiest access during acute resuscitation due to the number of providers in the head and neck area performing airway management, chest compressions, etc.
Alternatives: PICC Lines

PARTICIPANT CONTENT

Considerations
- Patient diagnosis (Example: long term antibiotics)
- Patient’s physical condition
- Planned infusion therapies

Indications
- Drugs that irritate the vein (Example: chemotherapy)
- Frequent venipunctures
- Continuous infusion of vesicants
- Long term IV therapy
- TPN
- Poor venous access

Contraindications
- Venous thrombosis in the extremity or proximally (Example: ipsilateral subclavian)
- Inadequate peripheral vasculature
- CVA with hemiparesis
- Dialysis grafts in chosen extremity
- Poor skin integrity
- Vascular disease secondary to chronic disease
- Poor venous return from extremity (Example: injury to upper arm)
- Orthopedic or neurological conditions
- Previous venipuncture attempts

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:
- Consider the patient’s physical condition before placing a PICC line
  - Example: Do not place a PICC line in an extremity that had axillary node dissection or extensive trauma.
## Alternatives: PICC Lines (continued)

### PARTICIPANT CONTENT

<table>
<thead>
<tr>
<th></th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For the patient</strong></td>
<td>• One catheter for all IV therapy and labs</td>
<td>• Some activities may not be allowed</td>
</tr>
<tr>
<td></td>
<td>• Fewer venipuncture attempts</td>
<td>• Patient has some responsibility for care</td>
</tr>
<tr>
<td></td>
<td>• Fewer risk factors associated with insertion</td>
<td>• Not all patients are candidates</td>
</tr>
<tr>
<td><strong>For the nurse or physician</strong></td>
<td>• Bedside placement</td>
<td>• Education and training required for insertion, care, and maintenance</td>
</tr>
<tr>
<td></td>
<td>• Reduced nursing time to maintain access</td>
<td>• Clinician’s skill level must be maintained</td>
</tr>
<tr>
<td></td>
<td>• Can be placed in an outpatient setting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• One catheter can stay with the patient from hospital to home</td>
<td></td>
</tr>
</tbody>
</table>

### INSTRUCTOR ACTIONS

Review the above material with participants.

**Discussion Points:**

- Examples of activities that may not be allowed: swimming, golf, weight lifting
Alternatives: Other

PARTICIPANT CONTENT

External jugular (EJ):
- No pneumothorax risk
- Sharp angle at external jugular-subclavian junction may direct catheter to distal location
- Minimal risk of nerve or carotid injury

Intraosseous (IO):
- Medial malleolus of distal tibia, body of the sternum, or head of the humerus
- 13 gauge marrow needle can be used
- Can infuse anything except hypertonic saline
- Risk of fat embolization, infection, or hematoma
- Risk of extravasation of fluid or drugs into soft tissue

Penis:
- Corpus cavernosum
- Tourniquet at base
- 18 gauge needle into lateral aspect of penis

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:
- For the intraosseous approach, commercial needles are also available.
- For the intraosseous approach, the following are examples of commonly infused fluids and medicines: blood, colloids, crystalloids, bicarbonate, dextrose (D50), calcium, atropine, lidocaine, heparin, or steroids.
Adjuncts: Monitoring, Manometry, and Line Transducing

**PARTICIPANT CONTENT**

**Monitoring**
- **ECG**
  - Arrhythmias from wire or catheter
  - P wave changes
  - Heart rate changes
- **Pulse oximetry (SpO₂)**
  - Changes with pneumothorax
  - Pulse rate changes
- **Blood pressure**
  - Changes (severe hypotension) with tension pneumothorax or cardiac tamponade

**Manometry**
- Connecting tubing to the needle after the needle has been inserted into the vessel.
- Used to distinguish between venous and arterial locations prior to placing the wire and dilator
- If catheter is venous, the phlebostatic column will vary with respirations
- If catheter is arterial, blood will continue to rise in the tubing in a pulsatile fashion

**Line transducing**
- Connecting the catheter to a transducer.
- Used to indicate that the catheter is venous (CVP tracing)
- If catheter is venous, a CVP wave tracing will be seen (view image)
- If catheter is arterial, an arterial wave tracing will be seen

**INSTRUCTOR ACTIONS**

Review the above material with participants.

**Discussion Points:**
- Manometry will be demonstrated in the skill station portion of the course.
- Show the CVP tracing by clicking the “view image” link on the Instructor CD.
Adjuncts: Ultrasound Guidance

**PARTICIPANT CONTENT**

**Ultrasound guidance**

- Used to visualize vessels during central line placement.
  - Arteries appear round, pulsatile, and not easily compressible.
  - Veins appear more flat and are easily compressible.
  - Scanning the vein in the transverse plane with ultrasound is better, since the vein can be kept in view.
- Pre-scan for normal anatomy of vasculature.
  - If multiples veins are seen (instead of one large, single vein) another site should be used. This may indicate an anomaly of the vasculature.
- Decreases number of needle passes, arterial sticks, hematomas, pneumothoraces, and wire misplacements.
- Routine use of the ultrasound decreases the procedure time and increases the success rate of central line placement.
- A 7.5 MHz probe can scan to a 4 cm depth for IJ, SC, or FEM.
- A 9.0 MHz probe can scan to a 2 cm depth for basilica, brachial, or radial.

**INSTRUCTOR ACTIONS**

Review the above material with participants.

**Discussion Points:**

- Ultrasound machine use will be discussed later in the lecture.
- Ultrasound guidance technique will be demonstrated in the skill station portion of the course.
- Refer to your ultrasound machine manual for specific instructions.
Patient Preparation

**PARTICIPANT CONTENT**

**Patient Education and Consent**
- Explain the procedure
- Explain the risks and benefits
- Acquire the proper procedural consent

**Medications**
- Use local anesthetic at the site of insertion on a conscious patient
- Consider using antianxiety and sedative agents for patient comfort and cooperation
- Heparin should be held three to four hours prior to procedure and coagulation studies should be checked
  - Depending on urgency, coagulopathies can be treated with fresh frozen plasma (FFP)

**Medical and Surgical History**
- It is important to be aware of the increased chance of complications due to the patient’s history:
  - Critical carotid stenosis can result in increased stroke risk via emboli
  - Prior chest or neck surgeries or cannulations
  - Thrombocytopenia
  - Local infection
  - Anticoagulation
  - Vascular grafts
  - Transplant(s)
  - Morbid obesity

**INSTRUCTOR ACTIONS**

Review the above material with participants.

**Discussion Points:**
- Discuss proper procedural consent per your organizational protocol.
- Stress the importance of a good medical and surgical history.
Patient Preparation (continued)

PARTICIPANT CONTENT

Monitoring
- Standard
  - ECG
  - SpO₂
  - Blood pressure
- Optional
  - Precordial Doppler
  - End tidal CO₂

Positioning
- 15° Trendelenburg, to increase IJ and SC caliber approximately 10% and to decrease risk of VAE
- Can place a rolled towel longitudinally under the midline of the thoracic back to increase SC success

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:
- Demonstrate Trendelenburg positioning if participants are unfamiliar.
Catheter Selection and Depth

**PARTICIPANT CONTENT**

**Catheter depth**

- To determine how deep to insert an IJ or SC catheter:
  - Measure from the insertion site to the angle of Louis and note the centimeter mark on the proximal end of the catheter
    - This proximal mark will provide a good estimate that the catheter tip is located in the superior vena cava (SVC) just above the pericardial reflection
  - The following are average depths from the insertion site to the SVC just above the pericardial reflection:
    - Right IJ = 16 cm
    - Right SC or left IJ = 18 to 21 cm
    - Left SC = 21 cm
  - The catheter depth can be viewed with TEE
- There is no need to determine how deep to insert the catheter for the femoral approach since the catheter is not long enough to enter the heart.

**INSTRUCTOR ACTIONS**

Review the above material with participants.

**Discussion Points:**

- If the guide wire is inserted beyond 18 cm, it will typically situate in the right atrium, causing cardiac arrhythmias.
Catheter Selection and Depth (continued)

PARTICIPANT CONTENT

Gauge
- The gauge of the catheter is important.
- Triple lumen catheters usually come with one 16 gauge and two 18 gauge lumens.
- If high flow volume resuscitation is necessary, an 8.5 French introducer would be appropriate.
- If transvenous pacing is indicated, a 6 French introducer would be needed.

Lumens
- Multiple lumens are indicated for use in patients receiving multiple IV therapies (dedicated lumen for TPN, fluids, drugs, etc)
- As the number of lumens increases, the risk of infection can increase

Duration of therapy
- Consider antibiotic coated catheters, but check for allergies to coatings (rare anaphylactoid reactions)
  - Can increase catheter durability to approximately 21 days
- Heparin bonded catheters
  - Decreased infection secondary to decreased thrombus formation
  - Can cause a heparin induced thrombocytopenia (HIT)

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:
- The gauge of the catheter is important. A larger gauge (8 French) will allow quicker fluid resuscitation than a smaller gauge.
INSTRUCTOR NOTES
Sterile Technique

PARTICIPANT CONTENT

These five protective barriers should always be used when placing central lines:

- Mask/Eye shield
- Cap
- Sterile gown
- Sterile gloves
- Large sterile drape

Hand washing

- Remove all hand and wrist jewelry.
- Ensure hands are washed thoroughly before putting on sterile gloves.

Sterile site preparation

- Clean site with soap and water if visibly dirty.
- Scrub with a sterile solution.
  - A single 2% chlorhexidine gluconate preparation is recommended.
  - A 10% povidone iodine (Betadine) or 70% ethanol can also be used.
- When scrubbing, start at the insertion site and scrub outward in a circular motion to cover approximately a six inch diameter.
- Place sterile drape with fenestration over the insertion site.

Refer to ROK cards “Sterile Technique” for reinforcement of material.

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:

- Sterile technique will be practiced during the first skill station.
Internal Jugular Technique

1. Draw up and inject 3 mL of lidocaine around the area of catheter insertion.
2. Align 22 gauge finder needle* bevel with syringe numbering to maintain bevel orientation.
3. Palpate carotid pulse with the opposite hand that is holding the syringe (keeping the finder needle lateral to the pulse).
4. Insert finder needle 60° to the skin at the apex of the two bellies of the sternocleidomastoid muscle, just inferior to the external jugular vein.
5. Direct finder needle toward the ipsilateral nipple.
6. Confirm finder needle placement by aspirating blood into the syringe.
7. Leaving the finder needle and syringe in place, insert 18 gauge introducer needle and syringe over the same pathway as the finder needle.
8. Confirm introducer needle placement by aspirating blood into the syringe.
9. Remove finder needle and syringe.
10. Disconnect syringe from the introducer needle and connect manometry tubing.
11. Raise manometry tubing above the introducer needle.
12. Check for phlebostatic column of blood to fill the tube.
13. Remove manometry tubing from the introducer needle.
14. Insert wire through the introducer needle in a controlled fashion.
15. Remove introducer needle, leaving wire in place.
16. Make a skin incision with a #11 scalpel at the insertion site.
17. Place gauze over incision.
18. Place tissue dilator over the wire down to the skin.
19. Continue inserting the dilator just into the vessel, advancing only 2 cm.
20. Remove dilator from wire.

Caution must be exercised with insertion of the dilator so as not to induce bradycardia from pressure on the carotid sinus.

* A 21 gauge finder needle may also be used.
Internal Jugular Technique (continued)

PARTICIPANT CONTENT

21. Uncap distal (brown) port of catheter.
22. Place catheter over the wire, down to the skin.
23. Ensure the end of the wire can be held coming through the distal (brown) port.
24. Hold wire at the distal (brown) port and finish inserting catheter into the vein.
   • Appropriate centimeter mark on the catheter should be aligned with the skin.
25. Remove the wire.
26. Uncap, flush, and recap all ports.
27. Place catheter fastening clamp on the catheter.
28. Suture fastening clamp to the skin.
29. Place a sterile transparent dressing over the entire insertion site.

Refer to ROK cards “Internal Jugular” for reinforcement of material.

INSTRUCTOR ACTIONS

Review the above material (continued from page 81) with participants.

Discussion Points:

• Feel for carotid pulse to ensure that the needle is kept lateral to the carotid artery.
• A small (21 or 22 gauge) finder needle is used as an added measure of safety. If the carotid artery is accidentally punctured, it is safer to be punctured with the smaller gauge needle rather than the 18 gauge introducer needle.
• Inserting the dilator just into the vessel helps to avoid through and through injury to the vessel.
• Fixation of the catheter to the skin (via the fastener and clamp) minimizes migration or accidental removal.

Skin fastener and clamp prevent migration only, not accidental removal.

• Not all steps of this procedure can be performed on the task trainer. Refer to your task trainer manual for a complete list of capabilities.
Subclavian Technique

PARTICIPANT CONTENT

1. Draw up and inject 3 mL of lidocaine around the area of catheter insertion.
2. Align 22 gauge finder needle* bevel with syringe numbering to maintain bevel orientation.
3. Rotate patient’s head toward the contralateral side of insertion.
4. Insert finder needle 60° to the skin, 1 to 2 cm lateral to the clavicular midpoint.
5. Direct finder needle toward the sternal notch.
6. Confirm finder needle placement by aspirating blood into the syringe.
7. Leaving the finder needle and syringe in place, insert 18 gauge introducer needle and syringe over the same pathway as the finder needle.
8. Confirm introducer needle placement by aspirating blood into the syringe.
9. Remove finder needle and syringe.
10. Disconnect syringe from the introducer needle and connect manometry tubing.
11. Raise manometry tubing above the introducer needle.
12. Check for phlebostatic column of blood to fill the tube.
13. Remove manometry tubing from the introducer needle.
14. Insert wire through the introducer needle in a controlled fashion.
   • Pain behind the ear can indicate that the wire has traveled into the IJ vein.
15. Remove introducer needle, leaving wire in place.
16. Make a skin incision with a #11 scalpel at the insertion site.
17. Place gauze over incision.
18. Place tissue dilator over the wire down to the skin.
19. Continue inserting the dilator just into the vessel, advancing only 2 cm.
20. Remove dilator from wire.

⚠️ The dilator should always stay parallel to ground to decrease the risk of pneumothorax.

* A 21 gauge finder needle may also be used.

(continued on next page)
Subclavian Technique (continued)

PARTICIPANT CONTENT

21. Uncap distal (brown) port of catheter.
22. Place catheter over the wire, down to the skin.
23. Ensure the end of the wire can be held coming through the distal (brown) port.
24. Hold wire at the distal (brown) port and finish inserting catheter into the vein.
   • Appropriate centimeter mark on the catheter should be aligned with the skin.
25. Remove the wire.
26. Uncap, flush, and recap all ports.
27. Place catheter fastening clamp on the catheter.
28. Suture fastening clamp to the skin.
29. Place a sterile transparent dressing over the entire insertion site.

Refer to ROK cards “Subclavian” for reinforcement of material.

INSTRUCTOR ACTIONS

Review the above material (continued from page 85) with participants.

Discussion Points:

• Placing the patient in a 15° Trendelenburg position increases the SC vein diameter.
• Placing a rolled towel under the spine allows the shoulders to fall posterior, bringing the subclavian vein closer to the surface.
• The needle should always stay parallel to the ground to decrease the risk of pneumothorax.
Femoral Technique

PARTICIPANT CONTENT

1. Draw up and inject 3 mL of lidocaine around the area of catheter insertion.
2. Align 22 gauge finder needle* bevel with syringe numbering to maintain bevel orientation.

Use N-A-V-L to remember the order of structures (lateral to medial):

- N - Nerve
- A - Artery
- V - Vein
- L - Lymphatics

3. Palpate femoral arterial pulse just under inguinal ligament.
4. Insert finder needle 60° to the skin, 1 to 2 cm inferior to the inguinal ligament, and 1 to 2 cm medial to the femoral pulse.
5. Direct finder needle toward the navel.
6. Confirm finder needle placement by aspirating blood into the syringe.
7. Leaving the finder needle and syringe in place, insert 18 gauge introducer needle and syringe over the same pathway as the finder needle.
8. Confirm introducer needle placement by aspirating blood into the syringe.
9. Remove finder needle and syringe.
10. Disconnect syringe from the introducer needle and connect manometry tubing.
11. Raise manometry tubing above the introducer needle.
12. Check for phlebostatic column of blood to fill the tube.
13. Remove manometry tubing from the introducer needle.
14. Insert wire through the introducer needle in a controlled fashion.
15. Remove introducer needle, leaving wire in place.
16. Make a skin incision with a #11 scalpel at the insertion site.
17. Place gauze over incision.
18. Place tissue dilator over the wire down to the skin.
19. Continue inserting the dilator just into the vessel, advancing only 2 cm.
20. Remove dilator from wire.

* A 21 gauge finder needle may also be used.

(continued on next page)
Femoral Technique (continued)

21. Uncap distal (brown) port of catheter.
22. Place catheter over the wire, down to the skin.
23. Ensure the end of the wire can be held coming through the distal (brown) port.
24. Hold wire at the distal (brown) port and finish inserting catheter into the vein.
   • Appropriate centimeter mark on the catheter should be aligned with the skin.
25. Remove the wire.
26. Uncap, flush, and recap all ports.
27. Place catheter fastening clamp on the catheter.
28. Suture fastening clamp to the skin.
29. Place a sterile transparent dressing over the entire insertion site.

Refer to ROK cards “Femoral” for reinforcement of material.

INSTRUCTOR ACTIONS

Review the above material (continued from page 89) with participants.
Ultrasound Guidance

PARTICIPANT CONTENT

Ultrasound use and vessel location
1. Adjust the gain and depth so the vasculature is well defined.
2. Confirm directional orientation.
3. Apply a small amount of non-sterile gel to the insertion site and ultrasound probe.
4. Scan the insertion site with the probe to confirm patency and location of intended vein.
5. Remove the probe from the insertion site and wipe off the remaining gel from the skin.

Procedure
1. Draw up and inject 3 mL of lidocaine around the area of catheter insertion.
2. Place the sterile transducer cover over the probe ensuring all air bubbles from the gel are removed as they will interfere with the quality of the ultrasound image.
3. Apply sterile gel on the transducer cover.
4. Scan insertion site with the transducer to find the vessel to be cannulated.
5. Insert introducer needle and syringe.
6. Watch introducer needle on the ultrasound monitor as it approaches, indents, and enters the vein.
7. Remove ultrasound probe.
8. Confirm introducer needle placement by aspirating blood into the syringe.
9. Complete the central line placement following proper procedure.

Refer to ROK cards “Ultrasound Guidance” for reinforcement of material.

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:
- Sterile preparation of the site is done after using the non-sterile gel to locate the vessels.
- An introducer needle and manometry tubing are not needed to confirm needle placement; confirm vessel location and needle placement using the ultrasound monitor.
Post CVC Assessment

PARTICIPANT CONTENT

For the internal jugular and subclavian techniques:

1. Use fluoroscopy, chest x-ray, or TEE to ensure that the placement of the catheter tip is in lower third of the SVC, at the pericardial reflection, and parallel to the vessel wall.

2. Monitor ECG lead II for any indication of arrythmia.

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:

• Post assessment with imaging is not done at the femoral site. Manometry already tested that the needle is not arterial. There are no concerns for the catheter to be too deep in the heart.
Intravascular Device Removal

PARTICIPANT CONTENT

In general:
- The supine position increases CVP.
- The Trendelenburg position increases CVP further.
- A CVP that is higher than ambient pressure will help prevent air aspiration into the venous system.
- If air is aspirated, greater amounts can be tolerated in the supine and Trendelenburg positions due to fact that air can collect in the right ventricle apex, away from the pulmonic valve.

Complications associated with removal of intravascular devices
- Air embolism
- Catheter fracture and embolism
- Dislodgement of thrombus or fibrin sheath
- Hemorrhage
- Infection
- Patient discomfort

INSTRUCTOR ACTIONS

Review the above material with participants.

Discussion Points:
-
Intravascular Device Removal (continued)

PARTICIPANT CONTENT

Removal of intravascular catheter devices – general guidelines:
1. Place patient in supine position (or slight Trendelenburg if patient can tolerate)
2. Discontinue the use of any infusions
3. Use aseptic technique to decrease risk of infection
4. Use gentle traction upon removal
5. Do not yank if any resistance is met
6. Apply gentle pressure to the venous entrance site
7. Apply occlusive dressing
8. Inspect catheter to ensure device is intact
9. Keep patient in supine position until occlusive dressing is applied
10. Observe patient for signs of discomfort, color, and respirations

Reference:

INSTRUCTOR ACTIONS

Review the above material with participants.

*Discussion Points:*
Introduction to the Task Trainer

PARTICIPANT CONTENT

Your instructor will review specific task trainer capabilities.

INSTRUCTOR ACTIONS

• Refer to your task trainer manual. Review task trainer capabilities with participants.
The following assessments are available on the SimsSimple website for participants to complete. The assessments are included in the Instructor Guide as a reference. The correct quiz answers are also provided.
1. Which of the following is a true statement?
   a. Under ultrasound guidance, arteries appear round, pulsatile, and easily compressible.
   b. When evaluating veins with ultrasound, if the operator sees multiple veins instead of one large, single vein, it is usually of no significance to the placement of the central line.
   c. Routine use of the ultrasound decreases the procedure time and increases the success rate of central line placement.
   d. Scanning the vein in the longitudinal plane with ultrasound is better, since the vein can be kept in view.

2. In a coagulopathic patient, the preferred site of central venous cannulation is:
   a. Subclavian vein
   b. Femoral vein
   c. Internal jugular vein
   d. Brachial vein

3. Inadvertent cannulation of which vessel can result in significant morbidity and mortality?
   a. External jugular vein
   b. Femoral artery
   c. Carotid artery
   d. Brachial vein

4. Central line placement should always be confirmed by:
   a. Chest x-ray
   b. Manometry
   c. Blood gas
   d. a and b
   e. a and c

5. In the event of a venous air embolism, which of the following positions should the patient be placed in to allow air to collect in the right apex of the heart instead of the outflow tract?
   a. Trendelenburg
   b. Right lateral position
   c. Reverse Trendelenburg
   d. Left lateral position
6. Which of the following is not an indication for a central line?
   a. Administration of fluids, medications, or blood
   b. Central vein thrombosis
   c. Poor IV access
   d. Total parenteral nutrition (TPN)

7. Which of the following are signs or symptoms of a pneumothorax?
   a. Chest pain
   b. Shortness of breath
   c. Hypotension
   d. Tachycardia
   e. All of the above

8. Relative to the right internal jugular______, the left internal jugular has a higher risk of:
   a. Pneumothorax
   b. Cardiac tamponade
   c. Ventricular arrhythmia
   d. Hemomediastinum

9. Which of the following is an alternative to central venous cannulation?
   a. External jugular vein
   b. Intraosseous
   c. Penis
   d. All of the above

10. Which of the following is a contraindication for a peripherally inserted central catheter (PICC) line:
    a. Venous thrombosis
    b. Irritating drugs
    c. Continuous infusion of vesicants
    d. TPN
Example

PRE-CLASS SURVEY

1. Have you ever performed a central line placement procedure?
   a. Yes
   b. No

2. If yes, how many times have you placed a central line?
   a. 1 to 3
   b. 4 to 6
   c. 7 to 10
   d. >10

3. How comfortable do you feel placing a central line?
   a. Not comfortable
   b. Comfortable with supervision
   c. Comfortable without supervision

4. Have you used ultrasound guidance for central line placement?
   a. Yes
   b. No

5. I anticipate that the CVCT course will be similar to actual clinical situations.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree

6. I am confident that the instructor(s) will be able to form an accurate opinion of my clinical skills during the CVCT course.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree

7. I anticipate learning about central line placement will be very challenging.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree

8. I anticipate that I will be more confident in my central line placement skills after participating in the CVCT course.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree

9. I anticipate that the CVCT course will help to improve the safety of my practice.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree

10. I anticipate that my knowledge will improve as a result of the CVCT course debriefing.
    □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree
1. Which of the following is a contraindication for a central line?
   a. Anatomic abnormalities
   b. Arteriovenous fistula
   c. Allergies to catheter coatings
   d. All of the above

2. The most common complication of CVC is pneumothorax.
   a. False
   b. True

3. Which of the following are signs or symptoms of arterial injury? (select all that apply)
   a. Chest pain
   b. Hemothorax
   c. Neurologic injury or changes
   d. Tachypnea

4. Which of the following is not a method of preventing CVC complications?
   a. Insert dilator only deep enough to reach vessel
   b. Limit needle insertions to five attempts
   c. Use bilateral subclavian attempts
   d. Use proper sterile technique

5. Which site placement carries the greatest risk of infection?
   a. Brachial vein
   b. Femoral vein
   c. Internal jugular vein
   d. Subclavian vein

6. Which of the following is not a contraindication for a peripherally inserted central catheter (PICC) line?
   a. Inadequate peripheral vasculature
   b. Orthopedic or neurological conditions
   c. Poor skin integrity
   d. Poor venous access
INSTRUCTOR NOTES


POST-CLASS QUIZ

7. Which of the following applies to the use of ultrasound guidance? (select all that apply)
   a. Decreases number of needle passes and wire misplacements
   b. Pre-scan for normal anatomy of vasculature
   c. Used to visualize vessels during central line placement
   d. All of the above

8. Determination of how deep to place the catheter applies to all of the following except:
   a. External jugular vein
   b. Femoral vein
   c. Internal jugular vein
   d. Subclavian vein

9. Which of the following statements about catheter selection and depth is false?
   a. As the number of lumens increases, the risk of infection can increase
   b. Multiple lumens are indicated for use in patients receiving multiple IV therapies
   c. For right internal jugular placement, the catheter should be placed at the 25 cm mark at the skin
   d. The gauge of the catheter is important

10. Post assessment with imaging is not done at the femoral site.
    a. False
    b. True
Example

POST-CLASS SURVEY

1. How comfortable are you now with performing central venous cannulation?
   a. Not comfortable
   b. Comfortable with supervision
   c. Comfortable without supervision

2. How comfortable are you now with performing central venous cannulation using ultrasound guidance?
   a. Not comfortable
   b. Comfortable with supervision
   c. Comfortable without supervision

3. The CVCT course was similar to actual clinical situations.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree

4. The instructor(s) were able to form an accurate opinion of my central line placement skills during the CVCT course.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree

5. Learning about central line placement was very challenging.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree

6. I am more confident in my central line placement skills after participating in the CVCT course.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree

7. My knowledge has improved as a result of the CVCT course debriefing.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree

8. The CVCT course will help to improve the safety of my practice.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree
COURSE EVALUATION

Course Content and Design
1. The variety of educational activities in the course contributed to my learning.
   - Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree
2. The course content was well organized.
   - Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree
3. The course content provided me with sufficient information to successfully complete the skill stations.
   - Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree
4. The course schedule offered sufficient time for demonstration and skill station practice.
   - Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree
5. I was satisfied with the course content.
   - Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

Instructor
6. Throughout the course the instructor(s) treated me in a professional manner.
   - Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree
7. Throughout the course the instructor(s) provided directions that were clear and easy to follow.
   - Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree
8. Throughout the course the instructor(s) provided clear and precise critiques.
   - Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree
9. Throughout the course the instructor(s) adhered to the course objectives.
   - Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree
10. Throughout the course the instructor(s) devoted an appropriate amount of time to each component (lecture, demonstrations, and skill stations).
    - Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree
11. Throughout the course the instructor provided practical suggestions to incorporate the skills I learned into my clinical work setting.
    - Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree
Example

COURSE EVALUATION

Transferability and Relevance
12. I have a better understanding of central venous cannulation now that I have completed the course.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree
13. The course met my expectations.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree
14. I found the course relevant to my current position and duties.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree
15. The debriefing during the course allowed me to learn from my own behavior(s).
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree
16. The complexity of the course content was appropriate for my knowledge and skill level.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree

Environment and Equipment
17. The location of the course training was convenient for me.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree
18. During the course the audiovisual equipment functioned properly.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree
19. The task trainers were realistic.
   □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree
20. I was able to perform the central line insertion on the task trainer in a similar
    □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree
21. During the course there was adequate lighting within the room.
    □ Strongly Disagree □ Disagree □ Neutral □ Agree □ Strongly Agree

22. General comments: ________________________________________________________________
    ________________________________________________________________
    ________________________________________________________________
    ________________________________________________________________
1. **Assessment Session**: A session in which the participants are evaluated on what knowledge, skills and abilities they have gained as a result of instruction and practice.

2. **Debriefing**: A post-simulation session discussion designed to promote reflective learning typically conducted immediately after the simulation session with a focus on specific participant performance and/or behavior elements.

3. **Demonstration**: A session in which participants observe a certain skill (how a procedure is performed, machine or device is operated, etc). The participants are then given the opportunity to practice the skill.

4. **Fidelity**: The degree to which a device (simulator), condition (scenario), or setting (environment) accurately reproduces the reality of the corresponding clinical situation.

5. **Full-Task Training**: An approach to simulation education in which the environment, simulator, or curriculum is used to represent an entire clinical situation, process, or interaction.

6. **Healthcare Simulation**: Instructional activities designed to mimic the reality of a clinical environment, demonstrating procedures, and stimulating decision-making or critical thinking for healthcare education using role play, manikins, task specific equipment, and/or interactive videos.

7. **Instructor**: The facilitator or trainer during the simulation course; participates by providing instruction, observing and documenting actions of the participants, and providing feedback during the debriefing session.

8. **Part or Partial-Task Training**: An approach to simulation education in which the environment, simulator, or curriculum is used to represent a specific or limited task, process, or interaction.

9. **Participant**: The person or learner who has been identified as a member of the target audience for the simulation course.

10. **Ring of Knowledge (ROK) Cards**: Used in the clinical environment as pocket reference guides for healthcare providers. The portability of ROK cards arm providers with easy access to key practices and policies in an effort to promote safe patient care delivery.

11. **Simulation Class**: A given instance of the delivery of a simulation course. It may be grouped into one or multiple days.

12. **Simulation Scenario**: A simulated event with a specific learning objective(s) where the participant is expected to perform certain tasks. These tasks may include interactions with a computerized human simulator, a part-task trainer, or a standardized patient.

13 **Simulation Session**: Any activity that can occur at any time within a simulation course. Examples include a simulation scenario, a skill station, or an assessment session.

14. **Simulator**: A human manikin used to recreate a clinical situation or event for training purposes. The manikin may or may not possess electronic capabilities to mimic physiological functions.

15. **Skill Station**: 
10 STEPS TO SUCCESSFUL SIMULATION

1. Instructor preparation
   - Review the curriculum package with focus on course and scenario objectives
   - Review the Instructor Guide, participant content and didactic material to ensure familiarization
   - Review the Scenario and Debriefing Guide prior to running the scenarios
   - Conduct practice session with other instructors and/or subject matter experts

2. Technical equipment preparation (simulators, audio visual (AV) equipment, software, hardware)
   - Identify simulators and verify function
   - Test all systems if using AV
   - Practice using software/simulator
   - Ensure hardware devices are functioning properly

3. Non-technical equipment preparation (props, supplies, charts, stethoscopes, etc)
   - Refer to equipment checklist for accurate stock totals
   - Gather needed props and supplies and verify that they are in working order

4. Environmental preparation
   - Set up the simulation area for the scenario
   - Verify function of equipment or devices within the environment

5. Simulation environment introduction
   - Verify that instructors and participants are familiarized with important aspects of the simulation environment (simulation room/simulator)
   - Conduct “meet the simulator” exercise if applicable
10 STEPS TO SUCCESSFUL SIMULATION

6. Instructor behavioral expectations (The Five P’s)
   - Preparation: evaluate participant completion of pre-class material (if applicable)
   - Professionalism: maintain a professional demeanor, act as you would in a normal clinical environment
   - Patient safety: focus on what is right and not who is right
   - Participate: maximize learning by encouraging active participation
   - Performance: during debriefing sessions, focus should be on the performance not the performer

7. Scenario start and stop points
   - Clearly define the initiation and termination points of the scenario
   - Adhere to these points and avoid unreasonable extension

8. Errors and glitches
   - Anticipate that small periods of downtime may occur
   - Have supplemental learning materials prepared in case of unexpected downtime
   - Avoid blaming the simulator, participants, or props

9. Debriefing
   - Facilitate active debriefing with identification of areas for improvement
   - Provide respectful, professional, and prompt feedback
   - Consider participant experience in gauging level of debriefing detail
   - Include examples of best practices, supporting evidence, and current literature in debriefing points
   - Refrain from instructor or group ridicule

10. Improving performance
    - Utilize checklists or other assessment tools to provide feedback
    - Apply assessment findings to promote improvement of future sessions
    - Review participant course and instructor evaluations for quality improvement
### TECHNICAL CONSIDERATIONS

#### PC

**Recommended System Requirements:**
- Operating System: Windows XP Professional
- CPU: Pentium M 1.8Ghz or Pentium 4 2.7 GHz or similar (Athlon 64 1.8GHz or Athlon XP 2GHz)
- RAM: 512MB
- HDD: 400MB free space
- CD Drive

#### Video Display

- Projector or large screen monitor

#### Software

- Adobe Acrobat Reader 9 or higher
- Adobe Flash Player 9 or higher