Prevention of Central Line-Associated Bacteremia
Robert Garcia, BS, MMT(ASCP), CIC
Brookdale University Medical Center
Brooklyn, New York

Background
Response to a Nationally Recognized Problem

- Institute for Healthcare Improvement: 100,000 Lives Campaign
- National initiative to reduce healthcare errors, infections, and associated death
- >3000 hospitals currently participating
- Addresses specific healthcare-acquired infections
  - Central line-associated BSI (CLAB)
  - "Central line bundle"
    - Hand hygiene
    - Maximal sterile barriers
    - Chlorhexidine skin antisepsis
    - Daily assessment for line necessity

Mandatory Reporting of Infection Data 2006

Measurement & Pay-for-Performance

- "...all-or-none measurements more closely reflects the interests and likely desires of patients. This is especially true when process components interact with each other synergistically...violation of a single step in the sterile technique in [a medical procedure] may vitiate the benefits of proper execution of all other steps..."
  - Nolan, Berwick. JAMA 2006

- The Take Away Message: in CLAB prevention, it makes little sense to assure that 2 or 3 interventions are performed if for example, the patient’s skin has not had optimal prepping, or the physician has not used maximal sterile barriers, or has not washed his hands, or...

- Beyond 2007, CMS will begin to institute system of payment for procedures ONLY IF accepted scientific interventions have been performed and documented

Nolan T, Berwick DM. All-or-None measurement raises the bar on performance. JAMA 2006; 295:1168-70.
Magnitude of the Problem

Severe Consequences

- 75% of all catheter-related infections are due to the use of a central line
- >250,000 CVC-related infections per year
- Mortality may be up to 35%
- The CDC estimates that attributable costs due to catheter-associated infections range from $34,508 to $56,000.


Evaluating the Cost to Treat Bloodstream Infections

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Cost Calculation</th>
<th>Incremental Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pittet</td>
<td>1994</td>
<td>SICU admissions, total costs of hospitalization for survivors and nonsurvivors</td>
<td>$28,090</td>
</tr>
<tr>
<td>DGiovone</td>
<td>1999</td>
<td>MICU admission, total direct costs</td>
<td>$34,508</td>
</tr>
<tr>
<td>Dominique</td>
<td>2001</td>
<td>PICU admission, total charges for hospitalization</td>
<td>$40,000</td>
</tr>
<tr>
<td>Storim</td>
<td>2001</td>
<td>PICU admissions, total hospital charges</td>
<td>$46,133</td>
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<tr>
<td>Dominick</td>
<td>2001</td>
<td>SICU admissions, total hospital and ICU charges</td>
<td>$56,167</td>
</tr>
<tr>
<td>Elbrand</td>
<td>2005</td>
<td>PICU admission, total direct costs of hospitalization</td>
<td>$60,098</td>
</tr>
</tbody>
</table>
Benchmark Rates for Intravascular Lines

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Studies</th>
<th>Mean no. BSIs per 100 devices</th>
<th>Mean no. BSIs per 1000 device days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral IVCs</td>
<td>13</td>
<td>0.2</td>
<td>0.6</td>
</tr>
<tr>
<td>Arterial</td>
<td>6</td>
<td>1.5</td>
<td>2.9</td>
</tr>
<tr>
<td>Central venous catheters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Standard, uncuffed</td>
<td>63</td>
<td>3.7</td>
<td>2.2</td>
</tr>
<tr>
<td>- Swan Ganz</td>
<td>17</td>
<td>2.5</td>
<td>4.3</td>
</tr>
<tr>
<td>- Hemodialysis</td>
<td>15</td>
<td>15.7</td>
<td>2.6</td>
</tr>
<tr>
<td>- Tunneled (e.g., Hickman)</td>
<td>30</td>
<td>10.4</td>
<td>1.2</td>
</tr>
<tr>
<td>- Surgically implanted PICCs</td>
<td>13</td>
<td>5.1</td>
<td>0.2</td>
</tr>
<tr>
<td>- PICCs (in-hospital)</td>
<td>9</td>
<td>1.9</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Maki DG. A meta-analysis of the risk of intravascular device-related bloodstream infection based on 223 published prospective studies. Abstract, 4th Decennial, 2000

PICC-Associated Infections

- Study of 251 PICCs in 115 hospital inpatients
- Mean duration of catheterization = 11.3 days
- 42% of patients had been in ICU
- Results:
  - Six infections
  - Coagulase negative staph (4), S. aureus (1), K. pneumoniae (1)
  - Rate: 2.1 per 1000 catheter days
  - Comparative Outpatient Rate: 0.4 per 1000 catheter days

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Terms

- CVC = central venous catheter
- CRBSI = catheter-related bloodstream infection
- CABS = catheter-associated bloodstream infection
- CLAB = Central line-associated infection

Definition of a Central Line

Central Line

Definition: A vascular infusion device that terminates at or close to the heart or in one of the great vessels.

Central Lines include the following if the line meets the definition of a central line:
- Implantable-ports
- Non-tunneled TLC
- Swan Ganz catheter
- Tunneled- Broviac
- Groshong
- Quinton
- Hickman
- ASHE catheter
- PICC
- Umbilical lines
- Dialysis catheter
- Permanent shunts
- Balloon pumps
- Temporary (Quinton) or Tunneled (ASHE) Hemodialysis catheters

INCLUDE THE FOLLOWING FOR PURPOSES OF REPORTING CENTRAL LINES:

Do NOT include:
- Pacemaker Wires
- Other Non-infusion devices inserted into central blood vessels or the heart

Can NOT be used to determine if a line qualifies as a Central Line:
- Location of the insertion site
- Type of device

The device must terminate in one of these vessels or in or near the heart to qualify it as a central line.

Great Vessels include:
- Aorta
- Pulmonary Artery
- Superior Vena Cava
- Inferior Vena Cava
- Brachiocephalic Veins
- Internal Jugular Veins
- Subclavian Veins
- External Iliac Veins
- Common Femoral Veins

In Neonates count, Umbilical Artery/Vein

Definition from: CDC National Nosocomial Infections Surveillance (NNIS) System.

Clinical Features of Line Sepsis

- Nonspecific
- Fever
- Chills, shaking rigors
- Hypotension, shock
- Hyperventilation
- Gastrointestinal
  - abdominal pain
  - vomiting
  - Diarrhea
- Neurologic
  - confusion
  - seizures

- Highly Suggestive of Line Sepsis
- Source of sepsis inapparent
- Patient unlikely candidate for sepsis
- Intravascular line in place (or recently in place)
- Inflammation or purulence at site
- Abrupt onset, with shock
- Sepsis response to antimicrobial therapy or dramatic improvement after removal of device

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Definition of a CLAB

- Primary CLAB – major site of infection is a bloodstream infection and is either laboratory confirmed or clinical sepsis.
- Vascular access device present, no other source
- 48-hour period after initial insertion

CDC, MMWR Aug. 9, 2002/51 (RR10);27-28

Pathogenesis

1 = 60%
2 = 12%
3 = <1%
Unk = 28%

Sources of CVC-Related Infection

<table>
<thead>
<tr>
<th>Potential source</th>
<th>Local (&lt;15 CFU) (n = 40)</th>
<th>With bacteremia (n = 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colonization of skin of insertion site</td>
<td>36</td>
<td>6</td>
</tr>
<tr>
<td>Contamination of catheter hub</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Contaminated IV fluid</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Colonization from remote site</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>


Microbial Profile of IVD-Related BSI

<table>
<thead>
<tr>
<th></th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. IVD-Related BSIs</td>
</tr>
<tr>
<td>Short-term, percutaneous: PIVCs, non-cuffed CVCs, Art lines</td>
<td>592</td>
</tr>
<tr>
<td>Long-term CVCs: Hickmans, ports, PICCS, cuffed HD</td>
<td>865</td>
</tr>
</tbody>
</table>

Kluger DM, Maki DG, 2000, Meta-analysis of 159 studies

Prevention Strategies

Current Prevention Recommendations

<table>
<thead>
<tr>
<th>Component</th>
<th>IHI</th>
<th>CDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand hygiene</td>
<td>✓</td>
<td>✓ (IA)</td>
</tr>
<tr>
<td>Maximal sterile barriers</td>
<td>✓</td>
<td>✓ (IA)</td>
</tr>
<tr>
<td>Chlorhexidine skin antisepsis</td>
<td>✓</td>
<td>✓ (IA)</td>
</tr>
<tr>
<td>Optimal catheter site selection</td>
<td>✓</td>
<td>✓ (IA)</td>
</tr>
<tr>
<td>Daily review of line necessity</td>
<td>✓</td>
<td>✓ (IA)</td>
</tr>
<tr>
<td>Weekly dressing changes unless damp, loosened, or visibly soiled</td>
<td>NA</td>
<td>✓ (IB)</td>
</tr>
<tr>
<td>Do not routinely replace CVCs solely for purposes of reducing the incidence of infection</td>
<td>NA</td>
<td>✓ (IB)</td>
</tr>
<tr>
<td>Use an antimicrobial or antiseptic-impregnated CVC</td>
<td>NA</td>
<td>✓ (IB)</td>
</tr>
<tr>
<td>Use of mechanical IV valves</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Minimize contamination risk by wiping the access port with an appropriate antiseptic</td>
<td>NA</td>
<td>✓ (IB)</td>
</tr>
</tbody>
</table>

CDC (HICPAC) Guidelines

- Issued 8/9/02
- Evidence based
- Recommendations categorized
- Peer reviewed

www.cdc.gov/mmwr/preview/mmwrhtml/rr5110a1.htm
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Are U.S. Hospitals Implementing Recommendations?

- A survey of 95 VA hospitals and 421 non-VA hospitals
- Only 72% use maximal sterile barriers
- Only 70% use CHG skin antisepsis
- 16% use routine catheter changes
- Barriers to change:
  - Not enough resources to implement recommendations
  - Lack of a physician champion
  - The economic cost of the practice


Surveys of Internists on Guideline Adherence

- Only 28.8% used maximal sterile barriers
- Only 17.0% insert into subclavian vein
- >10% reported use of CHG
- Possible reasons:
  - Little awareness of published guideline
  - Maximal sterile barriers not believed to effect outcomes
  - Lack of immediate availability of CHG


10 Essential Interventions to Prevent CLAB
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1. Establish Credibility

- Recruit Physician & Nurse Champions
- Key areas:
  - ER
  - ICUs
  - Anesthesiology
- All must be committed to same goals
- Leaders must convince their own
- Appoint “CLAB Leader” for each patient unit

Key Strategy: Have Materials Management Join the Team

- Novel technologies will have incremental costs
- Key person who will facilitate purchase of needed products

2. Educate & Train the “Frontline” Healthcare Worker

- A. Educate health-care workers regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection-control measures…Cat IA.
- B. Assess knowledge of and adherence to guidelines periodically for all persons who insert and manage intravascular catheters. Cat. IA
Performance-Based Training

- Educational focus is on the continuous improvement of worker performance
- Worker skills and competencies are identified to achieve the department mission
- Curriculum is organized around learner needs and regulatory mandates. A collaborative approach is used with manager, worker, and educator input.
- The evaluation measures the workers' abilities to meet standard; it also determines if learned skills are enough to perform the job effectively.

Education as a Main Intervention

- 9 hospitals, 5,200 beds
- Multidisciplinary task force
- 10-page self-study module
- Pre-test avg score: 78.3%
- Post-test avg score: 89.9%
- Pre-education CR/BSI rate: 10.8/1000 CD
- Post-education CR/BSI rate: 3.7/1000 CD


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Effect of Education on CLAB

<table>
<thead>
<tr>
<th>Study</th>
<th>Type of unit</th>
<th>Pre-intervention rate (per 1000 catheter days)</th>
<th>Post-intervention rate (per 1000 catheter days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coopersmith, Crit Care Med, 2002</td>
<td>Surg/burn/trauma ICU</td>
<td>10.8</td>
<td>3.7</td>
</tr>
<tr>
<td>Rosenthal, AJIC 2003</td>
<td>ICU</td>
<td>17.0</td>
<td>9.9</td>
</tr>
<tr>
<td>Warren, Crit Care Med, 2003</td>
<td>ICU</td>
<td>4.9</td>
<td>2.1</td>
</tr>
<tr>
<td>Warren, Chest 2004</td>
<td>MICU (Univ. Hosp.)</td>
<td>9.4</td>
<td>5.5</td>
</tr>
</tbody>
</table>

Education Failure

- Audit following study in a SICU in a referral hospital
- Within 18 months after education program, compliance with handwashing, documentation of dressing dating, stopcock use, and use of maximal sterile barrier had decreased
- **Conclusion:** Compliance with best practice principles wanes over time


Basic Education on CLABs

- Handout designed for nurses and physicians
- Required education session for all Managers and “front line” workers
- Includes information on:
  - Magnitude of problem
  - Hospital rates by unit
  - Mortality
  - Cost
  - Prevention strategy
  - Policy

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Training Video on Insertion

- Required viewing by all residents
- Reflects acceptable aseptic practice & policy
- Emphasizes key interventions including:
  - Kit setups
  - Handwashing
  - Maximal barriers
  - Proper skin prepping
- Corresponding handout

Training on Mannequins

- Held weekly
- All first year residents are required to attend
- Conducted by IC and Surgical Attending
- Walk through on insertion steps

Credentialing & Competency

- Physicians:
  - 1st-year residents required to be assisted by 2nd-year or greater physician for first 5 subclavian/jugular insertions and 3 femoral insertions
- Nurses:
  - In addition to basic education, must attend dressing and maintenance education session
  - Observed for policy adherence 2x year

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3. Demand Strict Hand Hygiene

- Observe proper hand washing procedures either by washing hands with conventional antiseptic-containing soap and water or with waterless alcohol-based gels or foams. Cat. IA
- JCAHO Patient safety Goal #7 requirement

Key Components of Hand Hygiene Compliance

- Usage monitoring
  - Collect data on empty soap/sanitizer containers
  - Educate PATIENTS to increase EMPLOYEE handwashing compliance
  - Calculated as hand hygienes per patient day
- Education mandate
- Observation monitoring (ownership by department heads/directors)
- Point prevalence surveys to ensure adequate supplies on patient units

4. Ensure Adherence to Policy During Insertion

- All insertions assisted by nurse
- Empower nurses to stop procedure if observed break
- Use checklist to reflect step-by-step policy adherence

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5. Optimal Site Placement

- Weigh the risk and benefits of placing a device at a recommended site to reduce infectious complications against the risk for mechanical complications (e.g., pneumothorax, subclavian artery puncture, subclavian vein laceration, subclavian vein stenosis, hemothorax, thrombosis, air embolism, and catheter misplacement). Cat. IA
- Use a subclavian site (rather than a jugular or a femoral site) in adult patients to minimize infection risk for nontunneled CVC placement. Cat. IA
- No recommendation can be made for a preferred site of insertion to minimize infection risk for a nontunneled CVC. Unresolved issue

Risk of Infection by Site

- Prospective study in ICU
- Standardized insertion techniques and care
- 831 catheters, 4735 cath days, 657 pts.
- Results (per 1000 catheter days):
  - SC: 0.881 (0.45%)
  - IJ: 0.00 (0.0%)
  - Fem: 2.98 (1.44%)


Skin Microbial Density: Antecubital Space

- Skin surface microbial density varies at different body sites and between genders
- Normal microbial colony counts at the antecubital space are 10 cfu per cm

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Skin Microbial Density:
Jugular and Subclavicular Space

- Skin surface microbial density is highest on the skin at the femoral, jugular, and subclavian sites

- Normal microbial colony counts at the jugular and subclavicular space are 1000 – 10,000 cfu per cm²


6. Use Maximal Sterile Barriers

- Use aseptic technique including the use of a cap, mask, sterile gown, sterile gloves, and a large sterile sheet for the insertion of CVCs (including PICCs) or guidewire exchange. Cat. IB

Study on Efficacy of Barrier Precautions of CR-BSI

<table>
<thead>
<tr>
<th></th>
<th>Minimal barrier group*</th>
<th>Maximal barrier group**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cath colonization</td>
<td>176</td>
<td>7.2%</td>
</tr>
<tr>
<td>CR-BSI</td>
<td>167</td>
<td>3.6%</td>
</tr>
</tbody>
</table>

* Sterile gloves, small drape
** sterile gloves, gown, mask, cap, large drape


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Maximal Sterile Barriers: Accessibility & Standardization Issues

- Seek vendor to create a “one stop shopping” custom kit
- Let the user decide on type of components
- Provide in all insertion areas: eliminates searching
- Eliminate all other items used before
- Also used during placement of other lines, e.g., arterial, PICC lines

Large Sterile Drape

Drape size approx. 7.5’ (90”) long x 5’ (60”) wide
TIP: Seek advice from surgeons/sterilization manager on correct packing of items in order to avoid contamination during donning procedures.
7. Provide Optimal Skin Antisepsis

- Disinfect clean skin with an appropriate antiseptic before catheter insertion and during dressing changes. Although a 2% chlorhexidine-based preparation is preferred, tincture of iodine, an iodophor, or 70% alcohol can be used. 

Cat. IA
Results of Trial of Three Antiseptics

<table>
<thead>
<tr>
<th>Source of Septicemia</th>
<th>10% Povidone-Iodine (n = 227)</th>
<th>70% Alcohol (n = 227)</th>
<th>2% CHG (n = 214)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catheter-related</td>
<td>6</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Contaminated:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infusate</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Hub</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>All sources (%)</td>
<td>7 (3.1)</td>
<td>6 (2.6)</td>
<td>1 (0.5)*</td>
</tr>
</tbody>
</table>

668 patients with either central venous or arterial catheters.

*Compared with the other two groups combined: OR=0.16, 95% CI 0.30-1.17, p=0.04


Meta-Analysis on CHG vs. PI

- Reviewed eight randomized, controlled trials involving a total of 4,143 catheters (peripheral venous, peripheral arterial, pulmonary arterial, PICC, introducer sheaths, hemodialysis).

- The summary risk ratio for CRBSI for all catheters was 0.49 indicating “a significantly reduced risk in patients using chlorhexidine gluconate.”


Microbiology of the Skin

- 80% of the resident bacteria exist within the first 5 layers of the stratum corneum of the epidermis

- The remaining 20% of the resident bacteria are found in biofilms within the hair follicles and sebaceous glands

- Complete recolonization of surface bacteria can occur within 18 hours of antiseptic application

Catheter Site Care Tips

- Alcohol/CHG product: 30/30 rule
- New movement: Revise policies from "cleaning from center to outer areas" to "SCRUB THE AREA THOROUGHLY"!
- Antiseptics only work if they are allowed to dry
- Iodine solutions should be allowed to dry for a minimum of 2 minutes

8. Consider Novel Technologies

- Antibiotic, Antimicrobial-Coated Catheters

Antibiotic/Antiseptic Coated Catheters
CDC on Antimicrobial Catheters

- CVCs: II.B. Use an antimicrobial or antiseptic impregnated CVC in adults whose catheter is expected to remain in place >5 days if, after implementing a comprehensive strategy to reduce rates of CRBSI, the CRBSI rate remains above the goal set by the individual institution based on benchmark rates and local factors (comprehensive strategy = education, use of maximal sterile barriers, and a 2% chlorhexidine skin prep). Cat. IB

Review of Vantex Trials

<table>
<thead>
<tr>
<th>No. of CRBSIs/ No. of CVCs studied</th>
<th>No. of Trials</th>
<th>Study</th>
<th>Control</th>
<th>RR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>8/275</td>
<td>21/295</td>
<td>0.41 (0.18-0.91)</td>
<td>.02</td>
</tr>
</tbody>
</table>


Silver-Platinum vs. Rifampicin-Minocycline Catheters

- Large, prospective randomized study
- Blood cultures matched to cath tip cultures
- DNA matching
- 574 catheters evaluated
- Colonization: RM caths – 8.9%; SP caths – 14.6%
- BSI: RM – 1.4%; SP – 1.7%
- Yeast: RM – 1.8%; SP – 0.3%

9. Provide Optimal Dressing Care

- **Replace the catheter site dressing when it becomes damp, loosened, or soiled**...Cat. IA

- **Replace dressings used on short-term CVC sites every 2 days** for gauze dressings and at least every 7 days for transparent dressings, except in pediatric patients where the risk for dislodging the catheter outweighs the benefit of changing the dressing. Cat. IB

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**Dressing Adherence Study I**

- **Point prevalence study** at teaching hospital
- **Of 114 pts who had CVCs, 78 (68%)** had sub-optimal site care (uncovered or bloody)
- **Study did not correlate with site colonization or BSI occurrence**


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**Does the Dressing Matter?**

<table>
<thead>
<tr>
<th></th>
<th># Pts</th>
<th># LD</th>
<th># Observ. Days</th>
<th># Dressings Peeled</th>
<th>% peeled</th>
<th># CRBSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prod. A</td>
<td>120</td>
<td>1227</td>
<td>345</td>
<td>180</td>
<td>52.2</td>
<td>6</td>
</tr>
<tr>
<td>Prod. B</td>
<td>117</td>
<td>1220</td>
<td>338</td>
<td>44</td>
<td>13.0</td>
<td>2</td>
</tr>
</tbody>
</table>

Study conducted at Brookdale University Medical Center; Population included adult patients with a central venous catheter; Product A & B are both transparent dressings; Similar percent by site in both groups (femoral, subclavian, jugular); Observations of site conducted on days 1,3,5 after application; dressing policy – replace as needed; unpublished data.
**Key Strategy:**
Monitor dressing protocols

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**Blood under dressing**

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**Loose Dressing**

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**Site Monitoring**

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there evidence of inflammation or purulence at site?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there blood at insertion site?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has dressing been applied correctly?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are all four sides of dressing adhered correctly?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does dressing appear clean and dry?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is dressing dated as per policy?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10. Conduct Daily Assessment of Line Necessity

- All physicians, especially chief residents, must be on board with this issue
- Every day, ask the following:
  - Does the patient still need the line?
  - If yes, can a less risky catheter be used (e.g., triple lumen to a PICC)?
  - If no, can we remove the line today?
- Incorporate into Daily Goal Sheets

Replacement of Intravascular Catheters

- Do not routinely replace central venous or arterial catheters solely for the purposes of reducing the incidence of infection. Cat. IB

- What is avg. duration of catheterization of CVC in your institution?

Calculation of Mean Duration
(98 catheters in 78 patients, Jan. 2005)

Calculation of mean: 761 catheter days / 98 catheters = 7.8 days

Avg. duration of cath. = 7.8 days
### Success Stories

### Effect of Multifaceted Approaches on CLAB

<table>
<thead>
<tr>
<th>Study</th>
<th>Type of unit</th>
<th>Pre-intervention rate (per 1000 catheter days)</th>
<th>Post-intervention rate (per 1000 catheter days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggman, 2000</td>
<td>MICU</td>
<td>11.3</td>
<td>3.8</td>
</tr>
<tr>
<td>Hoyer, 2003</td>
<td>2 ICUs</td>
<td>9.15</td>
<td>3.58</td>
</tr>
<tr>
<td>Wallace, 2003</td>
<td>SICU</td>
<td>25.1</td>
<td>6.2</td>
</tr>
<tr>
<td>Fauerbach, 2004</td>
<td>Household</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Vinsel, 2004</td>
<td>PICU</td>
<td>7.8</td>
<td>6.1</td>
</tr>
<tr>
<td>Vinsel, 2004</td>
<td>NICU</td>
<td>10.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Muto, 2006</td>
<td>Neuro ICU</td>
<td>9.9</td>
<td>4.6</td>
</tr>
<tr>
<td>Berenholz, 2004</td>
<td>SICU</td>
<td>11.3</td>
<td>0</td>
</tr>
<tr>
<td>Gillam, 2004</td>
<td>PICU</td>
<td>9.2</td>
<td>5.0</td>
</tr>
<tr>
<td>Greene, 2005</td>
<td>Household</td>
<td>8.9</td>
<td>3.9</td>
</tr>
<tr>
<td>Fauerbach, 2005</td>
<td>MICU</td>
<td>15.51</td>
<td>4.16</td>
</tr>
<tr>
<td>Ellis, 2005</td>
<td>ICUs in 4 hospitals</td>
<td>1.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Bryant, 2006</td>
<td>PICU</td>
<td>6.96</td>
<td>2.1</td>
</tr>
<tr>
<td>Koll, 2006</td>
<td>ICU</td>
<td>8.5</td>
<td>0</td>
</tr>
<tr>
<td>Koll, 2006</td>
<td>Non-ICU</td>
<td>13.3</td>
<td>0</td>
</tr>
<tr>
<td>Muto, 2006</td>
<td>6 ICU types in 20 hospitals</td>
<td>4.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Boren, 2006</td>
<td>MICU</td>
<td>6.5</td>
<td>2.2</td>
</tr>
</tbody>
</table>

### Effect of Multifaceted Approaches on CLAB: more Examples

<table>
<thead>
<tr>
<th>Study</th>
<th>Type of unit</th>
<th>Pre-intervention rate (per 1000 catheter days)</th>
<th>Post-intervention rate (per 1000 catheter days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greene, 2005</td>
<td>Household</td>
<td>6.9</td>
<td>3.9</td>
</tr>
<tr>
<td>Fauerbach, 2005</td>
<td>MICU</td>
<td>15.51</td>
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<tr>
<td>Boren, 2006</td>
<td>MICU</td>
<td>6.5</td>
<td>2.2</td>
</tr>
</tbody>
</table>
Overview of Brookdale Study

- 5+ year project including all hospital patients with central venous catheters (CVC)
- Largest U.S. trial to date on effect of interventions: >5000 pts, >60,000 catheter days
- Results presented at 2003-2005 APIC conferences
- Awarded NYS Patient Safety Award, 2004
- Peer reviewed by Johns Hopkins & Duke University MCs
- Selected as best practice project, JCAHO
- Project included as part of JCAHO video broadcast on Infection Control, 4/15/04
- Methodology presented to members of the Greater New York Hospital Association and Maryland Patient Safety Center on prevention of CRBSI

As of 5/06
Prevention of Central Line-Associated Bacteremia
Robert Garcia, Brookdale University Medical Center
A Webber Training Teleclass

Key Strategy:
Identification of Needs

- A uniform education program for nurses and physicians
- A certification process for first year residents on proper insertion
- Selection of insertion site to reduce risk
- Standards for aseptic practice during maintenance
- Standardization of sterile attire
- Standardization of skin antisepsis

GNYHA CLAB Project

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Robert Garcia, Brookdale University Medical Center
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CLAB Rates, 1999-2005

CLAB by Year

Cost Avoidance
Prevention of Central Line-Associated Bacteremia
Robert Garcia, Brookdale University Medical Center
A Webber Training Teleclass

Infections & Costs Avoided

<table>
<thead>
<tr>
<th>Year</th>
<th># CRBSI</th>
<th># CRBSI avoided</th>
<th>Costs avoided*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>97</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>2000</td>
<td>47</td>
<td>50</td>
<td>$2,262,700</td>
</tr>
<tr>
<td>2001</td>
<td>26</td>
<td>71</td>
<td>$3,213,034</td>
</tr>
<tr>
<td>2002</td>
<td>17</td>
<td>88</td>
<td>$3,620,320</td>
</tr>
<tr>
<td>2003</td>
<td>15</td>
<td>82</td>
<td>$3,710,828</td>
</tr>
<tr>
<td>2004</td>
<td>18</td>
<td>79</td>
<td>$3,575,066</td>
</tr>
<tr>
<td>2005**</td>
<td>12</td>
<td>85</td>
<td>$3,846,590</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>447</td>
<td></td>
<td><strong>$20,228,538</strong></td>
</tr>
</tbody>
</table>

*Cost per CRBSI case based on CDC mean of $45,254
**projected based on 1st quarter data

Incremental Cost of New Interventions

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Incremental cost per item</th>
<th># items used in 10 days</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximal sterile barrier kit</td>
<td>Sterile gown, gloves, mask, large drape, dressing components</td>
<td>$7.00</td>
<td>2</td>
<td>$14.00</td>
</tr>
<tr>
<td>Dressing kit</td>
<td>Transparent dressing, 2% CHG antiseptic, tincture of benzoin, tape</td>
<td>$2.00</td>
<td>1</td>
<td>$2.00</td>
</tr>
<tr>
<td>Antiseptic patch</td>
<td>70% alcohol-2% CHG in 3ml applicator</td>
<td>$0.70</td>
<td>2</td>
<td>$1.40</td>
</tr>
<tr>
<td>Antiseptic patch</td>
<td>Chlorhexidine-impregnated patch</td>
<td>$0.50</td>
<td>2</td>
<td>$1.00</td>
</tr>
<tr>
<td>Antimicrobial patch</td>
<td>Silver-platinum catheter</td>
<td>$10.00</td>
<td>2</td>
<td>$20.00</td>
</tr>
<tr>
<td><strong>Total incremental cost per patient:</strong></td>
<td>$47.40</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conclusion

• High-morbidity, high-cost infections are an ever-increasing focus of patient safety and quality improvement initiatives

• Application of several specific preventive measures targeting key routes of catheter colonization resulted in significant overall infection reduction

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Robert Garcia, BS, MMT(ASCP), CIC
Assistant Director of Infection Control
Brookdale University Medical Center
One Brookdale Plaza
Brooklyn, NY 11212
718-240-5924
rgarcia@brookdale.edu

2007 Teleclass Schedule

January
01 - "The Role of Antimicrobial Stewardship in Curbing BAC" by J. Wine, Baruch College
04 - "Antimicrobial Stewardship: The Good, the Bad, and the Ugly" by J. Wine, Baruch College
06 - "Antimicrobial Stewardship: The Good, the Bad, and the Ugly" by J. Wine, Baruch College
February
01 - "Uniting the Forces of Public Health and Public Health" by J. Wine, Baruch College
01 - "Uniting the Forces of Public Health and Public Health" by J. Wine, Baruch College
March
01 - "Uniting the Forces of Public Health and Public Health" by J. Wine, Baruch College
01 - "Uniting the Forces of Public Health and Public Health" by J. Wine, Baruch College
April
01 - "Emerging Issues: The Role of the Infection Control Practitioner" by J. Wine, Baruch College
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May
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