Eliminating Healthcare Associated Infections: Strategies for Success

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Medical Director, Coronary Care Unit
Allegheny General Hospital
Pittsburgh, Pennsylvania
Leading Causes of Death in the U.S 1997

- Heart Disease
- Malignant Neoplasms
- Stroke
- Medical Errors
- Diabetes
- Pneumonia
- Car Accidents
- Breast Cancer
- Suicide
- Homicide
- AIDS

Source: CDC mortality data 1997
Where It All Started
Poorly Organized Delivery System

- Failure to provide planned care.
- Failure to reorganize care.
- Failure to supply information and education.
- Failure to facilitate access to care.
- Failure to create supportive infrastructure.
Institute of Medicine: Healthcare Imperatives

- Assure equal care
- Eliminate waste
- Avoid needless waits and delays in care
- Provide patient-centered care
- Provide highly reliable, effective care
- Assure patient safety
Enter the Watchdog Agencies
The Advent of Public Reporting
The Advent of Public Reporting

![Hospital-acquired Infections in Pennsylvania 2005](image-url)
The Advent of Public Reporting

Hospital-acquired Infections in Pennsylvania 2005

This interactive database can be searched by hospital, by infection, and by peer group.
Selecting a hospital will show hospital-acquired infection data for the specified facility or for all facilities if that option is chosen.

Selecting a single infection will show data for a single infection type, all infections (listed individually), or overall infection numbers (in aggregate). If a single infection is chosen, the user can sort the data by clicking on the measure of interest (e.g., clicking on the heading “Number of Cases” will sort the data by that measure).

Selecting a peer group will show the summary data for the peer group and display the data for each hospital in that peer group.

<table>
<thead>
<tr>
<th>Infection Type</th>
<th>Number of Cases</th>
<th>Infection Rate per 1,000 Cases</th>
<th>Mortality Number</th>
<th>Mortality Percent</th>
<th>Average Length of Stay in Days</th>
<th>Average Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allegheny General</td>
<td>27,003</td>
<td>NA</td>
<td>808</td>
<td>2.9</td>
<td>5.2</td>
<td>$37,826</td>
</tr>
<tr>
<td>Cerebrospinal Inf.</td>
<td>527</td>
<td>19.9</td>
<td>75</td>
<td>13.5</td>
<td>23.5</td>
<td>$177,716</td>
</tr>
<tr>
<td>Urologic Infection</td>
<td>402</td>
<td>14.6</td>
<td>44</td>
<td>10.8</td>
<td>20.6</td>
<td>$166,774</td>
</tr>
<tr>
<td>Surgical Site Inf.</td>
<td>41</td>
<td>4.7</td>
<td>2</td>
<td>4.5</td>
<td>12.2</td>
<td>$39,637</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>27</td>
<td>1.0</td>
<td>4</td>
<td>14.8</td>
<td>27.6</td>
<td>$327,480</td>
</tr>
<tr>
<td>Bloodstream</td>
<td>51</td>
<td>1.6</td>
<td>12</td>
<td>23.5</td>
<td>30.5</td>
<td>$229,522</td>
</tr>
<tr>
<td>Multiple</td>
<td>31</td>
<td>1.1</td>
<td>13</td>
<td>41.9</td>
<td>35.2</td>
<td>$331,266</td>
</tr>
<tr>
<td>Total</td>
<td>27,376</td>
<td>NA</td>
<td>731</td>
<td>2.7</td>
<td>4.5</td>
<td>$34,776</td>
</tr>
</tbody>
</table>

Notes:
- NA – Not applicable
- NR – Not reported. Not fewer than 5 cases evaluated.
- Surgical Site Infection Rate – Based on the number of surgical cases, not the total number of cases.
- Milton S. Hershey – Electronic surveillance technology was only used to report Quarter 1 - 2005 hospital-acquired infection data.
Estimating The Burden of Healthcare Associated Infections

Annual HAI ~1.7 million
(4.5 infections per 100 admissions)

Deaths associated with HAI:
98,987

Pneumonia 35,967
CR-BSI 30,665
UTI 13,088
SSI 8,205
Other 11,062

Decubitus Ulcers 25%
Nosocomial Infections 20%
Adverse Drug Events 16%
Procedural Events 12%
Post Op Events 11%
Falls 4%
DVT/PE 4%

Klevens RM et al. Public Health Reports, 2007 160-166
CR-BSI Multiples The Cost of Care

- LOS: 11 vs. 45
- Cost: $23K vs. $83K
- Mortality: 28% vs. 51%

The Burden Is Disproportionate

Patients Without Infection
- Medicaid: 36.7%
- Commercial: 28.1%
- Other: 21.4%
- Other

Patients With Infection
- Medicaid: 57.2%
- Commercial: 17.2%
- Other: 14.2%
- Other

Murphy D et al. “Dispelling the Myths: The True Cost of Health care-Associated Infections”
APIC Briefing 2007
The New York Times

Medicare Says It Won’t Cover Hospital Errors

By ROBERT PEAR
Published: August 19, 2007

The new policy raises the possibility of changes in medical practice as doctors hew more closely to clinical guidelines.
The Allegheny General Hospital Story

- Dr. Richard Shannon
  - Chairman, Department of Medicine
- Drs. Michael Brown, Glen Miske, Amy Schuett
  - Cardiology fellows
- Joy Peters RN, MBA
  - Nursing Director, Coronary Care Unit
- Kimberly Curry BSN
  - Unit Facilitator, Coronary Care Unit
- Anne Behers RN, Christine Ciocco RN, Amy Snyder RN, Chris Zanone RN, Cher Schmude RN
  - Unit Charge Nurse, Coronary Care Unit
- Cheryl Herbert RN, Veronica Andrews RN
  - Nursing Director, Infection Control
- Diane Frdnak
  - Vice President Quality and Patient Safety

......And a cast of hundreds working 24/7!
## CR-BSI Had Standard” Rates

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<tr>
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<th>No. of units</th>
<th>Central line-days</th>
<th>Infection rate</th>
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<tr>
<td>Coronary</td>
<td>60</td>
<td>116,546</td>
<td>3.5</td>
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<td>48</td>
<td>182,407</td>
<td>2.7</td>
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<tr>
<td>Medical</td>
<td>94</td>
<td>312,478</td>
<td>5.0</td>
</tr>
<tr>
<td>Major teaching</td>
<td>100</td>
<td>430,979</td>
<td>4.0</td>
</tr>
<tr>
<td>All others</td>
<td>109</td>
<td>486,115</td>
<td>3.2</td>
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<td>30</td>
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CCU Quarterly CR-BSI Surveillance

![Bar chart showing BSI rate per 1000 line-days from Q3 01 to Q2 03 with NNIS Std. line at 5.5.]

- Q3 01: 8.5
- Q4 01: 7
- Q1 02: 3.5
- Q2 02: 4
- Q3 02: 6
- Q4 02: 6.5
- Q1 03: 3
- Q2 03: 4
What Did We Conclude?

• Our results were average and average is ok.
• CR-BSI’s are inevitable. It is the price you pay for sophisticated, complex care.
• CR-BSI’s are readily treated with antibiotics.
• CR-BSI’s are a common accompaniment of complex care and covered in outlier payments.
What Concerned Us?

- 5.1 infections per 1000 line days meant that nearly **40 people** were infected in the department of medicine alone.
- Central lines had a 4-5% chance of bloodstream infection.
- Two-thirds of the infections involved virulent organisms. Twenty percent were MRSA.
- CR-BSI was associated with 50% mortality.

We were obligated to better...........But how?
2003: What Was Happening?

- No specified role of personnel.
- No standardized definition of "site at risk".
- No standard insertion techniques employed.
- No standardized procedure for dressing change.
- No standard for documentation and policy compliance.

"I know how to do this"

"It's how they care for the lines"

"No!"

"#!&%#

"This is how I like it"

"I can do it faster this way"
What Did We Do?

Perfecting Patient Care/Toyota Production System

Step 1: Set ambitious goals
Step 2: Observe variations in work
Step 3: Real time problem solving
Step 4: Implement countermeasures

Step 5: Reassess and revise
Process Standardization Worked...........but didn’t get us to ZERO!

AGH Medical Intensive Care Unit
Catheter Related Blood Stream Infections
2003-2005

AGH Coronary Care Unit
Catheter Related Blood Stream Infections
2003-2005
Why Not Zero?

We Were Poor Managers
- Didn’t articulate the message clearly.
- Didn’t establish priorities.
- Didn’t provide training
- Didn’t ensure compliance
We Invested In People and Programs

Central Line Self-Learning Module Test

1. Which statement is TRUE?
   A. The internal jugular vein lies medial to the carotid artery.
   B. The internal jugular vein lies posterior to the carotid artery.
   C. The internal jugular vein lies lateral to the carotid artery.
   D. The internal jugular vein lies adjacent to the trachea.

2. Which statement is TRUE?
   A. The subclavian vein lies beneath the first rib.
   B. The subclavian vein lies beneath the medial 1/3 of the clavicle.
   C. The subclavian vein lies behind the subclavian artery.

3. Which activity is NOT required prior to central line insertion?
   A. Compliance with hospital “time out” policy.
   B. Obtaining informed consent.
   C. Reviewing pertinent lab data.
   D. Advising the nursing staff of equipment needs.
   E. Antibiotic prophylaxis.

4. Strict sterile technique requires all of the following EXCEPT:
   A. Vigorous hand washing.
   B. Surgical mask, gown and gloves for all participants.
   C. Skin preparation with chlorhexidine.
   D. Removal of any nasogastric or endotracheal tubes.
   E. Sterile drape of entire patient.
Continuous Education Enhances Process Standardization

<table>
<thead>
<tr>
<th>Year</th>
<th>Blood Stream Infections (♯)</th>
<th>AGH Medical Intensive Care Unit</th>
<th>AGH Coronary Care Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>4</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>2006</td>
<td>2</td>
<td>2006</td>
<td>2004</td>
</tr>
<tr>
<td>2007</td>
<td>3</td>
<td>2007</td>
<td>2005</td>
</tr>
</tbody>
</table>

Process Standardization | Continuous Educations

Process Standardization | Continuous Educations
Continuous Education Enhances Process

PICC line repositioned over guide wire on day 3

These lessons were readily transferrable to other units.
The Message Has Spread.....

To the Other ICU’s
The Message Has Spread..... Outside of the ICU

- Seven fold decrease in BSI over four years
- Non ICU BSI rate of 1.2 BSI/1000 line-days
- The majority of central lines are now PICC
The Message Has Spread…… Across the Country
The Message Has Spread……

Into the Community

Skin is the Source of Deadly — Preventable — Infections

Did you know your own skin could be the source of deadly infections that could kill you? Currently, 27,144 people a day die on average from healthcare-associated infections (HAIs).¹ Many people, possibly including you, aren't even aware of these deadly infections let alone how to prevent them. It all starts at their source — your skin.
The Message Has Spread……

Across the Ocean

Process Standardization and Continuous Training Leads to the Elimination of Catheter Related Blood Stream Infections (CR-BSI)

Jerome E. Granato MD MBA, Kimberly Curry RN BSN, Joy Peters RN MSN MBA, Julie Gerstrbein RN MSN CCRN, Veronica Andrews RN, Cheryl Herbert RN CIC, Richard P Shannon MD.
Allegheny General Hospital Pittsburgh, Pennsylvania, USA
Barnes-Jewish Healthcare HAI Elimination Efforts

Number of Infections

- CABG SSI
- Spinal SSI
- CR-BSI
- VAP

2000 vs 2004
Barnes-Jewish Healthcare
HAI Elimination Efforts

1300 Bed Teaching Hospital
$350,000 Investment in programs
$50-150,000 in people
$2,495,294 in savings

Savings (x $100,000)

CABG SSI | Spinal SSI | CR-BSI | VAP | TOTAL SAVINGS

$2,495,294

Murphy DM. Dispelling the Myths: The True Cost of Healthcare APIC Briefing Feb 2007
Michigan Health and Hospital Association

- Keystone Project: 108 ICUs across the state of Michigan
- Evidence-based intervention included:
  - Central line bundle
  - Daily goals sheet
  - VAP prevention
  - Safety program
  - Support from hospital administration
- Results: large (66%), sustained reduction in CLABSI

Michigan Health and Hospital Association

Where Are We Now With Respect to CR-BSI?

- Pathogenesis
- Evidence based practices
- Process improvement initiatives
- Achieving cultural transformation
- Future Challenges
There Are Multiple Sources of Infection

Skin organisms
- Endogenous
  - Skin flora
- Extrinsic
  - HCW hands
  - Contaminated disinfectant

Nearly 80% of CR-BSI originate from skin flora
Catheter-Related Blood Stream Infections: Bio-film Formation

At insertion

- Bacteria/polyurethane/silicon

Seconds/Minutes

- Protein/Platelets/White Blood Cells

Hours

- Fibrin Sheath

Days

- Thrombus Formation
- Detachment and Seeding
Variable Mortality Rate By Organism Causing Nosocomial Infection

<table>
<thead>
<tr>
<th>Organism</th>
<th>Proportion</th>
<th>Crude Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. Aureus</td>
<td>32</td>
<td>25</td>
</tr>
<tr>
<td>Enterococcus</td>
<td>11</td>
<td>32</td>
</tr>
<tr>
<td>Candida</td>
<td>8</td>
<td>40</td>
</tr>
</tbody>
</table>

Enforcing Hand Hygiene Is Important

• Hand hygiene must be performed prior to insertion or manipulation of any vascular catheter [IA]

• Can be accomplished with soap and water or an alcohol-based hand sanitizer

• Use of gloves during procedure does not remove need for proper hand hygiene
Enforcing Hand Hygiene Is Difficult

Healthcare Workers Perception of Hand Hygiene

- Self Compliance: 85%
- Peer Compliance: 51%
- Average: 28%
Enforcing Hand Hygiene Is Difficult

HealthCare Workers Perception of Hand Hygiene

- Self Compliance: 85%
- Peer Compliance: 51%
- Average: 28%

<table>
<thead>
<tr>
<th>Medical Specialty</th>
<th>Percent Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Medicine</td>
<td>87.3%</td>
</tr>
<tr>
<td>Surgery</td>
<td>36.4%</td>
</tr>
<tr>
<td>Critical Care</td>
<td>62.6%</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>82.6%</td>
</tr>
<tr>
<td>Geriatrics</td>
<td>71.1%</td>
</tr>
<tr>
<td>Anesthesiology</td>
<td>23.0%</td>
</tr>
<tr>
<td>Emergency Medicine</td>
<td>50.0%</td>
</tr>
<tr>
<td>Other</td>
<td>57.2%</td>
</tr>
</tbody>
</table>
Using Maximal Sterile Barriers Matters

- Use of sterile gown, gloves, and large drapes, and non-sterile masks and caps reduces incidence of CR-BSI [IA]
Requiring Maximal Sterile Barriers

- Maximal barrier precautions reduce the incidence of infection

- Maximal barrier precautions are cost effective

- For every 270 catheters placed:
  - Seven CR-BSI avoided
  - One death prevented
  - $68,000 saved

Insertion Site Preparation Is Important

- 2% CHG is preferred antiseptic for prevention of catheter-related infections

  Tincture of iodine, iodophors, 70% alcohol listed as alternatives.

  Use of CHG in infants <2 months of age is unresolved issue but there is question of skin irritation.
Evidence Supporting 2% CHG Use

![Bar chart showing incidence BSI (%) for different ICU settings with comparison of Std. Prep and CHG]

- Kelly ICU
- Duncan SICU
- Duncan MICU
- Muto 15 ICU's
- Berriel-Cass 4 ICU's
- George Transplant

Legend:
- Std. Prep
- CHG
## The Site of Insertion Matters

<table>
<thead>
<tr>
<th>Catheter Location</th>
<th>Overall Infection</th>
<th>Sepsis</th>
<th>Partial Thrombosis</th>
<th>Complete Thrombosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subclavian</td>
<td>4.5%</td>
<td>1.5%</td>
<td>1.9%</td>
<td>0%</td>
</tr>
<tr>
<td>Femoral</td>
<td>19.8% *</td>
<td>4.4% †</td>
<td>21.5% *</td>
<td>6% ‡</td>
</tr>
</tbody>
</table>

*Merrer J De Jonghe et al. JAMA 2001; 286:700*
Operator Training and Experience May Matter

831 insertions 4735 line days

- Teaching Hospital
- Minimum of 50 Insertions
- Attending and Fellows only
- Coverage 24/7

The Importance of Nursing Care

- Doubling hours of float nurses/shift
- Increasing nursing ratio from 1:1 to 2:1
- Floating nurse care > 60% catheter days
- CR-BSI rate 4x
- CR-BSI rate 6x
- CR-BSI rate 2x
ICU Physicians and ICU RN Collaboration

- Many misperceptions
- More nursing empowerment
- Regular meetings and communication
Standardized Catheter Site Care

• Use chlorhexidine impregnated patch

• Catheter site remains covered with sterile gauze or a sterile, transparent, semi-permeable dressing [IA]

• Do not routinely change dressing
Standardized Catheter Site Care

- During dressing changes, disinfect skin with chlorhexidine (or other antiseptic) [IA]
- Antibacterial ointments should not be used on insertion sites due to increased risk of fungal infections\(^1\) and antimicrobial resistance [IA]
Evidence-Based Guidelines

- Enforcing hand hygiene
- Maximal barrier precautions
- Insertion site preparation
- Insertion site selection
- Daily review of line necessity, with prompt removal of unnecessary lines
Barriers To Change

- High staff turnover
- New Residents
- Medical students
- Nursing staff.

Training
Relevance
Interest

Challenging!
Barriers To Change

- High staff turnover
- Competing projects

- Reduction in UTI
- MRSA transmission
- Reduction in VAP
- Decubitus ulcer protocol
- Improving patient transport and flow
- Conversion to an electronic medical record
Barriers To Change

• High staff turnover
• Competing projects
• Winning a mandate

• Hospital administration
• Physician leadership
Barriers To Change

- High staff turnover
- Competing projects
- Winning a mandate
- Challenging organizational structure
Essential Ingredients For Cultural Change

1. **Know** The Evidence
   - Select interventions clearly associated with improved outcomes.
   - Implement interventions that are easiest.
   - Convert interventions to behaviors: Training, Testing Promoting
   - Observe staff performing interventions.
   - Enlist all of the stakeholders in improving the process.
   - "Walk the process" from beginning to end.

2. **Identify** Barriers To Implementation
   - Real time analysis.
   - Record the right metrics: Process and/or outcome.
   - Post the information.

3. **Measure** Performance
   - Engage Explain why the interventions are important
   - Evaluate Regularly assess performance measures
   - Educate Share the evidence supporting the interventions
   - Execute Design an intervention as "tuned" targeted to barriers encountered, supported by feedback, and reminders, and learning from errors

4. **Never** Stop!

- Frame the problem in a larger and more relevant context.
- Engage collaborative multidisciplinary teams

Adapted from Pronovost, Berenholtz, Needham. BMJ 2008
Culture Change Can Be Achieved
We Are Serious About Stopping Infection!
Contact Information

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Pittsburgh, Pennsylvania 15212

412 359-4997
JGranato@WPAHS.org
Selected Reading


• O Grady NP et al. *Guidelines for the Prevention of Catheter Related Infections*. MMWR (RR10) 1-26
APIC Thanks Bard Access Systems for Supporting the Development of the CATHETER-RELATED BLOODSTREAM INFECTION (CRBSI) INITIATIVE through an Unrestricted Educational Grant

EXCLUSIVE SUPPORTER

BARD

Access Systems