Eliminating Hospital Acquired Infections

Is it Possible?
Is it Sustainable?
Is it Worth It?

Richard P. Shannon
Professor of Medicine
Senior Vice Chair
Department of Medicine
University of Pennsylvania
School of Medicine
The Key Message

- The data must not only be reportable, but actionable.
- It’s not about policies and procedures; it’s about processes.
- You can come surprisingly close to eliminating hospital acquired infections with standardization as opposed to resources.
- Hospital acquired infections are costing hospitals and society millions of dollars, illustrating the conspiracy of error and waste.
What Did We Know (or think we knew) Before?

- Our results were average and average is ok.
- CLABs/HAI are inevitable. It is the price you pay for sophisticated, complex care.
- CLABs/HAI are benign and readily treated with antibiotics.
- CLABs/HAI are a common accompaniment of complex care and covered in outlier payments.
Problems With Benchmarking

The Difference Between Reporting and Actionable Data
### Where Would You Want to Have a Central line Placed?

<table>
<thead>
<tr>
<th>Rates</th>
<th>Unit 1 Teaching</th>
<th>Unit 2 Community</th>
<th>Unit 3 AMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/1000 line-days</td>
<td>5/1000 line-days</td>
<td>4/1000 line-days</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># of Infections</th>
<th>25</th>
<th>1</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line-days</td>
<td>500 lines x 10 days</td>
<td>50 lines x 4 days</td>
<td>360 lines x 19 days</td>
</tr>
<tr>
<td>Deaths</td>
<td>10 (40%)</td>
<td>0 (0%)</td>
<td>7 (25%)</td>
</tr>
<tr>
<td>Risk</td>
<td>1 in 20</td>
<td>1 in 50</td>
<td>1 in 13</td>
</tr>
</tbody>
</table>
What Does 5.1 infections/1000 line days Really Mean??

- 37 patients / total of 49 infections
- 193 lines were employed (5.2 lines / patient)
- 1753 admissions
- 1063 patients had central access for more than 12 hours
- 1 out of 22 patients with a central line became infected.
- We were reporting only half the actual infections (not including femoral line infections!!)
- Two-thirds of the infections involved virulent organisms. Twenty percent were MRSA
- 19 patients died (51%)

Journal of Quality and Patient Safety 2006;32:479
What Not to Do?

• Don’t blame
• Don’t form another committee
• Resist the temptation to meet / embrace the desire to act
• Make everybody responsible (not just the infection control officer !)
• At the start, there are no right answers
Toyota Production System
Rules in Use

• Activity (specified as to content sequence, timing, location, expected outcome)
• Connections (direct and unambiguous)
• Pathways (predefined, simple and direct)
• Improvement (highly specified under the guidance of a mentor, at the level of the work, toward an ideal)
The Rules of TPS Applied to Healthcare

- Work (line placement and maintenance) should be highly specified such that variations/problems are immediately apparent.
- When problems (CLABs) are encountered, they should be solved to root cause in real time by the people doing the work.
- When a worker cannot solve a problem, they invoke the help chain to solve the problem.
Current Conditions
Decode: 37 CLABS (July 2002-June 2003)
PRHI Central Line Data
Observations of Dressing Changes

Root Cause Analysis
Solve to root cause in real time the origins of CLABS in MICU / CCU

Counter Measures Generated By the People That Do The Work

Eliminate CLABS In MICU/CCU In 90 days

Reassess Results

Generate Additional Counter Measures

PPC™
Variation in the Course of Work (Line Placement)

- No standard pre-procedure checklist
- Informed consent in 25% of procedures
- Eight different ways to “gown and glove”
- Six different ways to “prep and drape”
- Four different approaches to central veins
- Five different insertion kits
- 55% of procedures were documented
Variation in the Course of Work (Line Maintenance)

- No specified role
- No standardized definitions of “site at risk”
- No standardized dressing kit
- No standardized procedure for dressing change
- No standard record of line location and duration.
Current Conditions
Decide: 37 CLABS (July 2002-June 2003)
PRHI Central Line Data
Observations of Dressing Changes

Root Cause Analysis
Solve to root cause in real time the origins of CLABS in MICU/CCU

Counter Measures Generated By the People That Do The Work

Eliminate CLABS In MICU/CCU In 90 days

Reassess Results

Generate Additional Counter Measures
Understanding Problems Leads to Solutions

Real Time Problem Solving

• Introducer linked and rewired
• Fem line in place > 96 hrs
• Patient transferred with line in place for 21 days
• Infected Groshon catheter

Countermeasures

• Dysfunctional catheters should be replaced, not rewired
• Replace all femoral lines within 12 hours
• Replace line present on transfer
• Subclavian or PICC line preferred
<table>
<thead>
<tr>
<th></th>
<th>Traditional Approach FY 03</th>
<th>PPC Approach FY 04 Year 1</th>
<th>PPC Approach FY 05 Year 2</th>
<th>PPC Approach FY 06 Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU Admissions (n)</td>
<td>1753</td>
<td>1798 (+45)</td>
<td>1829 (+76)</td>
<td>2,141 (+388)</td>
</tr>
<tr>
<td>Atlas Severity Grade</td>
<td>1.9</td>
<td>2.0</td>
<td>2.1</td>
<td>2.2</td>
</tr>
<tr>
<td>Age (years)</td>
<td>62 (24-80)</td>
<td>62 (50-74)</td>
<td>65 (39-71)</td>
<td>64 (56-76)</td>
</tr>
<tr>
<td>Gender (M/F)</td>
<td>22/15</td>
<td>3/3</td>
<td>4/7</td>
<td>2/ 2</td>
</tr>
<tr>
<td>Central lines employed (n)</td>
<td>1110</td>
<td>1321* (211)</td>
<td>1487* (377)</td>
<td>1998*</td>
</tr>
<tr>
<td>Line-days</td>
<td>4687</td>
<td>5052*</td>
<td>6705*</td>
<td>9006*</td>
</tr>
<tr>
<td>Infections</td>
<td>49</td>
<td>6*</td>
<td>11*</td>
<td>4*</td>
</tr>
<tr>
<td>Patients Infected</td>
<td>37</td>
<td>6*</td>
<td>11*</td>
<td>4*</td>
</tr>
<tr>
<td>Rates (infections/1000 line-days)</td>
<td>10.5</td>
<td>1.2*</td>
<td>1.6*</td>
<td>0.44*</td>
</tr>
<tr>
<td>Deaths</td>
<td>19</td>
<td>1 *</td>
<td>2 *</td>
<td>2*</td>
</tr>
<tr>
<td>Reliability (# of lines placed to get 1 infection)</td>
<td>22</td>
<td>185*</td>
<td>135*</td>
<td>500*</td>
</tr>
</tbody>
</table>

*Journal of Quality and Patient Safety 2006;32:479*
Additional Countermeasures

Real Time Problem Solving

• Line Skills
  • Lines for a long time
  • Difficult access
  • Accessing the line

Countermeasures

• Education / Credentialing
  • Antibiotic coated catheters
  • Site Rite/ SonoSite ultrasound
  • Micropuncture kits
  • Vascular access team
  • Antibiotic locks
Why Did We Slip?

- Informed consent 84%
- Pre-procedure checklist 96%
- Scrub/Gown/Glove 98%
- Drape/Prep 98%
- Site Selection/Success 72%
- Line Dressing 100%
- Line Maintenance 98%

<30%
Observations of Variation In PICC Placement

- Line repositioning
- Delays in confirmation of position
- “Pistoning” and “Sizing”
- Line manipulation during flushing
- Line used for blood draws rather than infusion
- We are using more and more PICC without proper technique and training of nurses
Central Line Training Module

Workers have to be given the training necessary to be successful

- 1 hour didactic with test
- “The Perfect Line Placement” Video
- Two Hours in the “Line training Simulator”
- Inter disciplinary (residents/fellows/nurses)
The Conspiracy of Error and Waste

• What is the cost of a CLAB in human and financial terms?
• What does society pay for healthcare associated infections (HAI)?
• Do hospitals and physicians make money on HAIs?
Case 1:

- 37 year old video game programmer, father of 4, admitted with acute pancreatitis secondary to hypertriglyceridemia.
- Day 3: developed hypotension, and respiratory failure
- Day 6: fever and blood cultures positive for MRSA secondary to a femoral vein catheter in place for 4 days.
- Multiple infectious complications requiring exploratory laparotomy and eventually tracheostomy
- Day 86: Discharged to nursing home
- Highmark Select Blue
# The Impact of CLABs on Gross Margin

<table>
<thead>
<tr>
<th></th>
<th>DRG 204/2721 (n=3)</th>
<th>DRG 191 (n=3)</th>
<th>DRG 483 (n=2)</th>
<th>Case 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acute pancreatitis</strong></td>
<td>Revenue ($)</td>
<td>Expense</td>
<td>Gross Margin</td>
<td>Costs attributable to CLAB</td>
</tr>
<tr>
<td></td>
<td>5,907</td>
<td>5,788</td>
<td>119</td>
<td>170,565</td>
</tr>
<tr>
<td><strong>Pancreatitis w cc</strong></td>
<td>99,214</td>
<td>58,905</td>
<td>40,309</td>
<td>170,565</td>
</tr>
<tr>
<td><strong>Pancreatitis w trach</strong></td>
<td>125,576</td>
<td>98,094</td>
<td>27,482</td>
<td>170,565</td>
</tr>
<tr>
<td></td>
<td>200,031</td>
<td>241,844</td>
<td>-41,813</td>
<td>170,565</td>
</tr>
</tbody>
</table>

**LOS**
- Case 1: 86
Case 3

• 49 year old obese female was admitted for elective surgical gastroplasty.
• She developed respiratory distress post operatively and was intubated for respiratory failure.
• On day 22, blood cultures were positive for *Staph epidermidis, enterococcus fecaealis, and Candida.*
• The right femoral line tip grew all three organisms. The line was in place for 16 days.
• On hospital day 48, she was transferred to a SNF.
• Medicare/ Three Rivers
# The Impact of CLABs on Gross Margin

<table>
<thead>
<tr>
<th></th>
<th>DRG 288 (n=10)</th>
<th>DRG 483 (n=3)</th>
<th>Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedures for obesity</td>
<td>22,023</td>
<td>153,566</td>
<td>101,521</td>
</tr>
<tr>
<td>Trach w obesity surgery</td>
<td>12,100</td>
<td>148,969</td>
<td>117,626</td>
</tr>
<tr>
<td><strong>Revenue</strong></td>
<td><strong>9,923</strong></td>
<td><strong>6,597</strong></td>
<td><strong>-16,105</strong></td>
</tr>
<tr>
<td><strong>Expense</strong></td>
<td><strong>12,100</strong></td>
<td><strong>148,969</strong></td>
<td><strong>117,626</strong></td>
</tr>
<tr>
<td><strong>Gross Margin</strong></td>
<td><strong>9,923</strong></td>
<td><strong>6,597</strong></td>
<td><strong>-16,105</strong></td>
</tr>
<tr>
<td><strong>Costs attributable to CLAB</strong></td>
<td></td>
<td></td>
<td><strong>41,009</strong></td>
</tr>
<tr>
<td><strong>LOS</strong></td>
<td><strong>6</strong></td>
<td><strong>51</strong></td>
<td><strong>47</strong></td>
</tr>
</tbody>
</table>
The Losses Attributable to CLABs are Staggering

- Average Payments: $64,894
- Average Expense: $91,733
- Average Loss from Operations: -$26,839
- Total Loss from Operations: -$1,449,306
- In only 4 cases did the hospital make money!
- The cost of the additional care averaged 43% of the total costs of care
- Average LOS: 28 days (7-137)
- Only three patients were discharged to home.
Eliminating CLABs

• **Is it Possible?**
  
  Unquestionably, but not without each individual accepting responsibility

• **Is it Sustainable?**
  
  Not without training and teamwork

• **Is it Worth It?**
  
  - No patient wants one
  - We lose substantial amounts on each CLAB
  - The loss is fully attributable to the costs of the CLAB
Eliminating VAP

• July 2005:
  We implemented “real time” problem solving around every VAP case

• October, 2005:
  We implemented countermeasures developed by the people doing the work (AGH VAP Bundle)

• July, 2006:
  We assessed improvement compared to data from the previous 2 years
The Losses Attributable to Ventilator associated Pneumonia are Equally Staggering

- Average Payments: $62,883
- Average Expense: $87,318
- Average Loss from Operations: -$24,435
- Total Loss from Operations: -$2,419,065
- The average payments were twice that for a similar care without VAP ($33,569)
- Average LOS: 34 days versus 17 days
- 32% of patients died and 43% underwent tracheotomy.
Eliminating VAP: How Did We Do It?

- Step 1: Elevate the head of the Bed 30°
- Step 2: Chlorhexidine mouthwash BID
- Step 3: Change vent tubing weekly
- Step 4: Change suction catheter daily
- Step 5: provide a hook for hanging resuscitation bag
- Step 6: Check endotracheal cuff pressure

Total Added Cost: $17/ ventilated patient
The Results with VAP

- FY 04: (46)
- FY 05: (45)
- FY 06: (8)
Savings Are Likely to Far Exceed the Costs of Intervention

<table>
<thead>
<tr>
<th>No. of prevented VAP cases</th>
<th>Nominal Savings</th>
<th>Cost of the Intervention</th>
<th>Actual Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$16,010</td>
<td>$10,897</td>
<td>$5,113</td>
</tr>
<tr>
<td>2</td>
<td>$32,020</td>
<td>$10,897</td>
<td>$21,123</td>
</tr>
<tr>
<td>10</td>
<td>$160,098</td>
<td>$10,897</td>
<td>$149,201</td>
</tr>
</tbody>
</table>

Cost of the Intervention:
- $10,897 (for all patients)

Nominal Savings:
- $16,010 (per one case)
The Incentives Are Not Aligned with Outcomes

126 more admissions

<table>
<thead>
<tr>
<th></th>
<th>MD</th>
<th>Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intubated</td>
<td>$3,292</td>
<td>$8,426</td>
</tr>
<tr>
<td>Intubated+VAP</td>
<td>$6,938</td>
<td>$24,435</td>
</tr>
</tbody>
</table>
Eliminating MRSA

- MRSA surveillance program
- Worker Safety and Patient safety
- Admission/discharge/ LOS cultures
- Define the reservoir, not just the infections
The Losses Attributable to MRSA Infections are Equally Staggering, but More Complex…

- 236 infections over 4 years
- Average Payment: $40,302
- Average Expense: $54,065
- Average Loss from Operations: -$13,763
- Total Loss from Operations: -$3,234,343
- Average Age: 63 years
- Average LOS: 31 days
- Most common DRG: CV (24%), GI (16%), ID(15%), Neuro (13%), Pul (11%)
The Costs and the Losses Do Not Stop There

- 49% readmitted (116 patients)
- 415 additional admissions
- LOS: 37 days (15,355 bed-days)
- Additional Loss per case: -$15,929
- Additional Loss: -$1,847,747
- Total Operating Loss (including readmissions): -$5,082,090
Eliminating MRSA Transmission

- MRSA Surveillance Program (Oct 2004)
- 8 month pilot project
- 2,141 ICU admissions screened in FY06
- 95% compliance with admission/discharge cultures
- 139 new carriers identified
- Transmission rates (CCU/MICU) have declined to 0.94%
## MRSA Surveillance Data FY 2006

<table>
<thead>
<tr>
<th>UNIT</th>
<th>CCU</th>
<th>MICU</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADMISSIONS</strong></td>
<td>1,325</td>
<td>816</td>
<td>2,141</td>
</tr>
<tr>
<td><strong>ADMIT CULTURES</strong></td>
<td>1,290 (97%)</td>
<td>749 (92%)</td>
<td>2,039 (95%)</td>
</tr>
<tr>
<td><strong>NEGATIVE ADMIT CULTURES</strong></td>
<td>1,166</td>
<td>599</td>
<td>1,765</td>
</tr>
<tr>
<td><strong>PRESENT ON ADMISSION</strong></td>
<td>70</td>
<td>69</td>
<td>139 (6.8%)</td>
</tr>
<tr>
<td>(Previously unknown)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>KNOWN POSITIVE</strong></td>
<td>54</td>
<td>81</td>
<td>135 (6.3%)</td>
</tr>
<tr>
<td><strong>DISCHARGES</strong></td>
<td>1,323</td>
<td>813</td>
<td>2,136</td>
</tr>
<tr>
<td><strong>DISCHARGE CULTURES</strong></td>
<td>1,230 (93%)</td>
<td>679 (83%)</td>
<td>1,909 (89%)</td>
</tr>
<tr>
<td>(On negative admit cultures w/ 24 hr minimum LOS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>** CONVERTERS**</td>
<td>12 (0.0098)</td>
<td>6 (0.0088)</td>
<td>18 (0.0094)</td>
</tr>
</tbody>
</table>
## MRSA Infection Data
### FY 2004 vs. FY 2006

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>CCU &amp; MICU</th>
<th>Other Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>22</td>
<td>56</td>
</tr>
<tr>
<td>2006</td>
<td>3 (-86%)</td>
<td>87 (+55%)</td>
</tr>
</tbody>
</table>

FY 04: 11 deaths  
FY 06: 1 death
Cost Effectiveness

- Surveillance costs = $50,680/year
- Savings/ MRSA infection prevented = $15,544
- We needed to prevent 4 new MRSA infections to recover the costs of surveillance.
- We prevented 19 infections and 10 deaths
CCU/MICU and HAI
A Big Return on Investment

- Total Operating Improvements
  CLAB= $1,235,765 (2 years)
  VAP= $1,003,162 (1 year)
  MRSA= $295,342 (1 year)
- Highmark PFP = $3,100,000 (2 years)
- HAI elimination Initiatives = +$5,634,269
- Investment = $85,607
- 388 additional ICU admissions
- 57 lives saved