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Healthcare Associated Infection and Infectious Diseases Control
Epidemiology Advisor to Clinical Excellence Commission

Central Line Associated Bloodstream Infections: Is achieving zero possible?
How much is infection prevention worth?
1. Insertion bundle for zero risk for CLABSI
   How large is the CLABSI problem?
   How did we introduce bundle intervention?

2. Dwell time associated with increased risk of CLABSI
   Is every patient with a CVC at risk of CLABSI?

3. Surveillance analysis to assist CLABSI prevention
   Is there a better surveillance method to identify dwell time for targeting infection control efforts?

4. Other CLABSI prevention methods
   Some are expensive so which patients should have additional prevention resources?
CDC DEFINITION OF A CENTRAL LINE

Insertion site or device type ARE NOT used to determine line as central line

Central line:

intravascular catheter that terminates at or close to the heart or in one of the great vessels which is used for infusion, withdrawal of blood, or hemodynamic monitoring

Great vessels:

Aorta, pulmonary artery, superior vena cava, inferior vena cava, brachiocephalic veins, internal jugular veins, subclavian veins, external iliac veins, common femoral veins [& in neonates: the umbilical artery/vein]

CVL MUST terminate in a great vessels or in/near the heart
**Laboratory Diagnosis**

**Criterion 1.** recognised pathogen from ≥ B/C
   And
   organism cultured from B/C is not related to infection at other site

**Criterion 2.** patient has at least 1: fever (>38°C) or chills or hypotension
   And
   common skin contaminants
   (Corynebacterium spp, Bacillus spp, Propionibacterium spp, coag neg staph, strep viridians, Aerococcus spp, Micrococcus spp) is cultured from ≥2 B/C drawn on separate occasions.

**Rate =** \( \frac{\text{Lab diagnosis CVL related BSI}}{\text{number of patients with ≥1 central lines}} \)
How large is the CLABSI problem?


12.2 infections per 1,000 central line-days
**How large is the CLABSI problem in adult ICUs?**

<table>
<thead>
<tr>
<th>Country</th>
<th>Number</th>
<th>CLABSI Rate (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>32 NSW</td>
<td>3.7 (95% CI 2.5-5.3)</td>
</tr>
<tr>
<td></td>
<td>13 VIC</td>
<td>2.3 (95% CI 1.5-3.3)</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>USA</th>
<th>5266</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>2.0 range across 10 ICUs 1.0 to 5.6</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Germany</th>
<th>248</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0 (95% CI 1.8-2.1)</td>
<td></td>
</tr>
</tbody>
</table>

What does this mean in terms of infected patients per year?

Germany
920 from 248 ICU ≈ 4 each ICU / year

USA
5266 from 1045 ICU ≈ 5 each ICU / year

AUSTRALIA (NSW + Victoria)
106 from 45 ICUs ≈ 2 each ICU / year
What does this mean in terms of death per year?

Attributable mortality 12% - 25%


≈1 death each ICU / year
15 years of Evidence

*CLABSI is preventable*
Early highlights on prevention


- **Prevention of intravascular catheter infection.** Eggimann P. *Curr Opin Infect Dis* 2007; 20:360-369
Major collaborative studies

- **CLABSI rate ↓ by 68% to 1.36/1000 line days** over a 4 year period 69 ICUs in South Western Pennsylvania
  

- **Comparable results were obtained in 46 ICUs in New York State & a group of Veterans Affairs hospitals**
  
  

- **A regional collaborative study 44 ICUs underway in Tuscany**
  

- **Low resourced setting**
  
Keystone ICU Project

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Median (IQR)</th>
<th>Rate per 1000 line-days</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 months</td>
<td>2.7 (0.6 - 4.8)</td>
<td>55 then 108 ICU Michigan</td>
</tr>
<tr>
<td>3 months</td>
<td>0.0 (0.0 - 2.4)</td>
<td></td>
</tr>
<tr>
<td>16-18 months</td>
<td>0.0 (0.0 - 3.0)</td>
<td></td>
</tr>
<tr>
<td>34-36 months</td>
<td>0.0 (0.0 - 1.2)</td>
<td></td>
</tr>
</tbody>
</table>
How did NSW introduce bundle intervention?

**Aim:** all 37 public ICUs in NSW
How did NSW introduce bundle intervention?

Multidisciplinary support

Clinical Excellence Commission
Intensive Care Centre Monitoring Unit
NSW Ministry of Health
Physician and Nurse from every ICU

Checklist produced

Clinician bundle
- Undertake competency assessment
- Clean hands
- Sterile gloves/gown
- Hat mask protective eyewear

Patient bundle
- Prep with 2% chlorhexidine & dry 2 mins
- Large sterile drape
- Maintain sterile technique
- No multiple passes
- Confirm catheter position
Q. Did the ICU staff co-operate with the bundle?

**Patient Bundle:** aseptic insertion of central line  
patient fully draped & skin prep

**Clinician Bundle:** hat, mask, hand hygiene, glove, gowns  
check inserted properly - transducer/x-ray

Q. Could anything else been responsible for change in CLABSI rate?

**Potential confounder:** type of central line, insertion site, coating  
level of ICU  
compliance with bundles  
ALOS  
accreditation for insertion
What issues affected co-operation?

😊 Initial clinician resistance

- ‘We don’t have CLABSIs’
- ‘I don’t believe the evidence’
- 4 ICUs would not wear hats
- ‘Where’s the money?’ (Data collection/reporting)
- Apathy

😊 Overcome these by...

- Increased involvement by senior intensive care physicians
- Increased checking of data submitted to Commission
- Increased feedback reports from us to participating units
<table>
<thead>
<tr>
<th>Checklist Item</th>
<th>Compliance Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire patient draped</td>
<td>93%</td>
</tr>
<tr>
<td>Alcoholic chlorhexidine prep allowed to dry</td>
<td>96%</td>
</tr>
<tr>
<td>Sterile technique maintained</td>
<td>96%</td>
</tr>
<tr>
<td>Hat, mask, eyewear</td>
<td>80%</td>
</tr>
<tr>
<td>Hands washed 2 mins</td>
<td>92%</td>
</tr>
<tr>
<td>Sterile gown/gloves</td>
<td>96%</td>
</tr>
<tr>
<td>Competency assessed</td>
<td>48% (23% No; 29% missing)</td>
</tr>
<tr>
<td>No multiple passes</td>
<td>81%</td>
</tr>
<tr>
<td>Confirm position radiologically</td>
<td>74%</td>
</tr>
<tr>
<td>Other method to confirm placement</td>
<td>44% (45% No; 11% missing)</td>
</tr>
</tbody>
</table>
Per cent of hospitals that regularly use practice to prevent Central Line-Associated Bloodstream Infection (CLABSI).

How successful was the intervention?

😊 CLABSI rate higher - clinician who did not wear hat compared with clinicians who did

- RR 1.6 (CI\textsubscript{95} 1.1 - 2.4, p=0.0178)
- Central RR 2.0 (CI\textsubscript{95} 1.2 - 3.2, p=0.0037)
- PICC RR 5.1 (CI\textsubscript{95} 1.03 - 25.0, p=0.059)

Conclusion: Proxy for other poor IC related behaviours

😊 Compliers with clinician + patient bundles

RR CLAB 0.6 (CI\textsubscript{95} 0.4-0.9, p=0.0103)
How successful was the intervention?

10,575 centrally inserted lines

No confounding dwell time or catheter utilization

1-12 months $3.7 \ (95\% CI \ 2.4-4.6) / 1000$ line-days [37/10974]

13-18 months $1.5 \ (95\% CI \ 1.1-2.0) / 1000$ line-days [40/26668]

$RR \ 0.44 \ (95\% CI \ 0.28-0.70) \ p=0.0003$
Lessons

Collaboration worked
Feedback loop with local data
Expect difficulties at organisational and clinician level
Clinician network important – needs to be driven by clinicians
Need to identify local champions/opinion leaders and ensure they have time to drive clinical change – not project officers

Encourage local champions to be involved in running project
Need to consider burden of data collection – need infrastructure
Improvements were due to

- Increased awareness of need for scrupulous aseptic insertion
- Increasing compliance with clinician bundle (if non hat wearers their clinician bundle data were coded non complier)
- Not due to ↓femoral lines or ↓dwell time
- Significantly better communication between ICU & infection control
- Greater understanding of surveillance definition
- Increased ownership by ICU care clinicians following reporting of individual ICU CLABSI data
How did we compare with Keystone?


<table>
<thead>
<tr>
<th>Duration</th>
<th>Median Infection Rate (IQR)</th>
<th>1000 Line-days</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 months</td>
<td>2.7 (IQR 0.6 - 4.8)</td>
<td>1000 line-days</td>
</tr>
<tr>
<td>3 months</td>
<td>0.0 (IQR 0.0 - 2.4)</td>
<td>1000 line-days</td>
</tr>
<tr>
<td>16-18 months</td>
<td>0.0 (IQR 0.0 - 3.0)</td>
<td>1000 line-days</td>
</tr>
<tr>
<td>34-36 months</td>
<td>0.0 (IQR 0.0 - 1.2)</td>
<td>1000 line-days</td>
</tr>
</tbody>
</table>
Who has reached zero?

CLABSI

The effect on rates of infection were mixed and the effect sizes were small, with the largest median effect for the change in level (interquartile range (IQR)) for the six CLABSI studies being observed at three months follow-up was a decrease of 0.6 (-2.74 to 0.28) cases per 1000 central line days (six studies and 36 sites). This change was not sustained over longer follow-up times. Flogen et al Cochrane Database Syst Rev 2013 doi: 10.1002/14651858.CD00655

Adult:

<table>
<thead>
<tr>
<th>Study</th>
<th>Mean Rate</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>NNIS (8 studies)</td>
<td>5.8/1000 CVC-days</td>
<td></td>
</tr>
<tr>
<td>Beathard 2003</td>
<td>7.0 → 1.7/1000 CVC-days</td>
<td></td>
</tr>
<tr>
<td>Coopersmith 2002</td>
<td>11.6 → 3.7/1000 CVC-days</td>
<td></td>
</tr>
<tr>
<td>Parra 2010</td>
<td>4.2 → 2.9/1000 CVC-days</td>
<td></td>
</tr>
<tr>
<td>Warren 2004</td>
<td>9.4 → 5.5/1000 CVC-days</td>
<td></td>
</tr>
</tbody>
</table>

Paed/neonates:

<table>
<thead>
<tr>
<th>Study</th>
<th>Mean Rate</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sannoh 2010</td>
<td>7.0 → 4.0/1000 CVC-days</td>
<td></td>
</tr>
<tr>
<td>Miller 2010</td>
<td>5.4 → 3.1/1000 CVC-days</td>
<td></td>
</tr>
</tbody>
</table>

Dubai

2.6 → 1.8 /1000 CVC-days

Latif et al ICHE April 2015 http://dx.doi.org/10.1017/ice.2015.70
Why aren’t we achieving zero infection?

http://fedoraproject.org/wiki/File:Artwork_F10Themes_Binary_grid_animated.gif
How long after aseptic insertion can you expect the patient to remain free from infection?

Is every patient with a CVC at risk of CLABSI?
First let’s look at the calculation for CLABSI
NNIS in 2005 became National Healthcare Safety Network

For device-associated HAI incidence density rates\(^9\): record daily the total number of patients and **total number of central line-days** in the patient care area(s) under surveillance; sum these daily counts at the end of the surveillance period for use as denominators” (CDC April 2006)

“..the number of patients with one or more central lines of any type is collected daily, at the same time each day, during the month and recorded on the Denominators for Intensive Care Unit (ICU)/Other Locations” (CDC May 2010)
Incidence Density – *theory and why this rate is flawed*

Total number of occupational injuries

∑ **Person years** at-risk of occupational injury

Allows persons at-risk to contribute their own sum of duration of risk

Total number of CLABSI

∑ **central line-days** (for every line in situ is counted)

or

Total number of CLABSI

∑ **central line-days** (exposure to at least 1 line at time of observation)
History sophistication of disease frequency and distribution

1620-74 John Graunt quantified disease patterns in *The Nature of Political Observations Made Upon the Bills of Mortality* (1664)

1807-83 William Farr vital statistics system (1837) for *surveillance* person-time
Statistics for a Fixed population

fixed
Mt (or Mb) in a fixed population is evaluated within successive ‘same time’ intervals so that time dependence of Mt can be elucidated.

Graunt’s Life table
Fixed populations

Table 1. Graunt’s Life Table

<table>
<thead>
<tr>
<th>Age Interval</th>
<th>% Surviving during Interval</th>
<th>% Survived at start of Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6</td>
<td>36</td>
<td>100</td>
</tr>
<tr>
<td>7-16</td>
<td>24</td>
<td>64</td>
</tr>
<tr>
<td>17-26</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<td>27-36</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td>37-46</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>47-56</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>57-66</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>67-76</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>77-86</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Statistics for a *dynamic* population

dynamic
Persons enter (born, migrate, aging into a stratum) as observation time proceeds. Some exit (emigrate, die, become diseased) but population is in a steady state.

number entering must = number leaving the population to be in a ‘steady state’

*Farr’s Person-time*
Rules for **incidence density** for a *dynamic* population:

- **constant dwell time** over the audit period

If you take a snapshot of the dwell-time experienced by *dynamic* population should be in a **steady state**
0 CLABSI = 0 / 1000
8 line days

3 CLABSI = 214 / 1000
14 line days

Population-time portion 1 ≠ Population-time portion 2
Prob of numerator not linear population-time not equal denominator not a steady state

Current calculation assumes (Pr) CLABSI rate (Pr)dwell time day1 = (Pr)dwell time 2 = (Pr)dwell time 3 = etc

CDC calculation expects linear relationship and denominator in a steady state
What has this got to do with Zero risk?
Risk by dwell time is not linear

lowest (Pr) CLABSI 0.9 in 100 chance of infection

Pre: end day-7 1.8/1000 line-days adjusted rate
Post: end day-9 0.9/1000 line-days adjusted rate

Patients with CVC are dynamic

Patients with a longest dwell time have lowest risks for CLABSI

Analysis needs to assist our CLABSI prevention approach

Q. is there a better method of identifying patients at different risk?
Table 1. Graunt’s Life Table (fixed populations)

<table>
<thead>
<tr>
<th>Age Interval</th>
<th>% Deaths in Interval</th>
<th>% Surviving at start of Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6</td>
<td>36</td>
<td>100</td>
</tr>
<tr>
<td>7-16</td>
<td>24</td>
<td>64</td>
</tr>
<tr>
<td>17-26</td>
<td>15</td>
<td>40</td>
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<tr>
<td>27-36</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
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<td>6</td>
<td>16</td>
</tr>
<tr>
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<tr>
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<td>2</td>
<td>3</td>
</tr>
<tr>
<td>77-86</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Dwell time | Total CLABSI | Total Dwell time |
-----------|--------------|------------------|
1-9 days   |              |                  |
≥10 days    |              |                  |
<table>
<thead>
<tr>
<th>Dwell time</th>
<th>Adjusted CLABSI/1000 line-days (CI$_{95}$)</th>
<th>Probability CLABSI-free for dwell time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-intervention</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-7 days</td>
<td>1.8 (0.9-3.3)</td>
<td>0.99</td>
</tr>
<tr>
<td><strong>Post-intervention</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-9 days</td>
<td>0.9 (0.5-1.5)</td>
<td>0.99</td>
</tr>
</tbody>
</table>

**CLABSI average rate for dwell time >9 days**

5.5/1000 line-days
Probability CLABSI-free Dwell time

First 7 days ≤99% CLABSI-free

First 9 days ≤99% CLABSI-free

≤Day 9 75% patients

>Day 9 25% patients

Denominator of this dynamic population is not in a steady state
Rates can be deceiving

CLABSIs are not equally distributed over dwell time (line-day)

There are 2 distinct ICU patient groups:
  75% Short (closer to steady state)
  25% long dwell time
Most patients ALOS ICU ≈ 3 – 5 days

Start with dwell day-5 as target of Zero CLABSI risk

Work up to first 9-days

Central 1591

Line-days ranged ≤24 hours – 96 days
25th Day 7; 50th Day 11; 75th Day 17

Days 1-7

Pre-intervention = 1.8 (95%CI 0.9-3.3/1000 CVC-days)
Post intervention = 0.9 (95%CI 0.5-1.5) !!!
## Hospital G

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>[lines inserted]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>73</td>
<td>[3389]</td>
</tr>
<tr>
<td>PICC</td>
<td>15</td>
<td>[700]</td>
</tr>
<tr>
<td>Dialysis</td>
<td>11</td>
<td>[533]</td>
</tr>
<tr>
<td>Other &amp; not specified</td>
<td>1</td>
<td>[33]</td>
</tr>
<tr>
<td><strong>TOTAL lines inserted</strong></td>
<td>100</td>
<td><strong>[4655]</strong></td>
</tr>
</tbody>
</table>

### lines

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Singular</td>
<td>74%</td>
</tr>
<tr>
<td>Concurrent</td>
<td>21%</td>
</tr>
<tr>
<td>Sequential</td>
<td>5%</td>
</tr>
</tbody>
</table>
Hospital G

Compliance with bundle items

Area for improvement

- 23% Competency training (70% no; 7% missing)
- 100% Clean Hands
- 100% Sterile gloves
  - 84% Hat
- 100% Prep procedure site
  - 96% Sterile drape
  - 100% Sterile technique maintained
- 87% No multiple passes
- 65% Position of line confirmed
- 59% Used Transducer (39.7% no; 1.6% missing)
Hospital G *Process Surveillance* for Anatomical insertion sites

<table>
<thead>
<tr>
<th>Line type</th>
<th>%</th>
<th>[lines]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Central:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subclavian</td>
<td>36%</td>
<td>[80]</td>
</tr>
<tr>
<td>Jugular</td>
<td>35%</td>
<td>[78]</td>
</tr>
<tr>
<td>Femoral</td>
<td>28%</td>
<td>[63]</td>
</tr>
<tr>
<td>Not specified</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>[257]</td>
</tr>
<tr>
<td><strong>Dialysis:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Femoral</td>
<td>81%</td>
<td>[22]</td>
</tr>
<tr>
<td>Jugular</td>
<td>11%</td>
<td>[3]</td>
</tr>
<tr>
<td>Subclavian</td>
<td>7%</td>
<td>[2]</td>
</tr>
<tr>
<td>Not specified</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>[27]</td>
</tr>
</tbody>
</table>

Area for improvement
Hospital G set process targets

1. Insertion site
2. Competency
3. Full sterile drape
4. No multiple passes/transducer

Set progressive targets for CLABSI with
1. dwell time for 50% ICU patients (Day 11)
2. dwell time for 75% ICU patients (Day 17)
simple analysis if numbers are large

CLABSI ≈10 per year Statistically rare

Distribution not normal

Dwell time is not in a steady state
Process surveillance report

- CVC dwell time (range, median, 75\textsuperscript{th})
- Daily audit: can you remove the CVC?
- Compliance with recommended insertion site
- CLABSI rates: CLABSI in 75\% patients (e.g. 1-8 line-day)
  1000 patient-days [95\%CI]
  100 patients [95\%CI]

- \textbf{Counts of prevention}
## Hospital G non compliance

<table>
<thead>
<tr>
<th>Hospital G by length of participation</th>
<th>Counts of non compliance with Clinician Bundle</th>
<th>[Patient Bundle]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; 6 months post-intervention</td>
<td>15</td>
<td>[7]</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>5</td>
<td>[5]</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>8</td>
<td>[0]</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>9</td>
<td>[4]</td>
</tr>
<tr>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>4</td>
<td>[3]</td>
</tr>
<tr>
<td>6&lt;sup&gt;th&lt;/sup&gt;</td>
<td>2</td>
<td>[0]</td>
</tr>
</tbody>
</table>

83% Clinician Bundle \( p=0.0003 \)
93% Patient Bundle \( p=0.049 \)

CVC inserted in ICU only
<table>
<thead>
<tr>
<th>Hospital G by length of participation</th>
<th>Counts of CLABSI [Malposition + haem]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; 6 months post-intervention</td>
<td>8 [4]</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>1 [4]</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>2 [1]</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>0 [3]</td>
</tr>
<tr>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>2 [0]</td>
</tr>
<tr>
<td>6&lt;sup&gt;th&lt;/sup&gt;</td>
<td>1 [1]</td>
</tr>
</tbody>
</table>

Malposition+/-Haemorrhage *reduction*

Pneumothorax for 3 years *0.4% [1 count]*
## CLABSI Rate (% of insertions)

<table>
<thead>
<tr>
<th>Length of intervention participation</th>
<th>Hospital G</th>
<th>level 6 (teaching) ICUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLABSI / 100 insertions p=0.037</td>
<td>13.8% (95% CI 6.1-25.4)</td>
<td>2.4% (95% CI 1.5-3.6)</td>
</tr>
<tr>
<td>CLABSI / 100 insertions p=0.0019</td>
<td>2.3% (95% CI 0.06-12.0)</td>
<td>1.4% (95% CI 0.7-2.4)</td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; 6 months</td>
<td>5.3% (95% CI 0.6-17.7)</td>
<td>0.9% (95% CI 0.4-1.6)</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>0.0% (95% CI 0.0-7.2)</td>
<td>1.0% (95% CI 0.5-1.8)</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>5.4% (95% CI 0.7-18.2)</td>
<td>0.7% (95% CI 0.2-1.5)</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>3.2% (95% CI 0.08-16.7)</td>
<td>0.5% (95% CI 0.2-1.2)</td>
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</table>

CVC inserted in ICU only
Other CLABSI prevention methods

Some are expensive so which patients should have additional prevention resources?

>9 days average rate 5.5/1000 line-days
Technologies for expected prolonged dwell time
• antiseptic/antibiotic impregnated lines & locks


**CHG bath – requires nursing time**

• **CHG**

Post-insertion care

Inexpensive intervention for all dwell time


- where possible removal of CVL on discharge from ICU
So where to from here

Counts of fewer CLABSI
(between last report and the current one)

75% patients should be at zero risk
- report for first x days (this cut point will differ by hospital)

Technology
• But for whom?.............................
So who gets technology

• Everyone with CVC?
• Just 25% of patients *expected* to have prolonged dwell time?

Ask CEO

Q. What is your maximum willingness to free up an ICU bed at $4000 per day?