Peripheral IVs: Infection Risks, Evidence and Patient Satisfaction

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Disclosures

• This educational activity is brought to you by Becton, Dickinson and Company (BD).

• Michelle DeVries is a paid consultant of BD.

• Data collection, program development at the hospital and publication by the author are not paid in any manner by BD.

• I will not be discussing any off label use of products or procedures.
Objectives

- Review the current literature surrounding risk of infection with peripheral lines.
- Consider the latest evidence based guidelines regarding short peripheral catheters.
- Review the main considerations when adopting a policy of extending dwell time with short peripheral catheters based on more than 3 years of successful implementation at my organization.
Thinking about Peripheral IVs

Most commonly used invasive device in hospitals across the globe

• **60-90%** of patients (in the US) have an IV placed during their hospitalization

HOWEVER...

• High failure rate reported
  - Mean across studies is **46%**
  - Rates are reported as high as **69%**
  - Large analysis of Australian data across 3 hospitals was **37%**

• Outcome measures rarely monitored or reported
  - We will talk about this later!

• Dwell time of clinical indication, not routine rotation, became part of the infusion therapy standards in 2011.

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Wallis, M, et al. Risk Factors for Peripheral Intravenous Catheter Failure: A Multi-variate Analysis of Data from a Randomized Controlled Trial.
Table 4. Subgroup analysis of studies of short-term intravascular devices*

<table>
<thead>
<tr>
<th>Device</th>
<th>All studies</th>
<th>Studies requiring microbial concordance between catheter and blood cultures</th>
<th>Studies requiring microbial concordance and all devices cultured</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of studies</td>
<td>IVD-related BSIs per 1000 IVD-days (95% CI)</td>
<td>No. of studies</td>
</tr>
<tr>
<td>Peripheral IV catheters</td>
<td>10</td>
<td>0.5 (0.2-0.7)</td>
<td>9</td>
</tr>
<tr>
<td>Midline catheters</td>
<td>3</td>
<td>0.2 (0.0-0.5)</td>
<td>2</td>
</tr>
<tr>
<td>Arterial catheters for hemodynamic monitoring</td>
<td>14</td>
<td>1.7 (1.2-2.3)</td>
<td>11</td>
</tr>
<tr>
<td>Peripherally inserted central catheters</td>
<td>15</td>
<td>1.0 (0.8-1.2)</td>
<td>5</td>
</tr>
</tbody>
</table>

Non-cuffed central venous catheters

| Non-medicated                                   |             | | | | | |
|--------------------------------------------------|-------------|-----------------------------------------------------------------------------|------------------------------------------------------------------|
| Non-tunneled                                     | 79          | 2.7 (2.6-2.9) | 63            | 2.9 (2.7-3.2) | 50            | 2.9 (2.6-3.2) |
| Tunneled                                         | 9           | 1.7 (1.2-2.3) | 7             | 0.9 (0.4-1.3) | 5             | 2.1 (1.0-3.2) |

Medicated

| Chlorhexidine-silver-sulfadiazine                  | 18          | 1.6 (1.3-2.0) | 16            | 1.3 (1.0-1.7) | 16            | 1.3 (1.0-1.7) |
| Minocycline-rifampin                              | 3           | 1.2 (0.3-2.1) | 3             | 1.2 (0.3-2.1) | 3             | 1.2 (0.3-2.1) |
| Pulmonary artery catheters                        | 13          | 3.7 (2.4-5.0) | 11            | 3.3 (2.0-4.6) | 10            | 3.3 (1.9-4.6) |

Non-cuffed, non-tunneled hemodialysis catheters  | 16          | 4.8 (4.2-5.3) | 11            | 5.0 (4.2-5.8) | 9             | 6.1 (4.9-7.4) |

*BSI = bloodstream infection; CI = confidence interval; IV = intravenous; IVD = intravascular device

State HAI reporting in Pennsylvania

Hospitals are required to report ALL laboratory confirmed bloodstream infections (LCBI)

- Not just CLABSI

In 2011 there were 2479 LCBI reported to the state

- 1540 were CLABSI
- Which means 939 (38%) did not have a central line in place
  - How many of these may be related to peripheral lines?
  - What else could be contributing?
  - Several studies have shown around 20% of all LCBI may be from PVC

The 2014 HAI report disclosed:

- 2163 bloodstream infections
  - 1140 CLABSI
  - This leaves 1023 with no central line (47%)

http://www.portal.state.pa.us/portal/server.pt/community/healthcare_associated_infections/14234/hai_annual_reports/1403644

More to the *S. aureus* story...

**Further analysis of the Pennsylvania data**

- Included all non-central line related BSI from 2011 and 2012

- Based on pathogen analysis and infection onset, they speculate that “it is likely that the majority of acute care primary BSIs in Pennsylvania are due to PVCRI”

- Additionally, they use *S. aureus* as an indicator for PVCRI and note that there is a substantial spike after 72 hours
Peripheral Venous Catheter-Related Staphylococcus aureus Bacteremia

- **24** *S. aureus* bacteremias
- **12%** of all device related *S. aureus* bacteremias were associated with PVCs
- Average treatment in this study was 19 days
- Serious complications noted:
  - 2 patient deaths and one transfer to hospice
  - 2 incision and drainage (I&D) of local site
  - 1 DVT from PICC line placed to treat PVC-BSI
  - 10 events that would be federally reportable in the US under current regulations
    - 8 MRSA bacteremias
    - 2 C. diff

Risk Factors

- Antecubital fossa (67%)
- Placement outside of the hospital (16%)
  - 2 from outside facilities
  - 2 field starts
- Placement in Emergency Room (67%)
- Longer duration of catheterization
  - 46% had duration greater than 3 days
  - No insertion or maintenance bundles in place to support longer dwell were mentioned

Looking at bundled success

- 8 year project with primary goal to reduce phlebitis and bacteremia related to peripheral lines
- **1631 patients with 2325 short catheters** were followed
- PIV bundle
  - Healthcare worker education and training
  - Withdrawal of unnecessary catheters
    - Any catheter not in use or more than 24 hours was systematically removed
- Catheter exchange policy
- Withdrawal of catheters at early stages of phlebitis
  - Use of scales as measuring tool
- Repeated period prevalence of PVC adverse events

Results

• 59 catheter related BSI were found during the study
  - 19% (11 infections) were PIV related

• For *S. aureus* bacteremias (32 infections)
  - 28% were PIV related
  - 81% of all the PIV infections were caused by *S. aureus*

• Intervention outcomes
  - 48% decrease in phlebitis
  - Significant incidence reduction in PIV bacteremia as well as *S. aureus* bloodstream infections was also seen
Case study of 75 year old man with history of CAD and CHF admitted for CHF exacerbation.

After PIV in for 4 days, RN requested orders to leave IV in an additional day or two because placement (given edema) would be difficult.

On day 6 patient developed erythema at the IV site and later that day developed fever and chills.

- Blood cultures grew MRSA.

Subsequently, patient complained of back pain. MRI of the spine revealed epidural abscess.

- Aspiration grew MRSA

Treatment required 6 weeks of antibiotics and is estimated to have cost hundreds of thousands of dollars.
And more...

**Kovacs 2016**
- 122 episodes of primary SA HABSI:
  - 78 (64%) were CLABSI (38 MRSA+)
  - 44 (36%) were non-CLABSI* (19 MRSA+)

**Austin 2016**
- 2-year, 445 cases of SAB, 34 (7.6%) of which were due to thrombophlebitis at a PIV site
  - Of the 34 PIV cases, 21 were caused by MSSA and 13 by MRSA.
  - 29% of site infections were missed by bedside staff. 79% occurred at old PIV sites

**Guembe 2017**
- 70 episodes of PVC-BSI (1.64 PVC 45 BSI episodes/1,000 IMD admissions)
  - *Staphylococcus aureus* was the most frequently isolated microorganism (41.7%).
CDC Recommendations

- There is no need to replace peripheral catheters more frequently than every 72-96 hours to reduce risk of infection and phlebitis in adults. Category 1B

- No recommendation is made regarding replacement of peripheral catheters in adults only when clinically indicated. Unresolved issue

- Replace peripheral catheters in children only when clinically indicated. Category 1B

- Some studies have suggested that planned removal at 72 hours vs. removing as needed resulted in similar rates of phlebitis and catheter failure. However, these studies did not address the issue of CRBSI, and the risk of CRBSIs with this strategy is not well studied.

INS Standards – 2016

• Remove the short peripheral catheter if it is no longer included in the plan of care or has not been used for 24 hours of more

• Remove short peripheral and midline catheters in pediatric and adult patients when clinically indicated, based on findings from site assessment and/or clinical signs and symptoms of systemic complications.

• Use the venous site most likely to last the full length of the prescribed therapy, using the forearm to increase dwell time, decrease pain during dwell time, promote self-care and prevention accidental removal and occlusions.

• Use a new pair of disposable, nonsterile gloves in conjunction with a “no-touch” technique for peripheral IV insertion, meaning that the insertion site is not palpated after skin antisepsis.

• Dressing changes are performed... every 5-7 days and immediately if the dressing integrity becomes damp, loosened, or visibly soiled, or if moisture, drained or blood are present under the dressing.

• Consider increased attention to aseptic technique, including strict attention to skin antisepsis and the use of sterile gloves, when placing short peripheral catheters... contamination of nonsterile gloves is documented.

INS Standards – 2016

- Consider monitoring bloodstream infection rates for peripheral catheters, or vascular catheter associated infections (peripheral) regularly
- Make no more than 2 attempts at short peripheral intravenous access per clinician, and limit total attempts to no more than 4
- Consider the use of maximal sterile barrier precautions with midline catheter insertion

- For peripheral catheters, consider two options for catheter stabilization: (1) in integrated stabilization feature on the catheter hub combined with a bordered polyurethane securement dressing or (2) a standard round hub peripheral catheter in combination with an adhesive ESD.
Bundling for success – Peripheral lines

• Insertion:
  - CHG skin prep
  - Sterile gloves if repalpating the site
  - Alcohol caps for intraluminal protection
  - Chlorhexidine impregnated sponge dressing for extraluminal protection
  - Updated catheter – integrated extension set
  - Bordered (securement) dressing
  - Neutral connectors
  - New addition 2017 – liquid gum mastic adhesive with dressing placement

• Maintenance:
  - Careful assessment – check the patient, not the box
  - Remove when clinically indicated, with dressing change at 7 days (or sooner if dressing compromised)
  - Re-prep when redressing the site

• Ongoing surveillance of process and outcomes

• Review any infections with floor staff in “real time” to discuss missed opportunities for prevention

What does the data show?

After 12 months of protected clinical indication policy:

- 38% statistically significant reduction in primary bacteremia (sustained at 24 months)
- 19% reduction in PIV associated bloodstream infections (with 6% further reduction at 24 months)
- 48% decrease in IV start kits
- 75% decrease in ICU CLABSI (sustained at 24 months)
- 24% increase in patient satisfaction scores for patients hospitalized at least 5 days


24 month data presented at AVA 2016
What did we learn about the Infections?

Of those (9) that took place 5 days or more after insertion:

- 2 were field starts
- 1 started with alcohol and no CHG sponge dressing placed
- 1 with dressing disruption/change at day 5
- 1 (day 14) had no documented dressing change
- 1 was likely secondary to a POA UTI, but did not meet CDC definition
- 1 had a POA BSI with the same organism on admission but still positive after 16 days so have to count again
Failed IVs

5/25 (20%) had 5 or more PIVs prior to the bloodstream infection

- 4/5 (80%) of these took place prior to Day 5
  - Do we need to expand our definitions/awareness of “attempts” to include serial failed IVs?
  - Early identification and referral to expert team?
Emergency Room starts

• 10/25 (40%) were initiated in the Emergency Department
• 2 more were field starts (EMS)
• Of those hospital based, 43.5% were started in the ER
• This is a similar ratio to the percent of PIVs overall that are placed in the ER in our hospital
  - Suggesting this may be largely attributed to volume as much as differences in practice
  - Provides opportunity for enhanced focus for this group to see the biggest impact per inserter
3 Year Post Implementation (Preliminary)

- Sustained original decrease in PIV bloodstream infections
- PIV performance remained strong despite institutional opportunities with CLABSI
More about those infections (year 3)

7/13 took place Day 4 or sooner:

- 1 of the 7 was MRSA
- 1 was likely a field start
- One occurred that day after a patient removed his own foley with same organisms in the urine

Of those (6/13) that were in the later period:

- 2 of the 6 were likely field starts (no inserter information recorded)
  - Including one MRSA case
- 2 of the 6 were E. coli in patients having liquid or loose stool documented
In total, this study looked at 639 lines in 267 different patients who had PIVs in on June 8, 2017.

- Does not include 34 lines from previous visits that had not been removed from EMR as of the patient’s current admission
- Does not include 5 IVs which were still in patients as of July 7, 2017

59 lines in this study were not removed from EMR after the patient was discharged

- 9.3% of all PIVs were not removed from EMR
- In July 2016, 11% of all PIVs were not removed from EMR
Dwell distribution – average 4.36

### Dwell Day Distribution

<table>
<thead>
<tr>
<th>Dwell Days</th>
<th># of lines</th>
<th>% of total</th>
<th>% Infiltrated</th>
<th>% due to Patient Discharge</th>
<th>% Removed by Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 day</td>
<td>67</td>
<td>11%</td>
<td>15%</td>
<td>24%</td>
<td>16%</td>
</tr>
<tr>
<td>2 days</td>
<td>136</td>
<td>22%</td>
<td>24%</td>
<td>22%</td>
<td>18%</td>
</tr>
<tr>
<td>3 days</td>
<td>119</td>
<td>19%</td>
<td>22%</td>
<td>33%</td>
<td>19%</td>
</tr>
<tr>
<td>4 days</td>
<td>88</td>
<td>14%</td>
<td>15%</td>
<td>44%</td>
<td>7%</td>
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<tr>
<td>5 days</td>
<td>53</td>
<td>8%</td>
<td>13%</td>
<td>25%</td>
<td>19%</td>
</tr>
<tr>
<td>6 days</td>
<td>43</td>
<td>7%</td>
<td>14%</td>
<td>23%</td>
<td>9%</td>
</tr>
<tr>
<td>7+ days</td>
<td>123</td>
<td>20%</td>
<td>11%</td>
<td>37%</td>
<td>9%</td>
</tr>
</tbody>
</table>
## Removal Reasons

<table>
<thead>
<tr>
<th>Reason</th>
<th>Avg. Dwell</th>
<th># of lines</th>
<th>% of lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catheter Damage</td>
<td>5.00</td>
<td>7</td>
<td>1%</td>
</tr>
<tr>
<td>Patient Discharged</td>
<td>4.64</td>
<td>193</td>
<td>31%</td>
</tr>
<tr>
<td>Drainage</td>
<td>5.52</td>
<td>33</td>
<td>5%</td>
</tr>
<tr>
<td>EMS</td>
<td>3.35</td>
<td>17</td>
<td>3%</td>
</tr>
<tr>
<td>Infiltrated</td>
<td>3.83</td>
<td>109</td>
<td>17%</td>
</tr>
<tr>
<td>Leaking</td>
<td>9.00</td>
<td>3</td>
<td>0%</td>
</tr>
<tr>
<td>Occluded</td>
<td>4.09</td>
<td>22</td>
<td>3%</td>
</tr>
<tr>
<td>Painful</td>
<td>4.50</td>
<td>2</td>
<td>0%</td>
</tr>
<tr>
<td>Per Order/Protocol</td>
<td>5.47</td>
<td>19</td>
<td>3%</td>
</tr>
<tr>
<td>Per Request</td>
<td>3.89</td>
<td>19</td>
<td>3%</td>
</tr>
<tr>
<td>Removed by Patient/dislodged</td>
<td>3.91</td>
<td>89</td>
<td>14%</td>
</tr>
<tr>
<td>Site Change</td>
<td>4.69</td>
<td>16</td>
<td>3%</td>
</tr>
<tr>
<td>Unknown/Not Documented</td>
<td>4.24</td>
<td>96</td>
<td>15%</td>
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# Impact of guage

<table>
<thead>
<tr>
<th>Gauge</th>
<th>Dwell</th>
<th># of lines</th>
<th>% of lines</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>3.25</td>
<td>4</td>
<td>1%</td>
<td>0.75</td>
</tr>
<tr>
<td>18</td>
<td>4.20</td>
<td>69</td>
<td>11%</td>
<td>0.96</td>
</tr>
<tr>
<td>20</td>
<td>4.46</td>
<td>290</td>
<td>46%</td>
<td>1.02</td>
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<tr>
<td>22</td>
<td>4.69</td>
<td>197</td>
<td>31%</td>
<td>1.07</td>
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<td>24</td>
<td>3.13</td>
<td>56</td>
<td>9%</td>
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<td>4.00</td>
<td>13</td>
<td>2%</td>
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# Insertion attempts

<table>
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<tr>
<th># of Insertion Attempts</th>
<th>Avg. Dwell</th>
<th># of lines</th>
<th>% of lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 attempt</td>
<td>4.47</td>
<td>429</td>
<td>68%</td>
</tr>
<tr>
<td>2 attempts</td>
<td>4.15</td>
<td>47</td>
<td>7%</td>
</tr>
<tr>
<td>3 attempts</td>
<td>4.29</td>
<td>14</td>
<td>2%</td>
</tr>
<tr>
<td>4 attempts</td>
<td>1.33</td>
<td>3</td>
<td>0.5%</td>
</tr>
<tr>
<td>5 attempts</td>
<td>3.00</td>
<td>3</td>
<td>0.5%</td>
</tr>
<tr>
<td>Unknown</td>
<td>4.17</td>
<td>133</td>
<td>21%</td>
</tr>
</tbody>
</table>
Prevalence summary:

Average dwell time 4.36 days

- Range 1-21 days
- 35% lasted over 5 days
- 20% lasted 7 or more days
- 1/3 were removed within 1st 48 hours
  - 23% due to patient discharge
  - 21% due to infiltration
  - 17% due to removal by patient
- Infiltration rates highest at days 2 & 3 (24%, 22%)
  - Rates of infiltration drop after 3rd day mark (15-11%)
## Process measures

### VAD DEVICE TYPE

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<tr>
<th>TYPE</th>
<th># OF DEVICES</th>
<th>% OF TOTAL</th>
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<tr>
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</tr>
<tr>
<td>PAC</td>
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<td>#DIV/0!</td>
</tr>
<tr>
<td>NONTUNNELLED CVC</td>
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</tr>
<tr>
<td>TUNNELLED CVC</td>
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<td><strong>TOTAL</strong></td>
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### INDICATION

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<tr>
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<td>PRESSORS</td>
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<td>MEDS REQUIRING CENTRAL ACCESS</td>
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</tr>
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<td>MULTIPLE INCOMPATIBLE MEDS</td>
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<tr>
<td>DIFFICULT ACCESS</td>
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<tr>
<td>OTHER</td>
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<td><strong>TOTAL</strong></td>
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### SITE ASSESSMENT

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<tr>
<td>DRAINAGE</td>
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<td>LEAKING</td>
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### ALCOHOL CAPS IN PLACE

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<th>% OF TOTAL</th>
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</tr>
<tr>
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### TUBING DATED

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<td>#DIV/0!</td>
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<tr>
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### DRESSING INTEGRITY

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### INTERVENTION

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<th># OF DEVICES</th>
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Surveillance for PIV BSIs

• The NHSN (and formerly NNIS) protocols are applied in the exact manner for PIVs as they are for central lines.

• Cultures are first screened to identify whether timing of collection is consistent with a hospital acquired infection, including readmissions from recent discharges.

• Pathogens are then assessed to determine which criteria from the protocol are to be considered.

• After fulfilling all elements of the definitions, and ruling out the presence of secondary infections (per the NHSN protocol) only then are line types assessed.
What about midlines?

• In an effort to reduce CLABSI incidence many hospitals are looking increasingly to midline catheters as part of their solution.

• Midlines are considered peripheral catheters per INS standards and CDC definitions regarding tip termination.

• How are you protecting your patients with these lines?
  - Insertion? INS says consider maximum sterile barriers.
  - Protection? These lines may dwell for up to 29 days. INS lists clinical indication as the appropriate choice for these devices as well.

• How are you measuring success?
  - Decrease in central line days?
  - Decrease in CLABSI?
  - Material costs and time savings?
  - Incidence of Midline associated bloodstream infection?

and Infusion Therapy Standards of Practice, Journal of Infusion Nursing. 2016, V39 (1S)

It’s not just about infections…

• Fewer sticks by reducing arbitrary restarts can impact:
  - Patient satisfaction
  - Vessel preservation
  - Supply costs
  - Nursing time

• Expanding interventions beyond just central lines *may* also benefit CLABSI rates

• Anyway you look at it, making an investment in safely implementing an approach to address peripheral IVs there is much to be gained
Planning for safety

- Engaging all involved disciplines in the development of a new policy for extending dwell time
- Addressing any product changes to assist with objectives of increased dwell time
- Reviewing staff training/competencies
- Understanding measures of success
  - Process measures
  - Outcome measures
    - Increased dwell time
    - Minimize risk of infections and complications
Knowing your own data...

- How do you know it’s not a problem if you aren’t looking?
- NHSN definitions are for laboratory confirmed bloodstream infections
  - “Become” Central line associated (CLABSI) by the presence of a central line
  - Same reasoning can be applied BSI with no source other than Peripheral venous access

- Process data is as important as outcome data
  - Take advantage of value added offerings from vendors to help leverage your data

- Consider product and practice interventions for all intravascular devices, not just central lines.

- Advocate for a national registry for IV complications to include all devices