Selective Blindness and Peripheral IVs:

Where Complications are Commonplace

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Clinical Applications Engineer Specialist
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Disclosure

• 3M employee and shareholder
Learning Objectives

• Identify current clinical standards addressing peripheral vascular care

• Discuss clinical challenges, including blood stream infections, associated with peripheral catheter maintenance that can impact outcomes

• Describe recommended practices and evidence-based interventions for peripheral catheter maintenance

• Identify potential solutions to address these challenges and clinical studies that support these solutions
Why Are These Treated Differently?
Standards and Guidelines
Infusion Therapy Standards of Practice
S33. Vascular Access Site Preparation and Device Placement

Infusion Teams
A. Consider implementation of specialized infusion teams to improve success rates with peripheral intravenous (IV) insertion (refer to Standard 4, Infusion Team).

CHG Skin Prep
D. Perform skin antisepsis using the preferred skin antiseptic agent of >0.5% chlorhexidine in alcohol solution.

Sterile Gloves and Elevated Aseptic Technique
2. Consider increased attention to aseptic technique, including strict attention to skin antisepsis and the use of sterile gloves, when placing short peripheral catheters. While there is a lack of evidence comparing bloodstream infection (BSI) rates with or without use of sterile gloves, longer dwell times have raised concerns regarding risk for BSI. Furthermore, contamination of nonsterile gloves is documented.21-23 (V, Committee Consensus)
Infusion Therapy Standards of Practice
S34. Needleless Connectors

Disinfecting Caps

G. Use of passive disinfection caps containing disinfecting agents (eg, isopropyl alcohol) has been shown to reduce intraluminal microbial contamination and reduce the rates of central line-associated bloodstream infection (CLABSI). Use of disinfection caps on peripheral catheters has limited evidence but should be considered.
Infusion Therapy Standards of Practice
S37. Vascular Access Device (VAD) Stabilization

Do Not Rely on Non-Bordered Dressings for Stabilization
C. Do not rely on VAD dressings (ie, standard, nonbordered transparent semipermeable membrane [TSM] dressings, gauze and tape dressings) as a means for VAD stabilization as there is insufficient evidence supporting their benefits as stabilization devices.11 (I)

Stabilization Catheter + Bordered Dressing or ESD
D. For peripheral catheters, consider 2 options for catheter stabilization: (1) an integrated stabilization feature on the peripheral catheter hub combined with a bordered polyurethane securement dressing or (2) a standard round hub peripheral catheter in combination with an adhesive ESD. Both have demonstrated equivalent complication rates, although complication rates for both types were not greatly reduced with either type of ESD.12,13 (III)
Infusion Therapy Standards of Practice
S41. Vascular Access Device (VAD) Assessment, Care, and Dressing Changes

Assess the Catheter-Skin Junction Site
C. Assess the VAD catheter-skin junction site and surrounding area for redness, tenderness, swelling, and drainage by visual inspection and palpation through the intact dressing and through patient reports about any discomfort including pain, paresthesias, numbness, or tingling.

Consider the Use of CHG Dressings
M. Consider use of chlorhexidine-impregnated dressings with peripheral arterial catheters as an infection reduction intervention.3,17,29 (III)
Infusion Therapy Standards of Practice

S44. Vascular Access Device (VAD) Removal

Remove When Clinically Indicated
B. 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 (e.g., bloodstream infection).

Label and Remove Emergently Placed Catheters ASAP
C. Consider labeling catheters inserted under suboptimal aseptic conditions in any health care setting (e.g., "emergent"). Remove and insert a new catheter as soon as possible, preferably within 24 to 48 hours.5-7 (IV)
Infusion Therapy Standards of Practice

Sutureless Securement
Use a sutureless securement device to reduce the risk of infection for intravascular catheters [105]. Category II

Clinically Indicated Removal?
1. There is no need to replace peripheral catheters more frequently than every 72–96 hours to reduce risk of infection and phlebitis in adults [36, 140, 141]. Category 1B
2. No recommendation is made regarding replacement of peripheral catheters in adults only when clinically indicated [142–144]. Unresolved issue
3. Replace peripheral catheters in children only when clinically indicated [32, 33]. Category 1B


Clinically Indicated
Routine care of peripheral intravenous catheters versus clinically indicated replacement: randomised controlled trial


- 755 Patients
- 379 Clinically Indicated, 376 Routine
- Control – 60.9/1000 failure rate
- Intervention – 59.8/1000 failure rate

No Statistical Difference
Randomized Controlled Trial: Routine Versus Clinically Indicated\(^4,5\)

Analyzed 6,000 peripheral IV catheters and their dwell time

<table>
<thead>
<tr>
<th></th>
<th>Routine Replacement</th>
<th>Clinically Indicated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phlebitis Rate</td>
<td>114 of 1690 (7%) of patients</td>
<td>114 of 1593 (7%) patients</td>
</tr>
</tbody>
</table>

No Difference in Phlebitis Rates


No Difference in Outcome\textsuperscript{5-7}

Webster, 2013 Clinically Indicated Replacement Versus Routine Replacement of Peripheral Venous Catheters

Performed a review of seven PIV trials: Out of 4895 PIV patients, there was no evidence to support changing catheters every 72-96 hours.

Results:
\begin{itemize}
\item No significant difference between CRBSI rate.
\item No difference in phlebitis rates.
\begin{itemize}
\item Even found decrease in rates with increased dwell time.
\end{itemize}
\item Lower cannulation costs of approximately AUD 7 ($5 USD)
\end{itemize}

Projected 5-year savings:
$300 million and 1 million health care worker hours
Evidence-Based Practice: Before and After

Post-Intervention Data

- PIV catheter use following implementation of 3 month pilot practice change decreased by 14.2%
  - *Despite an increase in patient days*
- 70 hours of RN time saved
- There were no peripheral catheter infections during the 3 months following the practice change.

Post-Intervention Data

<table>
<thead>
<tr>
<th>Pre-Intervention</th>
<th>Post-Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Days of SPC Use</td>
<td>Patient Days of SPC Use</td>
</tr>
<tr>
<td>SPC Use per 1000 Patient Days</td>
<td>SPC Use per 1000 Patient Days</td>
</tr>
</tbody>
</table>

Clinically Indicated Considerations and Complications
Inconsistency in Practice\textsuperscript{9-12}

Alexandrou, 2018 Use of Short Peripheral Intravenous Catheters: Characteristics, Management, and Outcomes Worldwide

Cross sectional study reviewed 40,620 peripheral IVs in 51 countries:

- 66\% placed in a non-recommended area
- 21\% of dressings were placed incorrectly or needed replacement
- 33\% of devices had no documented site assessment
- 71\% of insertions by ward RNs
Bacterial Phlebitis

- The skin cannot be sterilized!
- Bacteria, or skin flora, reside on and under the skin surface
- Unsecured catheters may physically transport bacteria into the bloodstream
- Skin flora regrow in 24-48 hours after skin antisepsis

Skin Flora Concentrations with and without antimicrobial dressing

Complications of Inadequate Securement

Helm et al, 2015 Accepted but unacceptable: Peripheral IV catheter failure.

<table>
<thead>
<tr>
<th>Complication</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catheter-Related Phlebitis</td>
<td>15.4%</td>
</tr>
<tr>
<td>Catheter Infiltration</td>
<td>23.9%</td>
</tr>
<tr>
<td>Catheter Occlusion/Mechanical Failure</td>
<td>18.8%</td>
</tr>
<tr>
<td>Catheter Dislodgement</td>
<td>6.9%</td>
</tr>
<tr>
<td>Catheter-Related Infection Up to</td>
<td>2.2%</td>
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<td></td>
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<tr>
<td>Overall PIV Catheter Failure Rate</td>
<td>46%</td>
</tr>
</tbody>
</table>

“The average cost of a short peripheral IV catheter insertion in the United States is between $28 and $35 for straightforward “first-stick” insertions.”

Complications of Inadequate Securement

Jackson, 2012 Retrospective comparative audit of two peripheral IV securement dressings.

“An internal review of 6500 peripheral cannula outcomes suggested that around 36% failed as a result of dislodgement.”

“Statistical analysis showed that during the period of use of the [securement dressing], the number of cannula reaching 72 hours increased by a factor of 2.94...”

“The total number of PVC restarts during the comparative audit periods was 9% lower...”

Emergently Placed PIVCs

Stuart 2016 - 137 S. aureus PVCR-BSIs
- 61% inserted by the ambulance service or ED
- 45% involved PVCs in situ beyond 4 days

Trihn 2011 – Emergency Department PIVCs
- 67% increased risk PVCR S. aureus bacteremia


How many CLABSIs may be related to PIVs?\textsuperscript{9-10}

Clear evidence exists in the literature that PIVs and midline catheters are linked to nosocomial bacteremia.

**Non-CLABSI Complications**

- Bacteremia more common
- Increase in complications: endocarditis, cardiac implant device infection
- Potential delay in diagnosis

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Complications of Inadequate Securement

Hadaway, 2012 Short Peripheral intravenous catheters and infections.

...pooled PIV infection mean rate of 1/1000 devices
...pooled PIV infection mean rate of 0.5/1000 device-days

9,700,000 PICCs & CVCs
350,000,000 PIVs

“Studies show venipuncture proficiency rates of 2.18 attempts and 2.35 attempts to establish 1 catheter site. If we consider that half of the catheters sold are successfully inserted, a rate of 0.1% of these catheters producing a BSI would result in 165 000 patients becoming infected annually.”


3M Internal Data on File
Systematic review: PIV dwell times, CRBSI, and catheter colonization

PVCs with dwell times >3-4 days have been associated with increased risk of *S. aureus* related PVCR-BSIs

65 articles reviewed from 1980-2017

Incidence of PVCR-BSI (0.18%)

23% of all hospital-acquired CRBSI were short term PVCs (*S. aureus* was most common pathogen)

33% of healthcare associated *S. aureus* CR-BSI’s are due to PIVs

Routine care of peripheral intravenous catheters versus clinically indicated replacement: randomised controlled trial


- 755 Patients
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- No statistical difference
Why Are These Treated Differently?
PIV Survival
Survival of PIVs $^{7,28}$

Wallis, 2013 Risk Factors for Peripheral Intravenous Catheter Failure
Secondary data analysis from a RCT of PIVC dwell time on 3,283 adult med/surg patients

- PIVC survival is improved by addressing modifiable risk factors

- PIVCs placed by OR or Radiology suite staff had a 20% lower occlusion risk than floor insertions
Central Line Insertion and Maintenance Bundles

Evidence-based recommendations

**Central Line Insertion Bundles**

- **Hand Hygiene**

- Skin antisepsis using >0.5% chlorhexidine in alcohol solution

- Maximal sterile barrier precautions (Mask, cap, sterile gown, large sterile drape and sterile gloves)

- Avoid the femoral vein for CVC placement

**Central Line Maintenance Bundles**

- Perform hand hygiene before manipulation of IV system

- Assess need for catheter daily

- Dressing change recommendations and guidelines based on dressing type

- IV tubing administration set, secondary set and add-on device change guidelines based on medication or product infused

- Disinfect IV access ports with appropriate disinfectant for a period of time
Peripheral Line Maintenance Bundle $^{28, 31, 33}$

Consider sterile barrier precautions

Perform hand hygiene before manipulation of IV system

Assess need for catheter daily

Proper site assessment and removal for s/s of phlebitis or infection

Use an ESD

Dressing change recommendations and guidelines based on dressing type

Use of disinfecting port protectors on all needleless connectors and Luers

Use of antimicrobial at the insertion site
Peripheral IV Care Bundle[^6,10,13,32,34-38]

Literature Review

- Specially trained nurses
  - Less signs and symptoms of infection
  - Greater number of catheters placed
  - Decrease costs
  - Enhanced quality of patient care

- Standardize catheter care after insertion
  - Proper dressing placement
  - Stabilization and securement
  - Connector cleaning and use
  - Catheter flush technique
  - Proper surveillance

- Caregiver education to optimize outcomes
A Bundled Approach to Decrease Primary Bloodstream Infections Related to Peripheral Intravenous Catheters

**DESIGN**
- Before and after intervention study on peripheral line associated bloodstream infections (PLABSI)

**INTERVENTION**
- PIV bundle implemented and compliance monitored
- Bundle included: disinfecting cap for needleless connectors, disinfecting cap for male luers, change all IV tubing every 96 hours and prohibit disconnecting IV tubing for convenience

**RESULTS**
- PLABSI rate was reduced from 0.57 to 0.11 infections per 1000 patient days (p <= 0.001)
- Compliance near 90% was attained
Evidence-Based Practice: Before and After

Pre-Intervention

Using Kotter’s Model of Change a 144-bed hospital implemented clinically indicated PIV removal policy change from 96 hour dwell time

- Gathered 3 months PIV use, phlebitis, and infections rates.
- Identify Team of Key Stakeholders:
  - Medical director for infection control
  - 2 infection prevention specialists
  - Director of quality and safety
  - Manager of regulatory preparedness
  - Director of nursing
  - Nurse manager and RNs from the pilot unit
  - Several RNs from other units in the health care system.
- Staff communication given by the project leader during the unit’s monthly staff meetings in advance of implementation
- Online education module
Evidence-Based Practice: Before and After

Using Kotter’s Model of Change a 144-bed hospital implemented clinically indicated PIV removal policy change from 96 hour dwell time

**Intervention Support**

- Weekly communication with implementation team:
  - nurse manager, clinical resource leaders, infection prevention specialists, and staff RNs
- IP surveillance for three months post
- Each month after the practice change, outcome data were displayed for the staff in a high-traffic area
Moving to Clinically Indicated
How to Sell an Idea to a Hospital

Make the clinical case

Make the business case

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How are hospitals reimbursed?

1983 – The DRG, the best of the worst ideas

58% Government Funded (42% Medicare & 16% Medicaid)
32% Private Insurance

DRG Weight
- Primary Diagnosis
- Secondary Diagnosis
- Tertiary Diagnosis, etc
- Surgical Interventions

Base Rate
- Labor (Regionally Adjusted)
- Non-Labor

Indirect Costs
- Teaching Hospital Adjustment

Cost Outliers
- Complex Patients
- Application Required

Disproportionate Share
- Low Income Patients


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The Business Case

The Problem or Goal
• Patient comfort?
• Cost?
• Clinical Outcomes?

Assessment
• Policy?
• Training?
• Supplies?
• Outcomes assessment?

Solutions
• Policy?
• Training?
• Supplies?
• Outcomes assessment?

Cost-Benefit
• Run the numbers

Your Allies
• Purchasing/Materials Management
• Infection Prevention
• Quality Improvement
• Clinical Champions
• Patient Experience Liaisons
• Medical Reps
How many PIVs will clinically indicated impact?

Can I just count the total amount of PIVs we purchase every year?

- Takes over 2 attempts to establish 1 site
- PIVs placed in the ED are not impacted by clinically indicated
- How are materials costs differ from inpatient compared to the hospital in total?
The Numbers
How Many PIVs?

**Average Hospital Profile**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Beds</td>
<td>150</td>
</tr>
<tr>
<td>Admissions</td>
<td>5,879</td>
</tr>
<tr>
<td>ED Visits</td>
<td>23,445</td>
</tr>
<tr>
<td>aLOS</td>
<td>4.0</td>
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</tbody>
</table>

**National Avg Profile**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Total Admissions</td>
<td></td>
</tr>
<tr>
<td>ER Visits</td>
<td></td>
</tr>
<tr>
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</table>

**Patient Flow**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Admits from ED</td>
<td>2,110</td>
</tr>
<tr>
<td>Admits Non-ED</td>
<td>3,769</td>
</tr>
<tr>
<td>ER Visits Not Admitted</td>
<td>21,405</td>
</tr>
</tbody>
</table>

**National Avg Patient Flow**

<table>
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<td>ER Visits</td>
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**IV Setup/Kit Volume**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>PIVs in ED: Admitted</td>
<td>2,110</td>
</tr>
<tr>
<td>PIVs in ED: Discharged</td>
<td>8,990</td>
</tr>
<tr>
<td>PIVs from Non-ED Admit</td>
<td>3,769</td>
</tr>
<tr>
<td>PIVs replaced on floor</td>
<td>4,409</td>
</tr>
</tbody>
</table>

**Total PIVs + Kits**

<table>
<thead>
<tr>
<th>Value</th>
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<tr>
<td>19,278</td>
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**Total Inpatient PIVs + Kits**

<table>
<thead>
<tr>
<th>Value</th>
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<tr>
<td>10,288</td>
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</table>

<table>
<thead>
<tr>
<th>Calculation</th>
</tr>
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<tbody>
<tr>
<td>(2,110 + 8,990 + 3,769 + 4,409)</td>
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The Numbers

What is the cost for PIV insertions?

Assumptions

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Insertion Cost Per IV | $28-$35 | (According to 2015 Helm)
Total Insertion Cost | $539,784-$674,730 | (19,278 x $28 | 19,278 x $35)
Material Cost Per IV | ~$10 | (kits, flush, extension, 2-PIV catheters)
Total Material Cost | $192,780 | (19,278 x $10)
## The Numbers

What is the financial impact of clinically indicated?

### Assumptions

<table>
<thead>
<tr>
<th>Total PIVs + Kits</th>
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<th>17,817</th>
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<td>Total Inpatient PIVs + Kits</td>
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<td>8,827</td>
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### Clinically Indicated Impact

| PIV Use Reduction | 14.2% | (Based on 2018 Stevens, Milner, & Trudeau) |
| Total PIV Reduction | 1,461 | (10,288 x 0.142) |
| Total Cost Reduction | $40,908 - $51,135 | (1,461 x $28 | 1,461 x $35) |
| Total Material Cost Reduction | $14,610 | (1,461 x $10) |

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Bacterial Phlebitis\textsuperscript{57-58}

- The skin cannot be sterilized!
- Bacteria, or skin flora, reside on and under the skin surface
- Unsecured catheters may physically transport bacteria into the bloodstream
- Skin flora regrow in 24-48 hours after skin antisepsis

Skin Flora Concentrations with and without antimicrobial dressing

# The Numbers

## Antimicrobial Financial Impact

### Assumptions

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- **Total Material Cost Reduction**: $14,610 (1,461 x $10)

### Financial Impact of Brining in an Antimicrobial

- **Antimicrobial**: $3
- **Total Material Cost Increase**: $26,481 (8,827 x $3)
- **Material Cost Minus Clin. Ind.**: $11,871 ($26,481 - $14,610)
- **Cost of 1 CABS1**: $45,000
- **Total Cost**: $33,129 ($45,000 - $11,871)

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“Insertion of an IV catheter is an invasive procedure that introduces multiple risks and potential morbidities, and even mortality, and should be given the respect it deserves.”

– Dr. Robert E. Helm
References

References


References


36. Maki DG. Improving the safety of peripheral intravenous catheters. *BMJ.* 2008;337:122-123


38. Lai KK. Safety of prolonging peripheral cannula and i.v. tubing use from 72 hours to 96 hours. *Am J Infect Control* 1998; 26:66–70.
