Welcome & Housekeeping

- Thank you for attending!
  - HMS data abstractors
  - Administrators
  - QI staff
  - Vascular access
  - Interventional Radiology
  - Hospitalists
  - Individuals not affiliated with HMS

- Q & A session following presentation
  - All phones muted
  - Please raise your hand using the webinar software or type your question
HMS: Collaborative Quality Initiative

- HMS: 1 of 17 CQIs in Michigan
- Funding: Blue Cross Blue Shield of Michigan
  - Coordinating Center
  - 0.85 FTE data abstraction per hospital
  - Pay for performance
- Michigan hospitals voluntarily enroll
HMS Hospitals

- 43-50 hospitals
- Diverse types / settings
  - Large AMCs - Small rural hospitals
- Hospital Participants
  - Physician Champion-hospitalist
  - Quality Lead
  - Data Abstractor
- Improving Care
  - Data / best practice sharing / facilitated implementation
HMS Goal

To improve the quality of care for hospitalized medical patients who are at risk for adverse events

- Current QI Initiatives:
  - Hospital-Associated VTE
  - Intravascular Devices (PICC-Midlines)
  - Inpatient Antimicrobial Use
Midlines: Middle Ground vascular access devices
Overview

- Introduction and Historical Aspects
- Evidence review – what do we know about midlines?
- HMS midline data review
- Questions and Answers
Overview

- Introduction and Historical Aspects
- Evidence review – what do we know about midlines?
- HMS midline data review
- Questions and Answers
Growing focus on alternatives to using PICCs
One such alternative: Midline catheter
HMS launched midline pilot in summer of 2017; data collection expanded collaborative wide winter 2018
Midline project was driven by HMS sites
  ○ More PICCs being replaced with midlines
  ○ Is midline use associated with potential complications?
  ○ Are midlines “safer” than PICCs?
To date~1,500 cases collected
What are Midline Catheters?

- **Midlines** – a diverse group of devices that share in common the following characteristics:
  - Inserted in peripheral veins of the arm
  - Do not enter the central circulation

- Consequently – midlines are best thought of as “middle ground” devices
  - Reside in larger, deeper veins of the arm → more blood flow
  - More hemodilution = ability to dwell longer, less phlebitis
    - PIV - 40 ml/min in peripheral vein
    - Midline - 120ml/min in the deep upper arm veins
Anatomic localization of Midline Tip

PICC

Midline
Historical Aspects

- **Midlines are not new!**
  - First devices introduced in the 1950’s (before PICCs)
    - Surgical patients >7 days of treatment
  - Suffered from many problems
    - Device failure ~ 40%
    - High rates of contact allergy and phlebitis (materials)

- **1970’s: PICCs introduced**
  - Attention to midlines dropped as PICC use grew

- Growing concern and reports of inappropriate PICC use/overuse → renewed interest in midlines
Midlines are called many things...

- Extended dwell peripheral IV catheters
- Long peripheral IVs
- US-guided peripheral catheters
- Medial venous catheter
- Peripherally inserted midline device

All meet midline criteria – the difference is catheter length
HMS Definition of a Midline

- To qualify as a midline, a device must:
  - Be inserted into one of the veins of the arm
  - Have a catheter tip that dwells in the basilic, cephalic, or brachial vein
  - Terminate at or below the level of the axilla

- Midlines thus may range from 6-25cm in length.
- For the purposes of the HMS project, extended-dwell peripheral IVs are included in data collection.
Characteristics of Modern Midlines

- 4-5 French in diameter; Single and double lumen
- some trimmed/others pre-cut
- Power compatible for radiographic injections
- Number of materials
- Number of insertion techniques (MST/AST)
- Majority are placed under US guidance
- Majority are placed using maximal sterile barriers
- Common indications: difficult access, antibiotic Rx
- A number of devices and manufacturers
Overview

- Introduction and Historical Aspects
- Evidence review – what do we know about midlines?
- HMS midline data review
- Questions and Answers
Evidence Review

- **Structured literature search**
  - Contemporary data only (2016 onwards)
  - All study designs
  - Adults Only

- **Focused on studies comparing midline to other vascular access devices:**
  - PICCs, CVCs
  - Peripheral IVs

- **Focused on types and rates of complications**
  - DVT, CLABSI, dislodgement, occlusion, etc.
The Risk of Adverse Events Related to Extended-Dwell Peripheral Intravenous Access

Sara Campagna, PhD, RN; Silvia Gonella, RN, MSc; Pietro Antonio Zerla, RN; Gianvito Corona, MD; Tiziana Correggia, RN, MSc; Baudolino Mussa, MD; Paola Berchialla, PhD; Valerio Dimonte, RN, MSc
Study Design

- Retrospective database review; 2 hospitals in Italy
- All patients that received a midline between Sept 2007-Dec 2014 were included
- Midlines inserted using maximal sterile barriers and ultrasound guidance by a trained team
- 4-5Fr devices; 20-25 cm in length
- Main outcome:
  - Removal due to an adverse event (occlusion, exit site infection, bloodstream infection, symptomatic DVT)
  - Removal due to other reasons (completion of treatment, accidental dislodgement, patient death or 28d of infusion)
Ten percent of midlines had adverse events (AEs) that required removal; 90% did not.

Midlines that had AEs were removed earlier than those that did not.
Low rates of Adverse Events

No bloodstream infections

Occlusion most common complication (6%)

DVT Rates ~ similar to PICCs (4%)

<table>
<thead>
<tr>
<th>Adverse Events</th>
<th>No.</th>
<th>No. of Complications per 1,000 MC days</th>
<th>Time Elapsed Between MC Positioning and Onset of AE, median d (IQR; range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occlusion(^a)</td>
<td>89</td>
<td>1.44</td>
<td>13 (6–28; 1–273)</td>
</tr>
<tr>
<td>Symptomatic thrombosis(^b)</td>
<td>57</td>
<td>0.92</td>
<td>19 (8–32; 1–307)</td>
</tr>
<tr>
<td>Exit-site infection(^c)</td>
<td>8</td>
<td>0.13</td>
<td>9 (7.8–39.8; 5–323)</td>
</tr>
<tr>
<td>All adverse events(^d)</td>
<td>154</td>
<td>2.49</td>
<td>14 (6–28; 1–323)</td>
</tr>
</tbody>
</table>
Major Article

Comparison of complications in midlines versus central venous catheters: Are midlines safer than central venous lines?

Ammara Mushtaq MD a, Bhagyashri Navalkele MD a, Maninder Kaur MD b, Amar Krishna MD b, Aleena Saleem MD b, Natasha Rana BSc c, Sonia Gera BSc c, Suganya Chandramohan MD b,*, Malini Surapaneni MD a, Teena Chopra MD, MPH a

a Department of Medicine, Detroit Medical Center/Wayne State University, Detroit, MI
b Division of Infectious Diseases, Detroit Medical Center/Wayne State University, Detroit, MI
c Wayne State School of Medicine, Detroit, MI
Study Design

- Retrospective cohort study; single center
- March – September 2016
- Midline outcomes compared to CVC/PICC outcomes
- Main outcomes:
  - Catheter-related Blood Stream Infection (CRBSI)
  - Mechanical complications
  - Length of Hospital Stay
  - Readmission
  - Death
Most midlines were placed during hospitalization. Common indications for midline placement included difficult IV access (76.6%) and antibiotics (19.4%). 97.3% midlines placed by vascular access team.
Many midlines were used in patients with an ICU stay. Midlines were associated with low CRBSI (1 vs 10). Few DVT (2) noted in this study. Higher number of mechanical complications among those that got midlines vs. CVCs (11 vs 1). No differences in removal rates between midlines and CVC.
Major Article

Safety and utilization of peripherally inserted central catheters versus midline catheters at a large academic medical center

Tianyuan Xu MPH a, Lawrence Kingsley DrPH a, Susan DiNucci RN, CIC b, Gwen Messer MT b, Jong-Hyeon Jeong PhD c,d, Brian Morgan RN e, Kathleen Shutt MS f, Mohamed H. Yassin MD, PhD, CIC b,f,*
Study Design

- Retrospective cohort study; single center Pittsburgh
- PICCs and midlines inserted by vascular access team
- Both PICCs and midlines were same manufacturer
- Main outcomes:
  - Severe complications (infection, phlebitis and DVT)
  - Readmission because of line issues
  - Minor complications
    - Leaking
    - Edema
    - Pain
    - Occlusion
<table>
<thead>
<tr>
<th>Complications</th>
<th>PICC (n = 206)</th>
<th>Midline catheter (n = 200)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe complications</td>
<td>10 (4.9)</td>
<td>18 (9.0)</td>
<td>.12</td>
</tr>
<tr>
<td>Phlebitis-infection</td>
<td>3 (1.5)</td>
<td>5 (2.5)</td>
<td></td>
</tr>
<tr>
<td>DVT</td>
<td>2 (1.0)</td>
<td>2 (1.0)</td>
<td></td>
</tr>
<tr>
<td>Readmission because of line issues</td>
<td>4 (1.9)</td>
<td>0 (0.0)</td>
<td></td>
</tr>
<tr>
<td>Positive culture</td>
<td>5 (2.4)</td>
<td>5 (2.5)</td>
<td></td>
</tr>
<tr>
<td>Infiltration</td>
<td>0 (0.0)</td>
<td>9 (4.5)</td>
<td></td>
</tr>
<tr>
<td>Minor complications</td>
<td>3 (1.5)</td>
<td>23 (11.5)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Pain</td>
<td>0 (0.0)</td>
<td>3 (1.5)</td>
<td></td>
</tr>
<tr>
<td>Nonpatent</td>
<td>3 (1.5)</td>
<td>17 (8.5)</td>
<td></td>
</tr>
<tr>
<td>Leaking</td>
<td>0 (0.0)</td>
<td>2 (1.0)</td>
<td></td>
</tr>
<tr>
<td>Edema</td>
<td>0 (0.0)</td>
<td>1 (0.5)</td>
<td></td>
</tr>
<tr>
<td>Total complications</td>
<td>12 (5.8)</td>
<td>39 (19.5)</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

- Midlines: more “severe” complications, non-statistical
- Three of the 5 phlebitis cases in the midline group = receiving Vancomycin (controversial)
- More readmissions in patients with PICCs than midlines
- Minor complications more common in midlines than PICCs
What do these three studies tell us?

- Overall, minor complications such as dislodgement, leaking, phlebitis ≥ more common in midlines
- Infection is less frequent; DVT is same or better
- Important limitations to these data:
  - All single centers retrospective studies
  - All used different devices, inserters, teams
  - A variety of infusates delivered through midlines
  - Different outcome measurement
- A substantial gap in knowledge about use and safety of midlines; HMS is well poised to fill these gaps
Overview

- Introduction and Historical Aspects
- Evidence review – what do we know about midlines?
- HMS midline data review
  - Current State
  - What does pilot data tell us?
  - Why are we asking for specific data elements?
- Questions and Answers
Midline Initiative: Current State

- **Baseline data collection ongoing**
  - Need to understand data before we make improvements
  - Place our findings in context:
    - What we know about midline use in our hospitals
    - Differences across device, insertion, infusate and care
    - Differences in complications across hospitals

- **Current focus**
  - Understand current practice in HMS hospitals
  - Generate new knowledge into best practice
  - Improve documentation related to insertion practices, complications, etc. across HMS hospitals
Midline Dwell Times Across the Collaborative

- 47.1% of midlines dwell for 0-5 days
- 29.5% of midlines dwell for 6-14 days
- 7.1% of midlines dwell for 15-30 days
- 16.2% of midlines dwell for greater than 30 days

32 Hospitals, 1,573 Midlines
Written Informed Consent for Midline

- No: 54.5%
- Unknown: 12.3%
- Yes: 33.1%
Should Midline placement require informed consent?

- Does a general consent cover placement of a Midline?
  - Given the risk associated with Midlines, we recommend informed consent

- Sample Midline placement consent*
  - Can also be incorporated with existing PICC consents

*Resource located on HMS website (http://mi-hms.org/)
Documented Indications for Midline Placement

Lots of unknowns! Need to better document indication for midline use!

32 Hospitals
1,573 Midlines
Documentation of Midlines

- Example template for documentation of midline insertion*
- Ensures documentation of key variables that can be tracked to assist with local QI efforts
- Ensures better understanding of drivers of complications or limited dwell time

### Midline Insertion Note Template

<table>
<thead>
<tr>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order requested by: (Provider ID)</td>
</tr>
<tr>
<td><strong>Indication for midline placement:</strong></td>
</tr>
<tr>
<td>- Antibiotics (intravenous)</td>
</tr>
<tr>
<td>- Blood transfusion or Blood Products</td>
</tr>
<tr>
<td>- Chemotherapy</td>
</tr>
<tr>
<td>- Blood Draws</td>
</tr>
<tr>
<td>- Difficult Access</td>
</tr>
<tr>
<td>- IV Fluids or Hydration</td>
</tr>
<tr>
<td>- Multiple Incompatible Fluids</td>
</tr>
<tr>
<td>- Radiographic Study</td>
</tr>
<tr>
<td>- Other</td>
</tr>
<tr>
<td><strong>Written informed consent obtained:</strong> Y/N (if no - reason)</td>
</tr>
<tr>
<td><strong>Device Type:</strong></td>
</tr>
<tr>
<td>- Access Scientific</td>
</tr>
<tr>
<td>- Angiodynamics</td>
</tr>
<tr>
<td>- BARD/BARD Access</td>
</tr>
<tr>
<td>- Cook</td>
</tr>
<tr>
<td>- MedComp</td>
</tr>
<tr>
<td>- Navilyst</td>
</tr>
<tr>
<td>- Teleflex</td>
</tr>
<tr>
<td>- Other</td>
</tr>
<tr>
<td><strong>Device length:</strong></td>
</tr>
<tr>
<td><strong>Device gauge:</strong></td>
</tr>
<tr>
<td><strong>Ultrasound guidance used:</strong> Y/N</td>
</tr>
<tr>
<td><strong>Catheter to vein ratio evaluated:</strong> Y/N (if no - reason)</td>
</tr>
<tr>
<td>- Document Catheter to Vein Ratio: &lt;30%, 33%, 45%, 50%, &gt;50% (include FREE TEXT option)</td>
</tr>
<tr>
<td><strong>Number of insertion attempts:</strong> 1, 2, 3</td>
</tr>
<tr>
<td><strong>Arm of insertion:</strong> L/R</td>
</tr>
<tr>
<td><strong>Vein of insertion:</strong> Brachial, Basilic, Cephalic, Other</td>
</tr>
<tr>
<td><strong>Midline tip confirmed to be at or below axillary line?</strong></td>
</tr>
<tr>
<td>- Method of confirmation:</td>
</tr>
<tr>
<td>- Physical exam</td>
</tr>
<tr>
<td>- Ultrasound</td>
</tr>
<tr>
<td>- Fluoroscopy</td>
</tr>
<tr>
<td>- X-ray</td>
</tr>
<tr>
<td>- Other</td>
</tr>
<tr>
<td><strong>Tolerated procedure well?</strong> Y/N</td>
</tr>
</tbody>
</table>

*Resource located on HMS website (http://mi-hms.org/)*
Q: What does it mean to confirm placement of a Midline? Does flashback count as midline confirmation?

A: Confirming midline tip placement ensures localization to a deep vein in the peripheral, not central, vasculature. Flashback is not sufficient confirmation of midline tip placement as flashback will occur when entering the vein.
Methods of Midline Tip Confirmation

- Physical Assessment (landmark: delto-pectoral groove, anterior axillary line, etc.)
- Ultrasound (during insertion)
- X-Ray
- Fluoroscopy
- Other

Still collecting data on method of tip confirmation (not enough data to share at this time)
Q: Is ultrasound guided placement necessary for all types of midlines?

A: Yes, ultrasound guided placement is recommended for all types of midline devices!
Q: Our vascular access team is not measuring catheter-to-vein ratio for midlines. Is this a practice we should adopt?

A: Yes, catheter to vein ratio is an important assessment when placing a midline and may be associated with midline dwell, complications.
Importance of Catheter to Vein Ratio

- Why do we care about catheter to vein ratio for midlines?
  - As with PICCs, catheter:vein ratio is important for ensuring blood flow in peripheral veins of insertion
  - Not respecting the C:V ratio is known to be associated with DVT, phlebitis and premature removal in PICCs
  - It is likely that the same holds true for midlines, but this association has not been well studied

HMS has a unique opportunity to shed light on this issue and improve the safety of Midline use in Michigan
Midline Complications

32 Hospitals
1,573 Midlines
Midline Complications

Q: Why track tip migration for midlines as they are peripheral access devices?

A: Tip migration is important to track because it might be linked to dislodgement, occlusion and DVT!
Most Common Midline Challenges Across the HMS Collaborative

- Failure to aspirate labs (21)
- Lack of knowledge regarding appropriate use (16)
- Infiltration or leakage (14)
- Concern about reliability of device (14)
- Documentation (12)
- Concerns related to future vesicant use (12)
- Premature failure resulting in device removal (10)
- ECF’s will not accept patients with midlines (9)
- Occlusion (9)
- Dislodgement (7)
- Deep Vein Thrombosis (DVT) (4)
- Other
  - Lack of buy in from IR/Vascular Access, financing the training, PICC preference

To answer these and related questions, we will have to go beyond current studies and look at aspects that have not been considered before!
Overview

- **Introduction and Historical Aspects**
- **Evidence review – what do we know about midlines?**
- **HMS data:**
  - Current State
  - What does pilot data tell us?
  - Why are we asking for specific data elements?
- **Questions and Answers**
  - Questions from HMS sites
Q: When is a midline appropriate?

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Proposed Duration of Infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤5 d</td>
</tr>
<tr>
<td>Peripheral IV catheter</td>
<td>No preference between peripheral IV and US-guided peripheral IV catheters for use ≤5 d</td>
</tr>
<tr>
<td>US-guided peripheral IV catheter</td>
<td>US-guided peripheral IV catheter preferred to peripheral IV catheter if proposed duration is 6–14 d</td>
</tr>
<tr>
<td>Nontunneled/acute central venous catheter</td>
<td>Central venous catheter preferred in critically ill patients or if hemodynamic monitoring is needed for 6–14 d</td>
</tr>
<tr>
<td>Midline catheter</td>
<td>Midline catheter preferred to PICC if proposed duration is ≤14 d</td>
</tr>
<tr>
<td>PICC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PICC preferred to midline catheter if proposed duration of infusion is ≥15 d</td>
</tr>
</tbody>
</table>

- Preferred over PICCs for use if proposed duration is ≤ 14 days
  - Peripherally compatible infusates
  - Difficult venous access
  - Frequent phlebotomy (every 8 hours)
- Can be used for up to 4 weeks (28 days)
- Some hospitals are using midlines for longer durations
Q: When is a Midline contraindicated?

- Continuous vesicant therapy
- Total parenteral nutrition (TPN)
  - Solutions greater than 600 mOsm/L
- Infusates requiring central access
- Patients with circulatory impairment, hemiparesis, history of upper extremity DVT
- Patients that may require renal replacement therapy
  - Avoid indwelling catheter in deep veins of the arm
    - Same logic as PICCs (avoid damaging venous return of the arm)
Is there a list of medications that can/cannot be administered via a midline?

- Depends on the pH, osmolarity, etc. of the medication
  - Avoid infusing medications with pH < 5 or > 9, Osmolarity > 600 through a midline (higher rates of phlebitis)

- There is no official single list!
  - Hospitals should refer to midline manufacturer guidelines and work in partnership with their pharmacists to identify inappropriate medications on formulary

Example hospital policy
Example Hospital Policy

POTENTIAL IRRITANT MEDICATIONS *

*(Consider administration via central venous catheter – should not administer via Midline)*

*An irritant is an agent capable of producing discomfort or pain along the internal lumen of the vein (s 105 INS SOP 2011)*

- aminocaproic acid
- amiodarone
- doxapram
- doxycycline
- nicardipine
- nitroprusside

POTENTIAL MEDICATIONS WITH VESICANT PROPERTIES †

*(Consider administration via central venous catheter – should not administer via Midline)*

†Capable of causing blistering, tissue sloughing, or necrosis if it escapes from the vascular pathway into tissues INS SOP S108

- acyclovir
- calcium chloride
- calcium gluconate
- carboplatin
- carmustine
- chlorothiazide
- cyclophosphamide
- dacarbazine
- dactinomycin
- daunorubicin
- dextrose over 10%
- dobutamine
- docetaxel
- dopamine
- doxorubicin
- edetate disodium
- epinephrine
- epirubicin
- esmolol
- etoposide
- idarubicin
- lorazepam
- mannitol 10%-20%
- meclorethamine
- methotrexate
- mitomycin
- mitoxantrone
- nafcillin
- norepinephrine
- oxaliplatin
- paclitaxel
- phenergan
- pentamidine
- pentobarbital
- phenobarbital
- phenylephrine
- phenytoin
- promethazine
- hydrochloride
- sodium bicarbonate
- streptozotocin
- teniposide
- tobramycin
- TPN
- vancomycin
- vasopressin
Midline Q&A: Midline Use

• Our facility does not use midlines. Is this something we should look into?
  ○ Evaluate vascular access needs at your facility
    ▶ Consider current PICC and CVC use
    ▶ Evaluate appropriateness of PICC and CVC use
  ○ Review current CLABSI and other CVAD complication rates – midlines have proven useful to reduce these!
  ○ Estimate costs and potential savings of a midline program
  ○ Review and trial the different types of midline products to determine which would best meet your needs
Midline Use Across the HMS Collaborative

**Does your hospital insert midlines?**
- Yes: 88%
- No: 12%

**Has your hospital begun to place midlines in adult hospitalized medical patients in the past year?**
- Yes: 51%
- No: 49%

N=43
Midline Use Across the HMS Collaborative

Has the introduction of use of midlines in your hospital led to a decrease in PICC placement?

- Yes: 47%
- No/Unknown: 53%

N=43
How to Build a Midline Program

Sample Midline Order Set

- HMS created a sample midline order set
- Resource located on HMS website
  - http://mi-hms.org/
Is it appropriate practice to trim a PICC to midline length? Are there any risks associated with this?

- There is little data to guide this practice.
Is it appropriate practice to trim a PICC to midline length? Are there any risks associated with this?

- Trimming catheters is thought to increase shear stress, turbulence at the catheter tip.
- Available evidence is limited, but suggests increased risk of DVT when trimming catheters.
- When possible, it is better to use a dedicated midline device than trim a PICC to midline position.
- More data is needed.
Is it necessary to place midlines under sterile conditions (i.e. draping, maximal barrier precautions)? What is the evidence behind this? Is draping necessary for all types of midlines?

- 2016 INS Standards of Practice and 2012 CDC guidelines both state that midline catheter placement should be done under maximal sterile barriers.
Thank you!

Questions?