

A photograph of a patient in a hospital bed, likely in an intensive care unit. The patient is lying under a white blanket, with their head resting on a pillow. Several medical monitors are visible, displaying vital signs and waveforms. A hand is seen interacting with one of the monitors. In the background, there are IV stands with bags of fluid and other medical equipment. The room has large windows with blinds. The text 'VASCULAR ACCESS ASSESSMENT' is overlaid in white on a dark blue background in the upper right corner.

VASCULAR ACCESS ASSESSMENT

Championing Appropriate Device Selection

Rich Lewis, RN, BS, VA-BC

Disclosures

The speaker's presentation today is on behalf of Bard Access Systems. Any discussion regarding Bard products during the presentation today is limited to information that is consistent with Bard labeling. Please consult Bard product labels and inserts for any indications, contraindications, hazards, warnings, cautions and instructions for use.

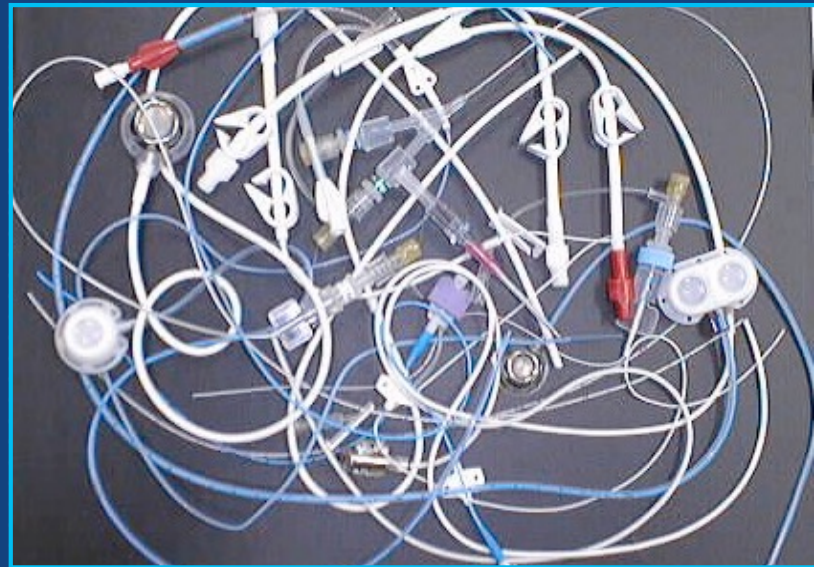
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Objectives

- **Asserting your role as vascular access champion**
- **Emphasize the importance of appropriate device selection**
- **Central Venous Access in the ICU**

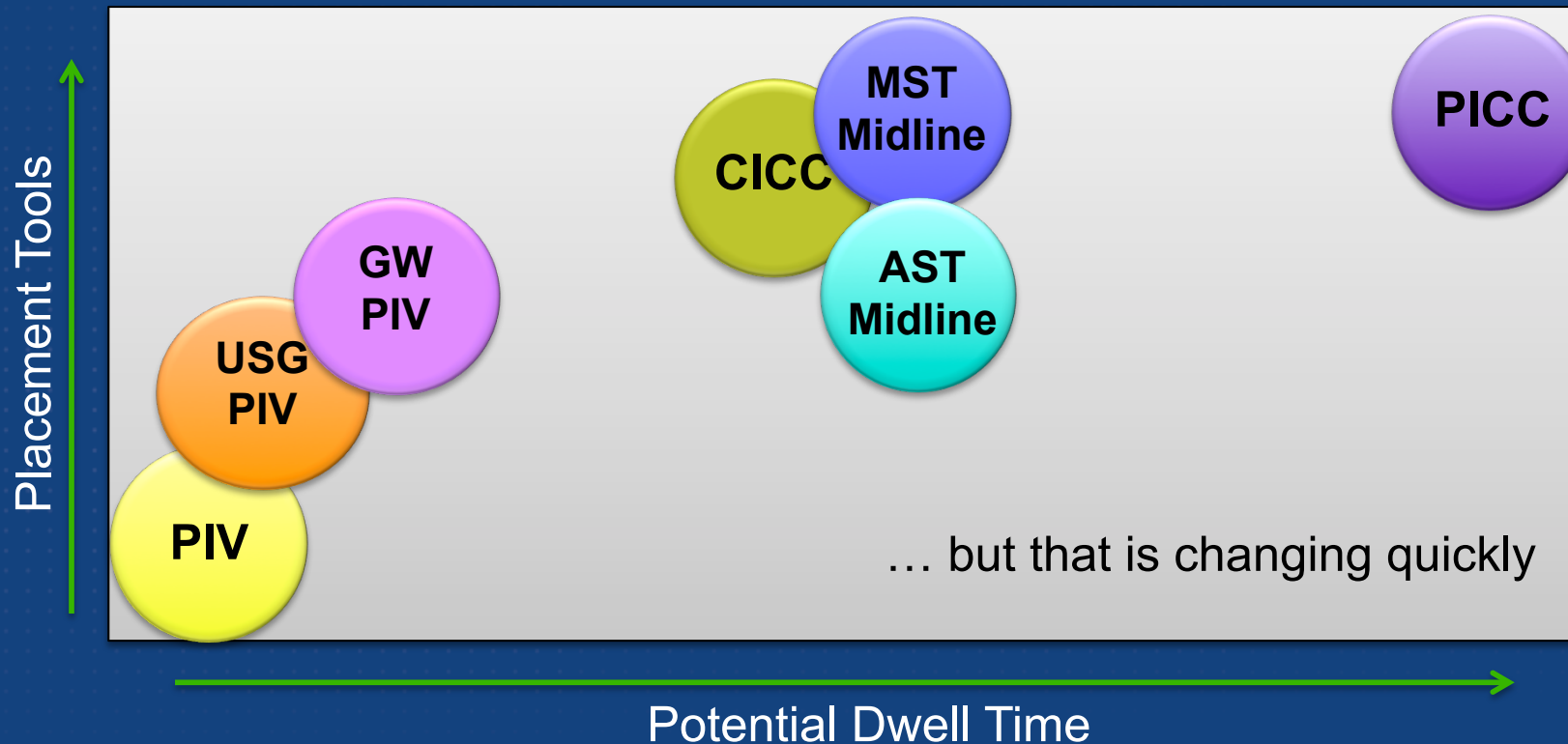
Why is Appropriate Selection So Important?

- Scrutiny on Hospital Acquired Conditions (HACs)
- More device choices
- Potential inappropriate use
- Consequences to patient



Vascular Access Continuum

Not long ago, most of us had a limited selection of devices ...



New device options create the potential to choose a device that:

- Is more readily available
- Has less risk of serious complications
- More closely matches patient needs
- Is less costly to place



New device options *also* create the potential to choose a device that may:

- Be inappropriate for required infusates
- Be unable to fulfill all required functions
- Be unable to last the duration of therapy
- Have risk of serious complications
- Be more costly over course of therapy

Critical Assessment is More Important Than Ever

Gorski, L., et al. "Infusion therapy standards of practice." *J Infus Nurs* 39.suppl 1 (2016): S1-S159.

Helm, Robert E., et al. "Accepted but unacceptable: Peripheral IV catheter failure." *Journal of Infusion Nursing* 38.3 (2015): 189-203.

Key Drivers of Critical Assessment

- Type of therapy
- Duration of Treatment
- Difficulty of insertion
- Patient factors
- Other Factors

Gorski, L., et al. "Infusion therapy standards of practice." *J Infus Nurs* 39.suppl 1 (2016): S1-S159.

Type of Therapy: Vesicants and Irritants



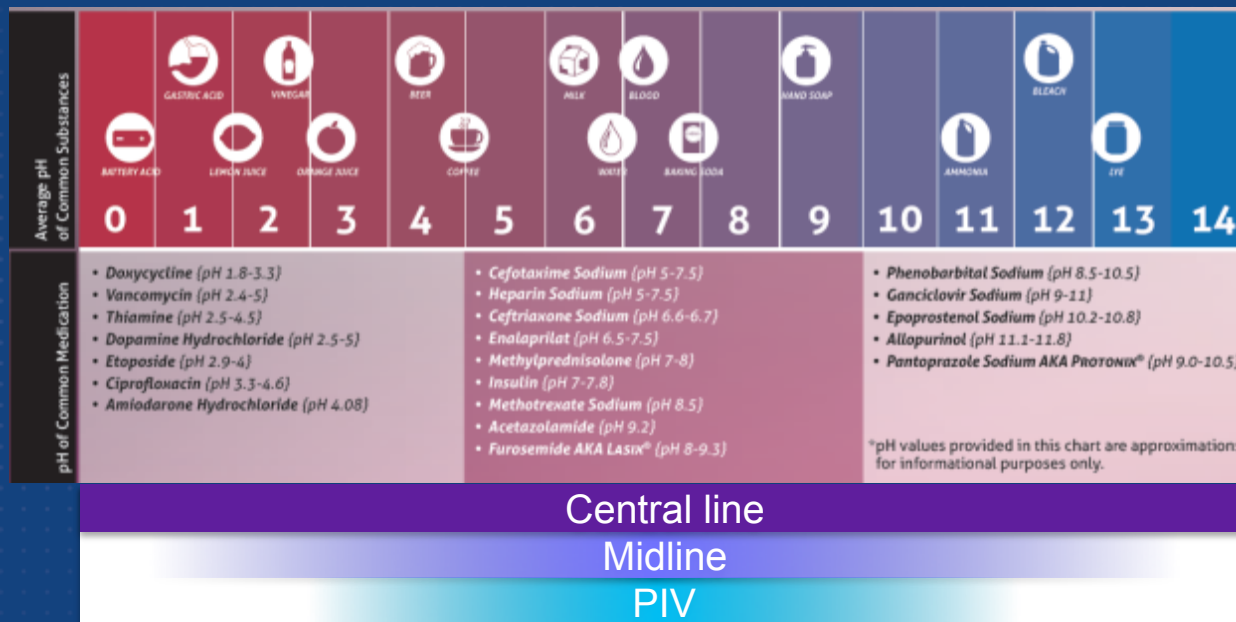
- Total parenteral nutrition
- Many chemotherapeutics
- Many antibiotics
- Vasopressors
- Hypertonic saline
- Calcium Chloride/Calcium Glutamate

Will your patient need these during the course of therapy?

Chemotherapy and Biotherapy Guidelines and Recommendations for Practice ONS (2009) pg 105

Type of Therapy: pH

Changing views on pH ... situational questions are important



- Continuous vs intermittent?
- Length of therapy?
- Patient tolerance?
- Multiple infusates?

Patient Considerations

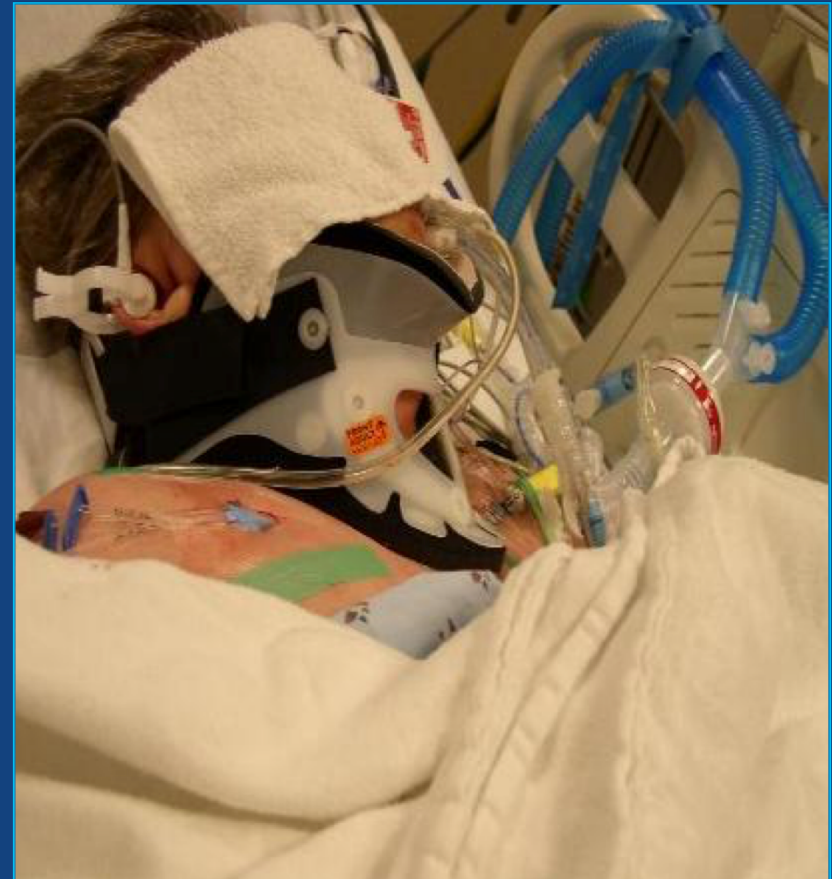
- Medical condition(s) existing simultaneously but independently with another condition
- Perform a history for:
 1. Potential previous I.V. Therapy
 2. Potential previous hospitalization
 3. Potential previous venous complications – including thrombosis

Additional Factors

- # of lumens required
- Required flow rates
- Need for blood draws
- Central venous pressure (CVP) monitoring
- Power injection

Central Venous Access Devices in the ICU

- Integral part of modern Intensive care
- Required for CVP monitoring (CVPM)
- May be needed for complex fluid / nutrition management
- Recommended for stable delivery of vasoactive medications



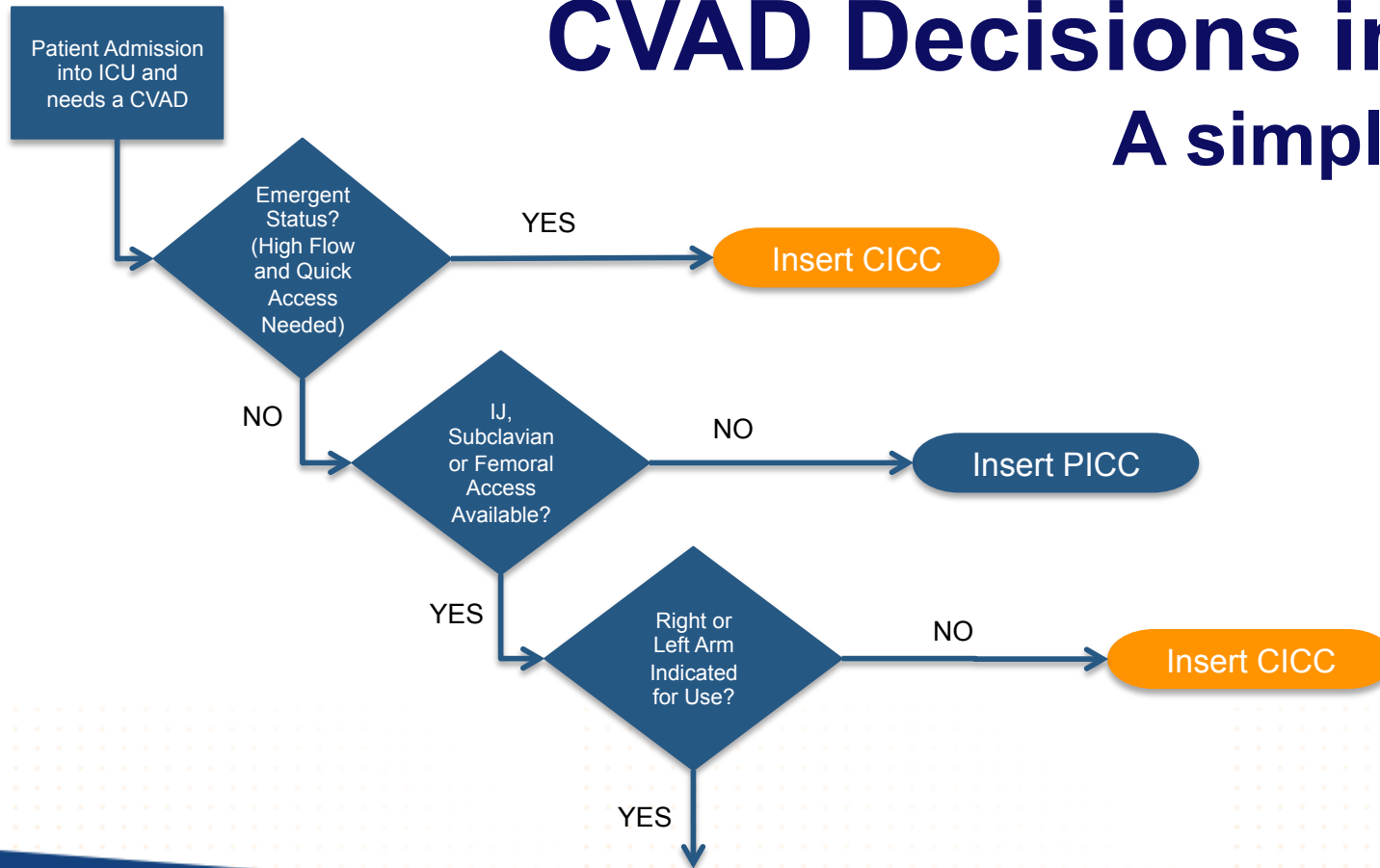
Ideal CVADs?

- **Easy to Insert or Inserted by Others**
- **Meets Complete Venous Access Needs**
- **Avoids Complications**
- **Removed When Not Needed**
- **No Negative Financial Impact**



CVAD Decisions in the ICU

A simple process?



Catheter Flow Rate

Example of CICC Flow Rates²

LUMEN	Ø FR.	LENGTH	INTERIOR LUMEN	DESIGN	MATERIAL	FILLING VOLUME	FLOW RATE*	MAX. PRESSURE INJECTION FLOW RATE**
2	7 Fr.	16 cm	18-14	D	PUR AGB	0.33/0.50	1300/5600	5/10
2	7 Fr.	20 cm	14-18	B	PUR AGB Plus	0.57/0.40	5700/1100	10/10
2	8 Fr.	16 cm	14-14	E	PUR AGB Plus	0.68/0.70	7650/6000	10/10
2	8 Fr.	20 cm	14-14	E	PUR AGB Plus	0.73/0.75	6450/4800	10/10
3	7 Fr.	16 cm	16-18-18	H	PUR AGB Plus	0.38/0.37/ 0.39	3000/1400/1600	10/5/5



²Teleflex™, Arrow™ Pressure Injectable CVC Brochure 1-2013

Example of PICC Flow Rates³

Lumens	Priming Volume (ml)	Max. Achievable Pump Flow Rate* (ml/hr)	Gravity Flow Rate (ml/hr)	Power Injection Flow Rate (ml/sec)@300 psig
18 Ga (Red)	0.68	Saline (1.0 cP) >999 TPN (2.0 cP) >999 Blood (3.5 cP) 611	743	5
19 Ga (Gray, White)	0.44	Saline (1.0 cP) >999 TPN (2.0 cP) 566 Blood (3.5 cP) 323	280	N/A

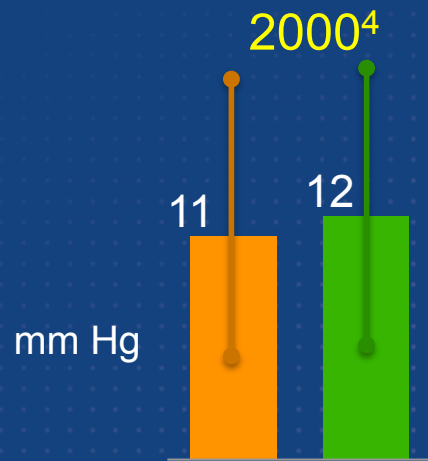
*Based on a simulated testing using a pump alarm setting of 500 mmHg and a full length catheter at 55 cm. May not be indicative of actual clinical performance.

Indications: The PowerPICC™ catheter is indicated for short or long term peripheral access to the central venous system for intravenous therapy, power injection of contrast media, and allows for central venous pressure monitoring. For blood sampling, infusion, or therapy use a 4 French or larger catheter. The maximum recommended infusion rate is 5 mL/sec for power injection of contrast media. For central venous pressure monitoring, it is recommended that a catheter lumen of 20 gauge or larger be used.

Please consult product labels and inserts for any indications, contraindications, hazards, warnings, precautions, and directions for use.

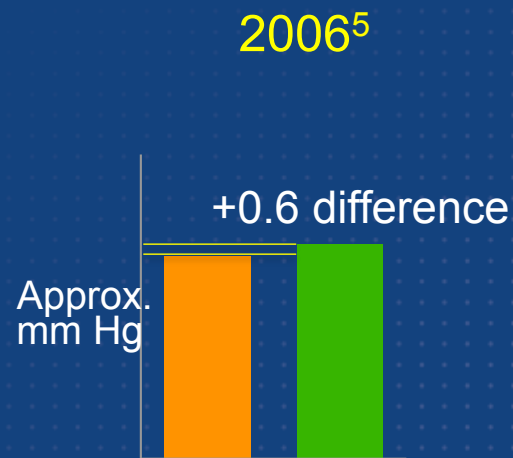
³Bard Access Systems, 5F TL PowerPICC™ HF Catheter Brochure 2011. MC-0914-01

CVP Comparison of PICCs vs CICC/PACs



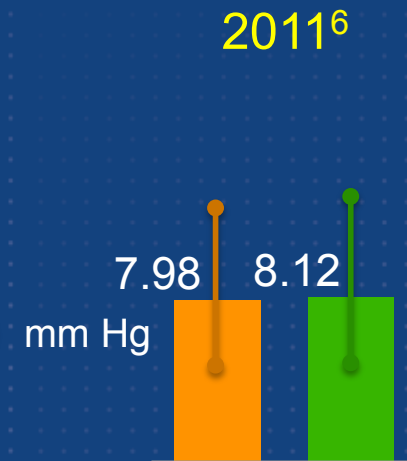
CICC PICC

n=12 Patients, 77 data sets
Conclusion: PICCs can be used to measure CVP.



PAC PICC

n=5 Patients, 73 data sets
Conclusion: PICCs are an effective method for CVP monitoring.



CICC PICC

n=35 Patients, 1,342 data sets
Conclusion: PICC pressure can be a reasonable alternative to CICC pressure.

⁴Black IH, et al. Central venous pressure measurements: peripherally inserted catheters versus centrally inserted catheters. Crit Care Med 2000;28(12):3833-3836.

⁵McLemore EC, et al. Intraoperative peripherally inserted central venous catheter central venous pressure monitoring in abdominal aortic aneurysm reconstruction. Ann Vasc Surg 2006;20:577-581.

⁶Yun, JY, et al. Comparison of the central venous pressure from internal jugular vein & the pressure measured from the peripherally inserted antecubital central catheter (PICC) in liver transplantation recipients. Korean J Anesth 2011, 61(4): 281-287.

...and PICCs have come a long way

Early Years

- AC insertion without US
- Over the needle insertion
- No CHG
- Suture/tape securement
- X-ray confirmation

21st Century Renaissance

- Upper arm USG insertion
- MST insertion
- CHG & maximum barrier
- Mechanical securement
- X-ray tip confirmation
- Power injection
- Reverse Taper

Modern Practice

- Vein-to-catheter ratio
- Hub cleaning & protection
- Tip guidance & ECG based tip positioning



COMPLICATION MANAGEMENT



Placement Risk Considerations

Risks of Placing and Removing PICCs & CICC⁷

HAC ⁸ /non-HAC	PICC	CICC
CLABSI ⁸	X	X
Air Embolism ⁸	Not Listed	X
Pneumothorax ⁸	--	X
Hemothorax	--	X
Brachial Arterial Injury	X	--
Carotid/Subclavian/Femoral ²³ Arterial Injury	--	X
Hematoma	X	X

Note: Arterial injury expanded to include femoral artery based on Bowdle (2014) observations.²³

⁷Dariushtnia et al. Quality Improvement Guidelines for Central Venous Access. 2010. J Vasc Inter Radiol. 21. 976-981

⁸Hospital-Acquired Conditions and Present on Admission Indicator Reporting Provision. Centers for Medicare & Medicaid Services. ICN 901046 September 2014

²³Bowdle. Vascular Complications of Central Venous Catheter Placement: Evidence-Based Methods for Prevention and Treatment. 2014. J Cardiothoracic and Vascular Anesthesia. 21. 358-368.

Patient Position & Condition Considerations

Example 1

Insertion Position

CICC: Trendelenberg (required)¹⁰

PICC: No requirement



Example 2

Neurology or Pulmonary Issues

CICC: Reverse Trendelenberg (required)¹⁰

PICC: No requirement



Other Considerations

PICC may be suboptimal if:

- ESKD (III or IV)²⁴
- Past breast surgery²⁵
- History of VTE²⁴
- Arm burn, infection, paralysis²⁴

CICC may be suboptimal if:

- Neck/chest abnormalities²⁴
- High infection risk/tracheotomy²⁴
- Longer dwell time foreseen²⁵

¹⁰Interdisciplinary Clinic Practice Manual. Vascular Access Device Policy, Adult (IFC035). The John Hopkins Hospital. 2008

²⁴Cotogni et al. Focus on peripherally inserted central catheters in critically ill patients. World Journal of Critical Care Medicine. 2014. 3(4). 80-94

²⁵Helen Hamilton and Andrew R. Bodenham. *Central Venous Catheters*. (United Kingdom. John Wiley & Sons Ltd. 2009) 38-84

Required Life Supporting Devices: Competing for Real Estate



Insertion Site Choice

CICC

- neck
- clavicular triangle
- groin

PICC

- either upper arm

Insertion Site Choices

CICC

- neck: proximity to ear, nose & throat
- clavicular triangle: upper chest
- groin ¹¹

PICC

- either upper arm



¹¹Avoid using the femoral vein for central venous access in adult patients.
(Category 1A). Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011.

CLABSI Risk of CVADs in the ICU

- Do not use peripherally inserted CVCs (PICCs) as a strategy to reduce the risk of CLABSI.¹²
 - The risk of infection with PICCs in ICU patients approaches that of CVCs placed in the subclavian or internal jugular veins.¹²
 - The majority of CLABSIs due to PICCs occur in non-ICU settings. The PICC-associated CLABSI risk may be different outside the ICU.¹²

¹²Marschall et al. Strategies to Prevent Central Line-Associated Bloodstream infections in Acute Care Hospitals:2014 Update. Infection Control and Hospital Epidemiology. 2014 Vol 35 No S2: S89-S107

Key CVAD Patient Considerations

- ☐ Status of bleeding
- ☐ Status of ability to cooperate
- ☐ Status of position for insertion and removal
- ☐ Status of neck and chest
- ☐ Status of breathing
- ☐ Status of hemodynamics
- ☐ Risk of infection with placement site

COMPLICATION MANAGEMENT

In-dwelling Catheter Risks Considerations

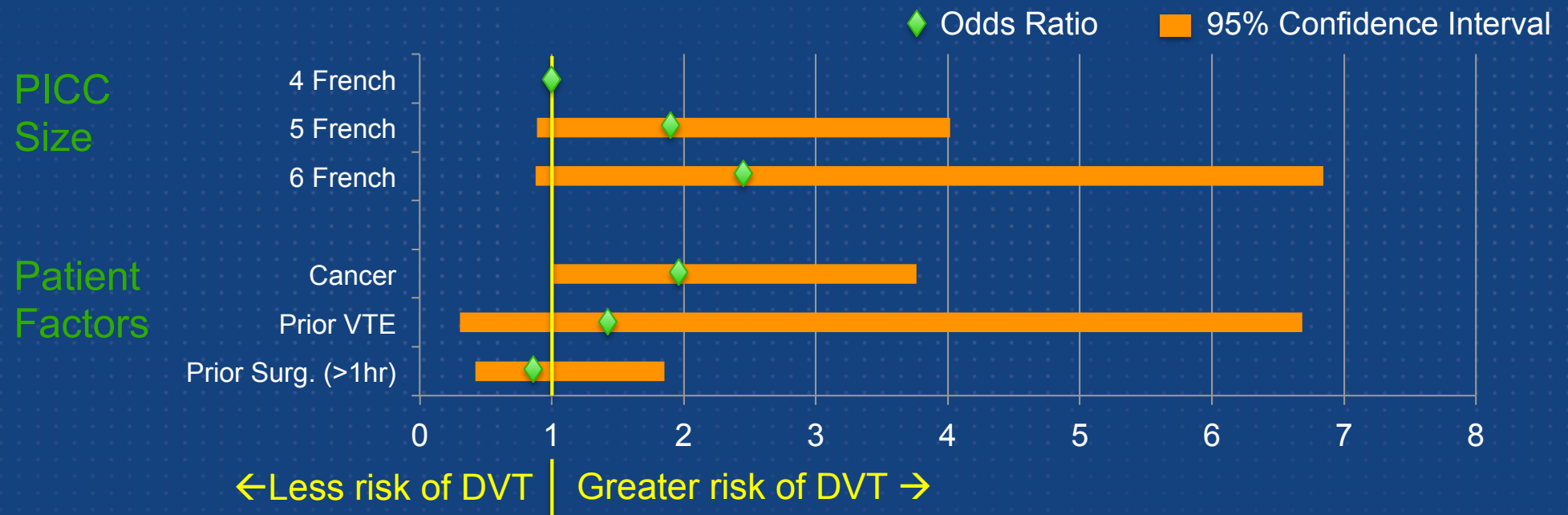
In-dwelling Catheter Complications⁷

HAC ⁸ /non-HAC	PICC	CICC
CLABSI ⁸	X	X
Air Embolism ⁸	Not Listed	X
Thrombosis	X	X
Phlebitis	X	Not Listed
Wound Dehiscence	X	X

⁷Dariushnia et al. Quality Improvement Guidelines for Central Venous Access. 2010. J Vasc Inter Radiol. 21. 976-981

⁸Hospital-Acquired Conditions and Present on Admission Indicator Reporting Provision. Centers for Medicare & Medicaid Services. ICN 901046 September 2014

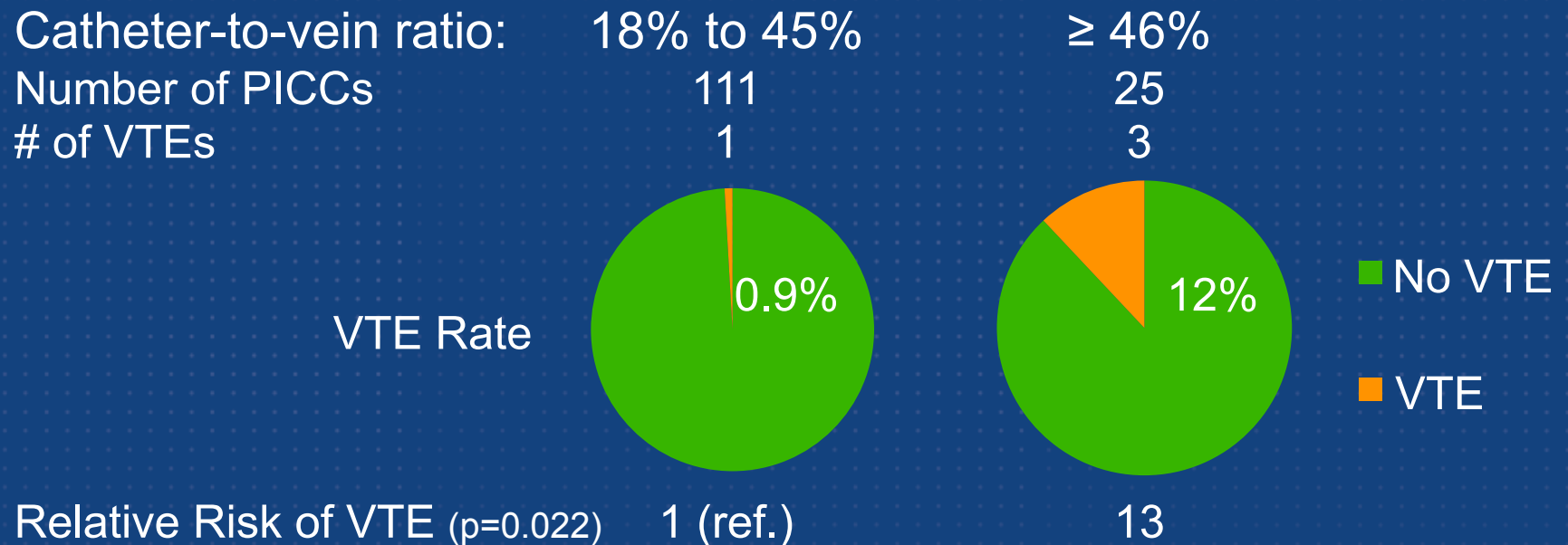
DVT – PICC size & Patient Factors



¹⁸Chopra V, et al. Peripherally inserted central catheter-related deep vein thrombosis: contemporary patterns and predictors. J Thrombosis and Haemostasis 2014;12:847-854.

Development of Venous Thrombosis¹⁹

In a prospective study, 136 PICC patients were monitored for VTE based on Catheter-to-Vein ratio

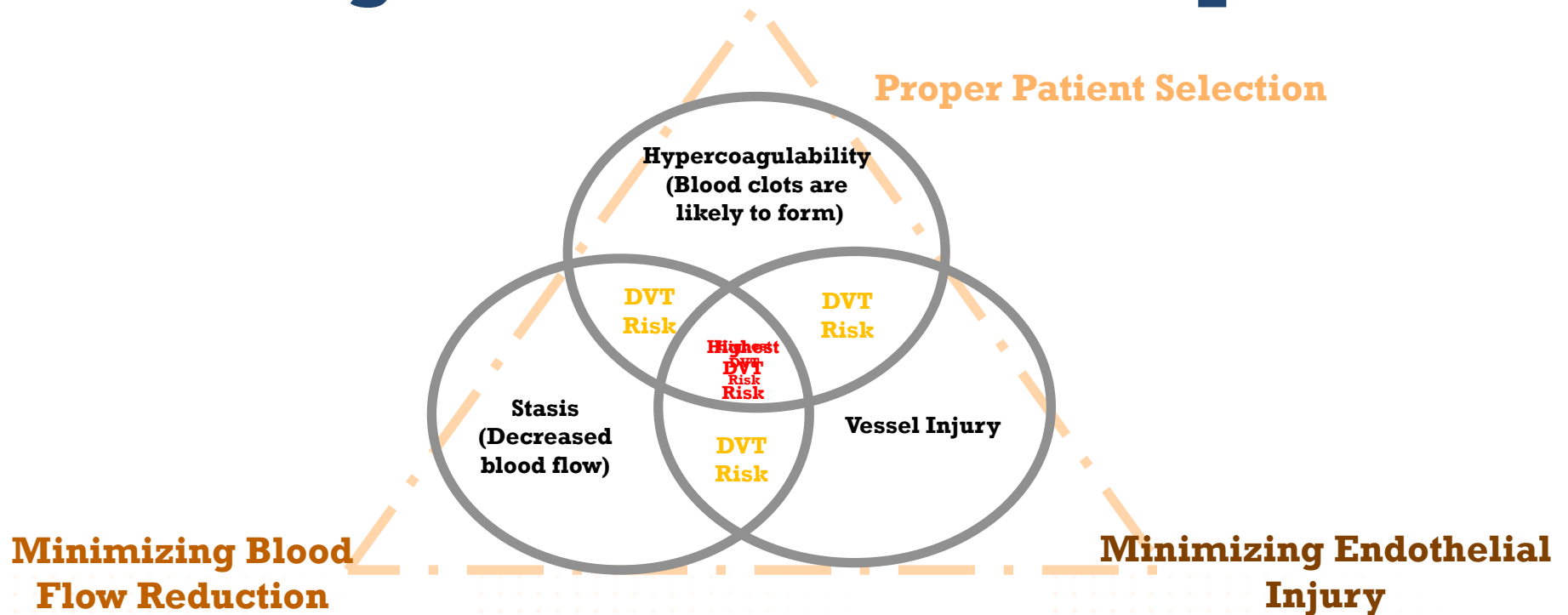


¹⁹Sharp R, et al. The catheter to vein ratio and rates of symptomatic venous thromboembolism in patients with a peripherally inserted central catheter (PICC): A prospective study. International J Nurs Studies 2015;52:677-685.



Reducing Risks

Reducing DVT Risk in PICC patients



Virchow's Triad

Managing for the Highest DVT Risk in PICC Patients

Factor	Potential Causes	Recommendations	Practice Considerations
Hypercoaguability	• Disease state • Patient Condition	• Patient Selection²² • Daily line surveillance for need²²	• Alternative VAD knowledge²²
Stasis	• Catheter to vein size	• Vessel Selection^{21,22}	• 4mm vein: 4F catheter²¹ • 5mm vein: 5F catheter²¹ • 6 mm vein: ≤ 6F catheter²¹ • Or scan proximal until above is true²¹
Vessel Injury	• Multiple needle sticks • Multiple devices	• Ultrasound^{21,22} • Modified Seldinger Technique^{21,22} • Catheter tip confirmation in the lower 1/3 of the SVC/CAJ^{21,22} • Catheter securement^{21,22}	• Ultrasound^{21,22} • 21 ga introducer needle, guidewire, dilator/sheath²¹ • ECG tip confirmation²¹

²¹ Emoli et al. SIP (Safe Insertion of PICCs) protocol: a bundle of 8 recommendations to minimize the complications of the peripherally inserted central catheter. GaVeCeLT 2014

²² Infusion Nurses Society. "Infusing Nursing Standards of Practice." Journal of Infusion Nursing. Jan/Feb 2011. Vol 34 Number 35

Critical Care Patients CVAD Considerations

Attribute	PICC	CICC
Multiple Sizes & Configurations	Yes	Yes
Multiple Indications for Use	Yes	Yes
Insertion Complication Risks (Hospital Acquired Condition Reportables) ⁸	CLABSI	Pneumothorax, Air Embolism, CLABSI
Patient Position Specific	No	Yes
Tip Confirmation	ECG or CXR	CXR
Contemporary Composite In-dwelling Complication Rates (ICU for DVT and/CLASBI) ^{a,20}	2%	1%
Short or Long Term Usage	Both	Short
Continuum of Care Usage	In/Outpatient, Alt. Care	Inpatient
Cost of Insertion	Generally lower than CICCs	Generally higher than PICCs

^a No significant difference in DVT rates, p=0.685.

⁸ Hospital-Acquired Conditions and Present on Admission Indicator Reporting Provision. Centers for Medicare & Medicaid Services. ICN 901046
September 2014

²⁰ Nolan et al. Complication rates among peripherally inserted central venous catheters and centrally inserted central catheters in the medical intensive
care unit. J Crit Care 2016;31:238-242

Critical Care Patient Considerations

1. **Complication Management**

- a. Are you responsible for HAC reportable events?
- b. Will the least invasive device reduce the risk of complications while delivering the required IV therapy?
- c. Is reducing the number of devices a benefit or a risk?

2. **Length of Stay**

- a. Is it predictable?
- b. Has the continuum of care been considered?
- c. Is reducing the number of devices a benefit or a risk?
- d. Is patient satisfaction important?

3. **Economic and Placer Considerations**

- a. How is your expertise being best utilized?
- b. Can a less invasive device placed by a nurse with similar risk meet the needs of monitoring the patient and delivering their IV therapy?

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13. Wise et al. National Estimates of Central Line-Associated Bloodstream Infection in Critical Care Patients. Infection Control and Hospital Epidemiology. 2013. Vol 34 No. 6; 547-554 Phillips, L.D. Manual of I.V. Therapeutics. Third Edition.2001. F.A. Davis Company
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19. Sharp R, et al. The catheter to vein ratio and rates of symptomatic venous thromboembolism in patients with a peripherally inserted central catheter (PICC): A prospective study. International J Nurs Studies 2015;52:677-685.

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