Transforming Peripheral Venous Access (PVA)

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Disclosures

- I am a consultant for B.Braun & Christie Medical Holdings
- No off label use will be discussed

Objectives

- The participant will be able to understand the importance of pre-access assessment and challenges of its application with current practice
- The participant will identify current PIVC failure rates and consider potential causes
- The participant will discuss current barriers to reducing PIVC catheter failure rates and implementation of objective measures to reduce catheter related complications

Ideal VA Encounter

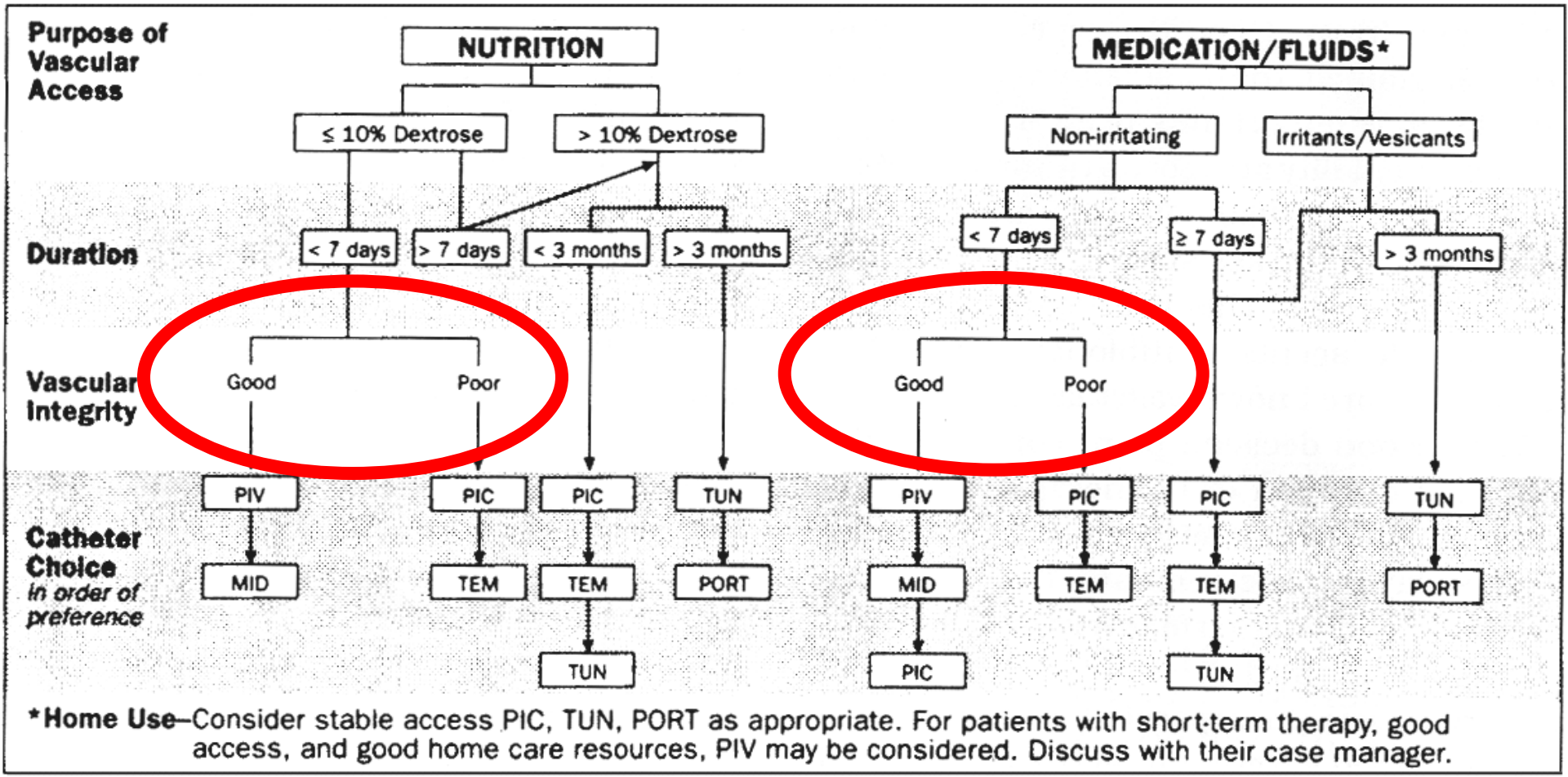
- Provide Pre-Access Assessment
- Pt Hx, Understand Therapy Goals
- Examine Pt, Consider Options
- Educate & Partner with the Patient
- Select & Optimally Place Best Device
- Uncomplicated Course-Success!!!
- Everyone's Satisfied

Pre-Access Assessment

VASCULAR ACCESS PLANNING

(NON-EMERGENT USE, REASSESS DAILY)

FOR MULTIPLE ACCESS NEEDS, SELECT A MULTILUMEN CATHETER



***Home Use**–Consider stable access PIC, TUN, PORT as appropriate. For patients with short-term therapy, good access, and good home care resources, PIV may be considered. Discuss with their case manager.

J Nursing Care Quality, 13 (2), 77-85, 1998

Standard

26.1 The appropriate type of vascular access device (VAD), peripheral or central, is selected to accommodate the patient's vascular access needs based on the prescribed therapy or treatment regimen; anticipated duration of therapy; vascular characteristics; and patient's age, comorbidities, history of infusion therapy, preference for VAD location, and ability and resources available to care for the device.

26.2 Selection of the most appropriate VAD occurs as a collaborative process among the interprofessional team, the patient, and the patient's caregiver(s).

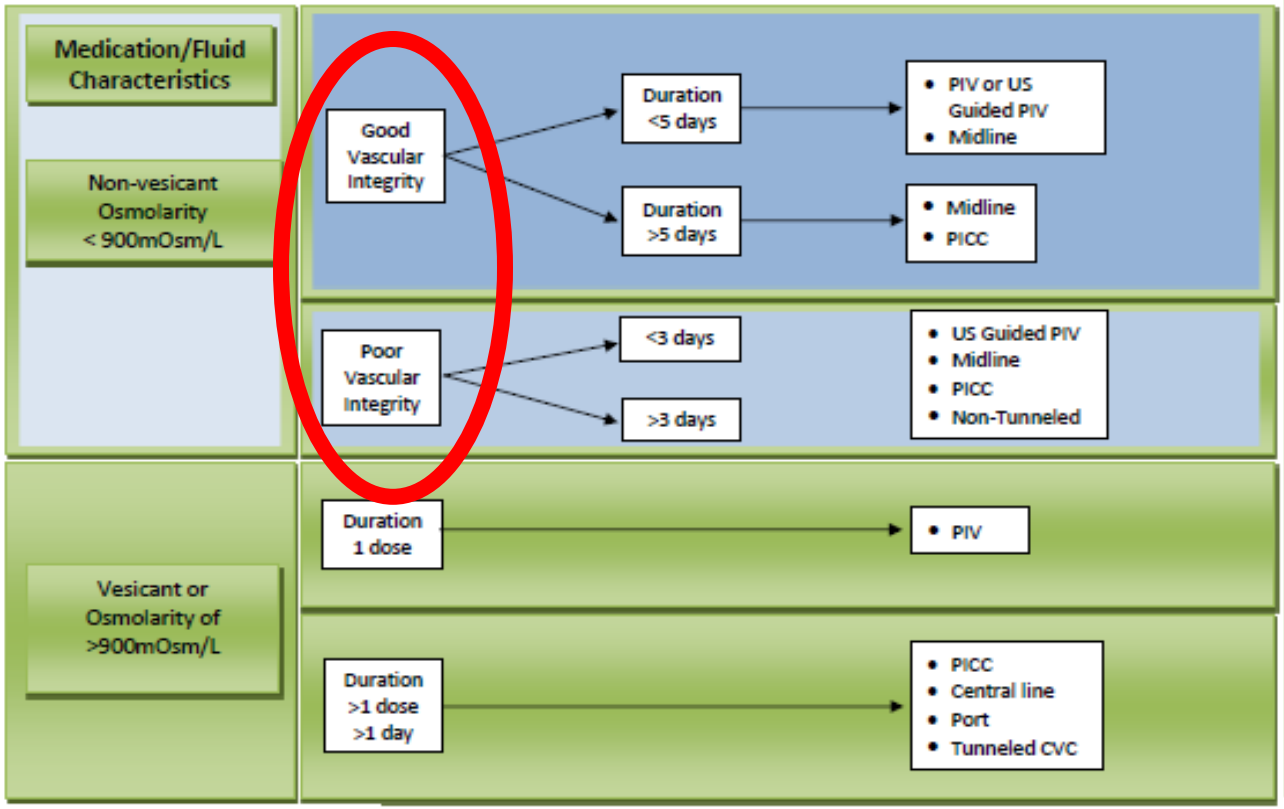
26. Vascular Access Device Planning , pS51, Gorski L, Hadaway L, Hagle ME, McGoldrick M, Orr M, DoellmanD. Infusion therapy standards of practice. *J Infus Nurs.* 2016;39(suppl 1):S1-S159

Standard

26.3 The VAD selected is of the smallest outer diameter with the fewest number of lumens and is the least invasive device needed for the prescribed therapy.
26.4 Peripheral vein preservation is considered when planning for vascular access.
26.5 Safety-engineered devices are selected and consistently activated and/or used.

26. Vascular Access Device Planning , pS51, Gorski L, Hadaway L, Hagle ME, McGoldrick M, Orr M, DoellmanD. Infusion therapy standards of practice. *J Infus Nurs.* 2016;39(suppl 1):S1-S159

Vascular Access Device Selection Algorithm



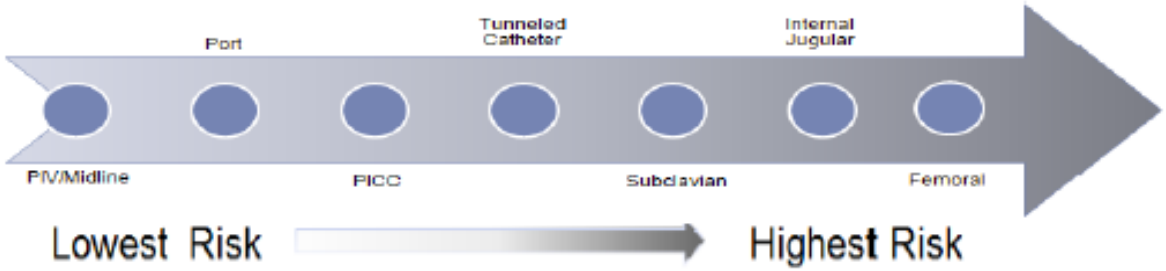
Medications/Solutions known to cause Phlebitis

Below is a listing of some common phlebogenic agents due to concentration/dilution or an inherently irritating chemical composition of the infusion.

- ☐ Amiodarone(Cordarone)
- ☐ Amphotericin B
- ☐ Penicillins = irritants Ampicillin, Penicillin, Ticarcillin, Oxacillin, Methacillin
- ☐ Calcium
- ☐ Ceftriaxone concentration irritant
- ☐ Chemotherapy agents (majority)
- ☐ Ciprofloxacin chemical irritant
- ☐ Dilantin
- ☐ All Vasopressors. Norepinephrine, Dobutamine, Dopamine = vesicants
- ☐ Epinephrine= vesicant
- ☐ Doxycycline
- ☐ Erythromycin = irritant
- ☐ Foscarnet
- ☐ Imipenem
- ☐ Iron Dextran
- ☐ Morphine concentration based
- ☐ Nafcillin chemical irritant
- ☐ KCl concentrations > 40mEq/L
- ☐ PPN (>900 mOsm/L)
- ☐ Promethazine = vesicant
- ☐ TPN
- ☐ Trimethoprim/Sulfam
- ☐ Thoxazole (Bactrim/Septra)
- ☐ Vancomycin concentration irritant >than 5mg/ml
- ☐ Zithromax (Azithromycin)

References

1. Infusion Nursing Standards of Practice 2016.
2. Patel BM. Dauehauer CJ, Rady MY, Larson JS, Benjamin TR, Johnson D, Helmers RA. (2007) Impact of Peripherally Inserted Central Catheters on Catheter-Related Bloodstream Infections in the Intensive Care Unit. J Patient Safety. 3:142-148.
3. Raly BA, Rakib MG, et al. (2010) Peripherally Inserted Central Catheters in the Acute Care Setting: A safe Alternative to High-Risk Short-Term Central Venous Catheters. AJC 38(2):149-153.
4. Maki D, et al. (2006) The risk of bloodstream infection in adults with different intravascular devices: a systematic review of 200 published prospective studies. Mayo Clin Proc. 81(9):1159-71.
5. Ryder M. (1995) Peripheral Access Options. Surg Clin NA. 403:395-427.



Practical Screening Tool for PVA

Pre-Access Assessment Tool

- Easy to apply, makes clinical sense
- Uses technology available - POC
- Provides meaningful categorization
- Allows refined algorithm for line choice
- Can be validated and is relevant
- Promotes research and CQI
- Entire Arms (legs) vs. Individual Veins

Screening

Screening

Screening

NIR Screening

Screening Tool

5 categories for PVA Difficulty

1. V-Easily locate accessible veins by sight
2. T-Easily locate accessible veins by palpation
3. N-Easily locate accessible veins with near-infrared vein visualization
4. U-Accessible veins only identified with ultrasound
5. 0-Lacks adequate veins for peripheral venous access

Screening Tool-cont.

Quantification

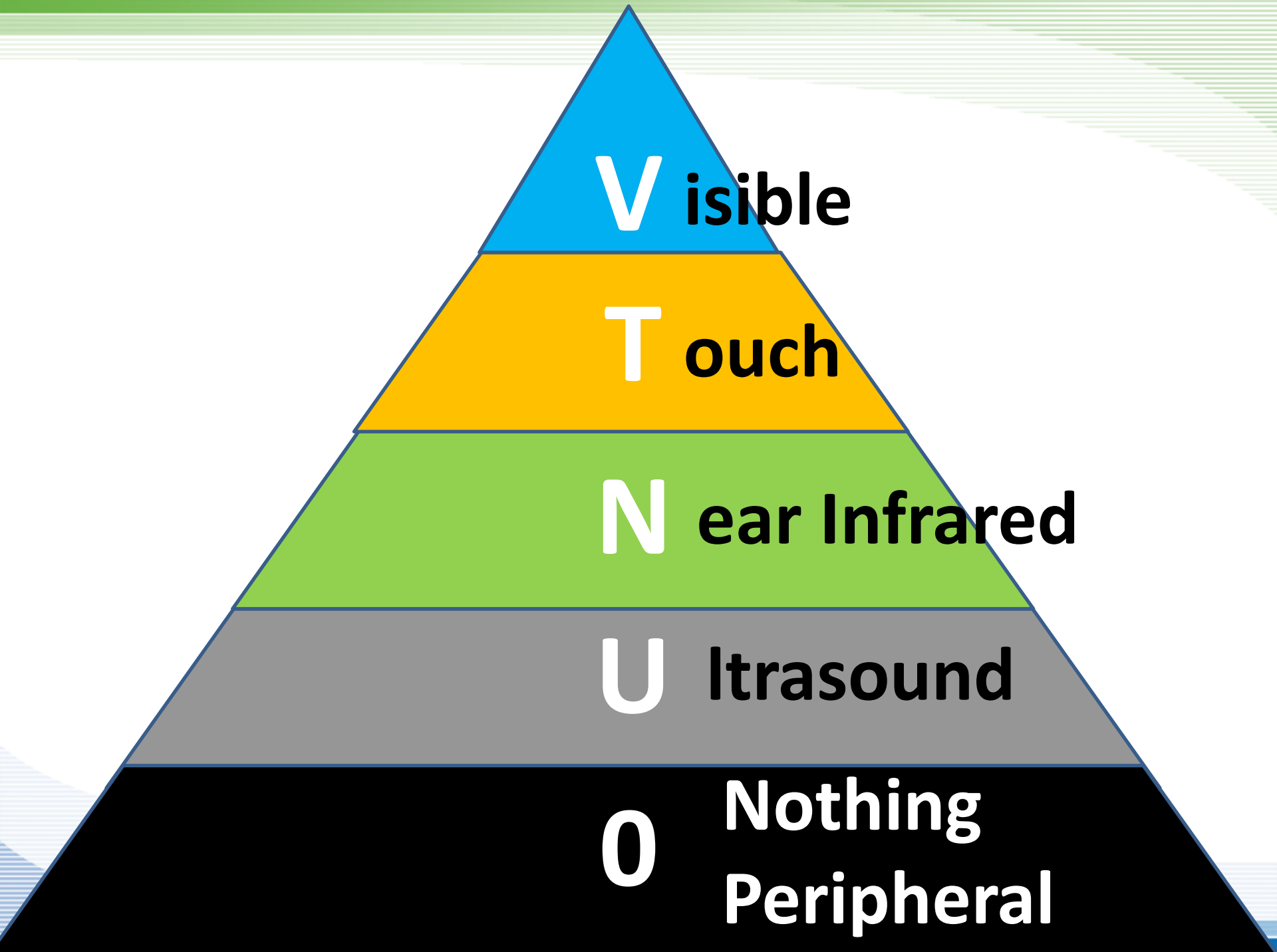
A. > 10 Optimal Choices
B. 5-10 Optimal Choices
C. 1-5 Optimal Choices

Qualifiers

A. RF-Renal Failure
B. CS-Chronic Steroids
C. SL-Site Limitations
D. LD-Limited Dwell
E. P-Pediatrics
F. G-Geriatrics
G. Site:B-Bilateral, L-Left, R-Right

Pre-Assessment

- Visible, Bilateral, 1-5 veins: V, B, C
- Palpable, Bilat, 1-5 veins: T, B, C
- Near Infrared, Bilat, > 10: N, B, A


V isible
T ouch
N ear Infrared
U ltrasound
0 Nothing
Peripheral

Section Summary

- Pre-Access Assessment elusive - POC
- Need Standardized Scoring Methods, Descriptions, & Documentation
- Better Communication, Research and CQI will Follow this Standardization
- Will Help Support Value of VA Teams
- Will Lead to Improved Patient Care
- NIR a Necessary Component to Process

Short PIV's Failure Rates and Causes

PIV Failure Rates 1990-2014

Study Type	Incidence of Failure (%)	Median	Mean
Prospective randomized controlled	36,[18] 37,[58] 39,[50] 40,[6] 45,[59] 51,[19] 55,[20] 63[60]	43%	46%
Prospective observational	23.5,[61] 25.5,[62] 32,[63] 36.5,[64] 47.5,[65] 47.6,[51] 65,[66] 66,[54] 69.2,[55] 77[53]	48%	49%
Retrospective	22.4,[67] 95[68]	58.7%	59%

Helm, RE, et al, 2015, JIN 38 (3) 189-203

PIV Failure Modes

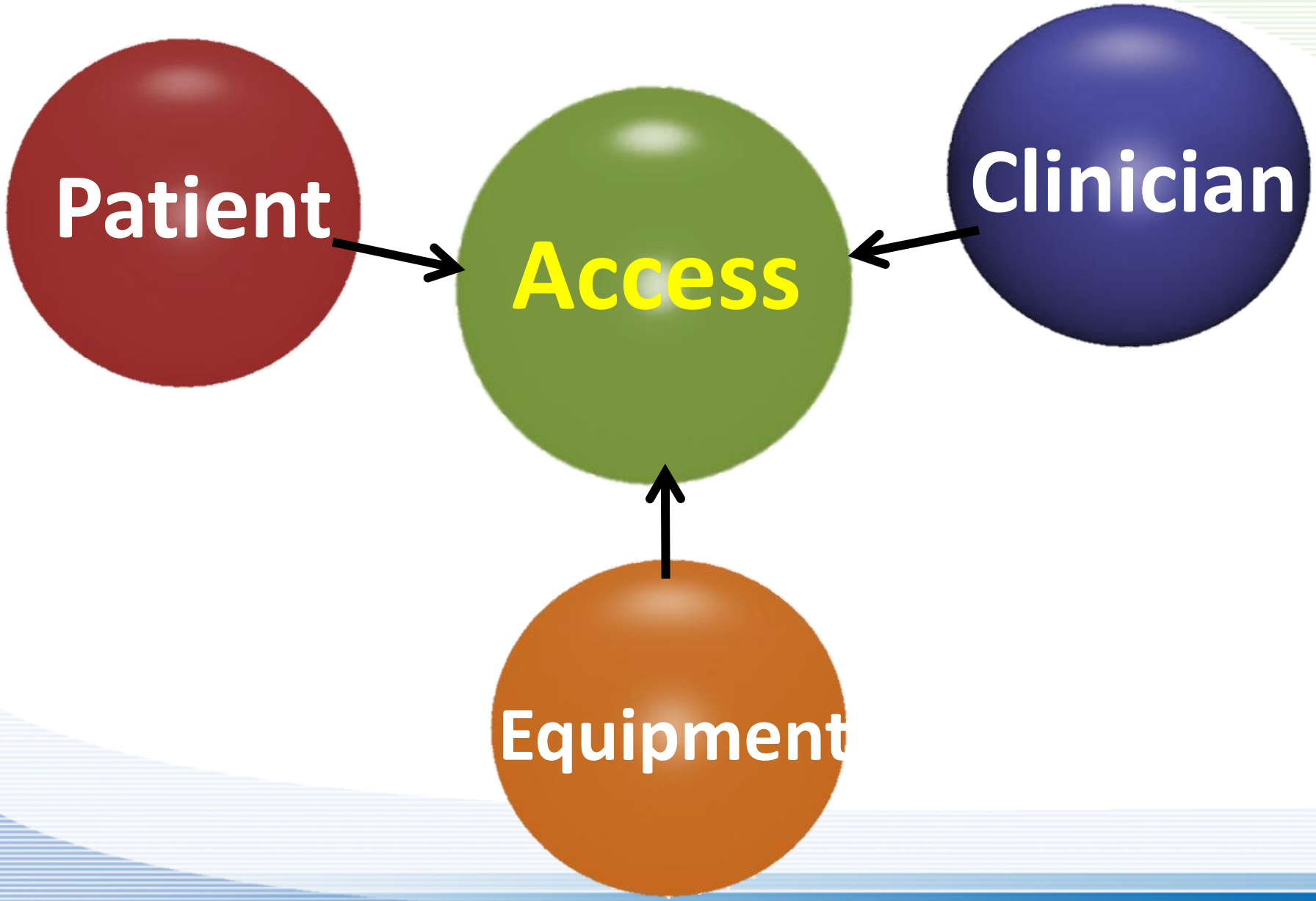
Mode of Peripheral IV Catheter Failure	Range	Mean	Median
Catheter-related phlebitis	0.1%-63.3%	15.4%	9.0%
Catheter infiltration	15.7%-33.8%	23.9%	22.2%
Catheter occlusion/mechanical failure	2.5%-32.7%	18.8%	22.8%
Catheter dislodgment	3.7%-9.9%	6.9%	7.0%
Catheter-related infection	0.0%-0.44%	0.2%	0.2%

[a] *Summary of data from* Tables 4 *to* 8.

Helm, RE, et al, 2015, JIN 38 (3) 189-203

Why Do PIV Failures Occur?

Vascular Access Paradigm



Typical Vascular Access Paradigm

"Skills & Tools"

+

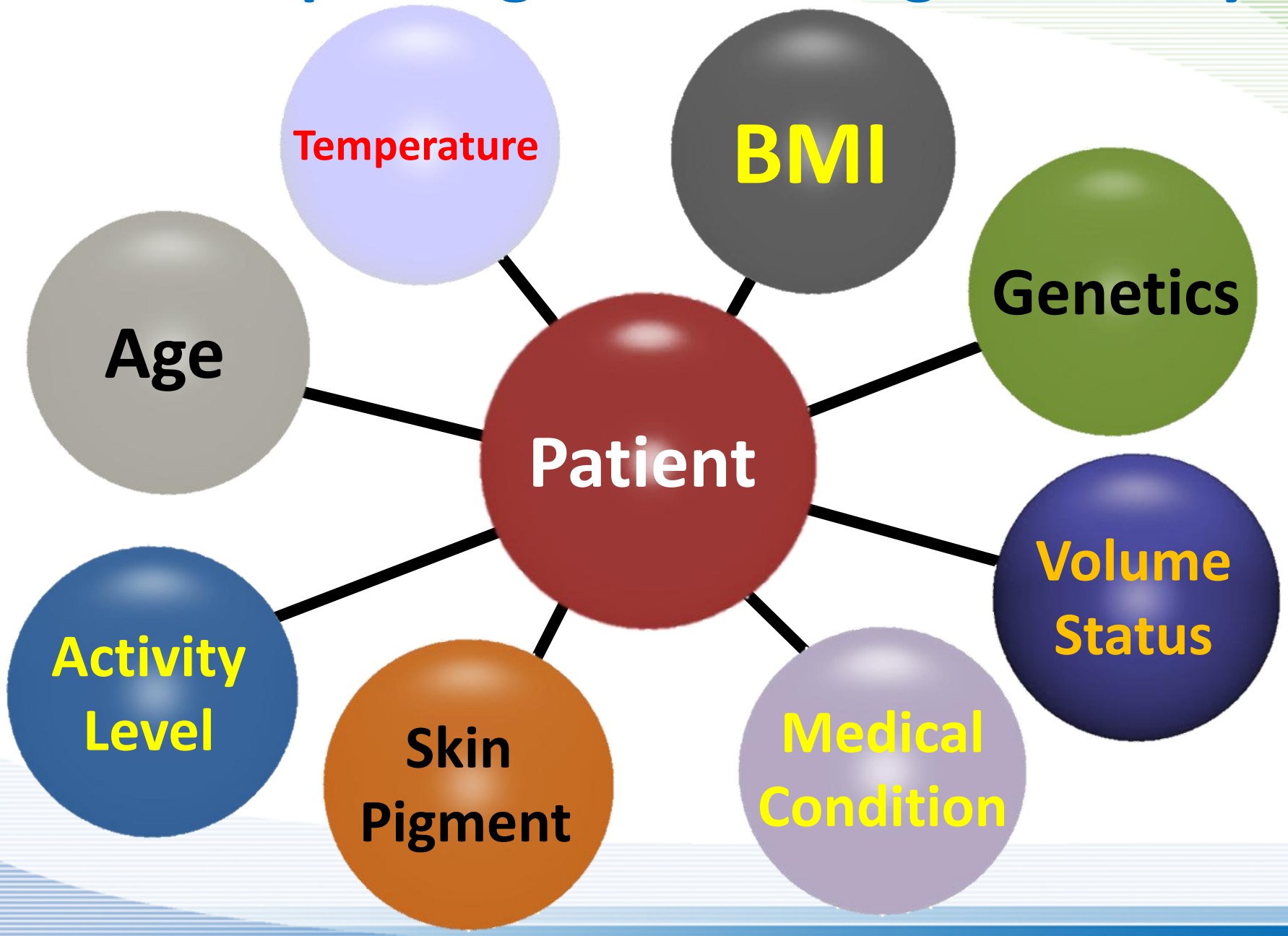
"Viable Targets"

≅ Peripheral Venous Access

In experienced hands 1 in 2.18 attempts

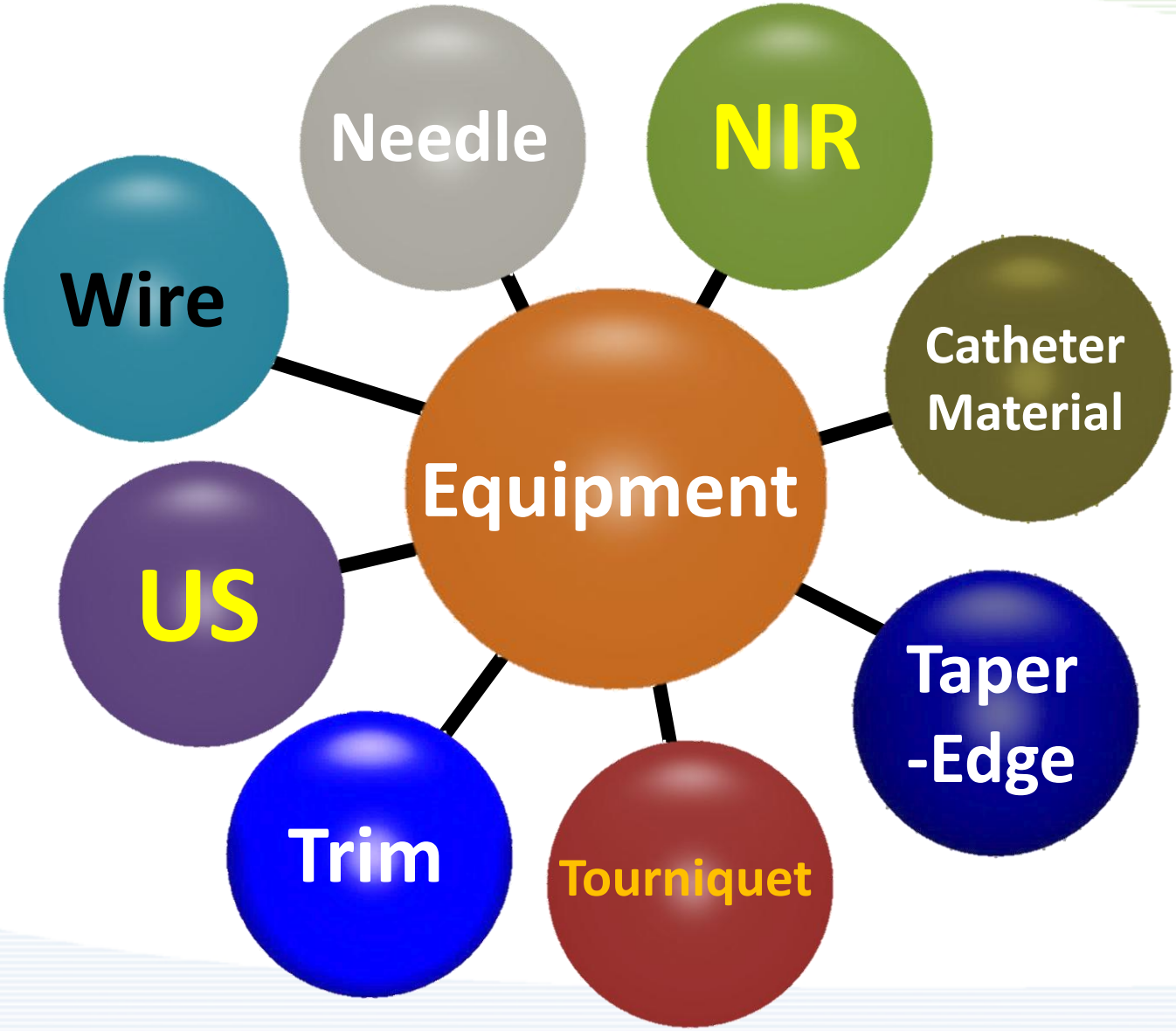
J Nursing Care Quality 13(2) 77-85, 1998

Factors Impacting Venous Target Quality

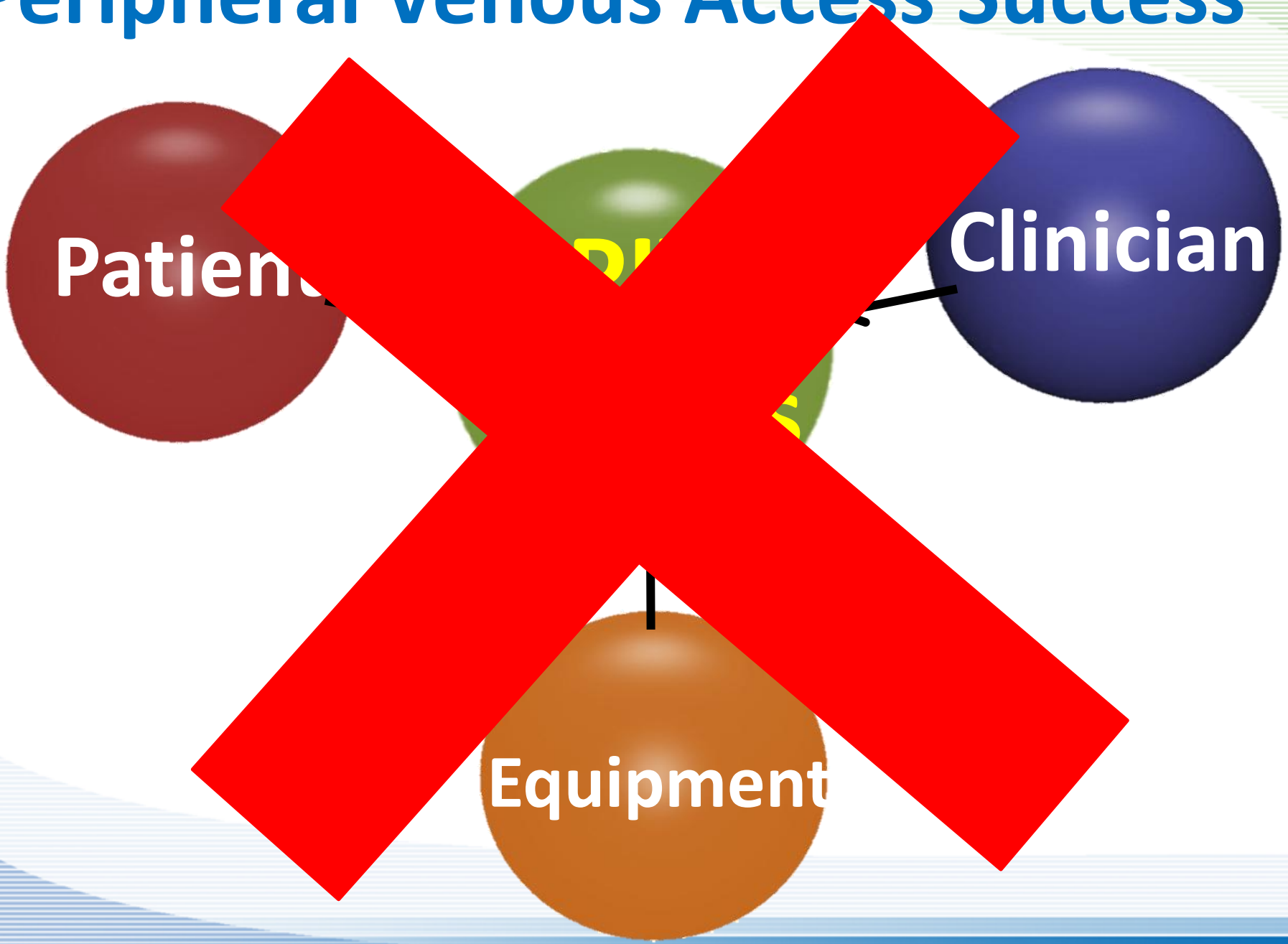


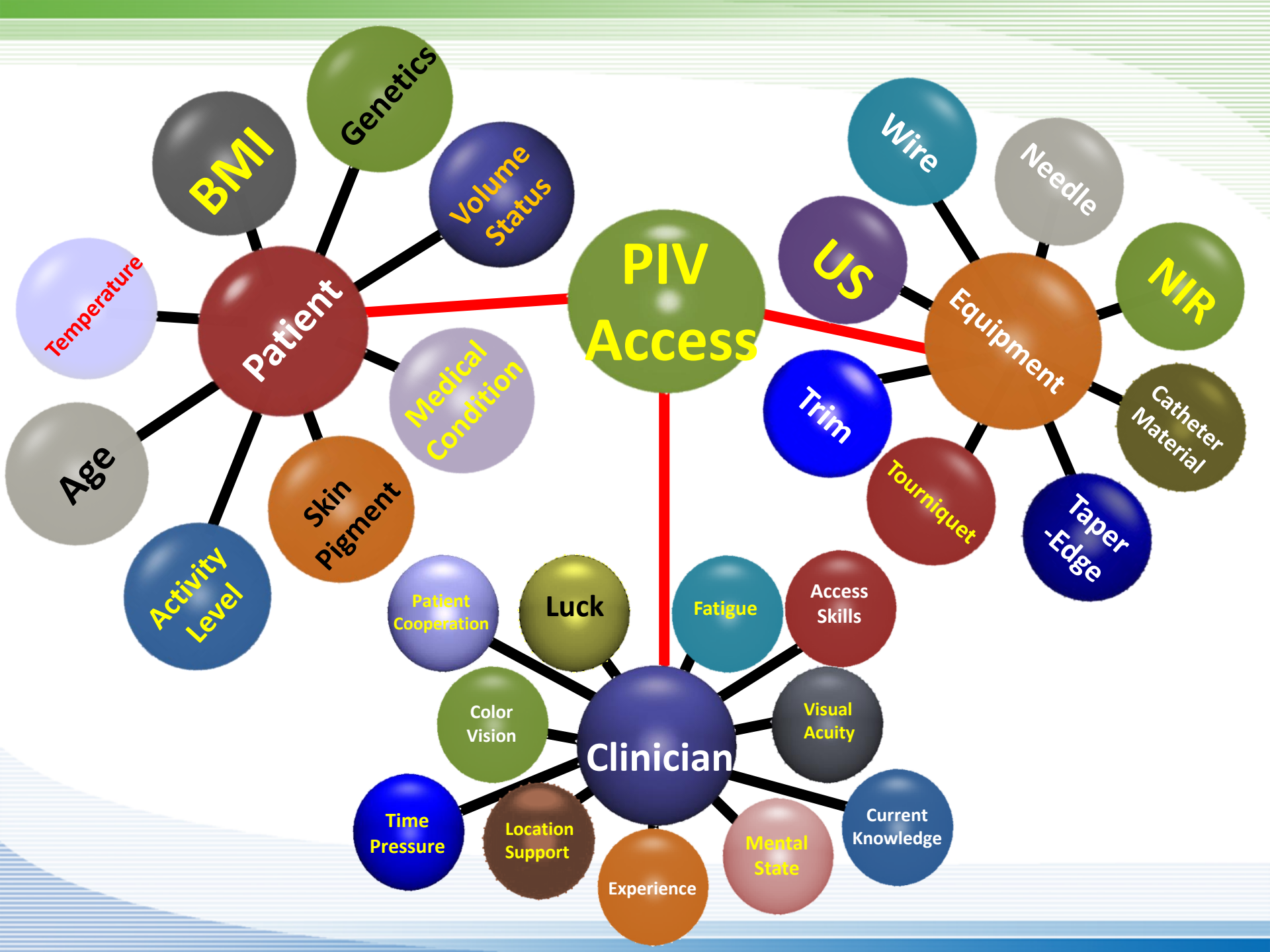
Clinician Access Factors

Access Equipment Factors



Peripheral Venous Access Success

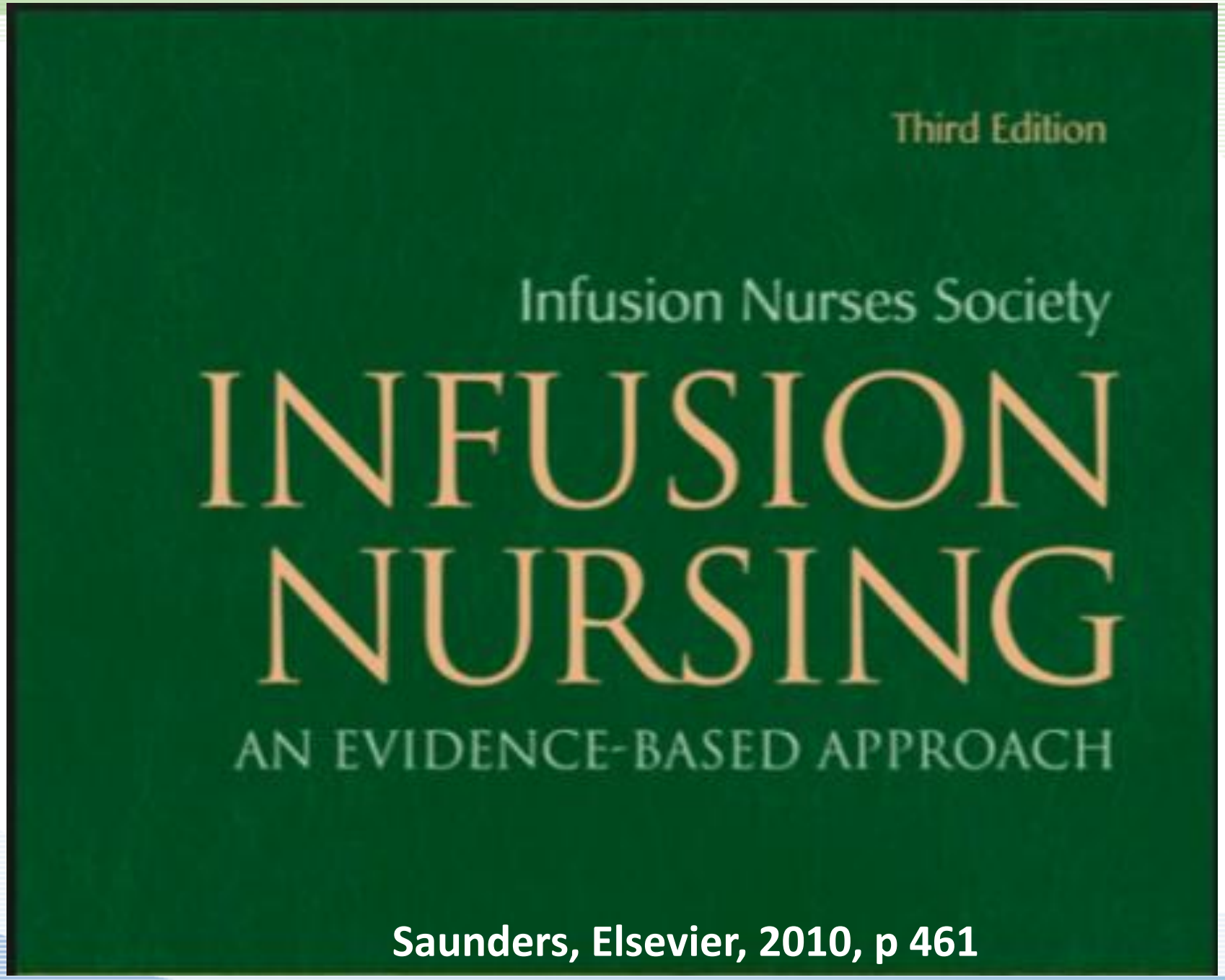



PIV Access
Patient
BMI
Genetics
Volume Status
Temperature
Age
Activity Level
Skin Pigment
Medical Condition
Equipment
Wire
Needle
US
NIR
Trim
Tourniquet
Taper -Edge
Catheter Material
Clinician
Patient Cooperation
Luck
Fatigue
Access Skills
Color Vision
Visual Acuity
Time Pressure
Location Support
Experience
Mental State
Current Knowledge

Causes of PIV Failure

- Patient Factors
- Clinician Factors
- Catheter Materials/ Designs
- Suboptimal Site Choice
- Stabilization & Motion
- Medications / Fluids

Suboptimal Site Choice



Saunders, Elsevier, 2010, p 461

Site Selection

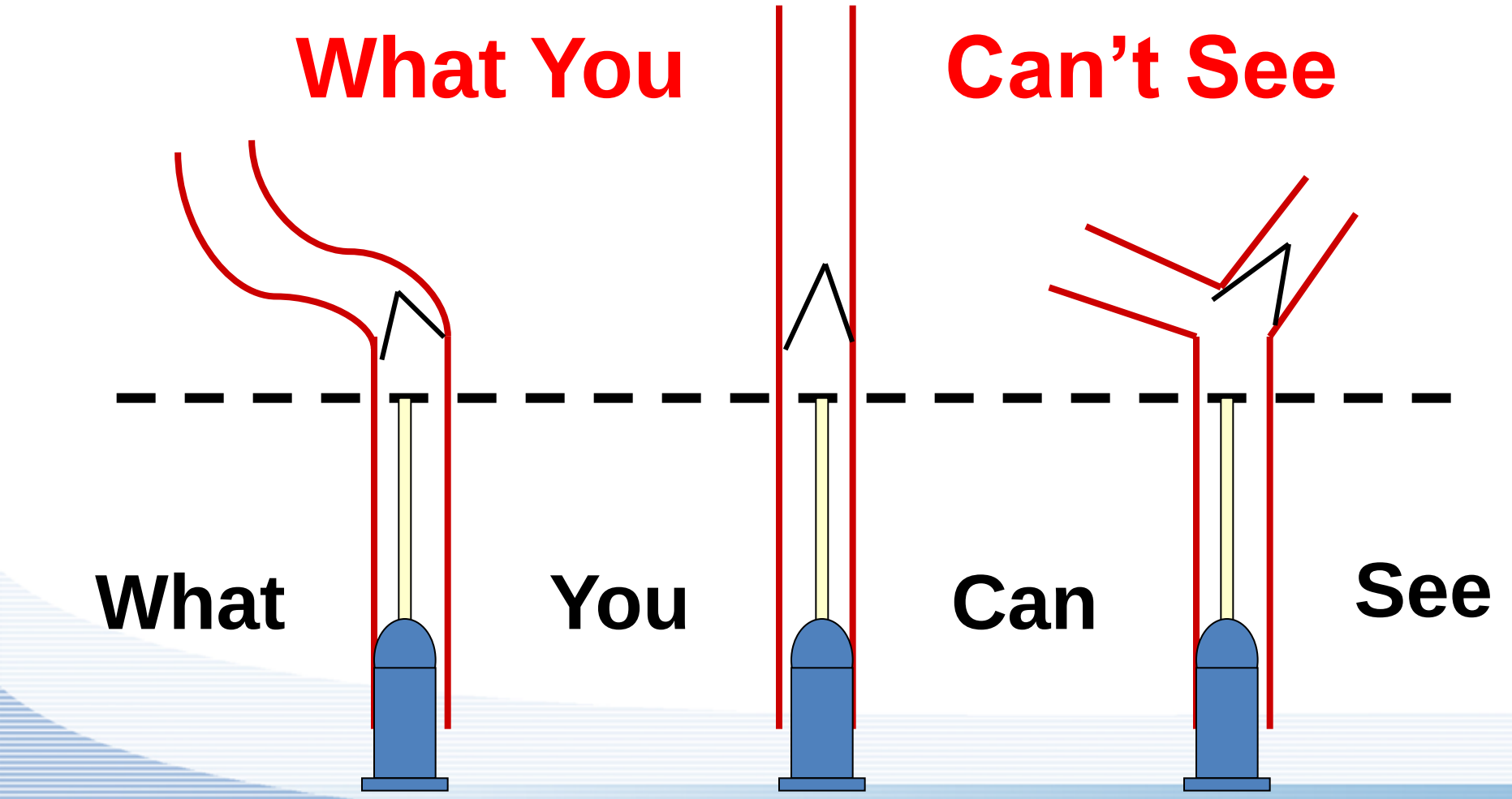
- Most distal site on extremity
- Avoid sites below previous insertion, infiltration, phlebitis or bruises
- Avoid areas of flexion such as wrist and antecubital fossa
- Metacarpal, cephalic, basilic and median veins are recommended because of their size and location.

INS, Infusion Nursing: Evidence Based Approach, Saunders, Elsevier, 2010, p 461

Reality

With unaided eye and fingers, we are very limited on vein based critical information

Picking an Optimal Access Site




AH-HA!

If we are going to advance PIV catheter insertion and reduce complications, we must embrace technology and better understand the dynamic relationship of the catheter within the vein particularly its tip position relative to other intravenous structures !

Method For Identification

Ideal Vein	Eye	Palp	U/S	NIR
Not Across a Joint	✓	-	-	-
Vein Size	+/-	+/-	✓	✓
Straight Pathway	+/-	+/-	+/-	✓
Avoid Valves	0	0	0	✓
Identify Obstruction	0	+/-	✓	✓
Venous Flow	0	0	+/-	✓
Catheter Tip- Valve	0	0	+/-	✓

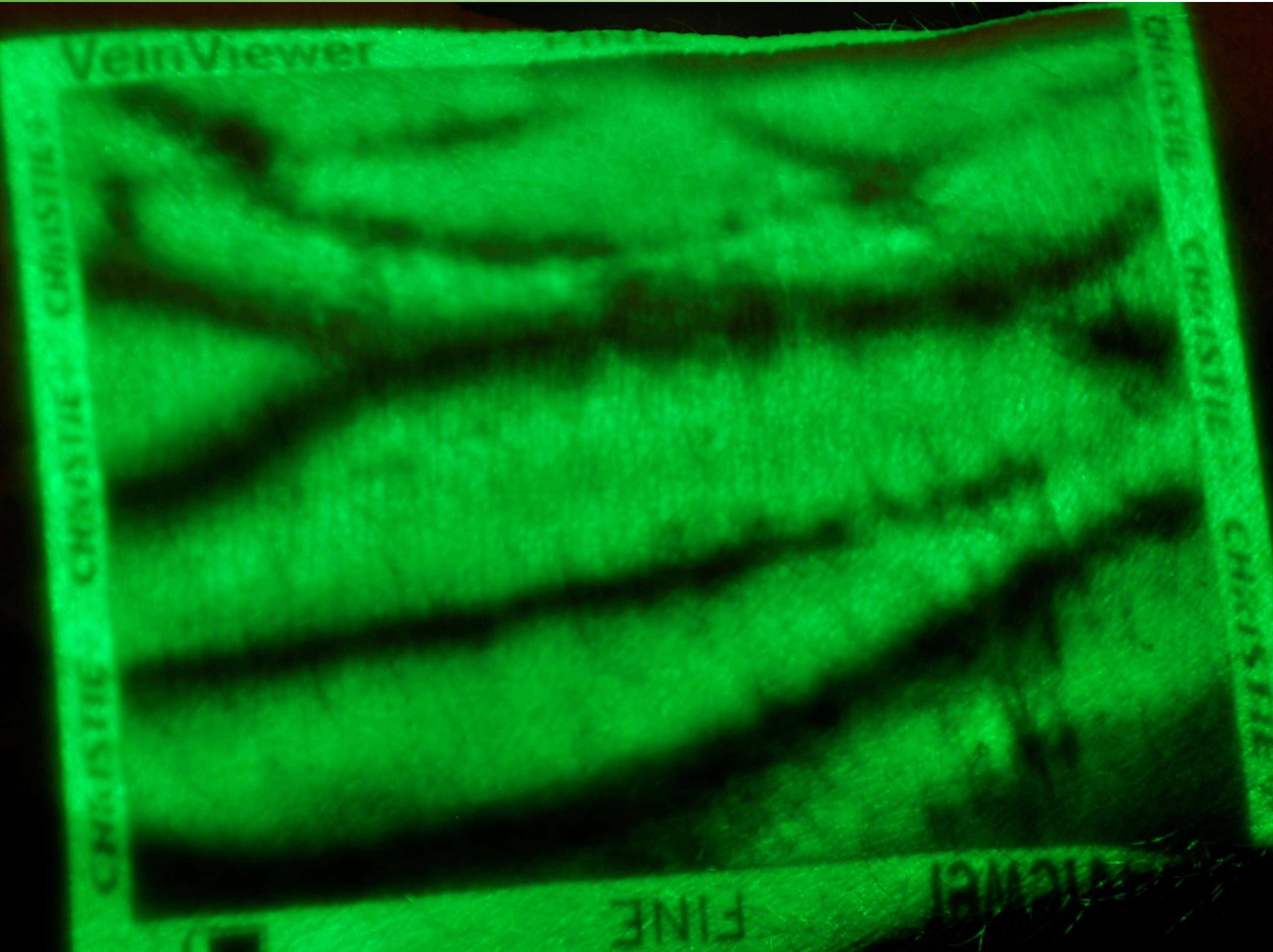
US & NIR

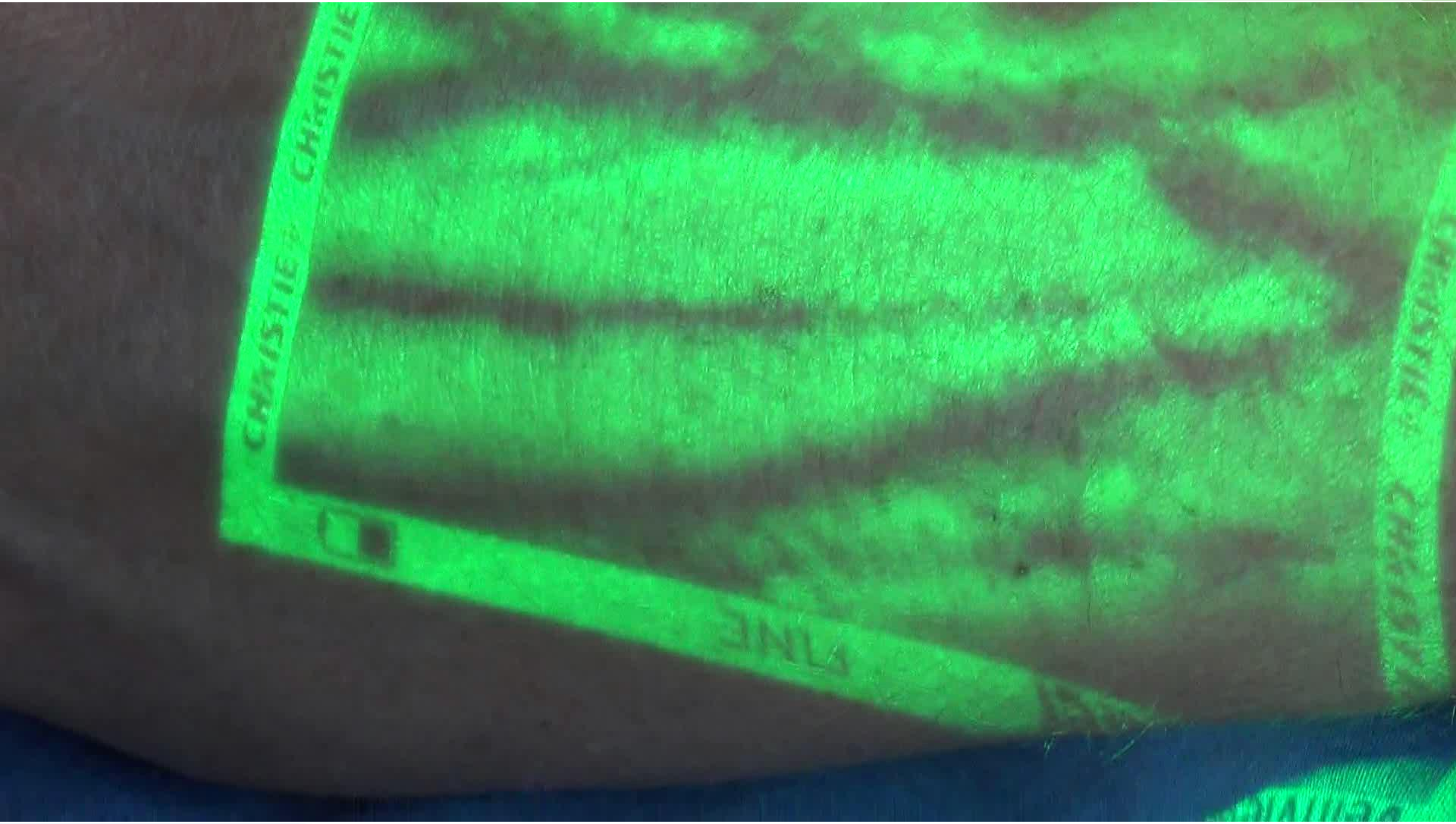
- **Complementary technologies that help identify additional viable targets that your eyes and fingers can’t find.**
- **Assist with process of obtaining access as well.**
- **NIR has additional abilities to screen for targets, identify valves and more easily judge catheter to vein ratios.**
- **Both technologies are necessary for modern vascular access best practice**
- **Each has a learning curve, US a bit steeper**

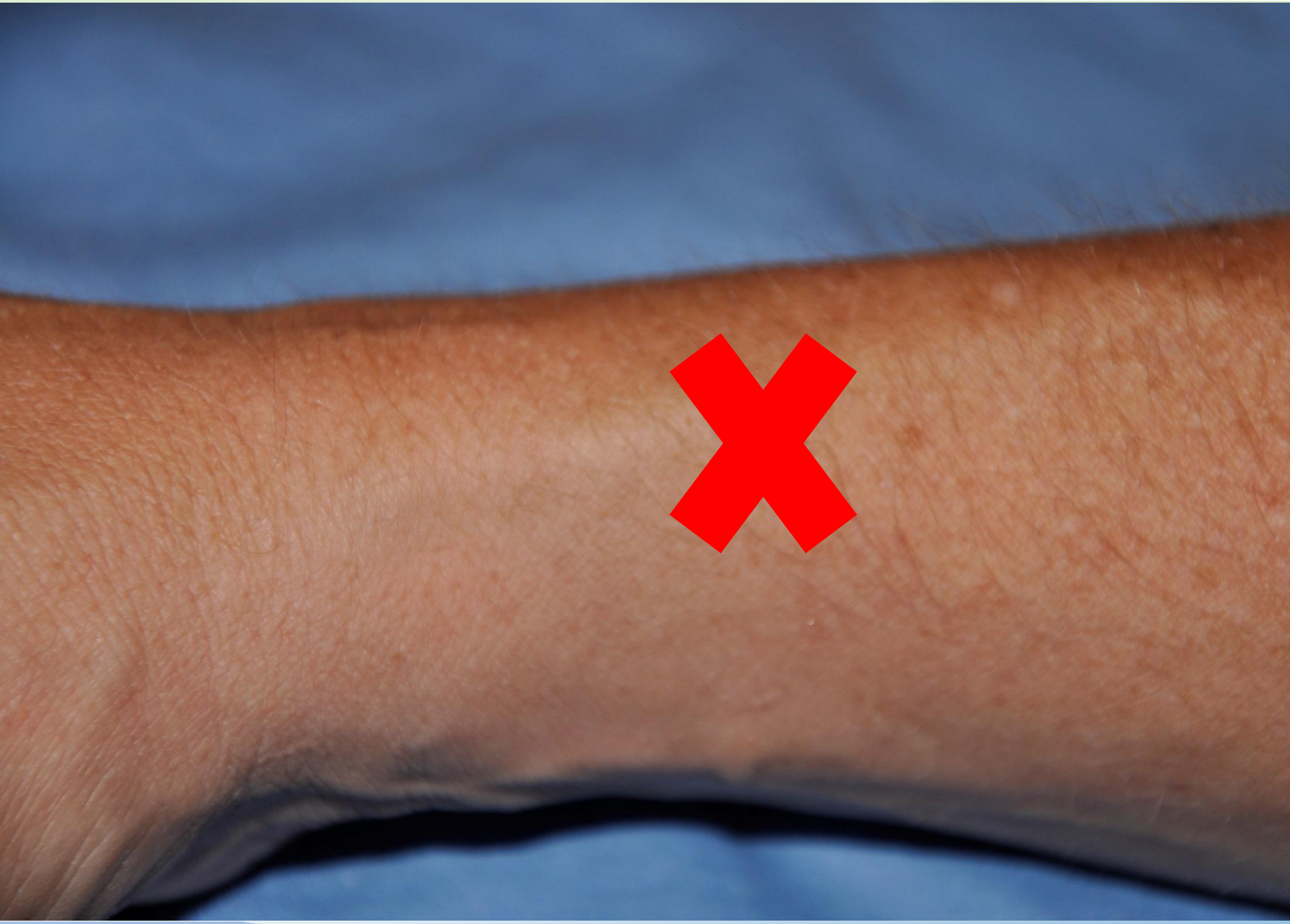
Veins and Valves

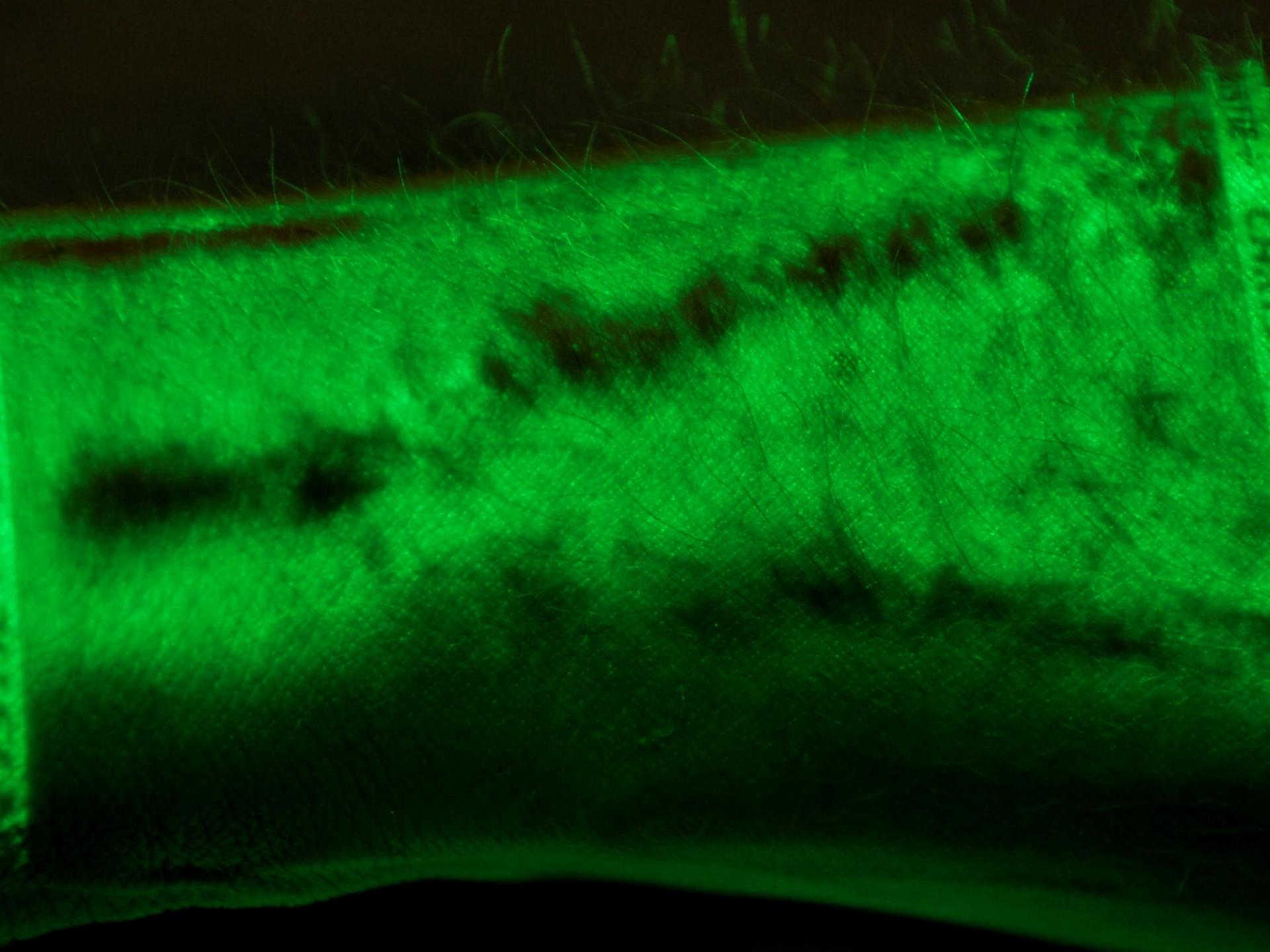
Have You Ever?

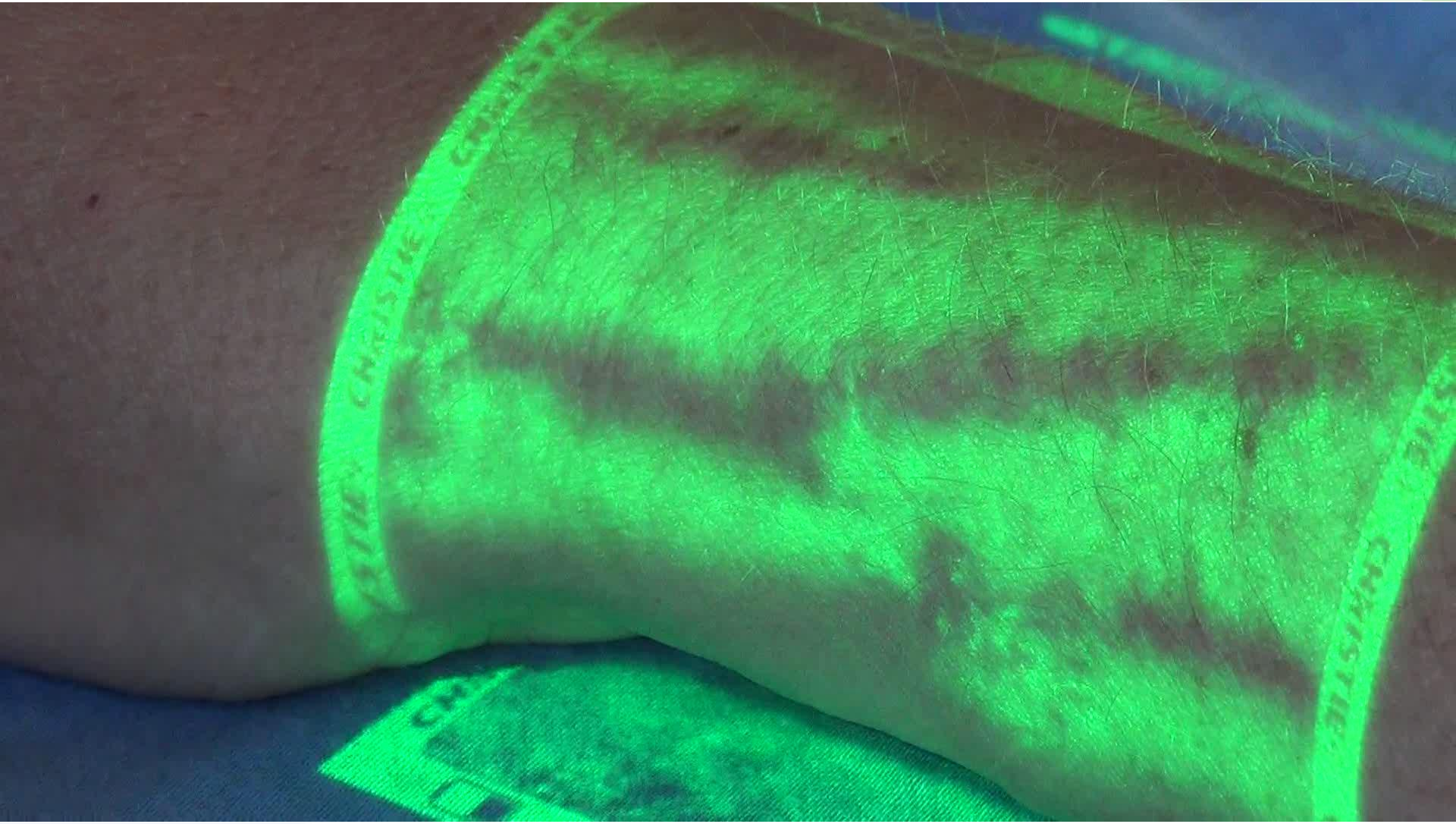
- Blown a vein due to hitting a valve?
- Caused more pain to a patient from hitting a valve? Second stick?
- Had the IV pump beep incessantly because the IV catheter tip bumps up against a valve?
- Have reduced IV flow because the IV catheter tip was up against a valve?


VeinViewer

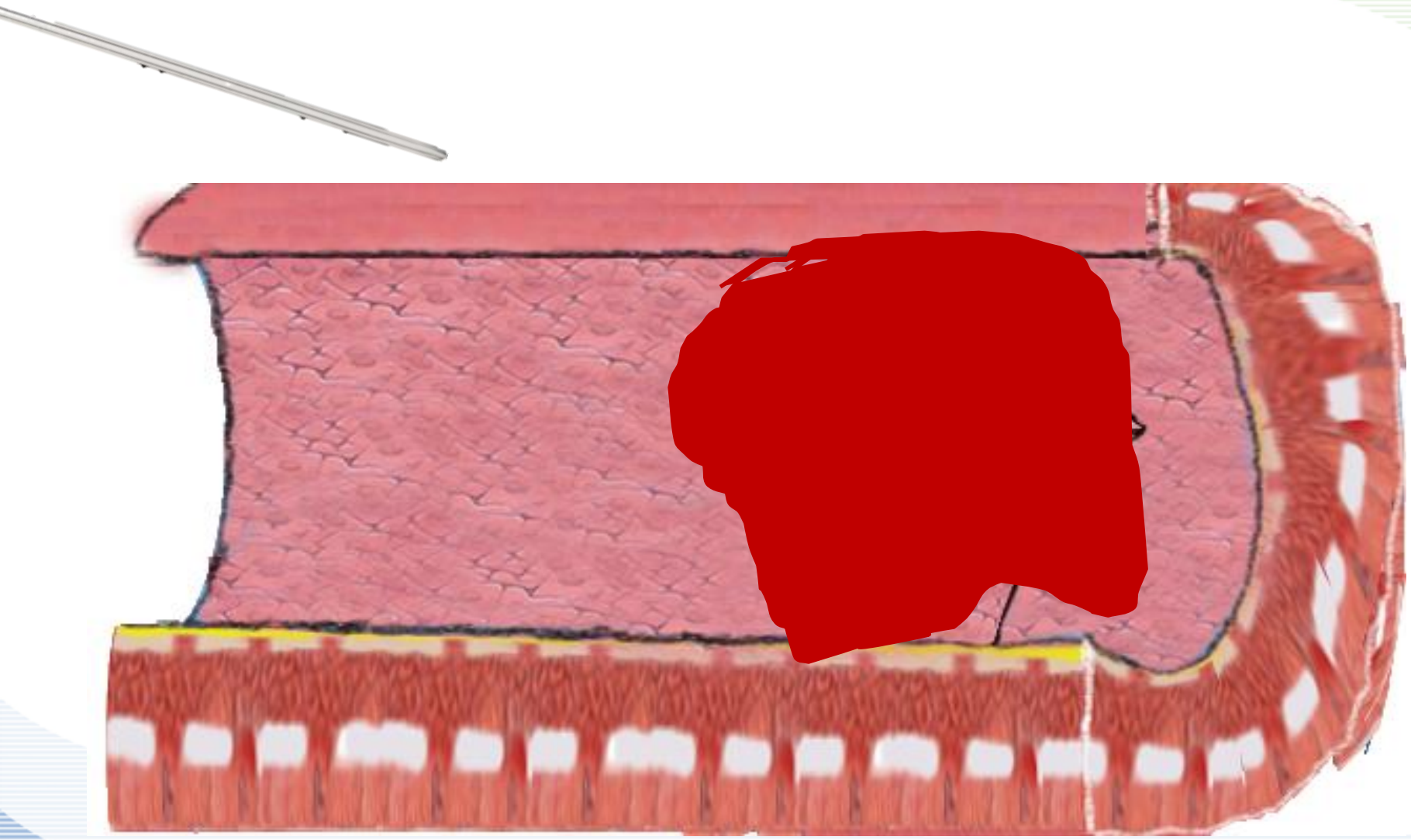

CHRISTIE
CHRISTIE

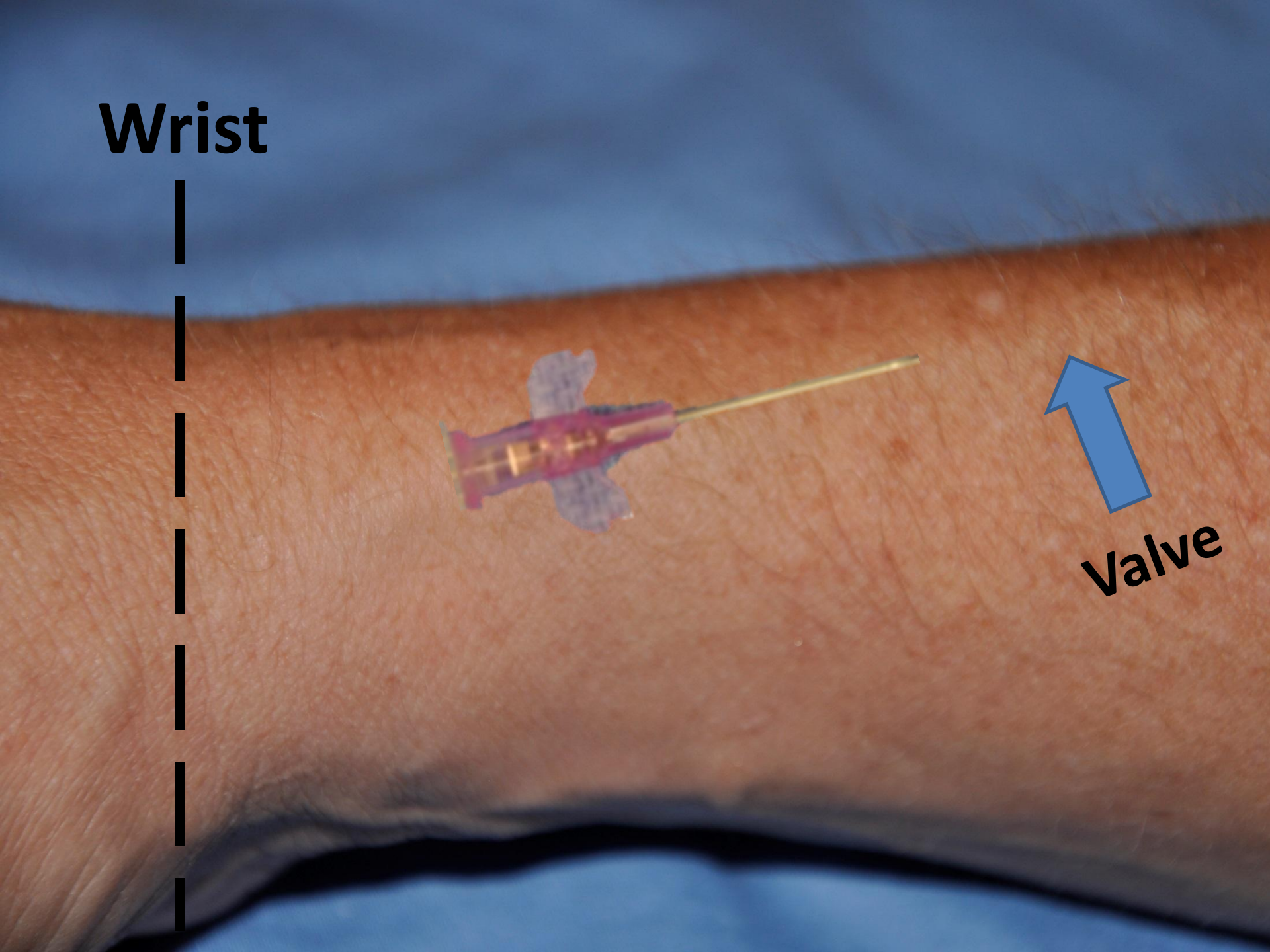






Vessel Hemtoma from Valve Strike



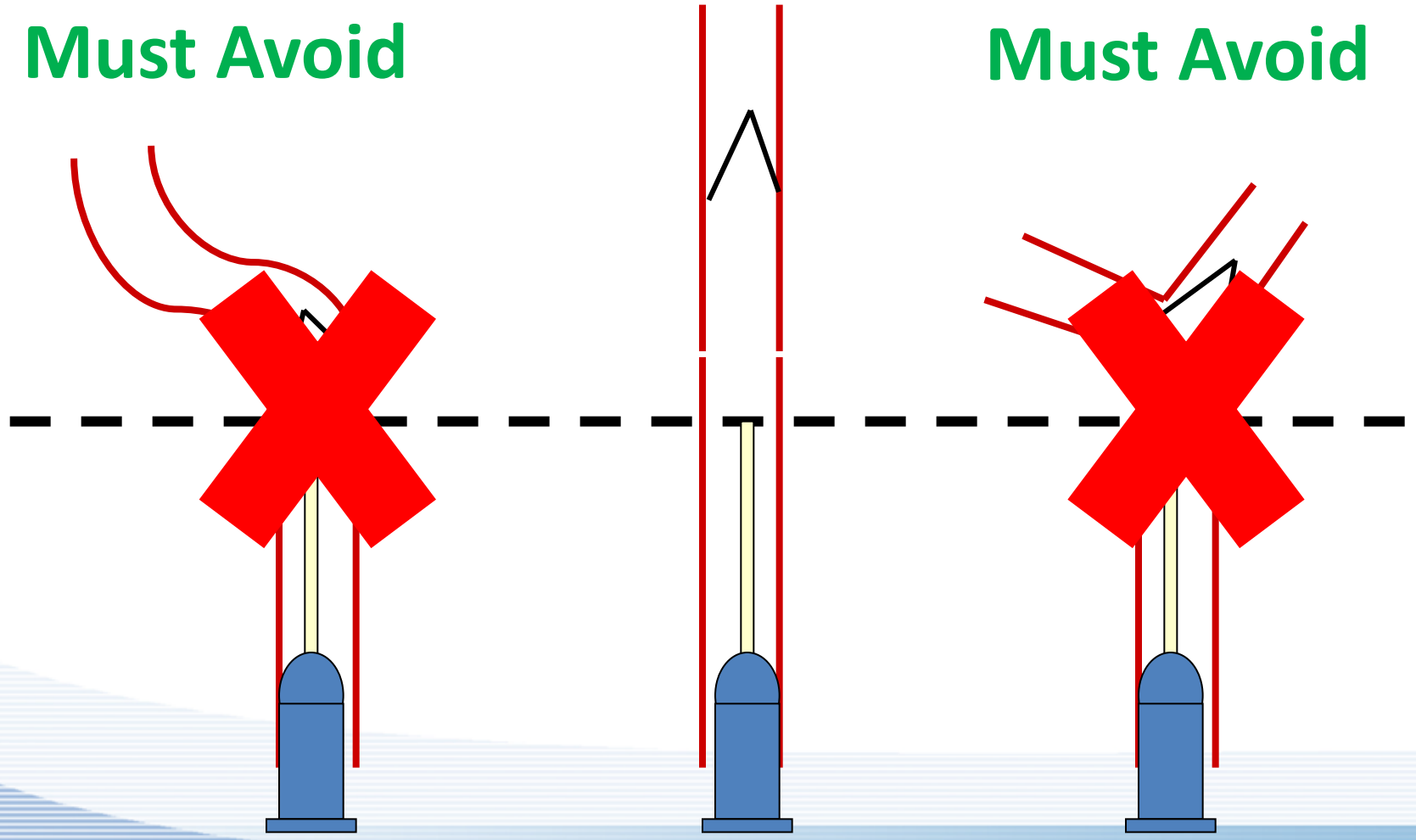

Wrist
Valve

Valve-ology

- Valves are well know to interfere with optimal PIV insertion-functionality
- Difficult to predict where valves will be
- Rarely can see with the naked eye
- Very difficult to identify with U/S
- NIR easily identifies valves by milking vein.
- Thus NIR necessary for optimal PIV positioning regardless of vein difficulty

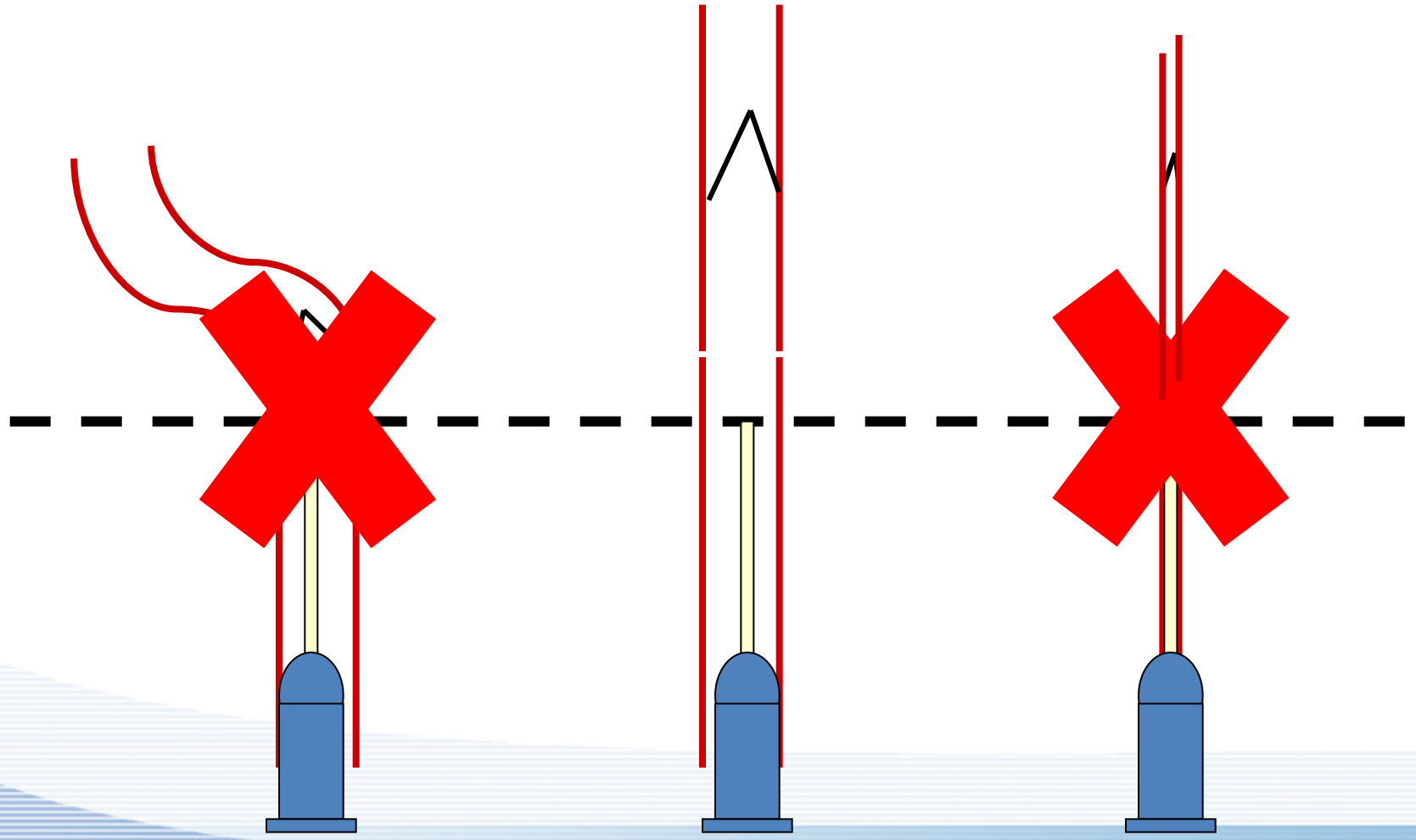
Picking an Optimal Access Site

Must Find



Finding the Straight and Wide

Picking an Optimal Access Site



Risk of Thrombosis

Catheter to vein ratio and cases of venous thromboembolism.

Characteristic		Venous thromboembolism					
		Yes ($n=4$)	No ($n=132$)	Total ($n=136$)	RR	95% CI	Sig.[a]
		n (%)	n (%)	n (%)			
Catheter to vein ratio	18–33%	1 (25)	66 (50)	67 (49)	1.04	0.99–1.09	0.097
	34–45%	0 (0)	44 (33)	44 (33)			
	46–70%	3 (75)	18 (14)	21 (15)			
	>71%	0 (0)	4 (3)	4 (3)			

[a] Based on log binomial generalised linear model (analysed as a continuous variable); CI = confidence interval; RR = relative risk.

Sharp R, et al. International J Nurs Studies 2015;52:677-685

Impact of Catheter Size to Venous Flow

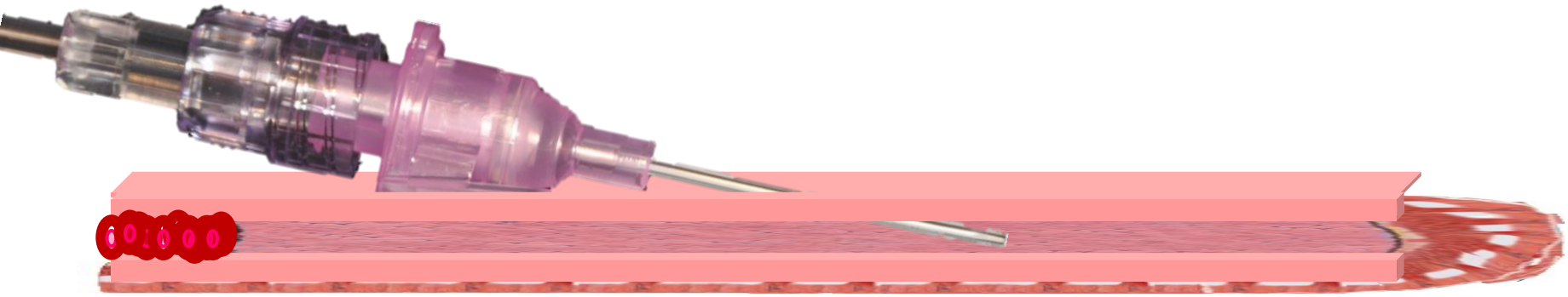
Table 1—*Experimental Results Using Combinations of Three Outer Tube (Cylinder) Diameters and Four Inner Wire (Catheter) Diameters*

Measure	Unobstructed	Inner Wire 0.67 mm (2F)	Inner Wire 1.33 mm (4F)	Inner Wire 2.0 mm (6F)	Inner Wire 2.6 mm (8F)
Outer tube, 4 mm					
D_{cath}/D_{cyl}	0	0.16	0.32	0.48	0.64
Average flow, mL/min	17	12	6.7	3.4	1.2
Relative flow, %	100	69	40	20	6.9
SD, mL/min	0.42	0.11	0.15	0.034	0.016
P value[a]	…	3.7×10^{-6}	6.8×10^{-11}	3.8×10^{-7}	3.6×10^{-11}
Outer tube, 5 mm					
D_{cath}/D_{cyl}	0	0.13	0.25	0.38	0.51
Average flow, mL/min	41	33	25	17	10
Relative flow, %	100	81	60	42	25
SD, mL/min	0.15	0.75	0.70	0.16	0.092
P value[a]	…	1.0×10^{-5}	8.5×10^{-8}	9.0×10^{-6}	5.3×10^{-11}
Outer tube, 6 mm					
D_{cath}/D_{cyl}	0	0.11	0.21	0.32	0.42
Average flow, mL/min	81	52	47	39	29
Relative flow, %	100	64	58	49	36
SD, mL/min	0.98	0.58	0.40	2.7	0.75
P value[a]	…	5.3×10^{-10}	1.0×10^{-6}	.0028	6.7×10^{-4}

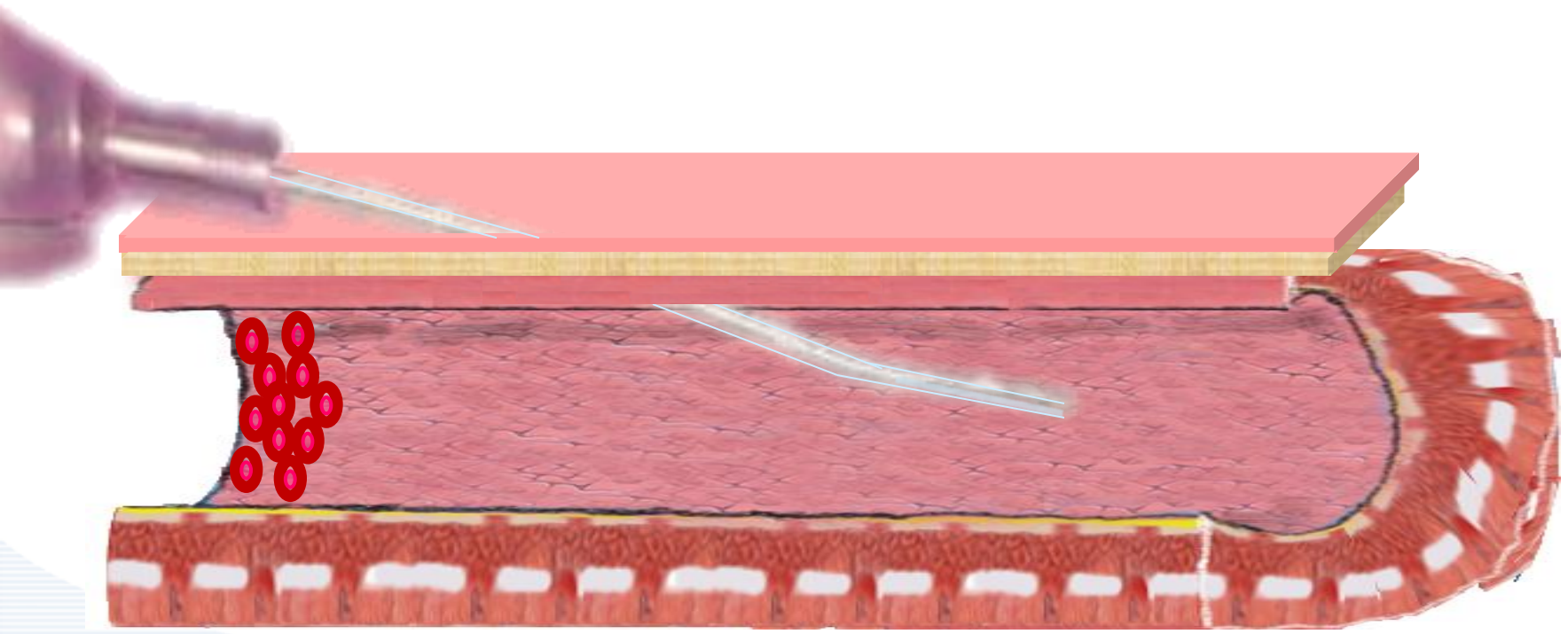
D_{cath} = diameter of the catheter; D_{cyl} = diameter of the cylinder.
[a]Compared with the next smallest catheter size.

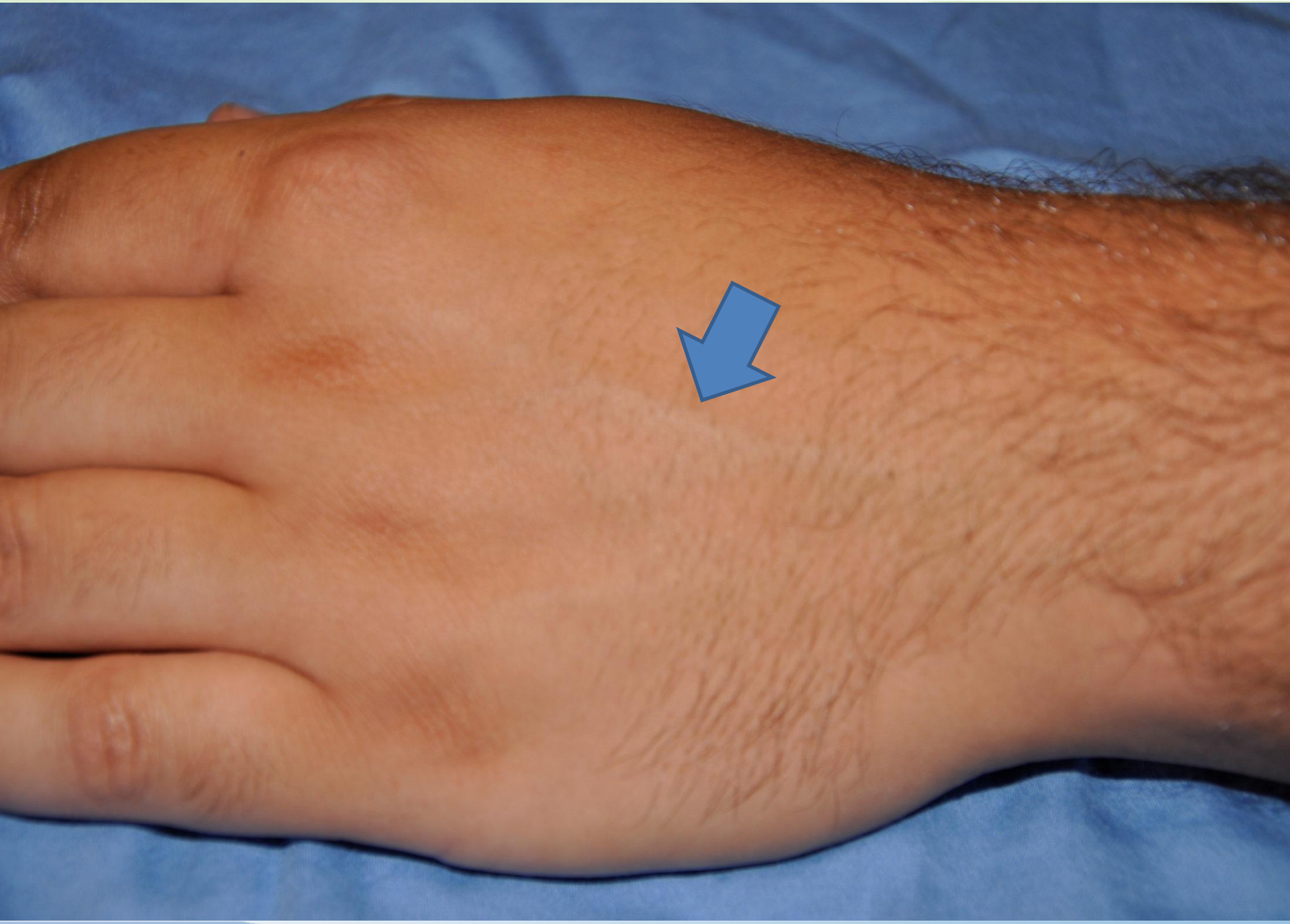
TF Nifong, TJ McDevitt, CHEST 2011; 140(1):48–53

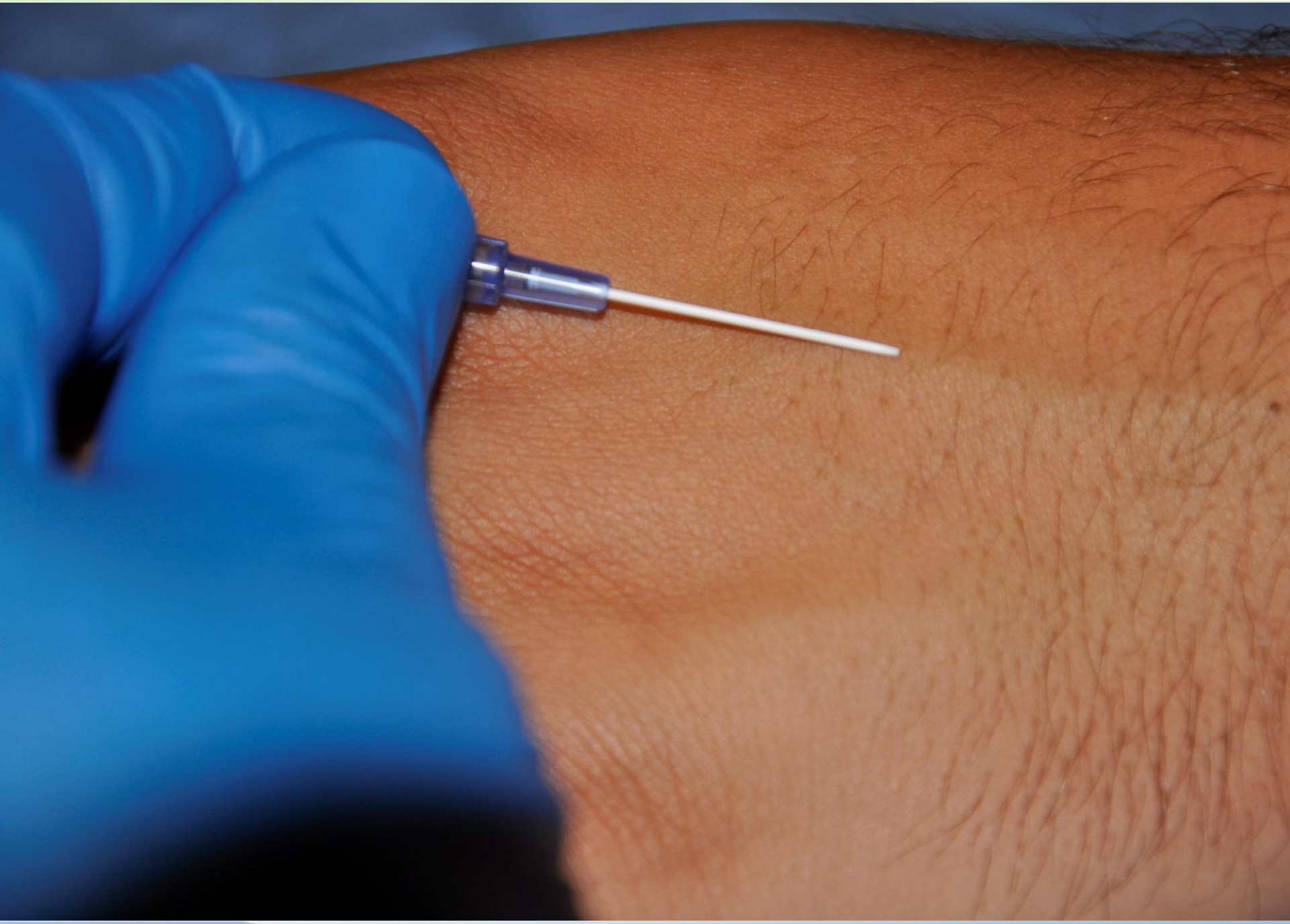
Suboptimal Catheter/Vein Ratio

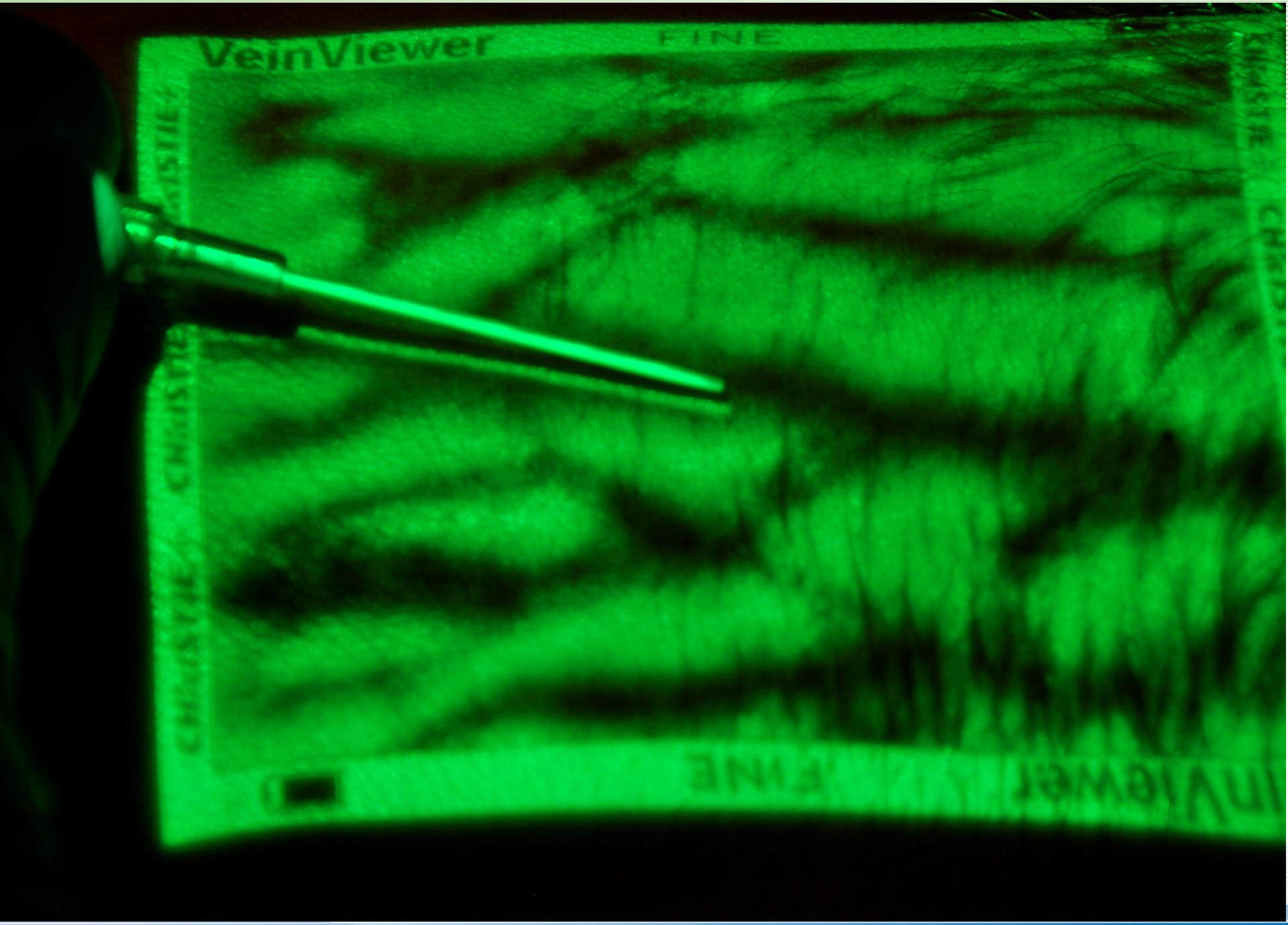


Optimal Catheter/Vein Ratio








VeinViewer
FINE

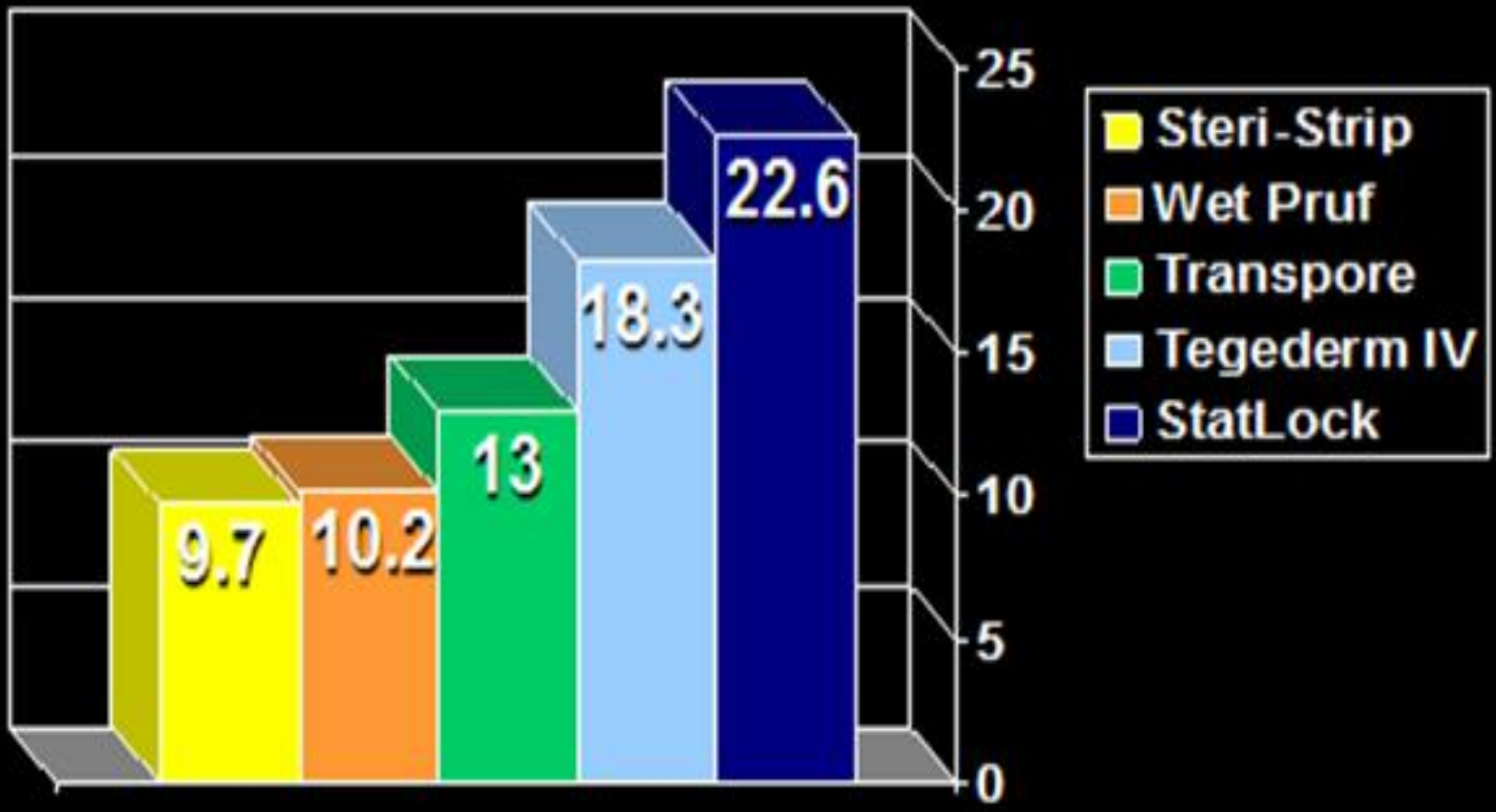
Optimal Catheter/Vein

- Difficult to estimate real vein size for most PIV access using unaided eye.
- Palpation even more difficult.
- U/S good but harder to know straightaways and can't easily see valves or tortuosities
- NIR easily identifies straightaways and projects exact vein width with some products.
- Thus NIR is necessary for optimal PIV catheter/ vein strategies to preserve flow & integrity.

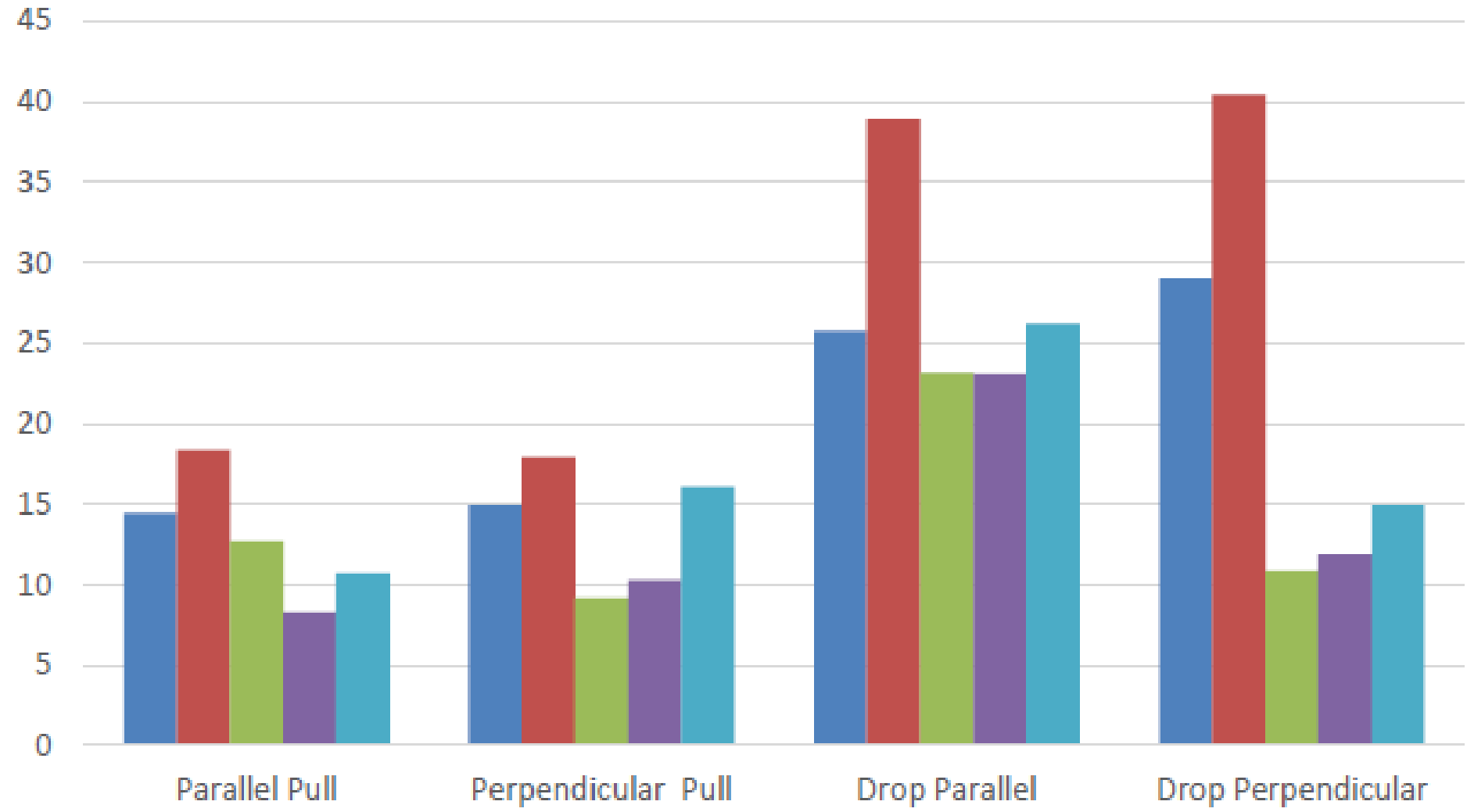
Enhanced Stabilization

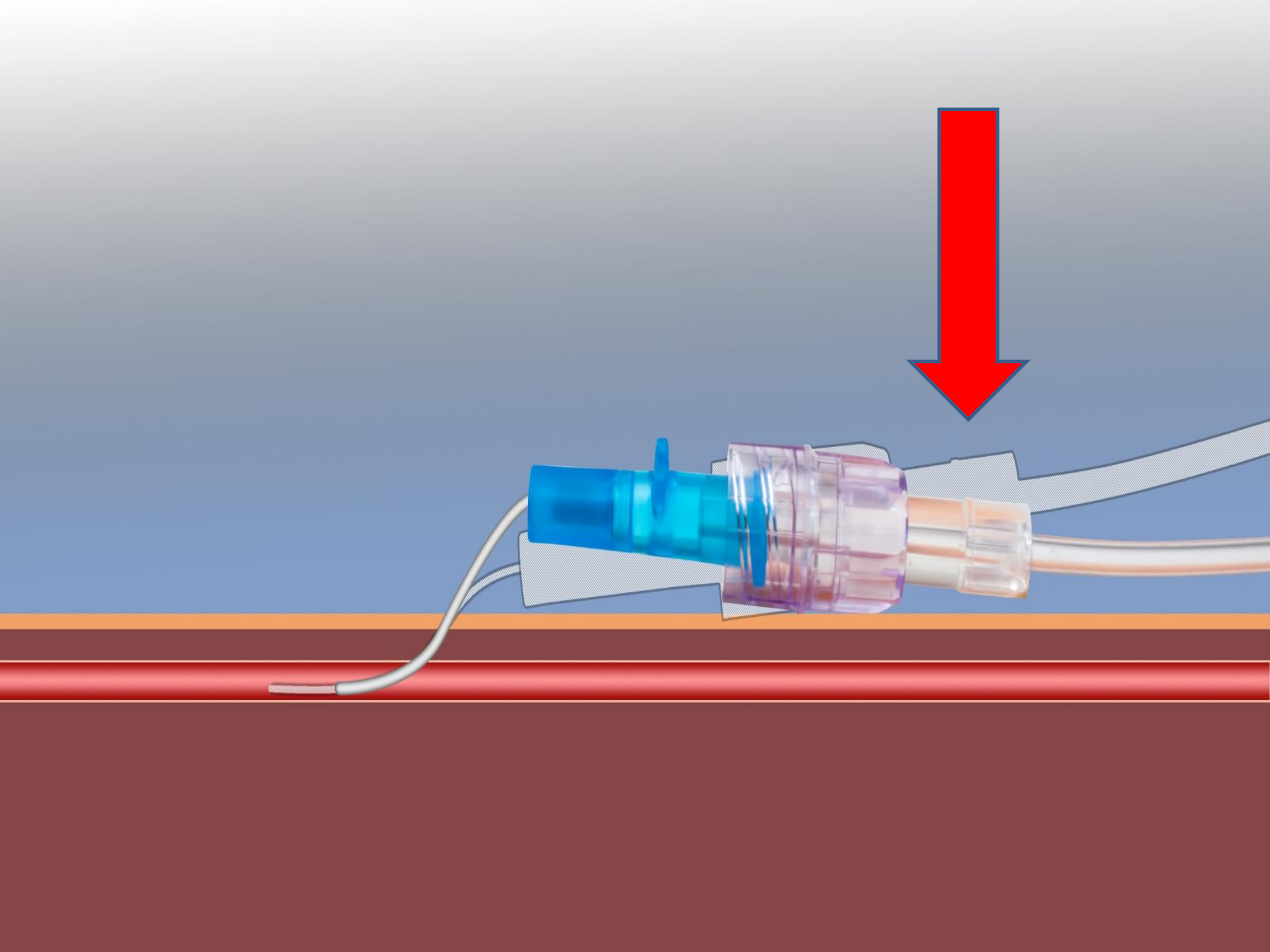
“Old Standards”

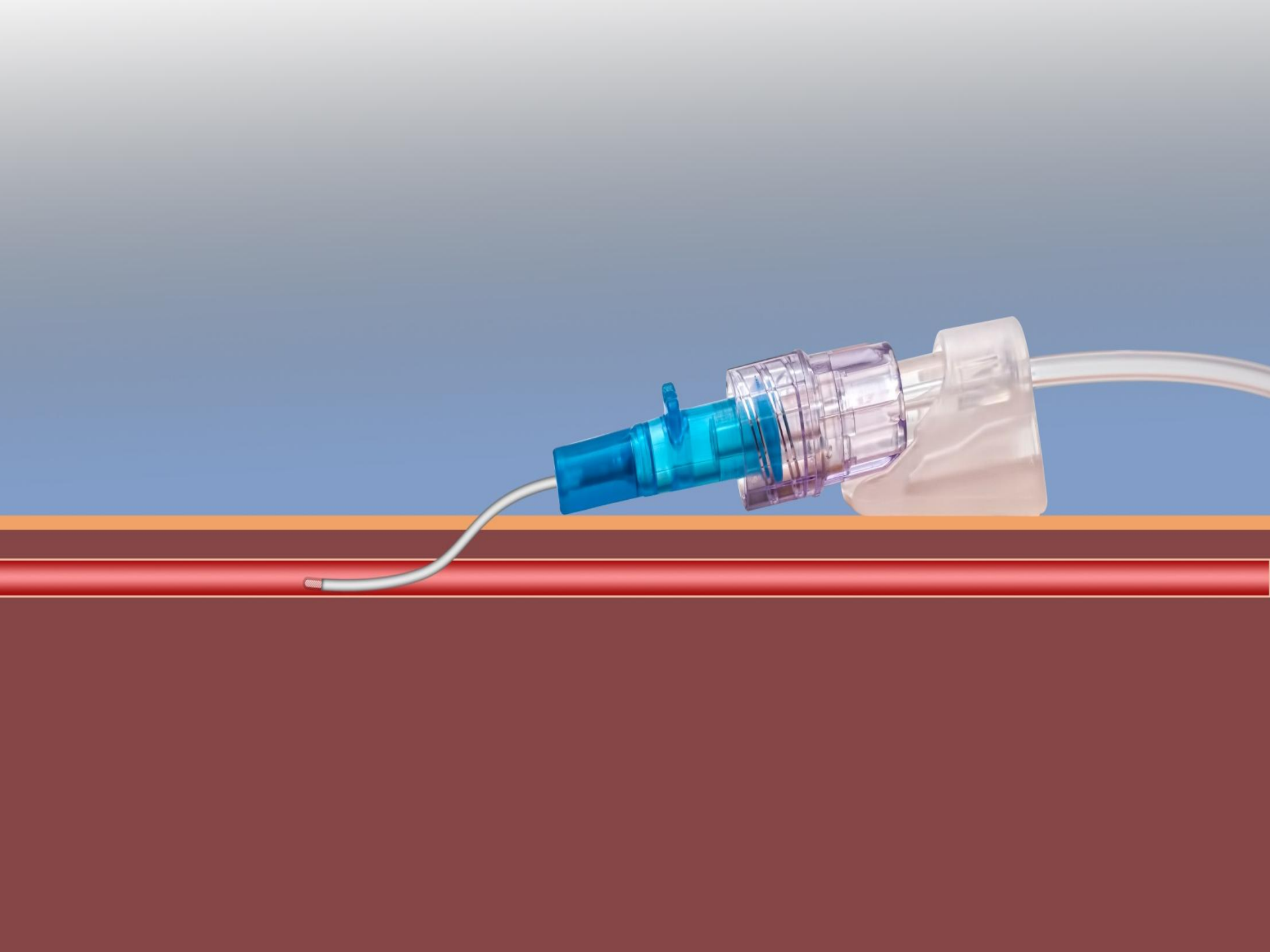
Summary of 90° Pull Test 1" X 1"



Catheter Securment Device Pull Strength (Pounds)







Summary

- Pre-Access assessment is necessary as POC to assess viable venous targets
- NIR is the only technology that can perform a timely assessment and easily identify valves & Catheter/Vein Ratio
- Further stabilization progress requires mechanical support to reduce rocking motion caused by lever arm of Luer connectors and IV tubing

Thank You

Questions?

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