Hospital Onset Bacteremia (HOB): How will HOB affect PIV insertion and care?

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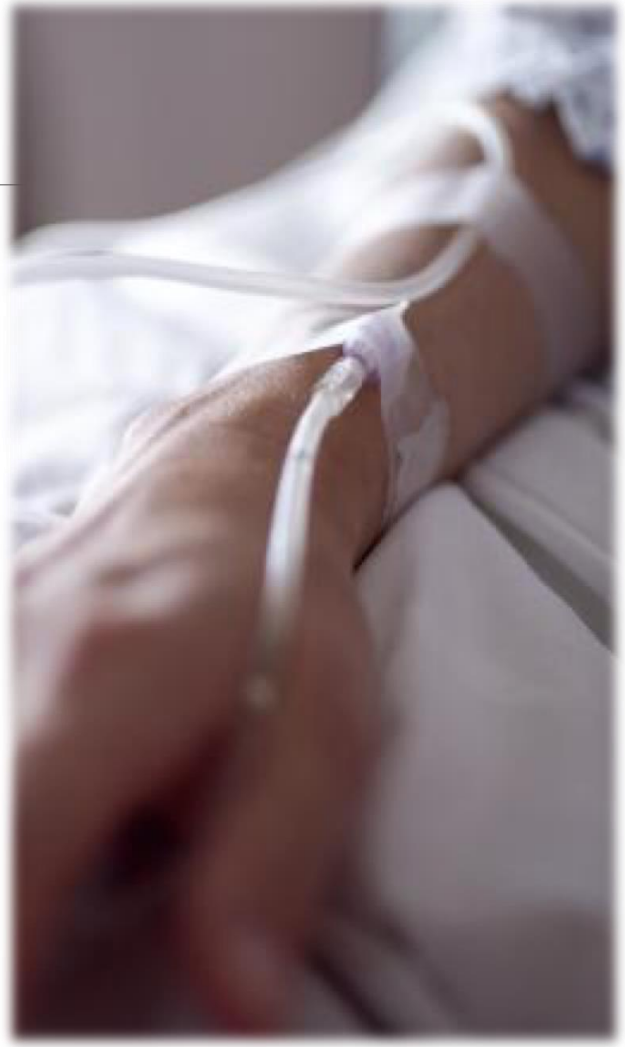
Objectives

1. Discuss prevalence of PIV bloodstream infections
2. Discuss possible effects of PIV infections as it relates to Hospital Onset Bacteremia and Fungemia
3. Demonstrate common ways touch contamination occurs
4. Discuss best insertion/management practices for PIV insertion (ANTT)
5. Compare chlorhexidine salts (CHG/CHA) and pure chlorhexidine (CHX)
6. Bringing better practices forward

Background

- PIVs are the most frequently used invasive device in hospitals (Alexandro 2018)
- Up to 90% of patients require a PIV during their hospital stay (Steere 2019)
- 350M IV catheters are sold in the US each year (Steere 2019)
- PIVC catheter dwell times are 15 times higher that CVADs (Zingg 2009)
- Up to 63% of PIVs fail prior to completion of therapy (Helm 2015)
- 35% to 50% insertion attempts fail to place device (Hadaway 2012, Jones 2018, Cook 2018)
- ECRI (2019 & 2021). Peripheral Vascular Harm on the "Top 10 Patient Safety Concerns”
- PIV Bloodstream infections – PVC-BSI, PVCR-BSI, PVCA-BSI, HOSAB with PIV



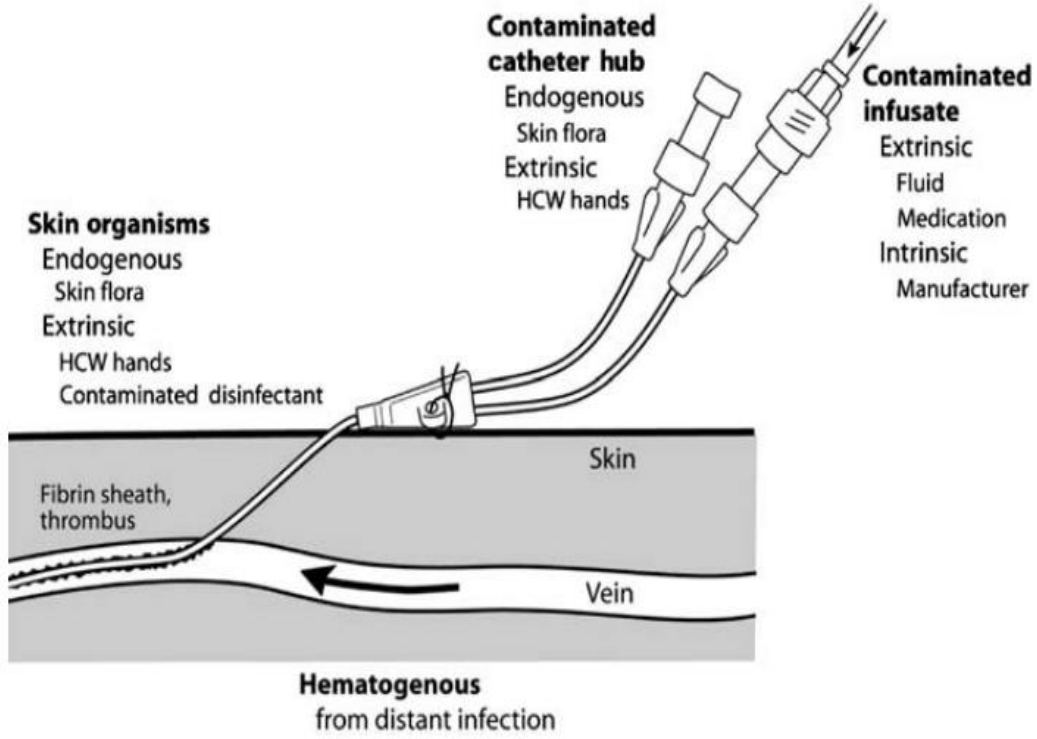
Vascular Access Device BSI Pathogenesis?

BSI pathways

- 60% Extraluminal
- 12% intraluminal
- 28% unknown

Causes

- Skin organisms
- Micropistoning
- Poor disinfection
- Contamination



Maki 2004

Helm 2015

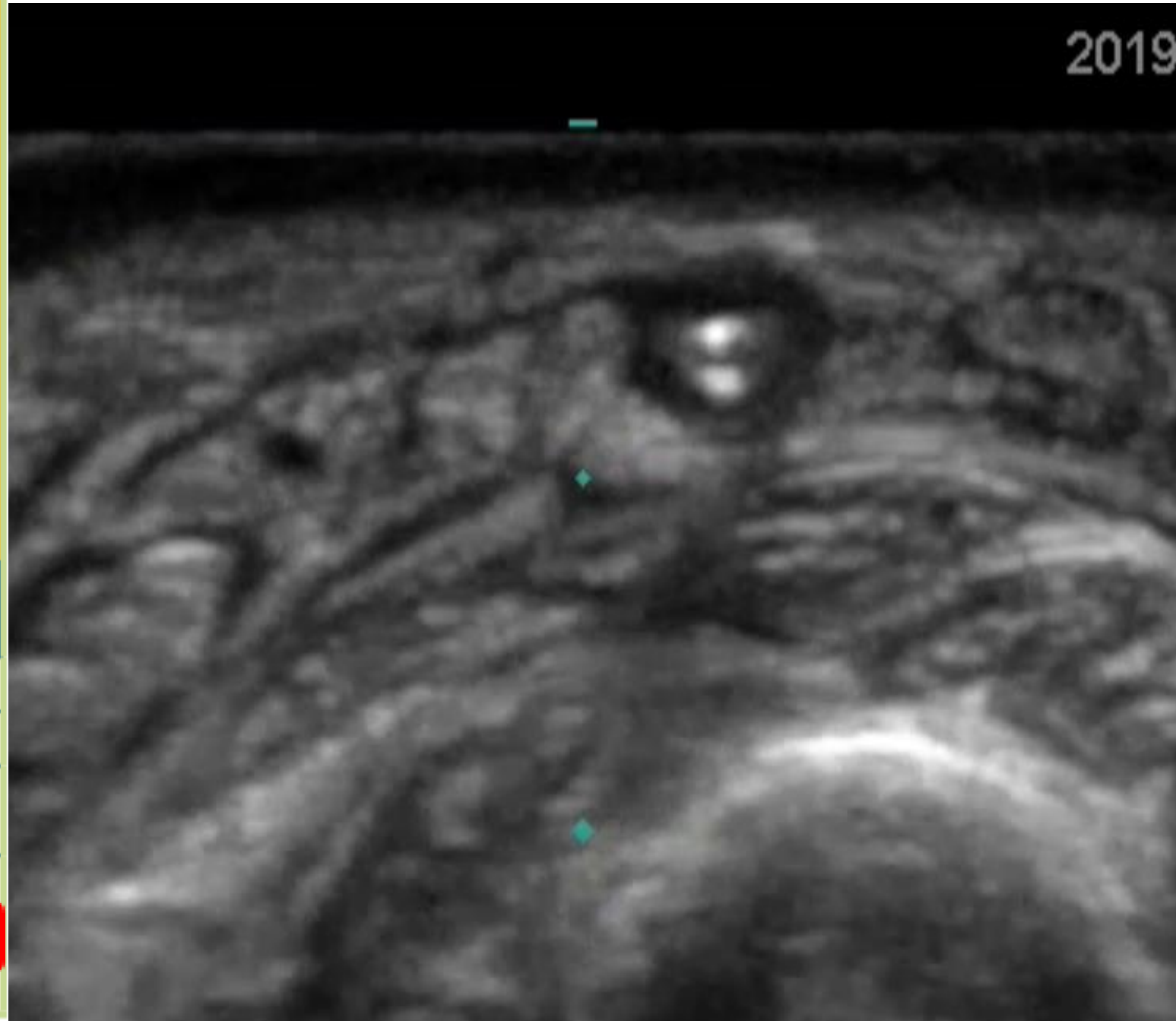
TABLE 2

The 5 Modes of Peripheral IV Catheter Failure: Prospective Randomized Controlled Studies, 1990-2014[a]

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.

Accepted, but unacceptable: PIV Failure



The Cost of Poor-Quality

TABLE 6

Everywhere Hospital's Cost for Poor-Quality Infusion Therapy

SPC Failure Mode	Occurrence Rate	Occurrence Percentage (%) Needing Pharmacy/Testing (n)	Costs of Catheter Failure ($)	Hospital's Costs for 1 Month
Insertion failures per 10 000 placement attempts	3510	100%	$35	$122,850
PICC placement 2% of patients	131	100%	$336	$44,016
CVAD placement 1% of patients	66	100%	$407	$26,862
Needlestick injury Blood exposure	3	100%	$400 (testing only)	$1,200
Mucocutaneous Blood exposure	1	100%	$400 (testing only)	$400
Dislodgement 70% replaced	440	70% (n = 308)	$53	$16,324
Phlebitis New catheter 80% hot compress 10% cultured	566	70% (n = 396) 80% (n = 452) 10% (n = 56)	$35 $40 $150	$13,860 $18,080 $8,400
Bloodstream infection	3	100%	$33,000	$99,000
Infiltration 70% replace SPC 80% hot compress	1391	70% (n = 973) 80% (n = 1112)	$35 $40	$34,055 $44,480
Extravasation 100% replace SPC 33% I&D	6	100% 33% (n = 2)	$35 $3,000	$210 $6,000
Mechanical failure 80% replace	1434	80% (n = 1147)	$35	$40,145
Total CPQ				$475,882

Abbreviations: CPQ, cost of poor quality; CVAD, central vascular access device; I&D, incision and drainage; PICC, peripherally inserted central catheter; SPC, short peripheral catheter.

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Jones RK. Short Peripheral Catheter Quality and Economics: The Intravenous Quotient. *J Infus Nurs.* 2018;41(6):365-371

A small percentage of a big number

is still a……..

BIG NUMBER!!!

PIV Bloodstream Infection BSI vs CLABSI

SAB	Year	# PIV infections	#of CVAD Infections	Notes
Nystrom	1983	23 (0.37%)	19 (4.5%)	PIV 6253 patients; CVC 423 patients
Collignan	1984	23 (0.1%)	29 (1.0%)	0.1% of 23 000 PVCs vs ~1% of 2970 CVCs
Mylotte	1987	14	14	SAB data for 18 months 700 bed hospital (79 total) 35% attributed to venous catheter
Richet	1990	8 (2.2%)	25 (5%)	362 PVCs and 503 CVCs
Maki	2006	13 (.5/1K)	15 (2.1/1k)	28,720-line days to 7,137 (.5 to 2.1). 10,910 PIV catheters to 625 CVAD)
Pujol	2007	77	73	30,281 inpatients and 400,583 patient-days Mean catheter insertion to bacteremia 15.4 days CVC to 4.9 days PIVC. SAB 33% CVC to 53% PIV catheters.
Collignan	2007	8 (0.03%)	11 (0.9%)	27,683 PVCs vs 1238 CVCs
Bruno	2011	10	21 (all cause)	SAB for 12-month period in 350 bed hospital
Blauw	2019	16	7	(36%) HO-SAB cases were PVC-associated

More Evidence: Death from PIVC BSI

1987 Mylotte
- 5X more likely to die
- 5 of 14 PIVC (35.7%) vs 1 of 14 (7.1%) CVC

2013 Stuart
- 30-day mortality rate for PVC-BSI is 26.5%

2019 Tatsuno - all-cause mortality
- no difference between PVC-BSI and CVC-BSI infections

2020 Lim IV complications –
- 5X more likely to die
- **3.6%** with complication (1.5M) and **0.7%** without complication

2020 Ham
- Staphylococcus aureus bloodstream infections (HO MRSA BSIs) continue be a major source of mortality

2020 Rosenthal (six-year study, 31,000 pts)
- 3X more likely to die!
- Mortality of ICU patients **29.36%** with PVCR-BSI vs **10.4%** without PVCR-BSI

Does any one care?

2016 DeVries

- "Protected Clinical Indication of Peripheral Intravenous Lines: Successful Implementation." Journal of the Association for Vascular Access **21**(2): 89-92.

2018 Saliba

- “Interventions to decrease short-term peripheral venous catheter-related bloodstream infections: impact on incidence and mortality." The Journal of Hospital Infection.

2021 Bhatt

- "Effect of multimodal interventions on peripheral intravenous catheter associated Staphylococcus aureus bacteremia and insertion rates: An interrupted time series analysis." Academic Emergency

Hospital Onset Infections

2014 Mitchell

- 12-year prospective study to reduce Hospital Onset SAB by 76%
- Improvements in the management of intravascular devices

2016 Goto

- 130 VHA facilities, there was a sustained decline in HO-GNR bacteremia incidence rates after the implementation

2016 Zasowski

- In patients with hospital-onset EBSI, receipt of appropriate therapy within the first 48 hours was associated with reduced mortality

2020 Ham

- Staphylococcus aureus bloodstream infections (HO MRSA BSIs) continue be a major source of mortality

(2017) A Multi-center longitudinal Study of Hospital-Onset Bacteremia: Time for a New Quality Outcome Measure?

Purpose

- Compare HOB and CLABSI rates
- The power of each to discriminate quality among ICUs.

Result

- 80 ICUs from 16 hospitals in the US and Canada
- 663 CLABSIs, 475,420 central line days
- 11,280 HOBs, and 966,757 patient-days.
- Nearly 8 times more HOB than CLABSI

Conclusion

- Consideration should be given to using HOB to replace CLABSI as an outcome measure in infection prevention quality.

(2022) Comparison of Trends in Hospital-Onset Bloodstream Infections (HOBSIs) and Central Line Associated Bloodstream Infections (CLABSIs) across a Three-Hospital Health System

HOBSIs rates did not correlate with CLABSI incidence across a three-hospital health system from 2017 and 2021 (5 yr)

HOBSI – 2,391 with 2,152,988 patient days

CLABSI – 622 with 643,474 line days

HOBSI increased but CLABSI rates remained flat.

	HO-BSI Counts					CLABSI Counts				
Hospital	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021
Total	427	459	458	475	572	138	112	136	101	135

	Patient Days					Central Line Days				
Hospital	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021
Total	450376	419095	426215	408121	449181	121932	121627	127480	131578	140857

	Central Line Utilization Ratio				
Hospital	2017	2018	2019	2020	2021
Total	0.27	0.29	0.30	0.32	0.31

Krishnan, J. R., et al. 2022

How likely are the following specific infection practices to reduce hospital onset bacteremia/fungemia Dantes et al 2019

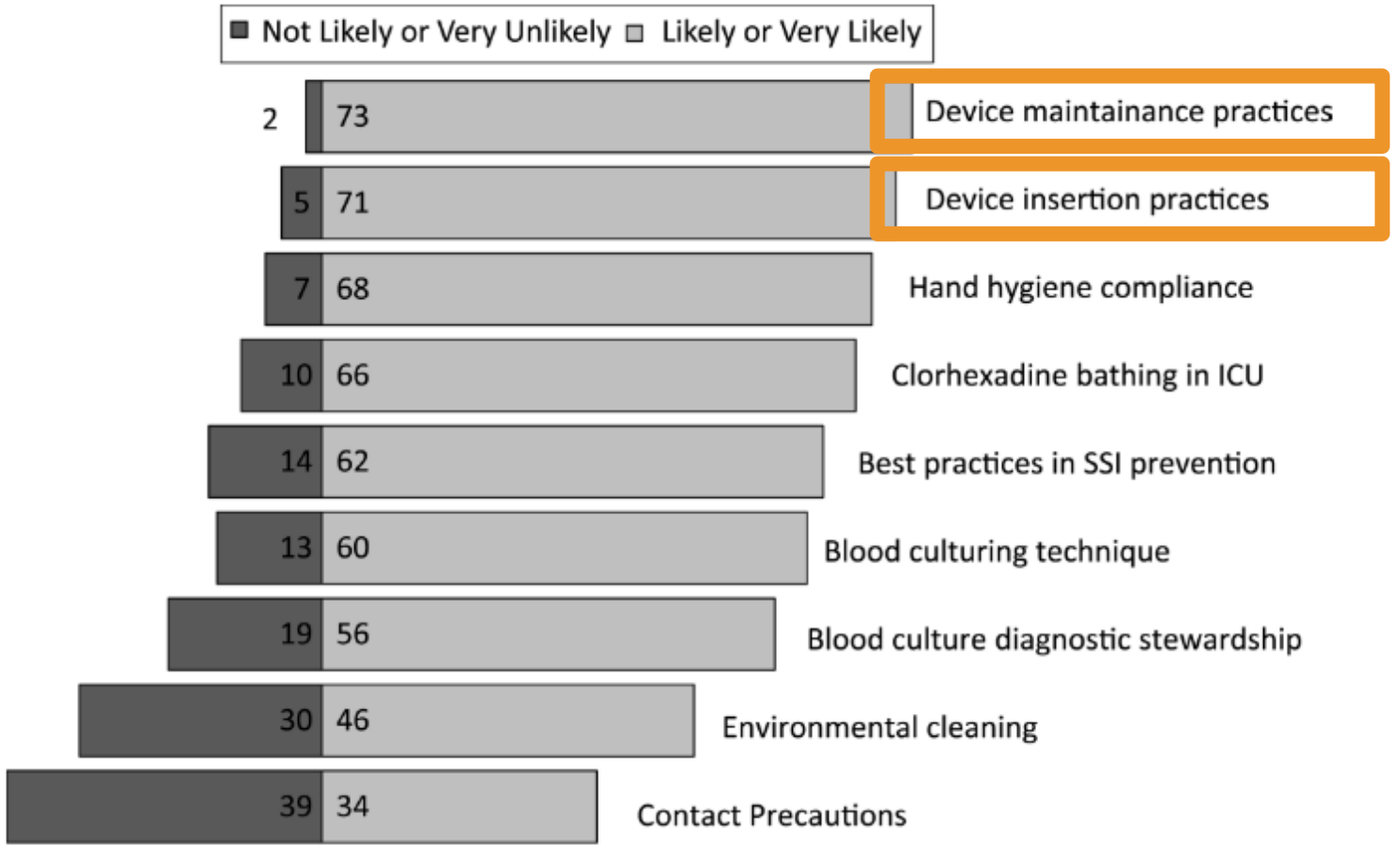


Fig. 3.
Infection prevention improvement initiatives perceived as most likely to reduce hospital-onset bacteremia and fungemia (HOB).*$n = 76$.
*Survey respondents were asked: "In your opinion, how likely are the following specific infection practices to reduce hospital-onset bacteremia/fungemia?"

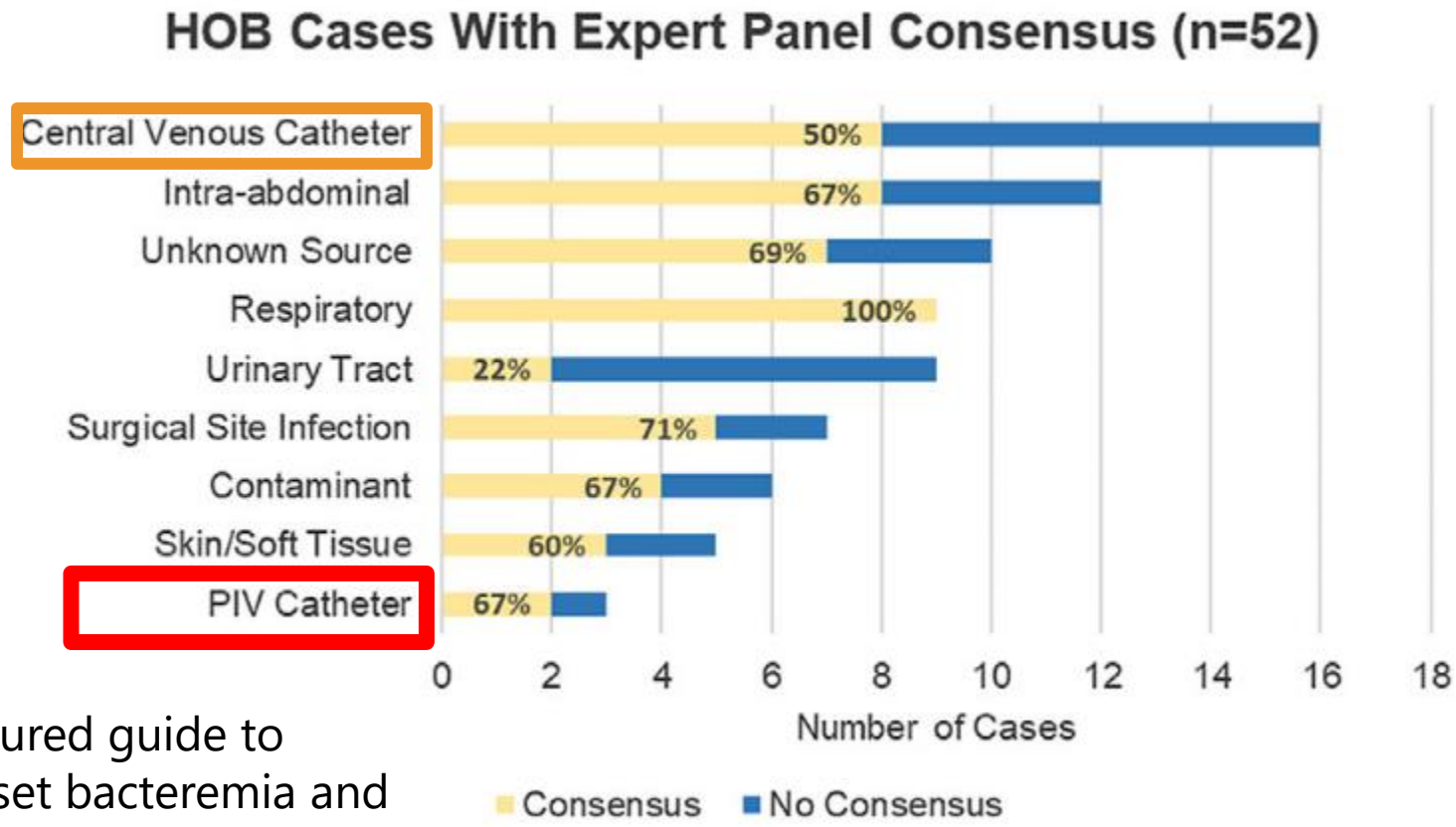
What's preventable and what's not?

10-member panel

52 HOB cases

Pick one:

- Preventable
- Not preventable
- Uncertain



Development and evaluation of a structured guide to assess the preventability of hospital-onset bacteremia and fungemia

Schrank, G. M., et al. 2022 SHEA

2022 "What fuels suboptimal care of peripheral intravenous catheter-related infections in hospitals? A qualitative study of decision-making among Spanish nurses." Blanco-Mavillard, I., et al.

Why?

- The clinical management of PIVCs appear ambiguous, unclear, and fragmented
- No clear professional responsibility and no nurse leadership, causing a gap in preventing infections.
- Furthermore, the perception of low risk on PIVC care impact can cause a relevant lack of adherence to the best evidence and patient safety.

What can we do?

- Implementing facilitation strategies could improve the fidelity of the best available evidence regarding PIVC care and raise awareness among nurses of impact that excellence of care.

Bottom line for PIVs

We got to have:

- Better insertion practices
- Better care and management of the devices
- Better protection of the sites!!!

Where are we now?

HOB

2017 Rock
- Consideration to new quality measure HOB
  - 80 ICUs from 16 hospitals in the US and Canada
  - 1 CLABSI for every 8 HOB

2019
- CMS Call for comments regarding HOB

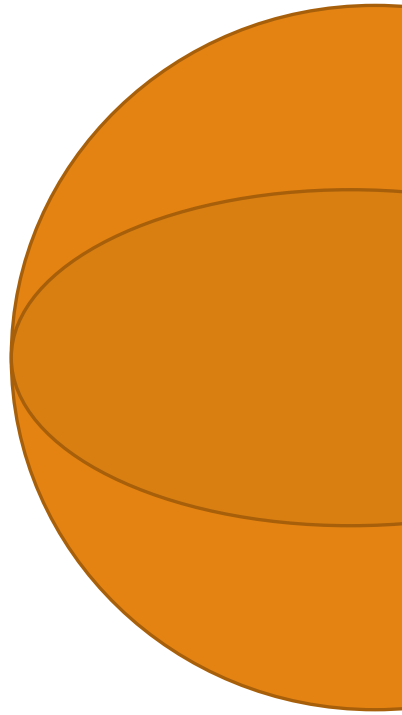
2019 Dantes
- Things Likely to reduce HOB
  - Better maintenance
  - Better insertion

2020 Covid

2022 Krishnan
- HOBSI increased but CLABSI rates remained flat.
  - 5-year study

2022 SHEA
- HOB preventable by source
  - PIVs 67% likely

2023 Hospital Onset Bacteremia and Fungemia
- CMS
  - IPPS- Inpatient Prospective Payment System
- Waiting for response



Hospital Onset Bacteremia:

How will folks respond?

Reactive

- Fearful
- Some say, “It is impossible to track and report all BSI”
- Excuses given
- Burdensome workload for current staffing
- The next “crisis” in the facility
- Financial crisis
- Other projects are placed on hold

Proactive

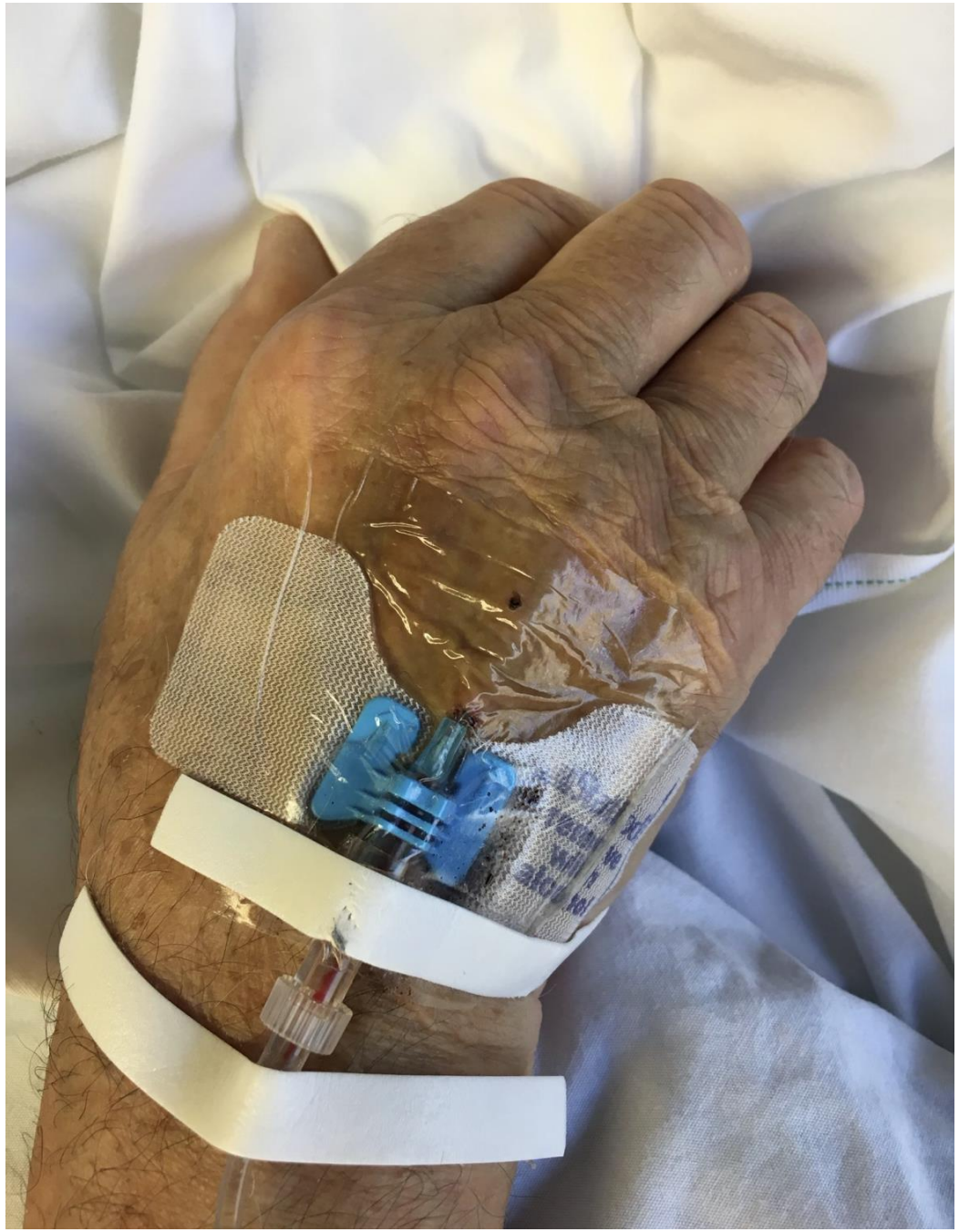
- It’s about time
- Recruit more help!
- Gear up to automate workflow and data collection
- Education on better practices to reduce infections

How will HOB affect PIV insertion and care?

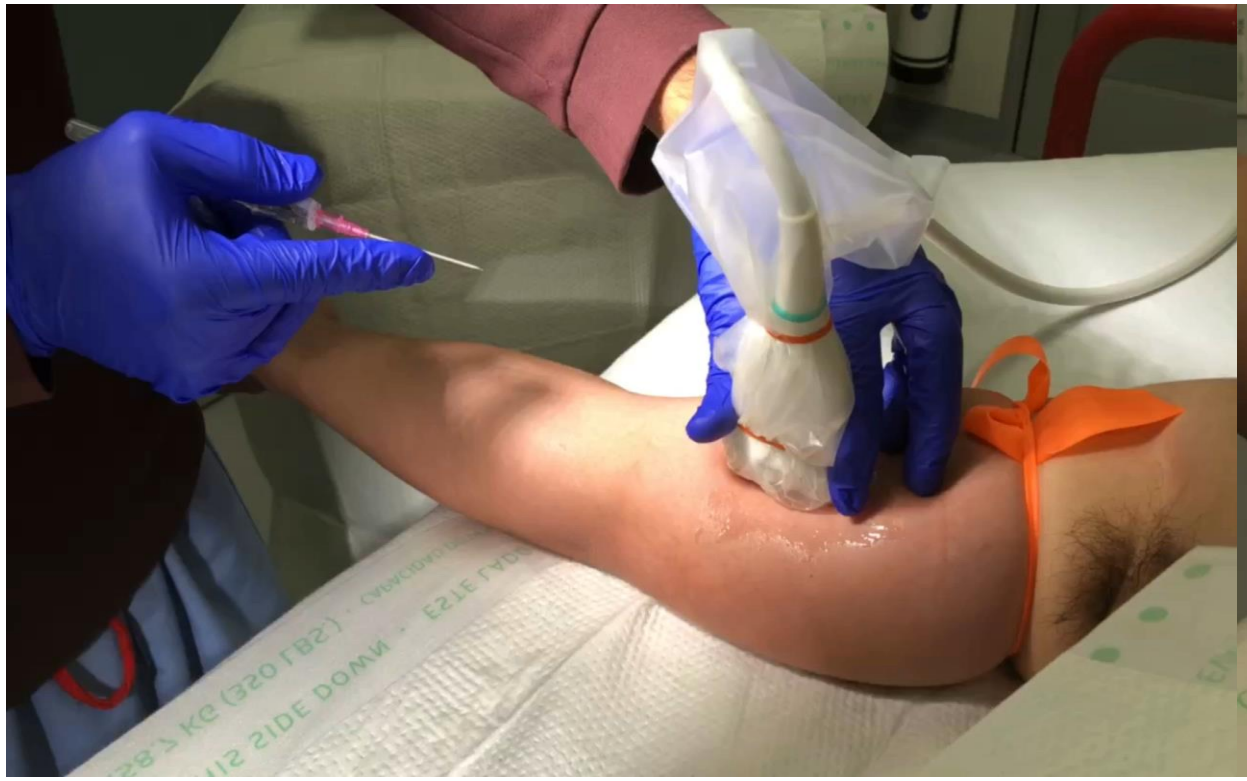
Hospitals will look at the root cause of HOB

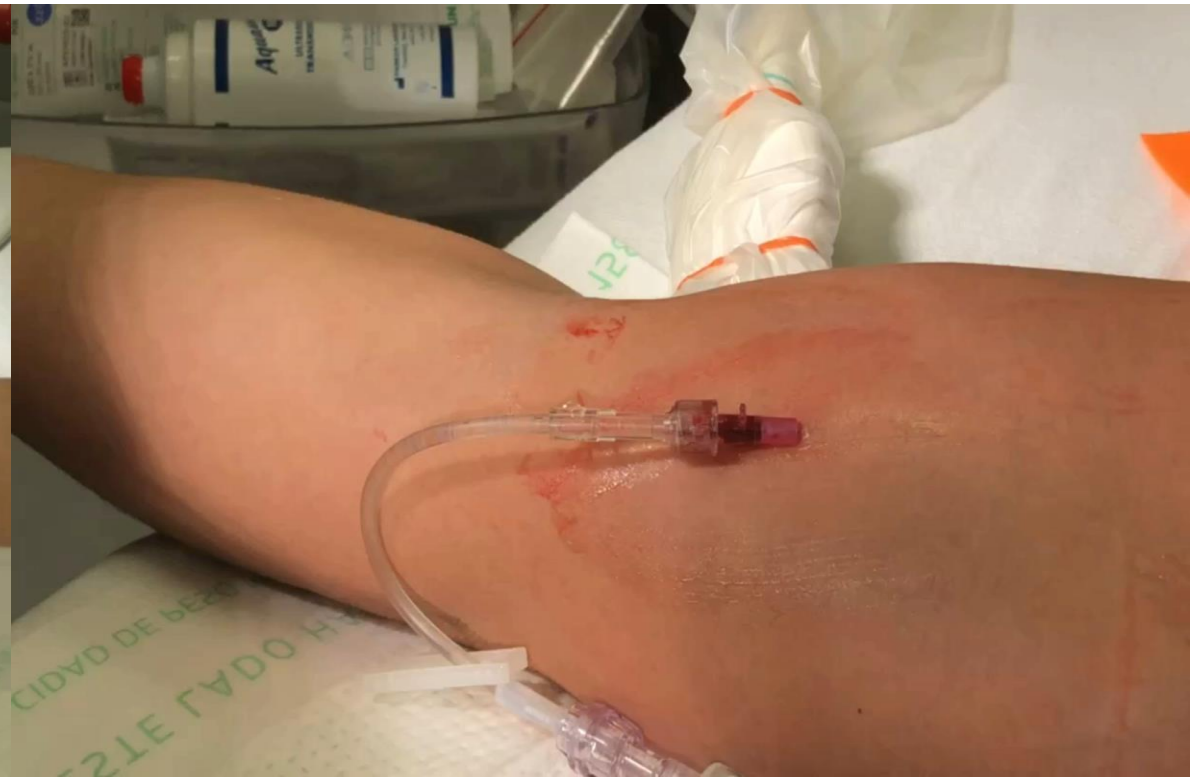
Current State

- Insertion practices
  - Remove fingertip
  - Scrub the finger
- Touch contamination
- Poor Technique
- Poor Disinfection
  - Too short disinfection
  - No drying time
- Open tip tubing
- Looping
- Mystery device



Contamination - Let me count the ways!



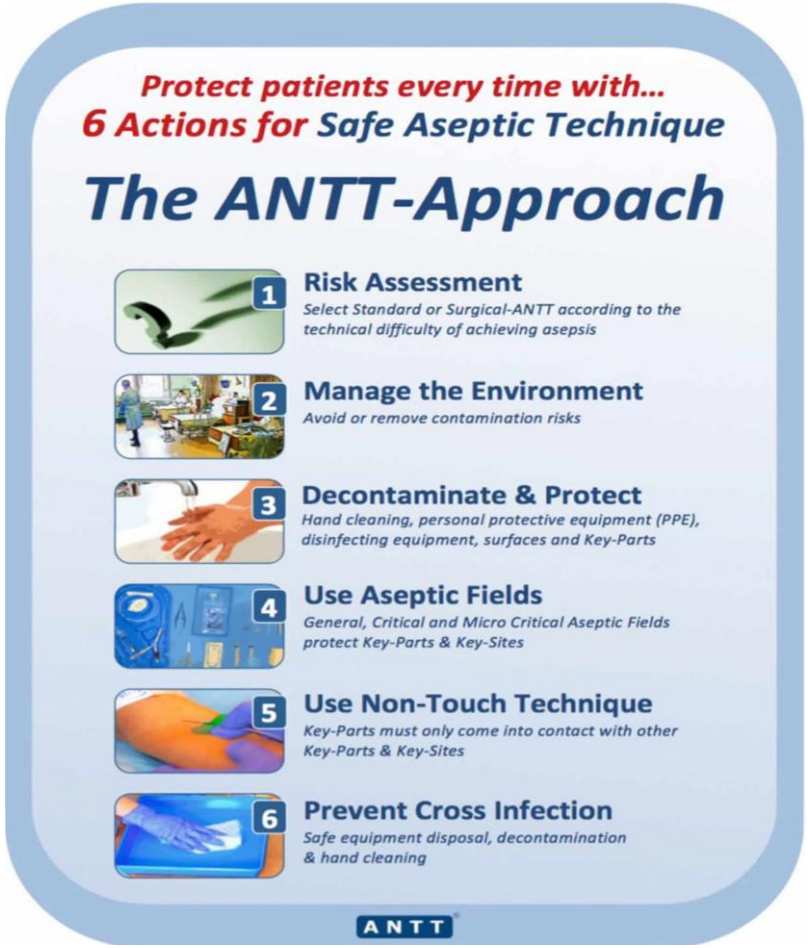


- Finger on catheter with non-sterile gloves
- Non-sterile gel and probe touching the catheter

- 2x2 on insertion site
- No Needleless connector septum disinfection

Introduction to Aseptic Non-Touch Technique

Framework for invasive procedures



ANTT: Aseptic Non-Touch Technique

FOUNDATION PRINCIPLES

- Protect patients from infection
- Protects Key-Sites and Key-Parts
- Efficient as well as safe
- Type (Chose based on complexity)
  - Standard - uncomplicated
  - Surgical - complicated
- Aseptic practice should be standardized
- Reliant on training, environment and equipment

SAFEGUARDS

- Basic Infective Precautions
- Identify Key-Sites and Key-Parts
- Non-Touch Technique critical
- Aseptic field Management

ANTT

General aseptic field

- Not sterile field
- Disposable tray or disinfected table

Critical micro aseptic fields

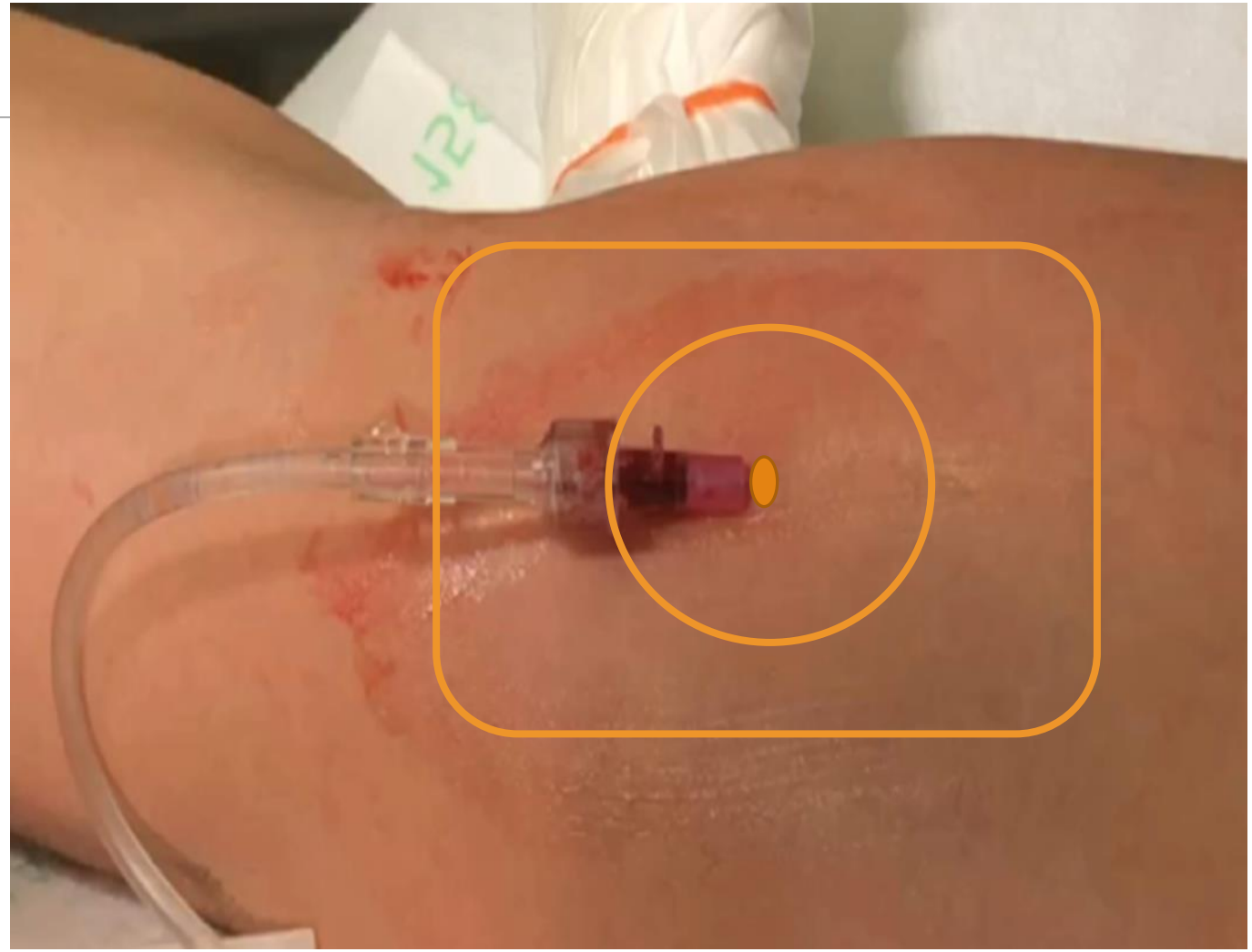
- Sterile
- Caps, cover or packaging
- If contaminated, high likeliness of spreading pathogens

Key parts

- Catheter lumen
- Inside hub of catheter
- Tip of syringe or tubing
- Needleless connector septum
- Probe foot

Key site (add insertion picture)

- The insertion site
- Define insertion site
  - 1 mm dot you stick the needle?
  - 1 cm around the insertion site?
  - All area under the dressing?

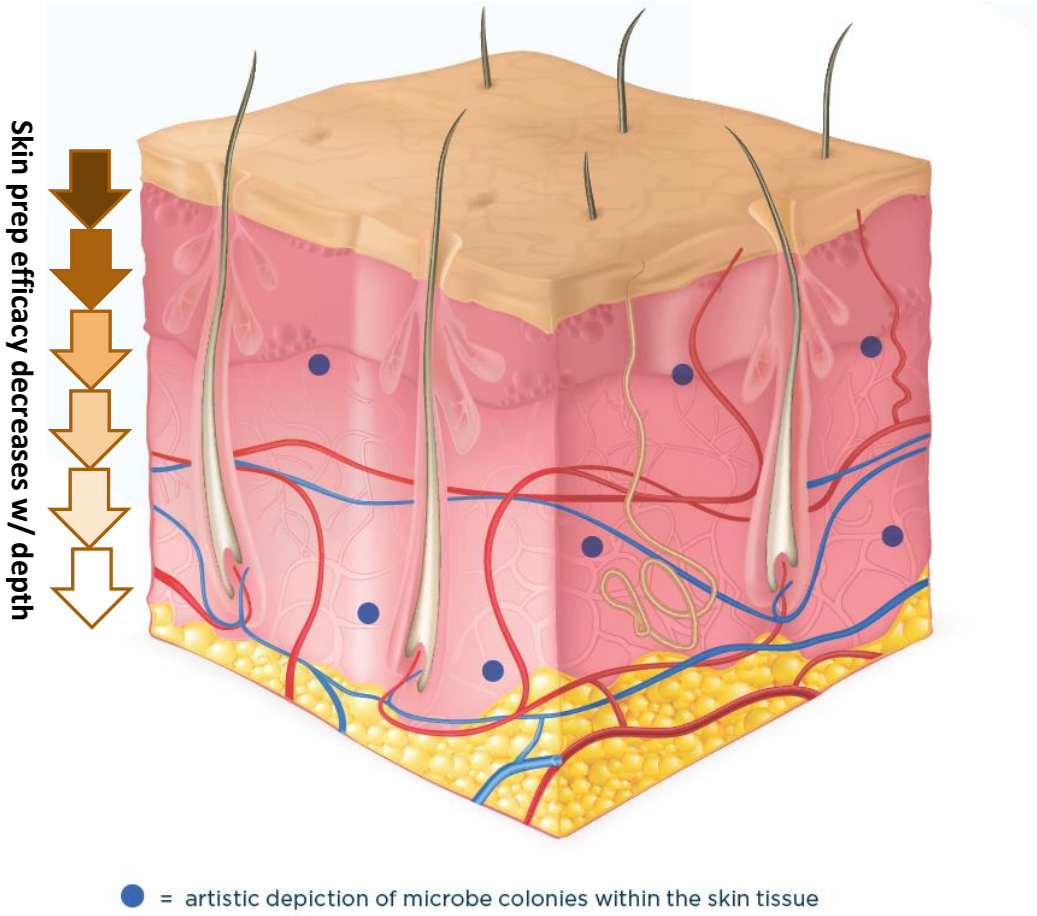


What Happens after Insertion?

Skin begins recolonization the first day

A PREPPED SITE DOES NOT REMAIN ASEPTIC THROUGHOUT TREATMENT

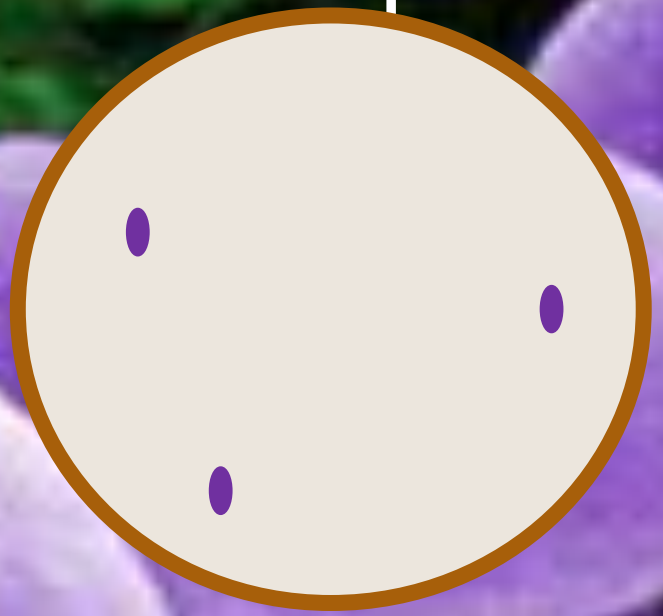
- Antiseptics typically only penetrate the top layers of skin
- 20% microorganisms remain in the underlying skin layers, hair follicles and sebaceous glands
- Microorganisms from patient's own skin are responsible for large portion of infections



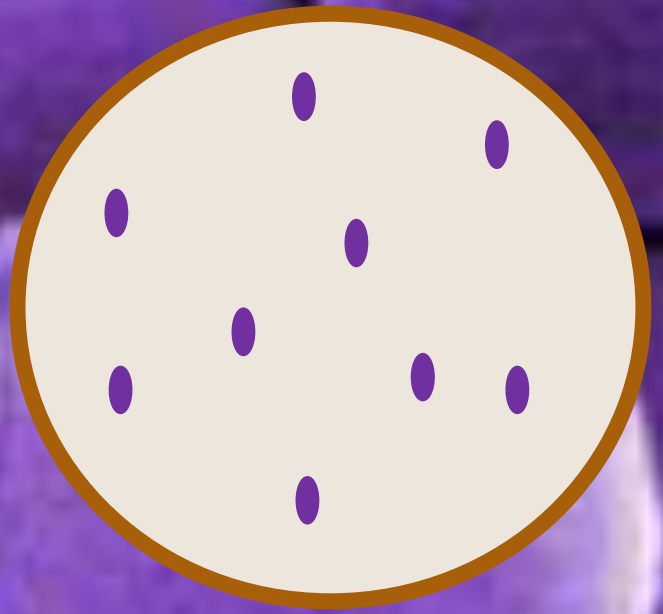
Maki DG, et al. Am J Med. 1988.
Hendley JO & Ashe KM, Antimicrob. Agents Chemother. 1991.
Karpanen TJ, et al. Antimicrob. Agents Chemother. 2008.
Bashir MH, et al. Am J Infect Control 2012

Days to recolonization

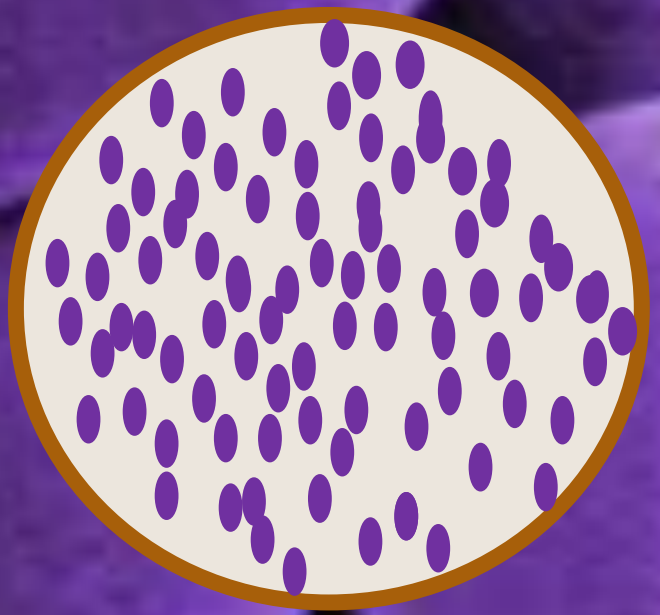
Insertion Prep



Day 2



Day 3



1. Maki DG, et al. Am J Med. 1988.
2. Hendley JO & Ashe KM, Antimicrob. Agents Chemother. 1991.
3. Karpanen TJ, et al. Antimicrob. Agents Chemother. 2008.
4. Bashir MH, et al. Am J Infect Control 2012

Antimicrobial Dressing Evolution

ANTIMICROBIAL DRESSING EVOLUTION OVER DECADES:

SILVER → CHG/CHA → CHX

Advances in dressings:

Tape Gauze → PU Film →Film + additional securement → AM Foam Disk/Gel → AM Films → Now, AM Films w/Integrated Securement Dressing

Emerging evidence:

- indicates new chlorhexidine formulations may provide more rapid and more comprehensive protection than previous formulas

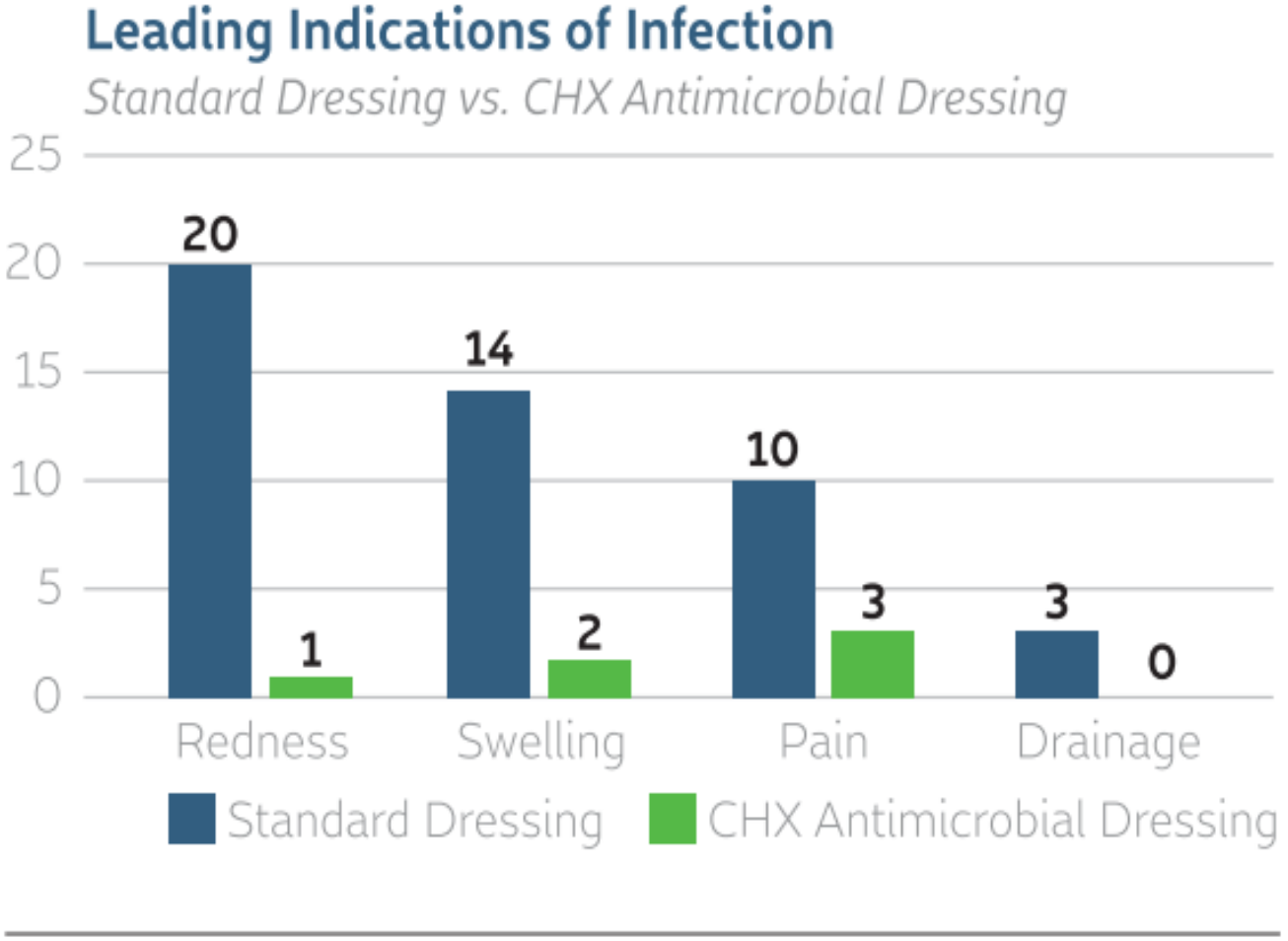
Challenge organism		Starting titer (CFU/ sample)	Cover film negative control mean log_{10} reduction				CHX			CHA + Silver			Mean log_{10} reduction colour temperature scale
			0-Hour	1-Day	3-Day	7-Day	1-Day	3-Day	7-Day	1-Day	3-Day	7-Day	
Gram (+) Bacteria	MRSA	2.4×10^6	0	0.66	1.51	2.65	6.05	6.18	6.38	3.56	4.43	2.76	
	MRSE	1.3×10^6	-0.18	2.96	1.71	1.97	5.93	6.02	6.1	3.52	5.12	6.1	-2
	E. faecium (MDR)	1.1×10^6	-0.04	-0.11	2.41	2.55	6.09	5.63	5.67	2.66	4.69	3.21	-1
	E. faecalis (VRE)	1.8×10^6	0	-0.09	4.01	2.4	6.24	6.21	6.44	2.77	4.72	6.44	0
	E. faecium	4.3×10^6	-0.01	1.16	2.94	3.71	6.42	6.07	6.55	3.11	6	6.51	1
Gram (-) Bacteria	*P. aeruginosa*	2.0×10^6	-0.05	-1.22	-0.92	1.48	6.3	6.26	6.3	5.21	6.3	6.17	2
	E. coli	4.3×10^6	0.01	-0.79	-0.13	3.86	6.22	6.64	6.64	6.64	6.64	6.64	3
	S. marcescens	8.6×10^6	-0.01	2.89	4.63	4.63	6.28	6.93	6.46	5.1	6.93	6.93	4
Yeasts	*C. albicans*	1.2×10^6	-0.04	0.14	1.85	3.77	6.07	6.07	6.07	2.23	2.74	6.07	5
	C. parapsilosis	3.3×10^6	-0.04	-0.04	-0.21	-0.12	5.11	5.91	5.79	0*	1.64	2.73	6
	C. tropicalis	4.7×10^6	0.03	0.17	1.26	1.31	6.49	6.58	6.5	2.69	3.32	3.95	7
Fungus	*A. brasiliensis*	3.7×10^6	0.04	0.41	0.46	0.5	2.99	3.89	3.75	1.72	1.67	1.74	

Holinga GJ & McGuire JE, J Wound Care, 2020

Garcia R, *The Role of Antimicrobial Transparent Film Dressings in the Prevention of Catheter-Related Bloodstream Infections*, White Paper, 2021

Compared current state and standardized care with bundle

- Bundle
  - Insertion site
  - Trained clinician
  - 1.75” 22 gauge
  - CHX securement dressing
  - Anti-reflux needleless connector
  - Port protectors
- Added gum mastic to increase dressing adherence



Protect the Site, Protect the Patient: Preventing Infection at Peripheral Sites. A Prospective, Multi-Modal Comparator Study

Lee Steere, RN, CRNI, VA-BC
Unit Leader of IV Therapy Services, Hartford Hospital

Reaching one PIVC per patient visit Steere 2019

Table 5. **Summary of Results for Dwell Time, Complications, and Cost**

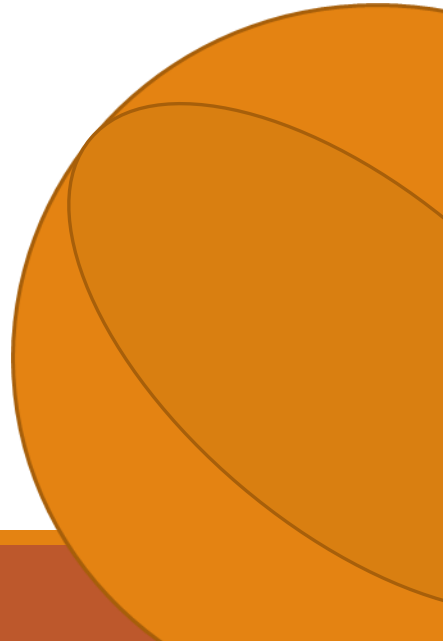
THE RESULTS		
Variable	**Group 1 (n=94)**	**Group 2 (n=113)**
Success Rate (therapy completed)	15%	89%
Dwell Time, Hours (mean ± SD, P<0.001)	29.6 ± 18.0	71.4 ± 58.8
Complication Rate (%, P<0.001)	40%	11%
Cost/Bed/Year (2018 USD)	$4,781	$1,405

Where to start?

Make friends!!!!!

Educate influencer and decision makers on problem

- Manager
- Director service line
- VP
- DON
- IP



Quality Improvement Methods

Six Sigma

Lean

DMIAC

Kaizen

PDCA

Your facility will likely have a process!

Quality Improvement Methods

SOP 6

Quality improvement (QI) activities are implemented to advance safety and excellence in infusion administration and VAD insertion and management.

Foster a just culture and individual accountability through a focus on improving systems and processes by clinicians and leaders

What Problem will you solve?

Examples:

- Catheter failure
- Phlebitis, infiltrations, dislodgement
- Number of catheters per patient
- Number of sticks
- Patient satisfaction
- PVC-BSI

Establish baseline

(include financial impact)

- Review policies
- Observe current practice
  - Insertion practices
  - Management
    - Aseptic management
    - Flushing Technique
- Review Technology
  - Visualization
  - Product evaluations

Proficiency

- Stop multiple insertion attempts by multiple staff
- Device placed in 2 sticks
- First stick success rate (greater than 90%)

Insertion Technique

- Integration of Aseptic Non-Touch Technique
- Use visualization technology to avoid rescue devices

Vein and Catheter

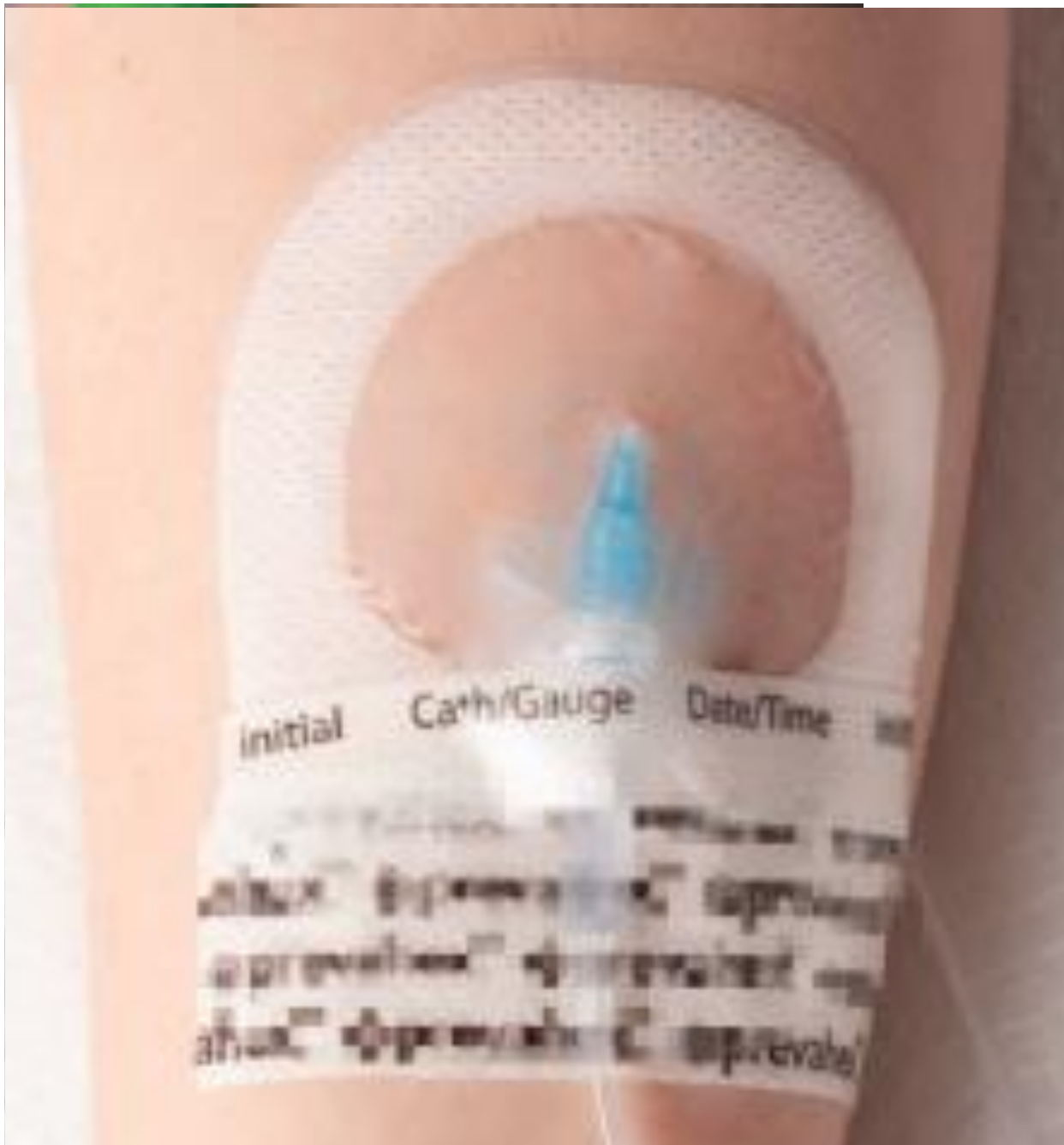
- Site selection - forearm veins
- Vein selection – Vein 3X catheter
- Device selection- vein purchase of > or = 2/3 of catheter (approximately 3 cm in vein)

Supplies

- IV Kit Standardized
- Securement and stabilization
- Anti-microbial dressing
- Port protectors
- Anti-reflux needleless connector

Proper Post Insertion Care

- Infusion peripherally compatible
- Dressing adherence
- Proper flushing
- Septum disinfection
- Continuation of site protect
  - Securement
  - Consider CHX



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Description:

Peripheral intravenous catheters (PIVCs) are the most inserted invasive device in the world. Hidden in plain sight, bloodstream infections from PIVCs is a serious problem. As a great mathematician once said, "A tiny percentage of a large number is still a large number!" Such is the case with PIVC bloodstream infection. The number of these infections compares with CLABSI and has for forty years, yet, no repercussions have been felt from CMS. Hospital Onset Bacteremia (HOB) may level the playing field. Join us as we explore the potential effect of HOB and how managing our PIVCs better may mitigate the effect! Oh, yes! and, don't forget, saves lives to boot!!!