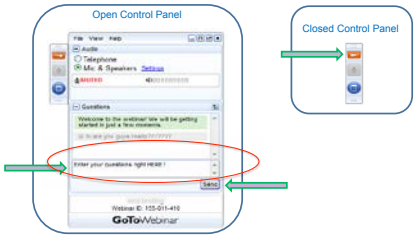
# Reducing Risk in Hemodialysis Vascular Access: A Review of Best Practices

Amy Bardin-Spencer, EdD(c),MS, RRT, VA-BC

## Show Your Control Panel




## Our Moderator

**Rita Larson**, BSN, CRNI, MBA, VA-BC.

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Amy Bardin-Spencer, EdD(c),MS, RRT, VA-BC

## Our Speaker

**Amy Bardin-Spencer**, EdD(c), MS, RRT, VA-BC

## Disclosures

Ms. Bardin is an employee of Teleflex Medical

## Continuing Education (CNE and CRCE)

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**Accreditation**

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- Provider (Saxe Communications) is approved by the California Board of Registered Nursing. Provider # 14477 and Florida Board of Nursing Provider # 50-17032

## Reducing Risk in Hemodialysis Vascular Access: A Review of Best Practices

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## Learning Objectives

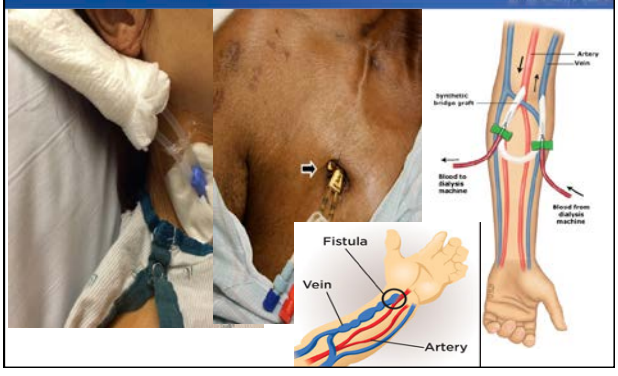
- Review current guidelines associated with placement and use of Acute Hemodialysis Catheters
- Discuss Vessel Health and Preservation considerations for Acute Catheter placement
- Discuss risk reduction strategies specific to Acute Hemodialysis Catheters
- Review CLABSI reporting compliance to include hemodialysis catheters

## Current State

More than 380,000 individuals in the United States rely on a vascular access device to receive hemodialysis (HD) treatments. (KDOQI 2006)

"Central venous catheters (CVCs) are used to provide acute HD in patients who are initiating dialysis or are awaiting maturation of existing access" (Bream 2016)

## Why are we here?




## NKF KDOQI Guidelines

- Originally published in 1997 – updated in 2006
- Current foundation for vascular access in HD therapies
- Failure of access was noted to be a major cause of morbidity for patients on HD therapy, with a number of reports indicating that a high percentage of hospitalizations for patients with CKD stage 5 were caused by vascular access complications.

KDOQI. 2006 Updates Clinical Practice Guidelines. Blood Press; 2006;33(5)

## Use of Temporary Access

- The NKF-KDOQI states that less than 10% of HD patients should be dialyzed chronically with a tunneled catheter. Clinicians and patients should advocate *Fistula First* (KDOQI 2006)
- Temporary and Tunneled catheters remain popular for both incidence and maintenance hemodialysis. (Bream 2016)

86%

## Acute HD Placement

## Why is this important?

- 46% decrease in CLASBI from 2008-2013
- 31,000 CLABSI annually in US hospitals

CVC → AHD → CVAD

## Advantages

There are many benefits of using catheters for HD;

a. there are a variety of sites for placement

b. they are immediately available for use

c. they are relatively low cost and easy to place and replace

d. venipuncture is not required for dialysis

e. and thrombotic complications are relatively straightforward to correct

Bream PR, Semin Intervent Radiol 2016;33:31–38

## Disadvantages

Unfortunately, catheters also have many drawbacks, including;

a. having the highest morbidity of all accesses due to thrombosis and infection

b. causing central venous stenosis and occlusion

c. the external hubs are disfiguring and cause low patient satisfaction

d. and their relatively lower blood flow rates demand longer dialysis times. (Ash 2007)

Bream PR, Semin Intervent Radiol 2016;33:31–38

## Lots of guidelines!


## Evidence Based Prevention Practices to Prevent CLABSI

TABLE 2. Estimated annual number of central line–associated blood stream infections (CLABSIs), by health-care setting and year — United States, 2001, 2008, and 2009

| Health-care setting | Year | No. of infections (upper and lower bound of sensitivity analysis) |
|---|---|---|
| Intensive-care units | 2001 | 43,000 (27,000–67,000) |
| | 2009 | 18,000 (12,000–28,000) |
| Inpatient wards | 2009 | 23,000 (15,000–37,000) |
| Outpatient hemodialysis* | 2008 | 37,000 (23,000–57,000) |

* Case definitions approximate current definition of CLABSI according to the National Healthcare Safety Network.

Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Early Release / Vol. 60 March 1, 2011

Vital Signs: Central Line–Associated Blood Stream Infections — United States, 2001, 2008, and 2009

In 2009 alone, an estimated 25,000 fewer CLABSIs occurred in U.S. ICUs than in 2001, a 58% reduction. This represents up to 6,000 lives saved and $414 million in potential excess health-care costs in 2009 and approximately $1.8 billion in cumulative excess health-care costs since 2001. A substantial number of CLABSIs continue to occur, especially in outpatient hemodialysis centers and inpatient wards.

## Guidelines


Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011

CDC HICPAC 2011 Guideline

http://www.cdc.gov/hicpac/pdf/guidelines/bsi-guidelines-2011.pdf

## CDC major emphasis areas are:

1. Education and training healthcare personnel who insert and maintain catheters
2. Using maximal sterile barrier precautions during central venous catheter (CVAD) insertion
3. Using a >0.5% chlorhexidine (CHG) preparation with 70% alcohol for skin antisepsis
4. Avoiding routine replacement of CVADs as a strategy to prevent infection

## CDC major emphasis areas are:

5. Using antiseptic/antibiotic impregnated short-term CVADs and chlorhexidine impregnated-style dressings, if the rate of infection is not decreasing despite adherence to other strategies;

   (i.e. education and training, maximum barrier precautions, and >0.5% CHG preparations with alcohol for skin antisepsis)
6. Performance improvement by implementing bundled strategies, and documenting and reporting rates of compliance with all components of the bundle as benchmarks for quality assurance and performance improvement.

## SHEA Guideline – July 2014


Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals: 2014 Update

- Society for Hospital Epidemiology of America (SHEA)
- Infectious Diseases Society of America (IDSA)
- American Hospital Association (AHA)
- Association for Professionals in Infection Control and Epidemiology (APIC)
- The Joint Commission

## SHEA Level of Evidence

TABLE 1. Grading of the Quality of Evidence

| Grade | Definition |
|---|---|
| I. High | Highly confident that the true effect lies close to that of the estimated size and direction of the effect. Evidence is rated as high quality when there is a wide range of studies with no major limitations, there is little variation between studies, and the summary estimate has a narrow confidence interval. |
| II. Moderate | The true effect is likely to be close to the estimated size and direction of the effect, but there is a possibility that it is substantially different. Evidence is rated as moderate quality when there are only a few studies and some have limitations but not major flaws, there is some variation between studies, or the confidence interval of the summary estimate is wide. |
| III. Low | The true effect may be substantially different from the estimated size and direction of the effect. Evidence is rated as low quality when supporting studies have major flaws, there is important variation between studies, the confidence interval of the summary estimate is very wide, or there are no rigorous studies, only expert consensus. |

NOTE. Based on Grades of Recommendation, Assessment, Development, and Evaluation (GRADE)[267] and the Canadian Task Force on Preventive Health Care.[268]

http://journals.cambridge.org/abstract_S0195941700093528

## SHEA recommendations

**Basic Practices**

- Catheter Checklist - II
- Hand Hygiene - II
- Insertion site - Femoral - I
- Cart - Kit - II
- Maximal Barrier Precautions - I
- Chlorhexidine (CHG) Skin Prep - I
- Scrub the Hub – I

**Catheter Insertion Bundle**

**Special Approaches**

- CHG Baths (ICU patients) - I
- Impregnated Catheters - I
- CHG Impregnated Disc - I
- Antimicrobial Locks - I

**Catheter Maintenance Bundle**

http://journals.cambridge.org/abstract_S0195941700093528

## Factors Known To Influence CLABSI Rates

- Types of patients with catheters (gastrointestinal, neonatal, cancer, immune-deficient, ICU/PICU/NICU);
- Type, number, site of insertion, and duration of catheters (impregnated or not, number of lumens);
- Types of connectors (needleless—split septum vs. mechanical valve, stopcocks;
- Infusion (esp., blood, lipid, TPN);
- Who inserts/manipulates the catheter (IV team or not);
- Method of documenting BSI (central line cultures—number of lumens and number of catheters cultured, only peripheral culture, etc);
- Interpretation and application of the CDC or other CLABSI definitions and protocols;
- Infection control practices, hand hygiene, etc.

## Independent risk factors for CLABSI

1. Prolonged hospitalization before catheterization
2. Prolonged duration of catheterization
3. **Heavy microbial colonization at the insertion site**
4. **Heavy microbial colonization of the catheter hub**
5. **High internal jugular catheterization**
6. **Femoral catheterization in adults**
7. Neutropenia
8. Prematurity (i.e. early gestational age)
9. Reduced nurse-to-patient ratio in the ICU
10. Total parenteral nutrition
11. Substandard catheter care
12. Transfusion of blood products (in children)
13. **Hemodialysis**

## 5 Evidence Based Strategies to Prevent CLABSI

Prevention of CLBSI revolves around 5 best practices. When these interventions are bundled together, they significantly decrease CLABSI. These practices are;

1. Hand Hygiene
2. Use of Maximal Barrier Precautions For Catheter Insertion
3. Use of Chlorhexidine & Alcohol to Prepare Skin
4. Optimal Catheter Site Selection, with Avoidance of the Femoral Vein for Central Venous Access in Adult Patients
5. Daily Surveillance of Lines with Prompt Removal of Unnecessary Catheters

Warren et al. ICHE 2006:27;662-7
Marschall et al. ICHE 2008:29; 22S-30S

## The Impact of Hand Hygiene – 2014 (AU)

Compliance Rate Overall

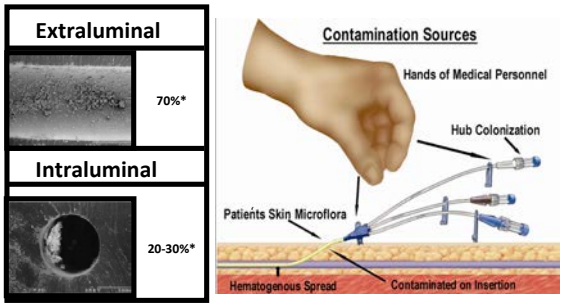
| | Correct Moments | Total Moments | Compliance Rate | Lower 95% CI | Upper 95% CI |
|---|---|---|---|---|---|
| Overall Rate | 439,856 | 537,154 | 81.9% | 81.8% | 82% |

Compliance Rate by Moment

| Moment | Correct Moments | Total Moments | Compliance Rate | Lower 95% CI | Upper 95% CI |
|---|---|---|---|---|---|
| 1 - Before Touching A Patient | 119,708 | 153,277 | 78.1% | 77.9% | 78.3% |
| 2 - Before Procedure | 43,217 | 50,925 | 84.9% | 84.6% | 85.2% |
| 3 - After a Procedure or Body Fluid Exposure Risk | 54,940 | 61,513 | 89.3% | 89.1% | 89.6% |
| 4 - After Touching a Patient | 133,336 | 154,069 | 86.5% | 86.4% | 86.7% |
| 5 - After Touching A Patient's Surroundings | 88,655 | 117,370 | 75.5% | 75.3% | 75.8% |

http://www.hha.org.au/LatestNationalData.aspx

## The bacterial route of all evil…




## BSI rates by catheter type

| | # Bloodstream Infections | | | |
|---|---|---|---|---|
| | Per 100 catheters | | Per 1000 catheter days | |
| Type of catheter | Mean | 95% CI | Mean | 95% CI |
| Peripheral IV | 0.2 | 0.1-0.3 | 0.6 | 0.3-1.2 |
| Arterial | 1.5 | 0.9-2.4 | 2.9 | 1.8-4.5 |
| Short-term CVC | 3.3 | 3.3-4.0 | 2.3 | 2.0-2.4 |
| Pulmonary artery | 1.9 | 1.1-2.5 | 5.5 | 3.2-12.4 |
| Hemodialysis | | | | |
| Noncuffed | 16.2 | 13.5-18.3 | 2.8 | 2.3-2.1 |
| Cuffed | 6.3 | 4.2-9.2 | 1.1 | 0.7-1.6 |
| PICC | 1.2 | 0.5-2.2 | 0.4 | 0.2-0.7 |
| Long-term CVC | 20.9 | 18.2-21.9 | 1.2 | 1.0-1.3 |
| Implanted port | 5.1 | 4.0-6.3 | 0.2 | 0.1-0.2 |

Crnish CJ, Maki DG. Clin Infect Dis 2002;34:1232-1262

Original Investigation

## Trends in Incident Hemodialysis Access and Mortality

Mahmoud B. Malas, MD, MHS; Joseph K. Canner, MHS; Caitlin W. Hicks, MD, MS; Iobal J. Arhuidese, MD, MPH; David S. Zarkowsky, MD; Umair Qazi, MD, MPH; Eric B. Schneider, PhD; James H. Black III, MD; Dorry L. Segev, MD, PhD; Julie A. Freischlag, MD

**OBJECTIVE** To assess the achievement of the practice goals for incident vascular access and the effects on HD outcomes.

**DESIGN, SETTING, AND PARTICIPANTS** This retrospective cohort study was conducted using the US Renal Data System. All patients with end-stage renal disease in the United States without prior renal replacement therapy who had incident vascular access for HD created between January 1, 2006, and December 31, 2010 (N = 510 000) were included.

**RESULTS** Of 510 000 patients included in this study, 82.6% initiated HD via HC, 14.0% via AVF, and 3.4% via AVG. Arteriovenous fistula use increased only minimally, from 12.2% in 2006 to 15.0% in 2010. Patients initiating HD with AVF had 35% lower mortality than those with HC (adjusted hazard ratio, 0.65; 95% CI, 0.64-0.66; $P < .001$). Those initiating HD with AVF had 23% lower mortality than those initiating with an HC while awaiting maturation of an AVF (adjusted hazard ratio, 0.77; 95% CI, 0.76-0.79; $P < .001$).

## Maximal Barrier Precautions

## NOT Maximal Barrier Protection

## Maximal Barrier Precautions Data

Maximum barrier precautions - the drape covers the patient from head to foot

Three studies

1) Mermel 1991 Am J Med 91(3B): 197S-205S. Prospective, Cross-sectional Study (Swan-Ganz Catheters) demonstrated that the risk of infection was **2.2 fold higher when MBP were not used (p=0.03)**

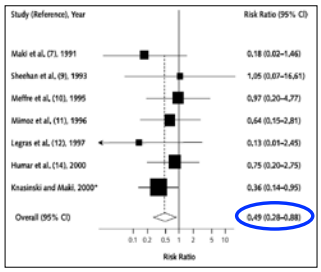
2) Raad 1994 Infect Control Hosp Epidemiol 15:231-8. Prospective, Randomized Study (Central Venous Catheters) demonstrated that the risk of infection **was 3.3 fold higher when MBP were not used (p=0.03)**

3) Lee 2008 Infect Control Hosp Epidemiol 2008;29:947-950 demonstrated that the risk for infection was **5.2 higher when MBP were not used (p=0.02)**

## CHG/Alcohol Skin Prep

Skin prep with CHG/alcohol is more effective than with povidone iodine (Betadine) in preventing CLABSI

This meta-analysis found that use of CHG reduced the risk of CLABSI by 49%




Chaiyakunapruk N et al. Ann Intern Med. 2002;136:792-801

## Chlorhexidine-Impregnated Dressing for Prevention of Catheter-Related Bloodstream Infection: A Meta-Analysis*

Nasia Safdar, MD, PhD[1,2]; John C. O'Horo, MD[3]; Aiman Ghufran, MD[2]; Allison Bearden, MD, MPH[2]; Maria Eugenia Didier, MD[2]; Dan Chateau, PhD[4]; Dennis G. Maki, MD[1]

*"The m*
*when s*
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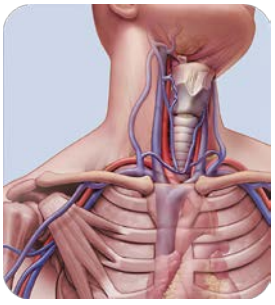
- 40% decrease in risk of CRBSI
- 48% decrease in catheter colonization
- Subclavian and IJ sites: Preferred in all trials
- Catheter dwell times similar

Safdar, N et.al Crit Care Med 2014

## Site Selection CVC vs. AHD



## Considerations for Site Selection

Other factors to consider in site choice include:

- Anatomical deformity
- Presence of coagulopathy
  - - Use of a compressible site (e.g., IJ/AxV, not SC)
- Hemodialysis patients:
  - National Kidney Foundation 2006 Guidelines recommended against the use of the subclavian vein for any central line, unless use of the IJ vein is absolutely contraindicated, due to the risk of subclavian vein stenosis.
- If the IJ vein is chosen, use the right side to reduce risk of mechanical complications.

## Use of Ultrasound

- CDC (2002) - Use of ultrasound guidance for catheter insertion substantially reduces mechanical complications
- NICE (2002) - Use ultrasound guidance for catheter insertion substantially reduced mechanical complications
- CNSA (2007) – Recommends use that patient safety could be improved by combining ultrasound guided puncture and ECG-guided positioning.
- APIC (2009) - Use ultrasound guidance for internal jugular catheter insertion.
- CDC/HICPAC (2011) - Use US guidance to reduce number of cannulation attempts and mechanical complications if technology is available (Level of evidence: 1B)
- ANZICS (2011) – No recommendations on ultrasound guidance for CVC insertion.
- EPIC 3 (2013) – US use may indirectly reduce the risk of infection by facilitating mechanically uncomplicated subclavian placement.
- SHEA (2014) - Use ultrasound guidance for internal jugular catheter insertion (quality of evidence: II)

## Update on Insertion and Complications of Central Venous Catheters for Hemodialysis

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Semin Intervent Radiol 2016;33:31–38

**Conclusion**

Although it is clear that HD CVCs are not desirable for long-term HD, the majority of patients who start HD do so with a catheter. Recent technologic advances and catheter designs have increased the efficiency and safety of placement and maintenance of CVC; however, they are not an ideal long-term solution. As long as catheters remain a prevalent method of providing HD, it is incumbent upon practitioners who place these devices to understand the methods for safe placement, recognition of complications, and adherence to guidelines that are designed to protect patients.

## HD Tip Positioning - KDOQI

***Catheters and Port Catheter Systems (CPG 2.4)***

***Basic Principles***

1. Long-term catheter systems—tunneled cuffed catheters (TCCs) and tunneled port catheter systems—should have their tips within the right atrium confirmed by fluoroscopy
2. Short-term catheter tips should be in the superior vena cava (SVC) and confirmed by using chest radiograph or fluoroscopically at the time of placement before initiating dialysis therapy

## Special Considerations

1. Use antiseptic- or antimicrobial-impregnated CVCs in adult patients (quality of evidence: I)
2. Use chlorhexidine-containing dressings for CVCs in patients over 2 months of age (quality of evidence: I)

3. connectors (quality of evidence: I)
4. Use silver zeolite–impregnated umbilical catheters in preterm infants (in countries where it is approved for use in children; quality of evidence: II)
5. Use antimicrobial locks for CVCs (quality of e

Protection Beyond Insertion

Marschall J et al ICHE July 2014, vol. 35, no. 7

## Dedicated Cart and Kit

Standardize

## Post Insertion Care

- Antimicrobial ointments do not reduce the incidence of CLABSI except HD catheters
- Apply a sterile dressing to the insertion site before the sterile barriers are removed
- Transparent dressings are preferred to allow visualization of the site
- If the insertion site is oozing, apply a gauze dressing instead of a transparent dressing
- Replace dressings when the dressing becomes damp, loosened, soiled or after lifting the dressing to inspect the site.

Journal of Critical Care

The effects of chlorhexidine gluconate bathing on health care–associated infection in intensive care units: A meta-analysis

ABSTRACT

*Purpose:* The purpose was to assess the effects of chlorhexidine gluconate (CHG) bathing on health care-associated infections among critically ill patients.

*Methods:* This meta-analysis evaluated English-language studies from the PubMed, Embase, and Cochrane databases. The Cochrane Collaboration methodology was used to evaluate all publications regarding daily CHG bathing and the risks of acquiring central line–associated bloodstream infection (CLABSI), methicillin-resistant *Staphylococcus aureus* (MRSA), and vancomycin-resistant *Enterococcus* (VRE). Risk ratios (RRs) and the ratio of the log RRs (RRR) were estimated with 95% confidence intervals (CIs).

*Results:* Eighteen studies were included. Compared with conventional care, the RRs (95% CIs) for CLABSI, MRSA, and VRE with CHG bathing were 0.45 (0.37-0.55), 0.67 (0.59-0.77), and 0.60 (0.42-0.85), respectively (all, $P < .05$). For MRSA acquisition, CHG bathing with concomitant nasal antibiotics provided a lower incidence compared with only CHG bathing (RRR: 0.81, 95% CI: 0.66-0.98, $P = .035$). Greater risk reduction was also observed in studies with prolonged interventions (RRR per 1-month extension: −0.02, $P = .027$).

*Conclusions:* Daily CHG bathing was associated with reduced risks of acquiring CLABSI, MRSA, and VRE. A prolonged intervention period and concomitant nasal antibiotic use were associated with lower risks of MRSA acquisition.

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## Use of Needless Connectors

- Utilize a needleless connector at CVC hubs and stopcocks (II)
- Minimize the use of stopcocks. If a stopcock is used, cap port(s) with a needleless connector and disinfect prior to use
- Educate clinicians on appropriate use of needleless connectors per manufacturer's guidelines
- Consider use of a closed system for infusion, medication administration, and blood withdrawal (IB)

70 Different NADs
KNOW your NAD

## Antisepsis of Needless Connectors & Catheter Hub

- Vigorously scrub needleless connector (diaphragm and sides) prior to entry with alcohol or chlorhexidine gluconate/alcohol combination using friction for a minimum of 5-60 seconds or manufacturer's guidelines and allow to dry completely (IB)
- Clean junctions e.g. needleless connector attached to catheter lumen or between IV tubing and needleless connector, prior to opening system with alcohol or chlorhexidine gluconate/alcohol using friction for a minimum of 5-60 seconds or manufacturer's guidelines and allow to dry completely (IB)

Scrub the HUB!

## Locking

- Lock hemodialysis CVADs with Heparin lock solution 1000 units/ml, 4% citrate, or antimicrobial lock solutions.
- Use recombinant tissue plasminogen activator to lock hemodialysis catheters once per week as a strategy to reduce CR-BSI. (I) ( INS 2016)

## Follow the Guidelines

CVC AHD CVAD

## In Summary

- 86% of all AHD patients receive treatment via an Acute HD catheter
- Low approach insertion is more optimal
- All CVAD inserters MUST comply to reduce risk
- CHG technology significantly reduces CLABSI
  - Catheter, Skin-Prep, Dressing
- BOTH Insertion and Maintenance Bundle strategies must be applied to reduce risk

## Continuing Education (CNE and CRCE)

- This activity has been approved for 1.0 contact hour of CRCE and CNE by the AARC and California Board of Nursing and the Florida Board of Nursing.
- At the end of this webinar, you can obtain those continuing education credits by logging on to www.saxetesting.com/vh
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**Accreditation**

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- Provider (Saxe Communications) is approved by the California Board of Registered Nursing. Provider # 14477 and Florida Board of Nursing Provider # 50-17032

## Questions

- This webinar will be available on-demand at www.vesselhealth.org in about 10 days
- A PDF of the slides can be downloaded at that time