Advanced Approaches to Prevent CLABSI

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HRET HEALTH RESEARCH & EDUCATIONAL TRUST

STRIVE States Targeting Reduction in Infections via Engagement

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Learning Objectives

- Describe methods to analyze CLABSI events and determine which advanced prevention strategies should be implemented
- List at least two advanced approaches to prevent CLABSIs
- Outline findings from recent systematic reviews of the efficacy of advanced prevention strategies

Tiers of CLABSI Prevention

TIER 1 Standardize Supplies, Procedures and Processes *(complete all interventions: review and audit compliance with Tier 1 measures prior to moving to Tier 2)*				
Assess appropriateness and need for Central Venous Catheter (CVC)	Select appropriate site of insertion; avoid use of femoral site	Ensure proper aseptic insertion using maximal sterile barriers and ultrasound guidance	Ensure proper care and maintenance of CVC; e.g. proper hand hygiene, adequate staffing, disinfection of connector, secure/intact dressing	Optimize prompt removal of clinically unnecessary CVCs

(If CLABSI rates remain elevated, start with CLABSI Guide to Patient Safety (GPS) and Target Assessment for Prevention (TAP) Strategy and then proceed with additional interventions)

Perform needs assessment with CLABSI GPS and TAP Strategy

Tier 2 Enhanced Practices				
Conduct multidisciplinary rounds to audit for necessity of continued CVC use	Feed back CLABSI and CVC utilization metrics to frontline staff in "real time"	Observe and document competency and compliance with CVC insertion and maintenance	Use additional approaches as indicated by risk assessment (e.g., antimicrobial coated CVC)	Full or mini root cause analysis of CLABSI

Recap of CLABSI Prevention Strategies: Insertion to Removal

Insertion	Maintenance	Special Approaches
1. Hand Hygiene 2. Chlorhexidine gluconate (CHG) – alcohol for site preparation 3. Maximum sterile barrier precautions during central line insertion 4. Site selection 5. Ultrasound guidance	6. Disinfect catheter hub before accessing the catheter 7. Promptly remove catheters when no longer needed 8. Bathe intensive care unit patients over 2 months of age with CHG on a daily basis 9. Change transparent dressing and perform site care with a CHG-based product every 5 to 7 days or every 2 days for a gauze dressing 10. Replace dressing immediately if dressing becomes damp, loose or visibly soiled 11. Replace administration sets not used for blood, blood products, total parenteral nutrition (TPN), or lipids at intervals of no longer than 96 hours. Administration sets used for blood, blood products, TPN, or lipids should be changed every 24 hours	12. Use a chlorhexidine/silver sulfadiazine- or minocycline/rifampin-impregnated central line 13. Use a CHG-containing dressing for central venous catheters in patients over 2 months of age 14. Use an antiseptic-containing cap to cover connectors 15. Antimicrobial lock solutions in select populations

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(Septimus EJ, F1000Res, 2016)

AHRQ’s CUSP and Sense Making Tools

CUSP Tools	Sense Making Tools
Staff Safety Assessment	Discovery Form
Safety Issues Worksheet	Root Cause Analysis
Learn from Defects Form	Failure Mode and Effects Analysis
	Probabilistic Risk Assessment
	Causal Tree Worksheet

(Identify Defects Through Sensemaking, AHRQ, 2012. https://www.ahrq.gov/professionals/quality-patient-safety/cusp/cusp-success/whatiscusp.html

Learn From Defects

1. What happened?

2. Why did it happen?

3. What will you do to reduce the risk of recurrence?

4. How will you know the risk is reduced?

(Identify Defects Through Sensemaking, AHRQ, 2012)

Asking the 5 Whys

Problem Statement: (One Sentence description of event)

Why?

Why?

Why?

Why?

Why?

- Method to identify underlying cause and effect of a problem through a series of “why” questions
- Begin with a problem statement

Root Cause(s):

1.
2.
3.

To validate Root Causes – Ask the following:
If you removed this Root Cause, would this event have been prevented?

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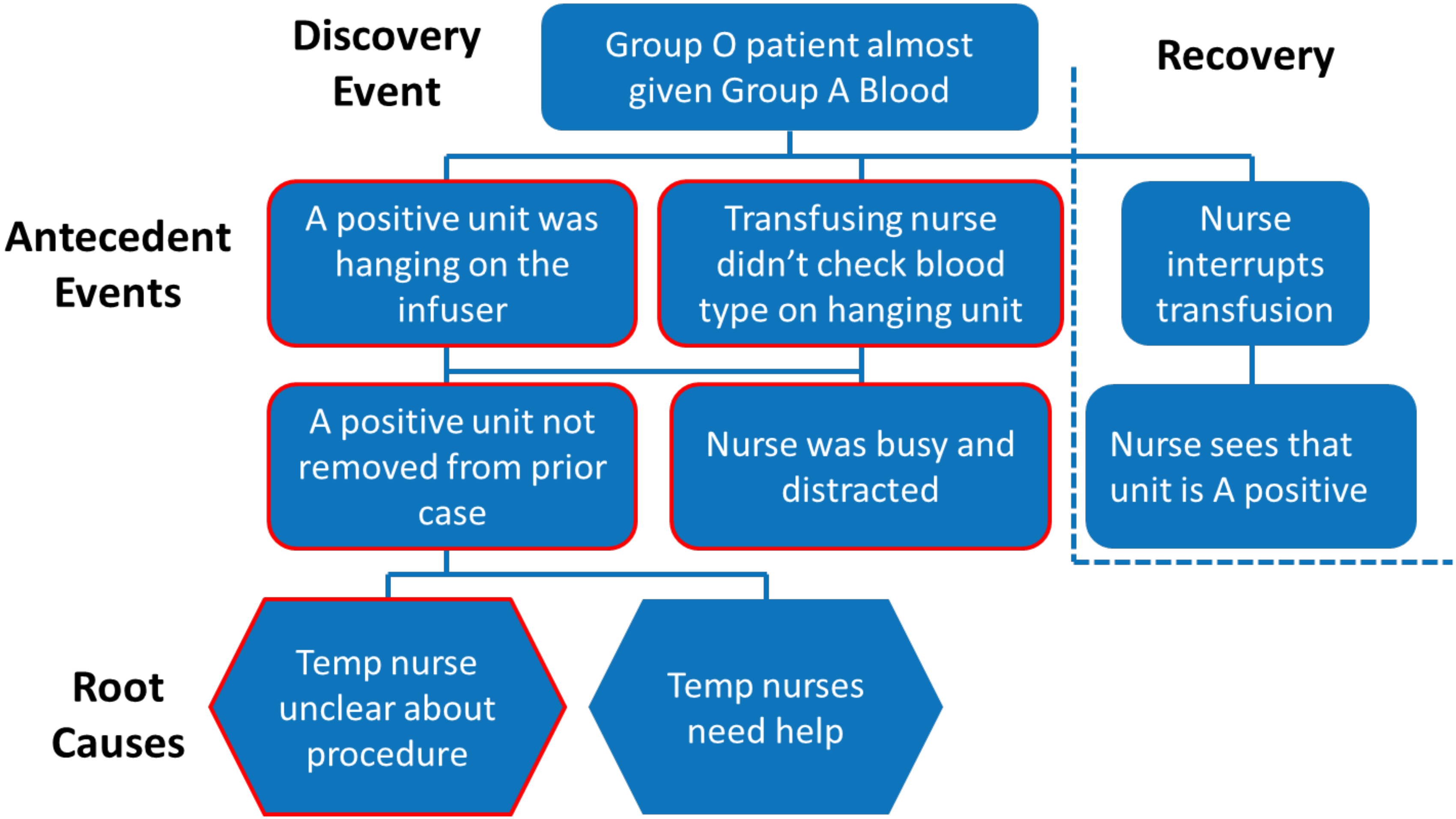
Root Cause Analysis



(Identify Defects Through Sensemaking, AHRQ, 2012)

Steps in Decision-Making to Implement Advanced Interventions

1. Collate findings from CLABSI events and review with inter professional team (e.g., learn from defects tool, mini or full root cause analysis)

2. Analyze CLABSI trends and findings from Step 1
   - Any patient populations at extraordinary risk that are common (e.g., neonates, oncology, burn injury)?
   - Any locations (patient units) that are more frequent (e.g., long-term acute care)?

3. For any populations/locations identified, are Tier 1 strategies reliably and consistently being applied?

4. If Tier 1 is fully and correctly implemented, then implement special approaches.

Summary Recommendations: Antimicrobial Central Venous Catheters

Healthcare Infection Control Practices Advisory Committee (HICPAC) 2011 Guidelines

- Use an antimicrobial or antiseptic-impregnated CVC in adults whose catheter is expected to remain in place >5 days if, after implementing a comprehensive strategy to reduce rates of CLABSI, the CLABSI rate remains above the goal set by the individual institution based on benchmark rates and local factors

American Society of Anesthesiologists (ASA) 2012 Guidelines

- Catheters coated with antibiotics or a combination of chlorhexidine and silver sulfadiazine should be used for selected patients based on infectious risk, cost and anticipated duration of catheter use

(O'Grady NP, Am J Infect Control, 2011; Practice Guidelines for Central Venous Access, American Society of Anesthesiologists (ASA), 2012)

Summary Recommendations: Antimicrobial Central Venous Catheters

Society for Healthcare Epidemiology of America (SHEA) 2014 Guidelines: Special Approaches

- Perform a CLABSI risk assessment before considering implementing special approaches, and take potential adverse events and cost into consideration. This is also an opportunity to review practices and consider behavioral changes that may be instituted to reduce CLABSI risk
- Special approaches are recommended for use in locations and/or populations within the hospital with unacceptably high CLABSI rates despite implementation of the basic CLABSI prevention strategies
- Use antiseptic- or antimicrobial-impregnated CVCs in adults for:
  - Hospital units or patient populations that have a CLABSI rate above institutional goals despite adherence with basic CLABSI prevention practices
  - Patients that have limited venous access and a history of recurrent CLABSI
  - Patients that are at heightened risk of severe sequelae from a CLABSI (e.g., patients with recently implanted intravascular devices, such as a prosthetic heart valve or aortic graft)

Note: new evidence by Gilbert and colleagues suggests antimicrobial CVCs can prevent CLABSI in pediatric ICUs

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(Marschall J, Infect Control Hosp Epidemiol, 2014; Gilbert RE, Lancet, 2016)

Antimicrobial Vascular Catheters

Antiseptic Coated

- Chlorhexidine and silver sulfadiazine
- Antimicrobial coating on external and internal lumen of catheter
- Available in CVC, PICC, and midline (peripheral)

Antibiotic Coated

- Minocycline and rifampin
- Antibiotics impregnated into external and internal lumen of catheter
- Available in CVC and PICC

Systematic Review: Efficacy of Antimicrobial CVCs

Overall, antimicrobial catheter impregnation significantly reduced catheter-related blood stream infection, with an absolute risk reduction of 2% (95% CI 3% to 1%), risk ratio of 0.62 (95% CI 0.52 to 0.74)

Catheter impregnation made no significant difference to the rates of clinically diagnosed sepsis, all-cause mortality and catheter-related local infections

Magnitude of benefits regarding catheter colonization varied according to setting, with significant benefits only in studies conducted in ICUs

Findings call for caution in routinely recommending the use of antimicrobial-impregnated CVCs across all settings

(Lai NM, Cochrane Database Syst Rev, 2016)

Clinical Experience with Antimicrobial CVCs

- Surgical ICU population at academic teaching hospital
- Observational study comparing incidence of CLABSI among chlorhexidine and silver sulfadiazine (C/SS) versus minocycline and rifampin (M/R) impregnated catheters
- Results
  - 2.1 per 1,000 catheter days for C/SS
  - 1.4 per 1,000 catheter day for M/R ($p < 0.05$)

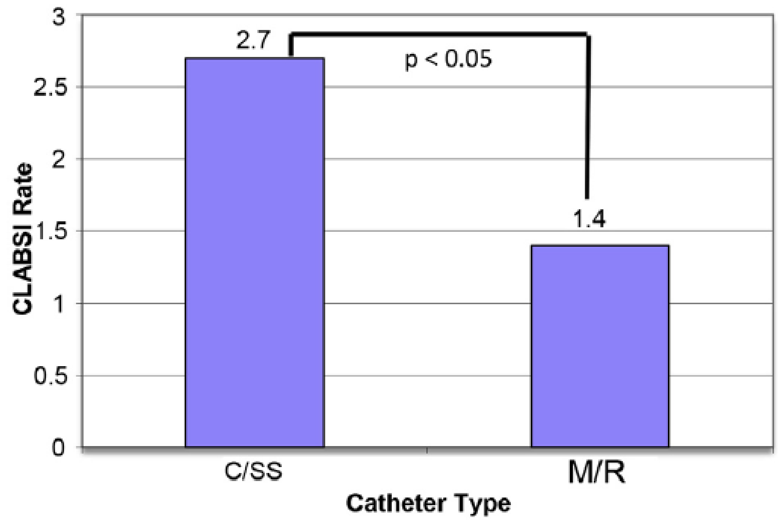

Figure 1. Central line-associated bloodstream infection (CLABSI) rate per 1,000 catheter days. C/SS, chlorhexidine and silver sulfadiazine-impregnated catheter; M/R, minocycline and rifampin-impregnated catheter.

Consider use of minocycline and rifampin coated CVCs in settings of ongoing CLABSI despite implementation of basic strategies

(Bonne S, J Am Coll Surg, 2015)

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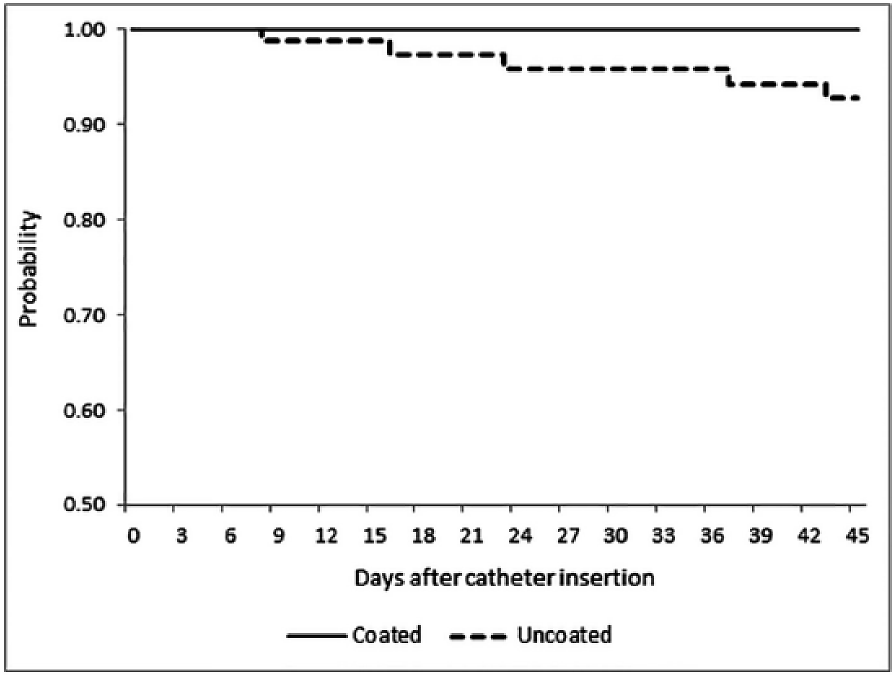
Clinical Experience with Antimicrobial PICCs

- Quality improvement study at academic cancer center
- Use of minocycline and rifampin coated PICC compared to concurrent uncoated controls
- Results
  - 5 CLABSIs in uncoated, incidence rate of 1.7/1000 catheter days
  - 0 CLABSIs in coated, incidence rate of 0/1,000 catheter days (P=0.066)
- Higher rate of failure on threading coated PICC compared to uncoated

Cumulative Probabilities of Being Infection-Free



(Yousif A, Am J Infect Control, 2016)

Systematic Review of Efficacy of Antimicrobial PICCs

The incidence of CLABSI in patients with antimicrobial PICCs was 0.2% compared to non-antimicrobial catheters was 5.3%

Incidence of CLABSI among those with antimicrobial PICC, 0.26 /1,000 catheter-days, was significantly lower than in non-antimicrobial PICC (P=0.014)

There was no significant difference in relative risk of infection for minocycline rifampin vs. chlorhexidine-coated PICCs

This review suggests use on patients at high risk of infection (e.g., cancer or burn populations) or those with long-term therapeutic need for vascular access

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(Kramer RD, et al. Am J Infect Control 2017)

Antimicrobial Locks

- **Antimicrobial locks**: fill the lumen of the catheter with a supratherapeutic concentration of an antimicrobial solution that is left in place until the catheter hub is re-accessed – typically after several hours
- Patient populations:
  - Long-term hemodialysis catheters
  - Limited venous access and a history of recurrent CLABSI
  - Long-term parenteral nutrition or chemotherapy
  - Salvage therapy of CVC
  - Increased risk of severe sequelae from a CLABSI

Examples of antimicrobials:
- Beta lactams
- Aminoglycosides
- Ethanol
- Vancomycin
- Tetracyclines
- Daptomycin

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Systematic Review of Efficacy of Antimicrobial Lock

Antimicrobial lock solution led to a 69% reduction in the risk of CLABSI and a 32% reduction in the rate of exit site infections among populations at high risk of infection

The majority of studies involved population undergoing hemodialysis

Factors to consider prior to use of antibiotic lock:

- Potential adverse events, ease of use
- Interactions with catheter material or medications infused
- Stability of the product, cost and lock dwell time

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(Zacharioudakis IM, Clin Infect Dis, 2014)

Systematic Review of Efficacy of Antimicrobial Locks in Neonates

The absolute risk reduction with use of the lock was 18.5%

Antibiotic lock solution appears to be effective in preventing CLABSI in the neonatal population, however, there was no impact on mortality associated with use of the lock

Each study used different antibiotics, so the risk of developing antibiotic resistance could not be reliably assessed

The evidence to date is insufficient to determine the effects of antibiotic lock on infections in neonates

(Taylor JE, Cochrane Database of Syst Rev, 2015)

Summary

- Conduct a risk assessment prior to considering advanced approaches to prevent CLABSI
- Assess adherence with Tier 1 strategies to prevent CLABSI and if gaps are identified, re-engage the inter professional team on improving use of these foundational aspects of prevention
- Use findings from surveillance of CLABSI, NHSN TAP reports, CLABSI GPS, and other tools (e.g., Learn from Defects, root cause analysis) to identify possible interventions
- Two possible interventions: antimicrobial vascular catheters or antimicrobial lock technique
- Review findings from systematic reviews to assess efficacy and applicability of evidence to the population at risk

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Speaker Notes

Speaker Notes: Slide 1

Welcome to the CLABSI prevention module titled “Advanced Approaches to Prevent CLABSI,” which addresses Tier 2 advanced approaches, such as novel technology, to prevent CLABSIs.

Speaker Notes: Slide 2

This module was developed by national infection prevention experts devoted to improving patient safety and infection prevention efforts.

Speaker Notes: Slide 3

After completing this module you'll be able to describe methods to analyze CALBSI events and determine which advanced strategies for prevention should be implemented, list at least two advanced approaches to prevent CLABSI and outline findings from recent systematic reviews of the efficacy of advanced prevention strategies.

Speaker Notes: Slide 4

The first set of modules on CLABSI prevention focused on the Tier 1 foundational interventions, outlined on the top of this slide. These are the basic prevention strategies that all hospitals should implement. The modules also described the impact a CLABSI can have on patients, and why developing strategies to prevent them is so important. If after implementing these strategies improvement does not occur, you should complete the Guide to Patient Safety or TAP process for CLABSI.

Speaker Notes: Slide 4 Continued

The GPS is a concise tool to target the main reasons why your facility may not be successful in preventing CLABSI. Review the two previous CLABSI modules to learn more about the GPS and Tier 2 strategies. This module will introduce you to the final two CLABSI Tier 2 prevention strategies, highlighted in the red box on this slide.

Speaker Notes: Slide 5

This table, adapted from work by Septimus and Moody, highlights CLABSI prevention tactics, including both Tier 1 and Tier 2 strategies. This module will focus on advanced or special tactics in our prevention toolkit, summarized above in the column on the right. Getting to this point in your prevention program means you've convened an inter professional care team at your facility and determined that more advanced strategies are necessary because the frequency of CLABSIs remain high despite full and correct implementation of basic insertion and maintenance practice. Tier 2 strategies or advanced tactics in this table may not apply to all patients and need to be considered for the patient population at hand.

Speaker Notes: Slide 6

The Agency for Healthcare Research and Quality has supported dissemination of a model called the comprehensive unit-based safety program or CUSP, which has been used as a foundation for patient safety around a variety of efforts including CLABSI, CAUTI and other device-associated infections. It is a flexible model for safety improvement that is comprised of five basic steps: educate staff in the science of safety, identify defects, engage executive leaders, learn from defects, and implement teamwork tools.

Speaker Notes: Slide 6 Continued

Sense making is a systematic approach to addressing patient safety events. It involves a conversation among members of an organization involved in an event/issue to better understand or make sense of what happened.

CUSP and sense making use similar tools that help clinicians systematically identify defects or failures and develop plans to prevent harm. This module will highlight some specific tools, such as Learn from Defects and root cause analysis. Both of these are aimed at identifying gaps or barriers to a facility's prevention program, which would then apply to improving quality in safety of care.

Speaker Notes: Slide 7

The Learning from Defects tool was developed by AHRQ and is used by the inter professional team to review details or information that led to a CLABSI. The questions on this slide are intended to help the care team identify the event. What led to the CLABSI? Were care practices applied consistently throughout the use of the central line? And were there opportunities to prevent this infection?

Speaker Notes: Slide 8

Another tool to improve patient care is a root cause analysis. This slide shows a method for achieving root cause analysis called the “Five Whys.” It's a method to identify the root cause of a problem through a series of why questions.

A root cause analysis focuses mostly on systems and processes, not on individual performance of a care provider team. The analysis progresses from special cause or intermittent or unpredictable factors that result in variation of care in clinical processes, to common causes such as inherent variation in organizational processes or systems. The goal of the analysis is to identify potential improvements in these processes or systems that decrease the likelihood of an unwanted event like a CLABSI in the future, should such improvement opportunities exist.

Speaker Notes: Slide 9

Here's an illustration of a root cause analysis applied to administration of blood products. A root cause analysis assesses factors that led to an event. Although this example involves administration of blood products, a care team can use these steps to analyze other events. For example, in the case of CLABSI, analysis might start with documentation in the patient's electronic medical record noting that the dressing on the central line needs to be changed every two days. The next question is why was this needed? Were there aspects related to care and maintenance that were missed? Or were the care team members involved not as familiar with the dressings in use at the facility? The boxes outlined in red are good examples of "why" questions.

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Speaker Notes: Slide 10

Next, it is important to consider a step-wise approach determining whether these advanced interventions are necessary and to keep in mind that many facilities throughout the US have achieved their goals for CLABSI prevention without the use of these advanced interventions. The first step in deciding whether or not to utilize these steps within the patient population you work with is to review the epidemiologic trends in CLABSI at the facility. Does this analysis identify whether CLABSI is more common in certain populations at higher risk? This is where NHSN TAP reports should be used to target efforts.

Speaker Notes: Slide 10 Continued

Next, conduct a more in-depth analysis of causes using the Learn from Defects tool or root cause analysis to find problems in processes or systems. If this in-depth analysis identifies particular populations most often involved in CLABSIs, the analysis can be used to look for problems in the processes or systems.

If Tier 1 practices are fully and correctly implemented, special approaches can then be added. If Tier 1 is not fully and correctly implemented, a root cause analysis and corrective actions should be undertaken before moving to special approaches.

Speaker Notes: Slide 11

A good place to start reviewing evidence-based recommendations is with national guidelines. For example, CDC and the Healthcare Infection Control Practice Advisory Committee (HICPAC) issued guidelines on the prevention of catheter-related blood stream infections in 2011. These guidelines indicate that use of an antimicrobial or an antiseptic impregnated central venous catheter is to be used in adults whose catheters are expected to remain in place for more than five days.

Speaker Notes: Slide 11 Continued

If after implementing a comprehensive strategy to reduce CLABSI rates, the rates remain higher than the goal set by your individual institution, your team can consider adopting a practice similar to this one. This recommendation is an example of one of the strategies we'll be talking about. The American Society of Anesthesiologists have also addressed this in their 2012 guidelines. They recommend that catheters coated with antiseptics or a combination of chlorhexidine and silver sulfadiazine be used for selected patients based on infectious risk, costs and anticipated duration of catheter use.

Speaker Notes: Slide 12

The Society for Healthcare Epidemiology of America, or SHEA, issued an updated compendium in 2014. They call for a risk assessment before considering more advanced or special approaches to CLABSI prevention and suggest also taking potential adverse events and costs into consideration. Some of these strategies take more resources to implement and not every facility needs to go to such lengths to prevent CLABSI. This is also an opportunity, according to SHEA, to review practices and consider behavioral changes that may be instituted to reduce CLABSI. If the special approaches by the inter professional team are deemed appropriate, determine where and when you might apply these.

Speaker Notes: Slide 12 Continued

Are there certain locations or populations within the hospital that have a very high frequency of CLABSIs, despite the basic foundational prevention strategies? After you've gone through these considerations, SHEA recommends considering antiseptic or an antimicrobial impregnated central venous catheter in adults.

Try to identify those areas where you may apply these CVCs. It may be in patients with limited venous access and a history of recurrent CLABSIs, or other groups that are at high risk of sequelae from CLABSI if they do develop it. For example, it could be a patient with a recently implanted intervascular device such as a prosthetic heart valve or aortic graft.

Speaker Notes: Slide 12 Continued

More recently, Gilbert and others published a randomized trial looking at antimicrobial central venous catheters in a pediatric population in intensive care units and found evidence that they were effective in that population. So, there are some other options available not strictly just for adults, but also for pediatric populations.

Speaker Notes: Slide 13

Antimicrobial vascular catheters fall into two general categories. First, antiseptic coated devices, including chlorhexidine and silver sulfadiazine, have an antimicrobial coating on both the external and the internal lumen of the device. These are available in a variety of different types of central venous catheters, as well as in some peripheral devices like midlines. The other category is an antibiotic coated device, which includes minocycline rifampin impregnated into the external and the internal lumen of the catheter. Those are also available in a variety of different types of catheters.

Speaker Notes: Slide 14

This slide shows a recently published example of a systematic review, described earlier. The Cochrane Collaboration's review of the efficacy of antimicrobial central venous catheters in adult patients finds that they do reduce risk of catheter-related blood stream infections in select populations, with an overall risk reduction of about 40 percent. Systematic reviews conducted by the Cochrane Collaboration limits studies included for analysis primarily to randomized controlled trials, which can produce strong and a high quality methodologic evidence.

Speaker Notes: Slide 14 Continued

This review by Lai and others captured studies published through March 2015. They concluded that the available evidence precludes the routine use of antimicrobial central venous catheters for all patient populations, but there may be certain groups that would benefit from it.

Speaker Notes: Slide 15

It's worth looking at the scientific literature subsequent to a recent systematic review. Subsequent to this systematic review, a more recent study was published, a clinical experience in a surgical ICU population at an academic teaching hospital. This study by Bonne and colleagues is not a randomized controlled trial, rather it's an observational study. The strength and quality of the findings are lower than you would expect with a true randomized trial. It compares the incidence of infection between two available central lines, one with chlorhexidine and silver sulfadiazine and the other rifampin minocycline. In this population, the rate of CLABSI was significantly lower in the latter group than the former.

Speaker Notes: Slide 15 Continued

The caveat is that while the authors recommend consideration in favor of this particular type of antimicrobial treatment of the catheter, they acknowledge it was not a controlled trial. A direct, comparative trial would be helpful, especially if it were random, as it would offer more generalizable results. As you review studies, it is important to consider the methodology used within each study.

Speaker Notes: Slide 16

Similarly, Yousif and colleagues published their recent investigation of the minocycline rifampin catheter. This study investigated coated peripherally inserted central catheters compared to uncoated. There were no CLABSIs in the small number of patients with the minocycline rifampin catheter. Importantly, even though there were no infections in the antimicrobial group with the catheter, this was not statistically significant, albeit the evidence was suggestive with a P value of 0.066. There was no difference in the overall incidence of mortality between these two groups. There was also a higher frequency of problems threading the antimicrobial PICC compared to the standard PICC.

Speaker Notes: Slide 17

Another recent systematic review by Kramer and colleagues looks at the efficacy of antimicrobial PICCs in literature published between about 2008 to 2016. The incidence of CLABSI in patients with the antimicrobial PICCs was 0.2% and the incidence among the non-antimicrobial PICCs was 5.3%. As you can see, the incidence of CLABSI was significantly less among those with the antimicrobial PICC. The authors conclude this technology should be considered for those at higher risk of CLABSI or populations in which long-term use of catheters that need prolonged, parenteral nutrition or even antibiotic therapy.

Speaker Notes: Slide 18

Another advanced intervention is the antimicrobial lock technique. In this technique, the clinician or provider fills the lumen of the catheter with a supratherapeutic concentration of an antimicrobial solution which is left in place until the catheter is re-accessed, typically after several hours.

Speaker Notes: Slide 18 Continued

This technique has been used successfully with several different patient populations, including: those on long-term hemodialysis, those with limited venous access and a history of recurrent CLABSI, those on long-term parenteral nutrition or chemotherapy, salvage therapy (which refers to the situation where there's a device in place, the patient has a documented CLABSI but, clinically, the clinicians are not comfortable trying to replace that device so they're trying to salvage the device by using antibiotic treatment alone), and then those with increased risk of severe sequelae from a CLABSI.

Speaker Notes: Slide 19

The study referenced here indicated that the use of lock led to a 69% decrease in the risk of CLABSI, meaning that routine use of antimicrobial locks could prevent 7 of 10 CLABSIs. There was no significant impact overall on all-cause mortality among those with an antimicrobial lock compared to those with heparin. Most studies in this systematic review involved patients undergoing hemodialysis; however, studies of other high risk populations, including pediatric cancer patients, critically ill neonates, and those on long-term parenteral nutrition, were also included. The factors to consider prior to the use of antibiotic locks include: potential adverse events, ease of use; interactions with catheter material or medications infused and; stability of the product, cost and lock dwell time.

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Speaker Notes: Slide 20

In 2015, Taylor and others published a systematic review of antibiotic lock studies in critically ill neonates. The risk of infection decreased with use of this technique. It is critical to note, however, that the three studies used different antibiotics, preventing the authors from concluding whether use of locks had increased the risk of antibiotic resistance.

Speaker Notes: Slide 21

This module outlined the more advanced practices or approaches to prevention of CLABSI, which need to be based on risk assessments of CLABSIs detected by the facility. It’s important to look locally, with your inter professional team, at which factors may be contributing to a higher frequency of CLABSI than desired. Because these approaches require additional resources, it’s important that the risk assessment includes reappraisal of the adherence among the direct care team to those foundational strategies in Tier 1 to prevent CLABSI, including maximum sterile barrier precautions for insertion of central lines, ongoing audit and feedback on care and maintenance of indwelling central venous catheters.

Speaker Notes: Slide 21 Continued

Cases of CLABSI can be analyzed in-depth using techniques, like root cause analysis, that are aimed at uncovering processes or systems issues potentially contributing to a high frequency of CLABSI. And finally, there is evidence that two advanced approaches, antimicrobial catheters and locks, are effective. However, most studies to date indicate there are specific populations for which these are most likely to be helpful.

Speaker Notes: Slide 22

No notes.

Speaker Notes: Slide 23

No notes.