

# MRSA Risk Assessment and Monitoring



# Presenter

## **David P. Calfee, MD, MS**

Professor of Medicine and Health Policy & Research  
Weill Cornell Medicine

## **Contributions by**

Vineet Chopra, MD, MSc

University of Michigan

Russ Olmsted, MPH, CIC

Trinity Health, Livonia MI

Kyle Popovich, MD

Rush University Medical Center



# Learning Objectives

- Discuss the importance of conducting a MRSA risk assessment to prioritize MRSA prevention strategies
- Identify data that can be used to conduct a MRSA risk assessment
- Describe a strategy to use data from hospital-onset MRSA bloodstream infections (MRSA BSI) to identify opportunities for future risk reduction



# Definition of MRSA BSI

**Definition:** MRSA isolated from a blood culture collected **more than three days after** admission to the facility, with no previous blood cultures prior to day four positive for MRSA, is considered a facility-onset MRSA BSI. MRSA isolated from a blood culture collected **within the first three days** of admission is considered a community-onset MRSA BSI.

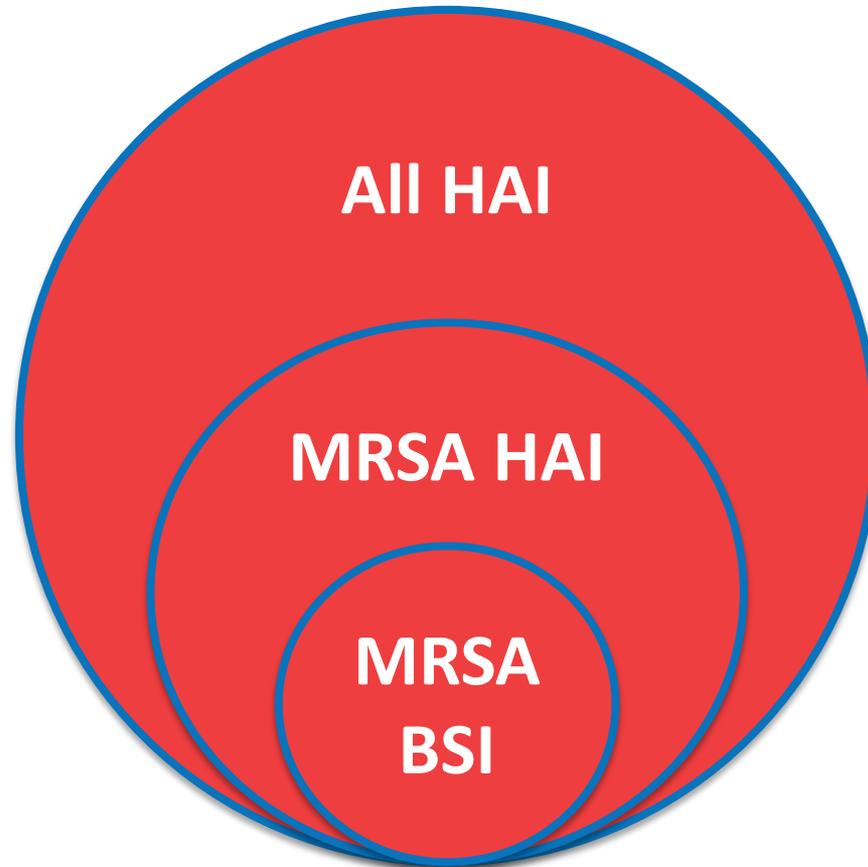
## Note:

- Reporting definitions are based solely on date(s) of admission and date(s) of blood culture collection
- Clinical data (e.g., signs and symptoms) not considered
- Cause of bloodstream infection (e.g., CLABSI, SSI, pneumonia, etc.) not assessed/identified

*(MDRO and CDI Module, CDC, 2016)*



# MRSA BSI Represents Only Part of a Hospital's MRSA Burden

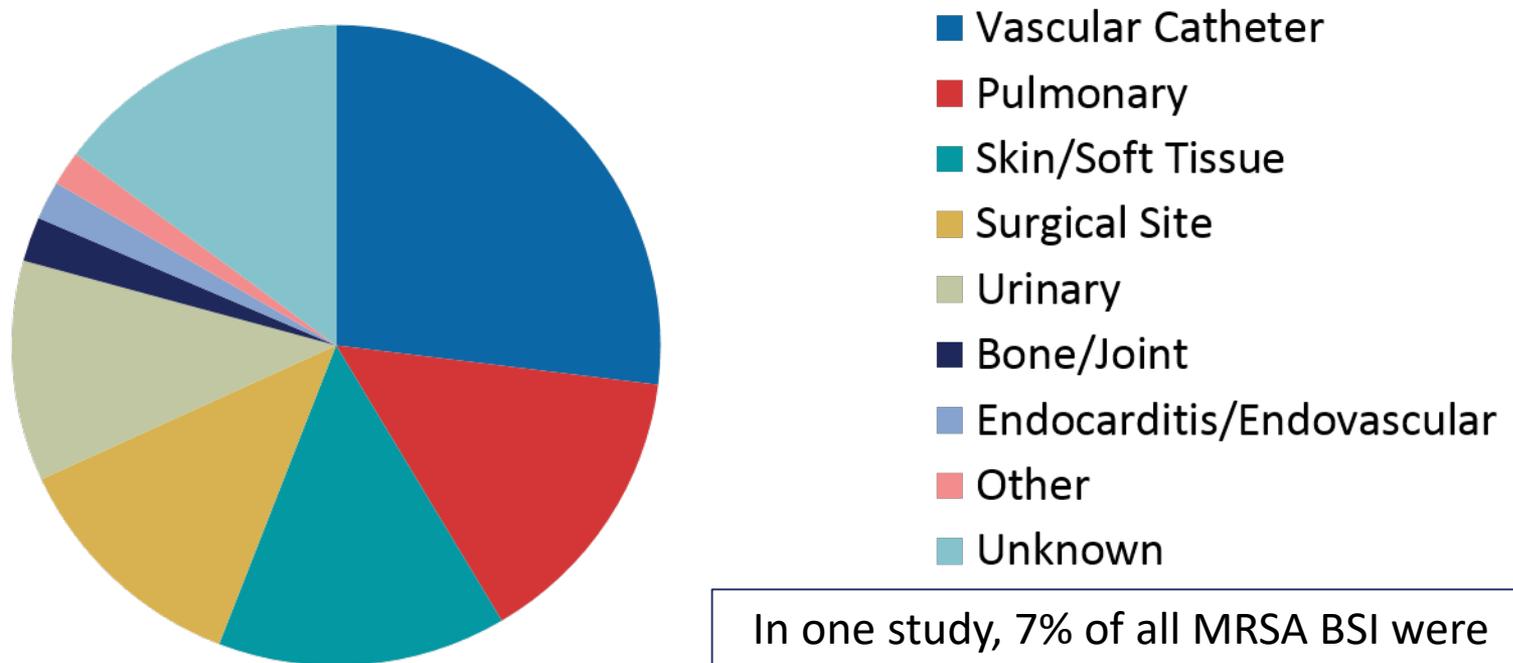


HAI, healthcare-associated infection



# MRSA BSI Can Result From a Variety of Infections and Processes

## Presumed Source of Healthcare-Associated MRSA Bloodstream Infection



In one study, 7% of all MRSA BSI were attributed to peripheral intravenous catheters.



# MRSA Data May Provide Insight Into HAI Prevention Opportunities

MRSA HAIs may reflect deficiencies in our infection prevention practices

MRSA risk assessment may include:

- Assessment of adherence with existing infection prevention policies and protocols
- Estimates of a facility's MRSA burden
  - e.g., rates of transmission and infection
- Case review of individual MRSA HAIs



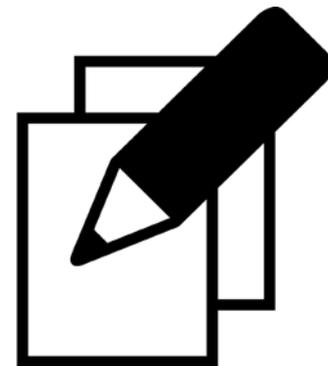
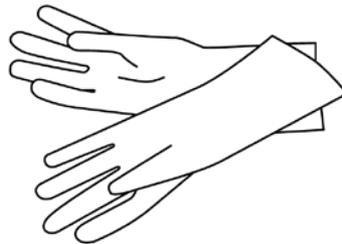
# Assess adherence with HAI Prevention Protocols and Policies

## Foundational Practices

- Hand hygiene\*
- Contact Precautions\*\*
- Environmental cleaning\*\*\*
- Prevention “bundles”

## Special practices

- Daily chlorhexidine bathing
- Active surveillance testing



# Assess MRSA Infection Burden and Transmission Risks

Estimates of a facility's MRSA burden can be made using existing data

- Antibigram
  - Proportion of *S. aureus* isolates that are methicillin-resistant
- Incidence and/or prevalence of MRSA
  - Line list of patients with MRSA
- MRSA infection burden
  - BSI, CLABSI, SSI
  - Clinical culture data
- Estimates of MRSA transmission
  - Results of active surveillance testing (if being performed)



(Calfee DP, *Infect Control Hosp Epidemiol*, 2014; Cohen AL, *Infect Control Hosp Epidemiol*, 2008)



# Review of MRSA BSI Cases May Help to Prioritize Prevention Interventions



Identify the primary source of the bloodstream infection

- Existing NHSN surveillance data (CLABSI, SSI, etc.)
- Medical record review (NHSN definitions or clinical diagnosis)

Look for epidemiologic trends and risk factors



- Facility location
- Invasive procedures
- Adherence to HAI prevention policies and protocols
- Known history of MRSA colonization
- Location prior to admission (e.g., nursing home)

Root cause analysis has been associated with a lower prevalence of MRSA among *S. aureus* blood culture isolates

(Borg MA, *J Hosp Infect*, 2014)



# Patient Scenario: Mr. Green

57 year-old man admitted from home with chest pain and shortness of breath

Diagnosed with acute myocardial infarction (MI)

Treated with angioplasty and stent placement

Course notable for prolonged Cardiac Intensive Care Unit stay due to congestive heart failure (CHF)

On hospital day 12, he had a new fever

Blood cultures were obtained and MRSA was subsequently isolated

He was not intubated, had no central lines and had not undergone any surgical procedures

He had an indwelling urinary catheter

*Disclaimer: All case studies are hypothetical and not based on any actual patient information. Any similarity between a case study and actual patient experience is purely coincidental.*



# Patient Scenario: Mr. Green (Continued)

Nursing notes on the day prior to fever onset describe redness, pain and swelling at right antecubital fossa peripheral IV site

Earlier in the day of the fever, the physician had documented redness, pain and scant purulent discharge from the peripheral IV site

IV catheter was removed the same day

No other localizing signs or symptoms of infection were documented

You determine that this case of MRSA BSI was due to a peripheral IV catheter-associated infection

*Disclaimer: All case studies are hypothetical and not based on any actual patient information. Any similarity between a case study and actual patient experience is purely coincidental.*



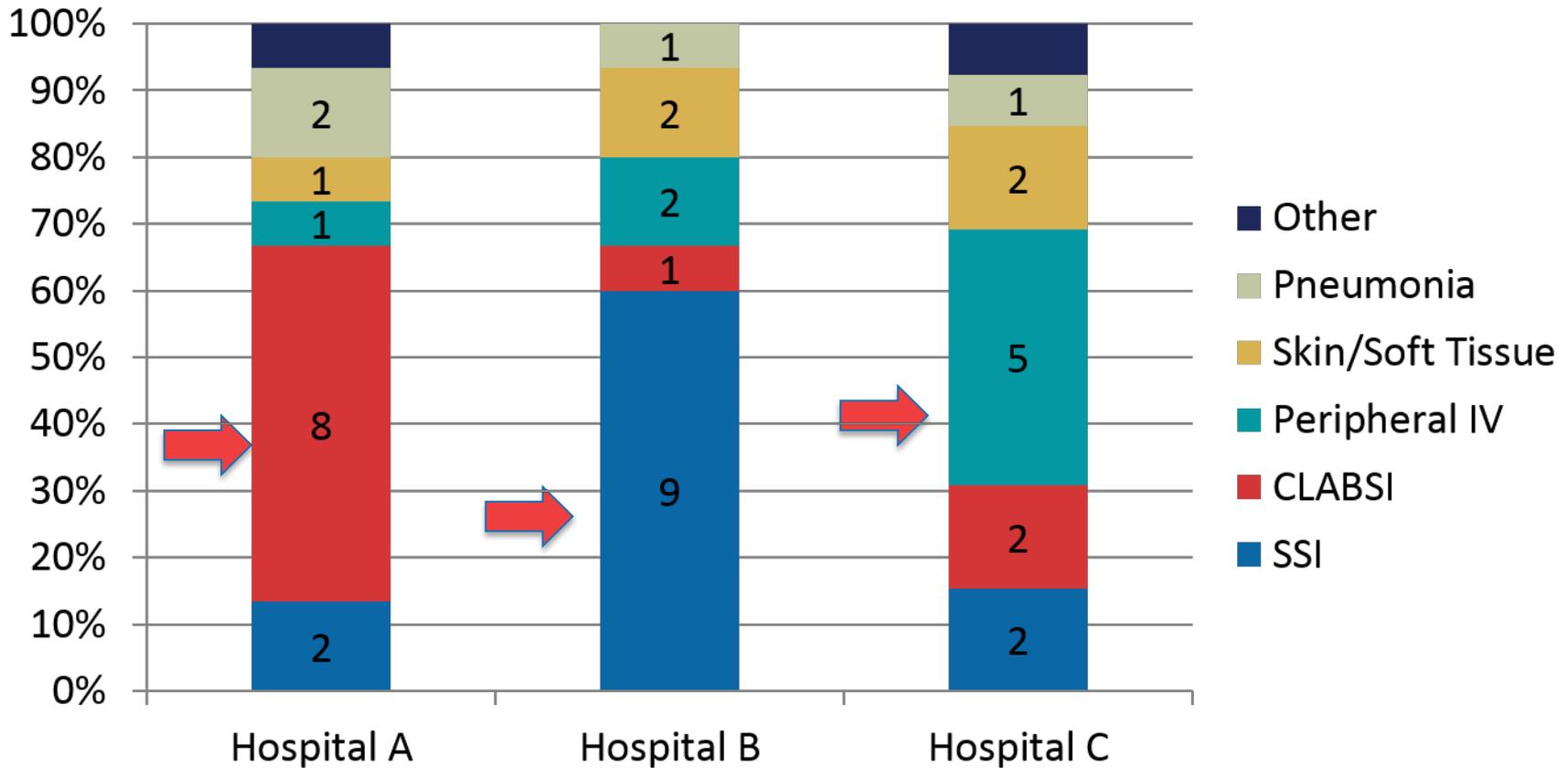
# Patient Scenario: Looking Beyond Mr. Green

Patient	Culture Date	Admit Date	LOS prior to BSI	Location	Source	History of MRSA?	CVC	Surgery	Vent
#1	8/17/19	8/4/19	14 days	CCU	Peripheral IV	Yes	No	No	No
#2	8/30/19	8/24/19	7 days	CCU	CLABSI	No	No	No	No
#3	9/7/19	9/2/19	6 days	Oncology	CLABSI	No	Yes	No	No
#4	9/11/19	9/4/19	8 days	Medicine	Peripheral IV	Yes	No	No	No
#5	9/23/19	9/12/19	12 days	CCU	Peripheral IV	No	No	No	No



# The Most Common Causes of MRSA

## BSI Can Vary Among Hospitals



**CLABSI prevention**

**SSI prevention**

**Peripheral IV infection prevention**



# Implement Interventions to Address Key Opportunities for Prevention

## Basic infection prevention strategies

- Hand hygiene
- Environment and equipment cleaning and disinfection
- Contact precautions

## Strategies that target specific types of infection

- Central line-associated bloodstream infections
- Peripheral IV site infections
- SSIs
- Ventilator-associated pneumonia



# Take-Home Points

- While MRSA represents only part of a hospital's overall HAI burden, it may mark a larger hospital HAI problem
- MRSA BSI are not a homogeneous group of infections, but rather complications that can be the result of a variety of underlying infections and deficiencies in our care practices
- Conducting a MRSA risk assessment and “mini” root cause analysis of MRSA BSIs can identify opportunities for improvement and help to prioritize infection prevention interventions



# References

Austin ED, Sullivan SB, Whittier S, et al. Peripheral intravenous catheter placement is an under recognized source of *Staphylococcus aureus* bloodstream infection. *Open Forum Infect Dis*. 2016; 3:ofw072.

Borg, MA, Hulscher M, Scicluna EA, et al. Prevention of methicillin-resistant *Staphylococcus aureus* bloodstream infections in European hospitals: moving beyond policies. *J Hosp Infect*. 2014; 87:203-11.

Calfee DP, Salgado CD, Milstone AM, et al. Strategies to prevent methicillin-resistant *Staphylococcus aureus* transmission and infection in acute care hospitals: 2014 update. *Infect Control Hosp Epidemiol*. 2014; 35: 772-96.

Centers for Disease Control and Prevention. Multidrug-resistant organism & *Clostridium difficile* infection (MDRO/CDI) module. 2016. [http://www.cdc.gov/nhsn/pdfs/pscmanual/12pscmdro\\_cdadcurrent.pdf](http://www.cdc.gov/nhsn/pdfs/pscmanual/12pscmdro_cdadcurrent.pdf)

Cohen AL, Calfee DP, Fridkin SK, et al. Recommendations for metrics for multidrug-resistant organisms in healthcare settings: SHEA/HICPAC position paper. *Infect Control Hosp Epidemiol*. 2008; 29:901-13.

Simor AE, Pelude L, Golding G, et al. Determinants of outcome in hospitalized patients with methicillin-resistant *Staphylococcus aureus* bloodstream infection: results from national surveillance in Canada, 2008-2012. *Infect Control Hosp Epidemiol*. 2016; 37:390-7.



# Speaker Notes



# Speaker Notes: Slide 1

Welcome to the second module of the methicillin-resistant *Staphylococcus aureus*, or MRSA, Tier 1 course titled “MRSA Risk Assessment and Monitoring.” This module will discuss the importance of developing a MRSA risk assessment and monitoring program within a health care facility.



# 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 course you will be able to:

- Discuss the importance of conducting a MRSA risk assessment to prioritize MRSA prevention strategies;
- Identify data that can be used to conduct a MRSA risk assessment; and
- Describe a strategy to use data from hospital-onset MRSA bloodstream infections to identify opportunities for future risk reduction.



# Speaker Notes: Slide 4

As previously described, MRSA bloodstream infections are associated with substantial morbidity and mortality, and many of these infections are preventable. Thus, surveillance for and efforts to prevent these infections are logical components of any healthcare-associated infection, or HAI, monitoring and prevention program. In recognition of this, the Centers for Medicare and Medicaid Services, CMS, now includes health care facility-onset MRSA bloodstream infections in its public reporting and health care facility reimbursement programs, using the Centers for Disease Control & Prevention's National Healthcare Safety Network (NHSN) definitions. It is important for all of us to be familiar with the NHSN definition that is used to identify health care facility-onset MRSA bloodstream infections.



# Speaker Notes: Slide 4 Continued

For MRSA bloodstream infection reporting, NHSN uses what is known as Laboratory-Identified, or LabID, event reporting. Using this classification system, a health care facility-onset MRSA bloodstream infection is identified when MRSA is isolated from a blood culture that was collected more than three days after admission to the facility. Cases in which MRSA is isolated from a blood culture collected within the first three days of admission are considered community-onset MRSA bloodstream infections. As you may have noticed, these reporting definitions are based solely on dates of admission and dates of positive blood cultures.



# Speaker Notes: Slide 4 Continued

They do not take into account clinical information, such as signs and symptoms, or attempt to identify the cause of the bloodstream infection (such as a central line-associated bloodstream infection or CLABSI, surgical site infection (SSI), or pneumonia), an issue that we will discuss in more detail later. This type of event reporting has the advantages of being objective, clear and not labor intensive.



# Speaker Notes: Slide 5

Although hospitals are only required to report MRSA bloodstream infections and CMS is using only health care facility-onset MRSA bloodstream infection data for inter-hospital comparison purposes, we should all recognize that our health care facility-onset MRSA bloodstream infections represent only part of our hospital's MRSA infection burden and overall HAI burden. However, MRSA infections, including MRSA bloodstream infections, may be a marker for larger HAI problems in a hospital and thus looking closely at our MRSA data may help us to identify opportunities to improve not only our MRSA infection rates, but our overall HAI rates as well.



# Speaker Notes: Slide 6

It is also important as we report cases and look at our health care facility-onset MRSA bloodstream infection data to recognize that these are not a homogeneous group of infections, but rather a complication that can arise from a variety of underlying infections and from any number of deficiencies in our patient care practices. Thus, as mentioned before, MRSA bloodstream infections may be a marker for a larger problem with one or more types of HAI or with how we are providing care to our patients.



# Speaker Notes: Slide 6 Continued

To illustrate this, this figure summarizes data from a study by Simor and colleagues. This study included 1,753 patients with health care facility-associated MRSA bloodstream infections at 53 Canadian hospitals between 2008 and 2012. The pie chart shows that these bloodstream infections were attributable to a wide variety of primary sources of infection. The most common sources identified included vascular catheters (which accounted for 26.4 percent of cases), pleuropulmonary infections (about 14 percent of cases), skin/soft tissue infections (another 14 percent), SSIs (about 12 percent) and the urinary tract (about 11 percent) of infections.



# Speaker Notes: Slide 6 Continued

With regard to MRSA bloodstream infections attributable to vascular catheters, we may assume that these are all central line-associated bloodstream infections or CLABSIs. While that is often the case, note that peripheral intravenous catheters are also relatively common causes of MRSA bloodstream infections. In fact, investigators at a large tertiary medical center determined that 7 percent of the MRSA bloodstream infections that occurred during a two-year period were attributable to peripheral IV catheters.



# Speaker Notes: Slide 7

As mentioned before, our MRSA HAIs may reflect deficiencies in our general infection prevention practices or in our device- and/or procedure-specific infection prevention practices. Thus, looking closely at our MRSA data may give us important new insight into our MRSA and overall HAI challenges, and help us to identify opportunities to improve the quality of care and patient outcomes. This closer look at our data is sometimes referred to as a MRSA Risk Assessment.



# Speaker Notes: Slide 7 Continued

In conducting a MRSA risk assessment, one can include different types of data that represent different process and outcome measures related to MRSA. Such data may include:

- assessments of adherence with existing infection prevention policies and protocols,
- estimates of the facility's MRSA burden (including direct or proxy measures of transmission and infection), and
- case reviews of individual MRSA HAIs.

Let's talk in a little more detail about these potential components of a MRSA risk assessment.



# Speaker Notes: Slide 8

Assessments of adherence with the hospital's existing HAI prevention policies and procedures are an important component of a MRSA risk assessment. These practices represent the core of our infection control program and if we aren't doing them consistently and effectively, it is unlikely that we will ever be able to optimally control MRSA or other healthcare-associated pathogens. You'll hear more about basic practices to prevent MRSA infection and transmission in the next module: these include critical and basic practices such as hand hygiene, environmental cleaning and disinfection, Contact Precautions including use of proper technique for donning and doffing gowns and gloves and prevention bundles such as the central line bundle.



# Speaker Notes: Slide 8 Continued

In hospitals that have implemented additional prevention strategies, such as daily chlorhexidine bathing or active surveillance testing for MRSA, an assessment of adherence with these strategies would also be an important component of the MRSA risk assessment. These enhanced MRSA prevention strategies will be discussed in more detail during Tier 2 education.



# Speaker Notes: Slide 9

In addition to the assessment of adherence to basic infection prevention practices, some effort should be made to estimate the facility's MRSA transmission risk and infection burden. This can sound like a daunting task, but often we can use existing data or data that is relatively easy to acquire and analyze to make such estimates and assessments.



# Speaker Notes: Slide 9 Continued

For example, the hospital antibiogram can be used to identify the proportion of *S. aureus* isolates that are methicillin-resistant. Most hospital laboratories produce an antibiogram at least once per year and thus these can be helpful in identifying changes in the prevalence of MRSA over time. In addition to overall hospital data, some hospitals provide antibiogram data for specific areas within the hospital, such as intensive care units or oncology units, which may provide more granular details about the MRSA burden within specific locations and populations.



# Speaker Notes: Slide 9 Continued

Similarly, many hospital infection prevention programs maintain lists of MRSA-positive patients which may be useful in determining incidence and prevalence rates and identifying locations and populations in which there is a larger MRSA burden.

We can also use data from other HAI surveillance efforts, including CLABSI and SSI surveillance, to measure MRSA burden among specific device- and procedure-related infections. Some hospitals assess MRSA burden by analyzing and reviewing data from all clinical cultures from which MRSA is isolated.



# Speaker Notes: Slide 9 Continued

Estimating or identifying MRSA transmission within the hospital may be more difficult. Hospitals that perform serial active surveillance testing for MRSA among hospital patients can identify patients who convert from MRSA-negative to MRSA-positive.

In hospitals where active surveillance is not conducted, some use hospital-onset MRSA (for example, patients whose first MRSA-positive clinical culture is obtained more than three days after admission as a proxy measure for in-hospital acquisition of MRSA).

More details about how to use these types of data can be found in the references provided at the bottom of the slide.



# Speaker Notes: Slide 10

Finally, conducting a review of individual MRSA BSI cases can identify opportunities for improvement and help to prioritize infection prevention interventions. As we already discussed, MRSA BSI can occur as a result of a wide variety of primary infections and our prevention interventions may differ depending on which primary infections are causing our MRSA BSI. Therefore, an important goal of the case review is to identify the primary source of the bloodstream infection. For some cases, we can do this using existing NHSN surveillance data. For example, a patient with a MRSA BSI may have already been identified and reported as a MRSA CLABSI or a SSI with a secondary MRSA BSI.



# Speaker Notes: Slide 10 Continued

For cases that were not already reviewed as part of the routine surveillance program, we can use NHSN definitions or clinical diagnoses to determine the most likely cause of the MRSA BSI. As we do the reviews we can also look for epidemiologic trends and risk factors that may have contributed to the infection. Noting the hospital location or locations where the patient was admitted, identifying invasive procedures that the patient may have undergone, looking for evidence of adherence or non-adherence to HAI prevention policies and practices (such as central line insertion bundles or pre-operative skin prep),



# Speaker Notes: Slide 10 Continued

known history of colonization with MRSA and location prior to admission (such as a long-term care facility) may help to identify important risk factors and epidemiologic links between cases that may otherwise go undetected.

This type of in-depth review of individual cases can provide invaluable information. In fact, in a study by Borg and colleagues conducted among 269 hospitals in 29 European countries found that completion of root cause analysis of MRSA BSI cases was associated with a lower prevalence of MRSA among *S. aureus* blood culture isolates.



# Speaker Notes: Slide 11

You may never have conducted a “mini” root cause analysis for a MRSA BSI case. Here is a helpful example of how it could work.

The process would begin by identifying a patient who meets the LabID definition of health care facility-onset MRSA BSI. This may be done during real-time surveillance or retrospectively by generating a line list of hospital-onset MRSA BSI cases that have already been reported to NHSN using the NHSN “analysis” options.



# Speaker Notes: Slide 11 Continued

In our example, we have identified a case that occurred in a 57 year-old man, Mr. Green. Upon chart review, we learned that he was admitted from home with complaints of chest pain and shortness of breath. He was subsequently diagnosed with an acute myocardial infarction and treated with angioplasty and stent placement. His hospital course was notable for a prolonged stay in the Cardiac Intensive Care Unit due to congestive heart failure. On hospital day 12, he had a new fever. Blood cultures were obtained and MRSA was subsequently isolated. He had not been intubated, had no central venous catheters, and had not undergone any surgical procedures. He did have an indwelling urinary catheter.



# Speaker Notes: Slide 12

In reviewing the nursing documentation during the few days prior to and after the date of the positive blood culture, you see that on the day prior to the onset of fever, the nurse had noted redness, pain and swelling at the insertion site of a peripheral IV that was located in his right antecubital fossa. On the day of the fever, the physician note documented redness, pain and a small amount of purulent discharge from the peripheral IV site. The IV catheter was then removed. There were no other documented localizing signs or symptoms of infection.

Based on this information, you conclude that this case of MRSA BSI was due to a peripheral IV catheter-associated infection.



# Speaker Notes: Slide 13

And while the information that you collect from an individual case can be very helpful, the data may become even more powerful as you gather this type of data from multiple cases. As you collect and analyze these data, previously unrecognized patterns and risk factors may begin to emerge. In this spreadsheet, we've added data from Mr. Green's case we just reviewed (shown as Patient #5) to that obtained during reviews of other MRSA BSIs. As we add more cases, we can look for patterns and common findings.



# Speaker Notes: Slide 13 Continued

For instance, here we see that three of the five cases we investigated occurred in the Cardiac Intensive Care Unit or CCU. Thus, we might want to look more closely at practices within that unit. We also see that three of the five cases were determined to be due to peripheral IV catheters, suggesting that there may be opportunities to improve peripheral IV insertion and/or access and maintenance techniques.



# Speaker Notes: Slide 14

This type of assessment is important because the distribution of underlying causes of MRSA BSI is likely to be very different across hospitals and even within a single hospital over time. This figure illustrates this point. In Hospital A, CLABSI accounted for 53 percent of the hospital-onset MRSA BSIs identified. In Hospital B, SSIs accounted for 60 percent of all cases, and in Hospital C peripheral IV infections were the single most common cause of MRSA BSI, accounting for 38 percent of all events.



# Speaker Notes: Slide 14 Continued

Thus, priority prevention initiatives at each of these hospitals might, and probably should, look different. Each hospital should make efforts to ensure that basic infection prevention measures, such as hand hygiene and environment and equipment cleaning, and disinfection, are being done properly, but they may prioritize other efforts to address more specific issues that are of particular relevance in the hospital.



# Speaker Notes: Slide 14 Continued

For example, Hospital A may target CLABSI prevention, while Hospital B targets SSI prevention and Hospital C focuses on peripheral IV catheter infections. While we of course want to prevent all infections, efforts directed at the most common causes of MRSA BSI in our hospitals may have the biggest impact and lead to the greatest and most rapid improvement.



# Speaker Notes: Slide 15

Although beyond the scope of this presentation, there are many resources available to help hospitals identify and implement effective evidence-based strategies to prevent HAIs. Useful information is available on the STRIVE website as well as from CDC, the Agency for Healthcare Research and Quality (AHRQ) and professional societies such as the Association of Professionals in Infection Control and Epidemiology or APIC, the Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA).



# Speaker Notes: Slide 16

As we come to the end of this module, please keep these three take-home points in mind:

- First, while MRSA represents only part of a hospital's overall HAI burden, MRSA may be a marker for a larger HAI problem in the hospital.
- Second, MRSA BSIs are not a homogeneous group of infections, but rather complications that can be the result of a variety of underlying infections and deficiencies in our care practices.
- Finally, conducting a MRSA risk assessment and “mini” root cause analysis of MRSA BSIs can identify opportunities for improvement and help to prioritize infection prevention interventions and resources.



# Speaker Notes: Slide 17

No notes.

