

Methicillin-Resistant *Staphylococcus aureus* (MRSA) Prevention Tier 2 Interventions



Presenter

Kyle Popovich, MD

Associate Professor
Rush University Medical Center

Contributions by

David P. Calfee, MD, MS

Weill Cornell Medicine

Vineet Chopra, MD, MSc

University of Michigan

Russ Olmsted, MPH, CIC, FAPIC

Trinity Health, Livonia, MI

Payal Patel, MD, MPH

University of Michigan



Learning Objectives

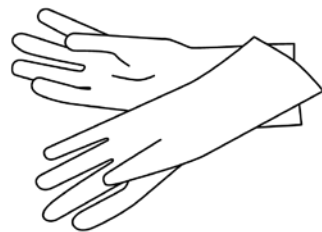
- Outline the difference between horizontal and vertical infection control strategies
- Identify the enhanced Tier 2 strategies that can be used to reduce methicillin-resistant *Staphylococcus aureus* (MRSA) transmission and infection
- Recognize the importance of adherence to recommended infection control interventions



Horizontal Infection Control Strategies

Interventions that can reduce MRSA transmission to other patients, but are **NOT** pathogen specific

These interventions have the additional benefit of preventing transmission of other organisms, including other multidrug-resistant organisms (MDROs)



Vertical Infection Control Strategies

Interventions that target a specific pathogen

- Active Surveillance Testing (AST) for high-risk patient populations
- Decolonization for patients colonized with MRSA or at high risk of infection

Vertical **AND** horizontal strategies combined offer maximal benefit!



Tier 2 MRSA Prevention Strategies

Tier 2 Enhanced Practices

Implement daily chlorhexidine bathing for populations at risk for developing MRSA bacteremia.

Consider decolonization for those patients colonized with MRSA and at high risk of infection.

Active Surveillance Testing (AST) for high-risk patient populations.

Consider gowning and gloving for all intensive care unit (ICU) patients.

Daily chlorhexidine gluconate (CHG) bathing in intensive care units (ICUs)

MRSA decolonization therapy

Active surveillance testing (AST) for MRSA

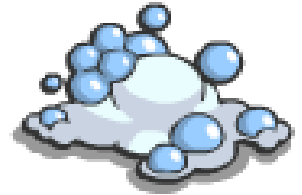
Universal gown and glove use in the ICU



Chlorhexidine Gluconate (CHG)

Daily bathing of ICU patients with CHG can decrease potential pathogens on patient skin

- i.e., source control



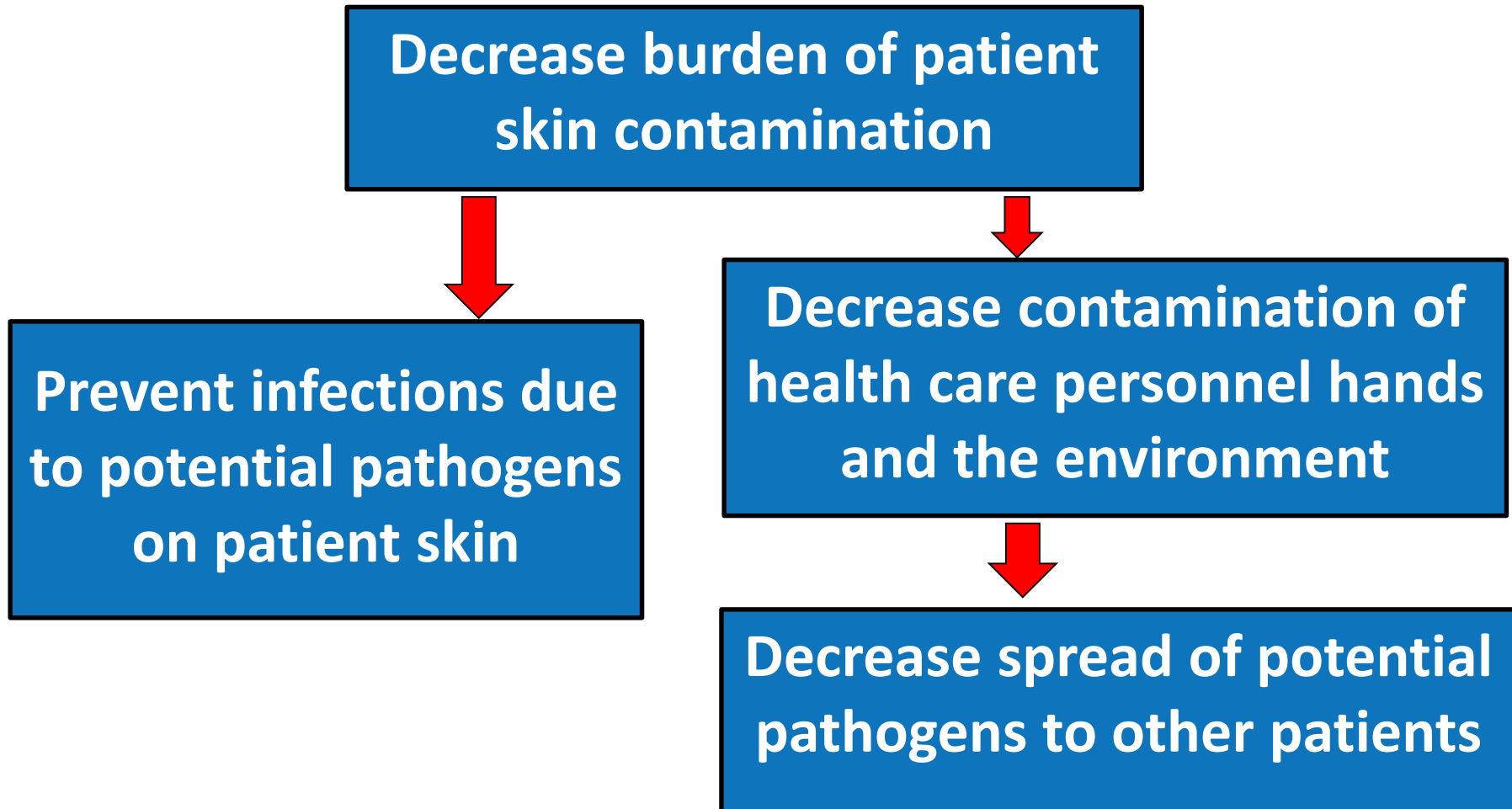
Daily bathing with CHG leads to a significant reduction in the risk for acquisition of multidrug-resistant organisms and healthcare-acquired bloodstream infections



(Ridenour G, *Infect Control Hosp Epidemiol* 2007; Evans HL, *Arch Surg*, 2010; Climo MW, *Crit Care Med*, 2009; Karki S, *J Hosp Infect*, 2012; Climo MW, *N Engl J Med*, 2013)



Why is Source Control Important?



CHG Bathing: Implementation

Develop standardized or protocol-based order sets to optimize adherence

Ensure adequate supplies for CHG bathing

Ensure skin products are compatible with CHG

Train health care personnel on appropriate application of CHG bathing techniques

Provide routine audits of adherence to CHG bathing with feedback to personnel



MRSA Decolonization Therapy

Decolonization therapy is the administration of antimicrobial or antiseptic agents to eradicate or suppress MRSA carriage

- Intranasal antibiotic or antiseptic (e.g., mupirocin, povidone-iodine)
- Topical antiseptic (e.g., chlorhexidine)
- +/- Systemic antibiotics



MRSA decolonization has been associated with reduction in MRSA carriage, transmission and infection



MRSA Decolonization Therapy



Targeted decolonization: administration of MRSA decolonization therapy to persons known to be colonized with MRSA



Universal decolonization: administration of MRSA decolonization therapy to all at-risk persons (e.g., all ICU patients)



MRSA Decolonization Therapy: Issues to Consider

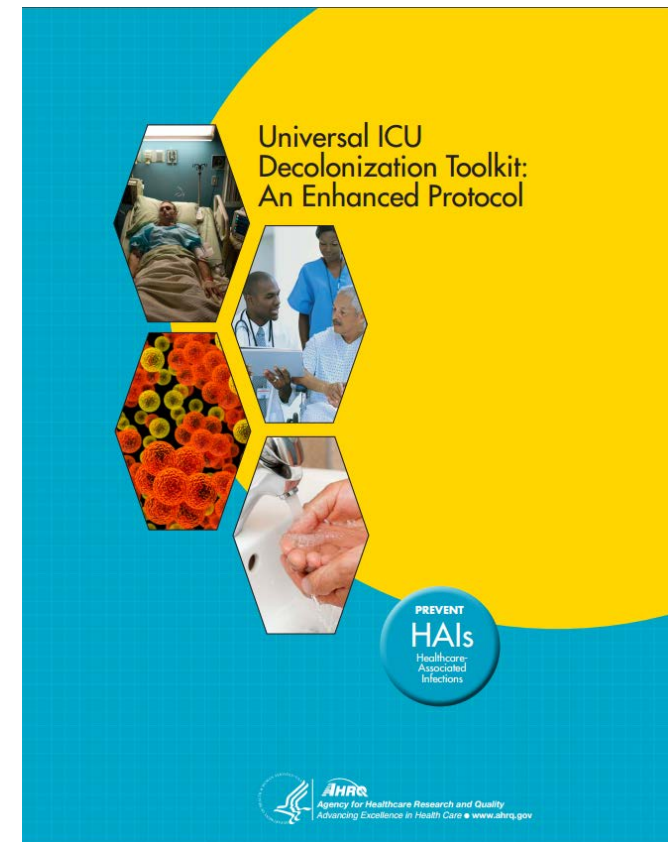
Logistics: who, with what, when,
how

adherence

Potential for development of
resistance to agents used for
decolonization

– e.g., mupirocin

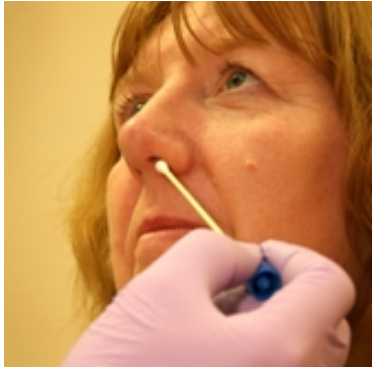
[AHRQ Universal ICU Decolonization Toolkit](#)



(Calfee DP, *Infect Control Hosp Epidemiol* 2014; Hayden MK, *J Clin Microbiol* 2016; AHRQ
Publication No. 13-0052-EF, 2013)

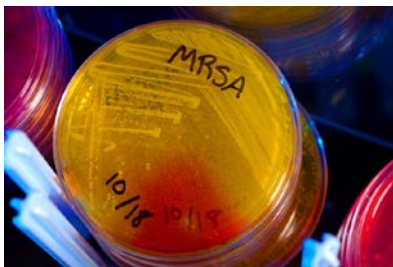


Active Surveillance Testing (AST)



AST refers to the collection of samples from patients for the purpose of detecting MRSA carriage

- Clinical cultures identify only a small proportion of patients who are colonized with MRSA
- Asymptomatic MRSA carriers may play a role in patient-to-patient transmission of MRSA



AST is a vertical (MRSA specific) infection control strategy

(Calfee DP, Infect Control Hosp Epidemiol, 2014; Image Sources:

http://www.dbh.nhs.uk/Library/Press_Releases/Swabbing%20Mar09.JPG, Gathany J, CDC 2014)



AST for MRSA Should be Part of a Larger MRSA Prevention Program

AST by itself will not reduce MRSA transmission or infection

- Basic MRSA prevention strategies should be optimized
- AST results should lead to an intervention (e.g., isolation or decolonization)

The role of AST in MRSA prevention remains controversial

- When considering AST, potential advantages and disadvantages of AST should be compared to those of other Tier 2 interventions



Active Surveillance Testing: Issues to Consider

- Logistics: who, with what, when, how
- Adherence
- Potential unintended consequences associated with contact precautions



Which Enhanced Strategy to Choose?

The NEW ENGLAND JOURNAL *of* MEDICINE

ESTABLISHED IN 1812

JUNE 13, 2013

VOL. 368 NO. 24

Targeted versus Universal Decolonization to Prevent ICU Infection

Susan S. Huang, M.D., M.P.H., Edward Septimus, M.D., Ken Kleinman, Sc.D., Julia Moody, M.S., Jason Hickok, M.B.A., R.N., Taliser R. Avery, M.S., Julie Lankiewicz, M.P.H., Adrijana Gombosev, B.S., Leah Terpstra, B.A., Fallon Hartford, M.S., Mary K. Hayden, M.D., John A. Jernigan, M.D., Robert A. Weinstein, M.D., Victoria J. Fraser, M.D., Katherine Haffenreffer, B.S., Eric Cui, B.S., Rebecca E. Kaganov, B.A., Karen Lolans, B.S., Jonathan B. Perlin, M.D., Ph.D., and Richard Platt, M.D., for the CDC Prevention Epicenters Program and the AHRQ DECIDE Network and Healthcare-Associated Infections Program*

In adult ICUs, universal decolonization with intranasal mupirocin and daily CHG bathing was the most effective strategy for reducing rates of MRSA clinical isolates.

(Huang SS, N Engl J Med, 2013)



AST, Targeted Decolonization or Universal Decolonization?

Outcome	AST plus Isolation	AST plus Targeted Decolonization	Universal Decolonization	p-value
MRSA Clinical Isolates	0.92	0.75	0.63	0.01
Bloodstream Infection (any pathogen)	0.99	0.78	0.56	<0.001
MRSA Bloodstream Infection	1.23	1.23	0.72	0.11



Universal Glove and Gown Use

Original Investigation

Universal Glove and Gown Use and Acquisition of Antibiotic-Resistant Bacteria in the ICU A Randomized Trial

Anthony D. Harris, MD, MPH; Lisa Pineles, MA; Beverly Belton, RN, MSN; J. Kristie Johnson, PhD; Michelle Shardell, PhD; Mark Loeb, MD, MSc; Robin Newhouse, RN, PhD; Louise Dembry, MD, MS, MBA; Barbara Braun, PhD; Eli N. Perencevich, MD, MS; Kendall K. Hall, MD, MS; Daniel J. Morgan, MD, MS; and the Benefits of Universal Glove and Gown (BUGG) Investigators

Universal gown and glove use did not result in a decrease in the acquisition of MRSA or VRE

- Fewer acquisitions for MRSA

Universal gown and glove use was associated with decreased health care personnel room entry, increased room-exit hand hygiene adherence, and no difference in adverse events



(Harris AD, JAMA, 2013)



Universal Glove and Gown Use

- If MRSA infections persist, consider implementing a strategy where all health care personnel don gowns and gloves when caring for all patients in the ICU, instead of Contact Precautions only for individuals colonized or infected with MRSA
- Are there adverse effects to patients who are placed on Contact Isolation?
- Adherence to the intervention is critical
- Hand hygiene is still essential



Take-Home Points

- Adherence to recommended infection control strategies is essential
- Horizontal infection control strategies can impact MRSA in addition to other MDROs
- Consider local factors, epidemiology and logistics when selecting Tier 2 MRSA prevention strategies



References

- 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.
- Climo MW, Yokoe DS, Warren DK, et al. Effect of daily chlorhexidine bathing on hospital-acquired infection. *N Engl J Med*. 2013; 368: 533-42.
- Climo MW, Sepkowitz KA, Zuccotti G, et al. The effect of daily bathing with chlorhexidine on the acquisition of methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant *Enterococcus*, and healthcare-associated bloodstream infections: results of a quasi-experimental multicenter trial. *Crit Care Med*. 2009; 37: 1858-1865.
- Evans HL, Dellit TH, Chan J, et al. Effect of chlorhexidine whole-body bathing on hospital acquired infections among trauma patients. *Arch Surg*. 2010; 145: 240-246.
- Gahtnay J. Public Health Library, ID #16813. Centers for Disease Control and Prevention, CDC. 2014. Available at <https://wwwn.cdc.gov/phil/>
- Harris AD, Pineles L, Belton B, et al. Universal glove and gown use and acquisition of antibiotic-resistant bacteria in the ICU: a randomized trial. *JAMA*. 2013; 310: 1571-1580.
- Hayden MK, Lolans K, Haffenreffer K, et al. Chlorhexidine and mupirocin susceptibility of methicillin-resistant *Staphylococcus aureus* isolates in the REDUCE-MRSA trial. *J Clin Microbiol*. 2016; 54: 2735-2742.
- Huang SS, Septimus E, Kleinman K, et al. Targeted versus universal decolonization to prevent ICU infection. *N Engl J Med*. 2013; 368: 2255-65.
- Karki S, Cheng AC. Impact of non-rinse skin cleansing with chlorhexidine gluconate on prevention of healthcare-associated infections and colonization with multi-resistant organisms: a systematic review. *J Hosp Infect*. 2012; 82: 71-84.
- Ridenour G, Lampen R, Federspiel J, et al. Selective use of intranasal mupirocin and chlorhexidine bathing and the incidence of methicillin-resistant *Staphylococcus aureus* colonization and infection among intensive care unit patients. *Infect Control Hosp Epidemiol*. 2007; 28: 1155-1161.
- Universal ICU Decolonization: An Enhanced Protocol. (Prepared by the REDUCE MRSA Trial Working Group, under contract HHS290201000008i. AHRQ Publication No. 13-0052-EF. Rockville, MD: Agency for Healthcare Research and Quality; September 2013. http://www.ahrq.gov/professionals/systems/hospital/universal_icu_decolonization/index.html
- Vernon MO, Hayden MK, Trick WE, et al. Chlorhexidine gluconate to cleanse patients in a medical intensive care unit: the effectiveness of source control to reduce the bioburden of vancomycin-resistant enterococci. *Arch Intern Med*. 2006; 166: 306-12.



Speaker Notes



Speaker Notes: Slide 1

Welcome to the second module of the methicillin-resistant *Staphylococcus aureus*, or MRSA prevention, Tier 2 course. This module will discuss additional MRSA prevention strategies that may be considered for use within a health care facility when the basic, or Tier 1, control measures, fail to adequately control MRSA infections or transmission within the 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 module, you will be able to:

1. Recognize the difference between horizontal and vertical infection control strategies,
2. Identify strategies that can be used in health care settings to reduce the transmission of MRSA,
3. And recognize the importance of adherence with recommended infection control interventions



Speaker Notes: Slide 4

Horizontal infection control intervention is NOT pathogen specific. Horizontal strategies can reduce the transmission of MRSA to other patients, but in addition, have the added benefit of reducing transmission of other multidrug-resistant organisms.



Speaker Notes: Slide 5

In contrast, “vertical” infection control strategies are those that only target a specific pathogen such as MRSA. Examples include active surveillance testing for MRSA in high-risk patient populations and decolonization of patients colonized with MRSA. Often studies examining this issue have combined vertical and horizontal strategies.



Speaker Notes: Slide 6

In this module, we will discuss four “Tier 2” MRSA prevention strategies, including: daily chlorhexidine bathing of ICU patients, MRSA decolonization therapy, active surveillance testing for MRSA often referred to as “AST” and universal gown and glove use in the ICU.



Speaker Notes: Slide 7

Chlorhexidine gluconate (CHG) is a horizontal infection control strategy that uses daily CHG bathing of ICU patients to reduce the spread of MRSA. CHG bathing, decreases potential pathogens on patient skin and therefore serves as a mechanism for “source control.” Daily bathing with CHG has been studied in several types of ICUs and it has been shown to reduce both infection incidence.



Speaker Notes: Slide 8

CHG contributes to source control. Why is source control important? CHG decreases the burden of patient skin contamination. This decrease helps prevent infections by potential pathogens on patient skin. In addition, the decrease patient skin contamination reduces the chance that health care personnel can contaminate their hands and reduces the opportunity for environmental contamination. These reductions help decrease the spread of potential pathogens to other patients.



Speaker Notes: Slide 9

Elements to include when implementing daily CHG bathing:

1. The facility needs to develop standardized or protocol-based order sets to optimize adherence;
2. Ensure adequate supplies for CHG bathing;
3. Ensure skin products on the unit are compatible with CHG;
4. Train health care personnel on appropriate application of CHG bathing techniques; and,
5. Provide routine audits of adherence to CHG bathing with feedback to personnel.



Speaker Notes: Slide 10

Another Tier 2 strategy is MRSA decolonization therapy. This strategy is a vertical prevention strategy that targets both MRSA and methicillin-susceptible *Staph. aureus* with the intent to eliminate carriage of MRSA. Decolonization therapy refers to the process of administering antimicrobial or antiseptic agents to people for the purpose of eradicating or suppressing carriage of MRSA. Because MRSA carriage is most common in the nares and on the skin (particularly in sites such as the axilla and groin), MRSA decolonization therapy typically includes intranasal application of an antibiotic or antiseptic, such as mupirocin or povidone-iodine, and topical application of an antiseptic, such as chlorhexidine gluconate.



Speaker Notes: Slide 10 Continued

In some cases, usually in persons who have had recurrent MRSA infections, systemic antibiotics may also be administered at the same time as the intranasal and topical antiseptics. Several studies have assessed the impact of MRSA decolonization therapy and have found that decolonization is associated with reduction in MRSA carriage, transmission and infection. Persons who are decolonized can become colonized again.



Speaker Notes: Slide 11

As part of an MRSA prevention program, a health care facility can take one of two approaches to the use of MRSA decolonization therapy. The first strategy is targeted MRSA decolonization. With targeted decolonization, MRSA decolonization therapy is administered only to persons known to be colonized with MRSA based on previous clinical cultures or the results of active surveillance testing performed to identify asymptomatic carriers of MRSA. We'll talk more about surveillance testing for MRSA in a few minutes. Universal decolonization, on the other hand, refers to administration of MRSA decolonization therapy to all potentially at-risk persons, such as persons admitted to the ICU without assessment of each person's MRSA carrier status.



Speaker Notes: Slide 11 Continued

This strategy has the potential logistic advantages of eliminating the need to perform active surveillance testing to identify carriers, which allows earlier initiation of decolonization therapy and is unaffected by the possibility of false-negative MRSA surveillance test results. On the other hand, this strategy will result in treatment of persons who are not colonized with MRSA. In a few minutes, we will look at the results of a large clinical study that compared the clinical outcomes associated with these two strategies for the use of MRSA decolonization therapy.



Speaker Notes: Slide 12

When planning a MRSA decolonization therapy program, there are several issues that must be considered. A number of these are logistical issues, including determining what patient population the program will include, whether you will use targeted or universal decolonization, what antiseptic or antimicrobial agents will be used for decolonization, and how the order for the decolonization therapy will be entered. In addition, a plan for the assessment of adherence with the decolonization therapy program should be developed.



Speaker Notes: Slide 12 Continued

Finally, the potential for development of resistance to the agents used for decolonization, such as mupirocin, must be weighed against the anticipated benefits of therapy. The Agency for Healthcare Research and Quality has published a protocol for universal MRSA decolonization that hospitals may find useful in their planning efforts. This protocol is referenced at the bottom of this slide.



Speaker Notes: Slide 13

The third enhanced MRSA prevention strategy that we will discuss today is active surveillance testing, also known as AST for MRSA.

We briefly alluded to AST during our discussion of targeted MRSA decolonization therapy. AST refers to the collection of samples from patients for the sole purpose of detecting MRSA carriage. Samples are most commonly taken from the anterior nares, although additional cutaneous and mucosal sites (such as axilla, groin, oropharynx and wounds) may be included to increase the sensitivity of AST. The detection of MRSA from these samples may be done using bacterial culture techniques or PCR-based technology.



Speaker Notes: Slide 13 Continued

This strategy is based on the fact that clinical cultures submitted for routine diagnostic testing purposes identify only a small proportion of patients who are colonized with MRSA and on the possibility that asymptomatic MRSA carriers are playing a role in patient-to-patient transmission of MRSA within a health care facility. Because MRSA AST is identifying patients colonized with a specific pathogen, it is considered a vertical infection control strategy.



Speaker Notes: Slide 14

A very important thing to understand about active surveillance testing for MRSA is that AST by itself will not reduce MRSA transmission or infection. First of all, basic MRSA prevention strategies should be optimized. This includes hand hygiene, environment and equipment cleaning and disinfection. Second, AST results should lead to an intervention that can further reduce the risk of MRSA transmission from or infection in the person identified as an asymptomatic carrier of MRSA. Such interventions include Contact Precautions with or without decolonization therapy.



Speaker Notes: Slide 14 Continued

It is worth noting that the role of AST in MRSA prevention remains controversial and that, when it is used, it should be used as a part of a larger MRSA prevention and control program. When considering an AST program, the potential advantages and disadvantages of AST should be compared to those of other Tier 2 interventions.



Speaker Notes: Slide 15

A number of these are logistical issues, including: determining the patient population (e.g. patients admitted to specific units or patients with identified risk factors for MRSA carriage), whether testing will be conducted only at the time of admission or if subsequent testing will be conducted to identify patients who acquire MRSA during their hospitalization, what testing method will be used (e.g., culture or PCR), who will obtain the specimens for testing, how the results of testing will be communicated to health care personnel and the patient, and how the appropriate intervention, such as Contact Precautions or decolonization therapy, will be implemented for patients who test positive for MRSA.



Speaker Notes: Slide 15 Continued

In addition, a plan for the assessment of adherence with the AST program should be developed. Finally, the possibility of unintended consequences associated with the use of Contact Precautions, such as decreased frequency of patient visits by health care personnel, should be acknowledged and efforts to prevent such consequences should be made.

The study we are about to describe is encouraging; however, the generalizability and sustainability of enhanced strategies such as decolonization require consideration.



Speaker Notes: Slide 16

A recent cluster-randomized multicenter study by Susan S. Huang et al compared the effects of targeted and universal MRSA decolonization to prevent infections in ICU patients. In addition to targeted and universal decolonization, they also studied AST with isolation in the absence of decolonization therapy. In this study, then, three strategies were compared: 1. AST for MRSA colonization with subsequent isolation of MRSA carriers, 2. surveillance and isolation of MRSA carriers with targeted decolonization of carriers with a 5-day regimen of intranasal mupirocin and CHG bathing, and 3. no screening for MRSA but universal decolonization with a 5-day regimen of mupirocin and daily CHG bathing for the duration of the ICU stay.



Speaker Notes: Slide 16 Continued

This study observed that the universal decolonization approach was the most effective of these three strategies for reducing rates of MRSA clinical isolates and bloodstream infections from any pathogen.



Speaker Notes: Slide 17

This table shows the results of the trial. The outcomes of interest are listed in the left-hand column and the hazard ratios comparing baseline to intervention periods associated with each strategy for each outcome are shown in the subsequent columns. As you can see, for the primary outcome (MRSA-positive clinical cultures), the hazard ratio was significantly different between the groups, with the lowest ratio, or greatest reduction, observed in the universal decolonization group. Similar results were seen for the secondary outcome of bloodstream infection due to any pathogen. For the secondary outcome of MRSA bloodstream infection, there were no significant differences among the groups.



Speaker Notes: Slide 17 Continued

It is worth noting that this study did not include an arm in which patients received daily chlorhexidine bathing alone, so it is not possible to know how the outcomes of that strategy would compare to those associated with the three strategies included in the study. Also, because the baseline practice in participating hospitals included MRSA AST plus isolation, this study does not allow us to determine the impact that any of these strategies would be expected to have when introduced into a hospital in which there were no Tier 2 strategies already in place.



Speaker Notes: Slide 18

The last strategy we'll discuss is universal gown and glove use in intensive care units. The major question is if universal gown and glove use, a horizontal infection prevention strategy, as opposed to usual care in an ICU, will reduce the acquisition of multidrug-resistant organisms like MRSA.



Speaker Notes: Slide 18 Continued

This cluster-randomized trial shown here examined universal glove and gown use in comparison to usual care in medical and surgical ICUs at several US hospitals. They observed that the intervention did not result in a decrease in the primary outcome of acquisition of MRSA or VRE, but it did lead to fewer acquisitions of MRSA alone. Secondary outcomes were that universal gown and glove use was associated with decreased room entry, increased room-exit hand hygiene adherence, and no difference in adverse events.



Speaker Notes: Slide 19

If there are ongoing issues with MRSA in an ICU despite implementation of basic, Tier 1 prevention strategies, consider implementing a strategy where all health care personnel don gowns and gloves when caring for all ICU patients and not just requiring Contact Precautions for individuals colonized or infected with MRSA. Despite the possible benefits, an unresolved issue is whether there are adverse effects to patients who are placed on Contact Isolation. Should this strategy be implemented, an important component is to ensure adherence to the intervention and that there is excellent adherence with hand hygiene.



Speaker Notes: Slide 20

There are several take-home points to keep in mind:

- First, adherence with the recommend infection control strategies is essential in order to see benefits.
- Second, horizontal infection control strategies can impact MRSA as well as other multidrug-resistant organisms.
- Lastly, it's important to consider local factors, epidemiology and logistics when making decisions regarding the selection of one or more Tier 2 MRSA interventions.



Speaker Notes: Slide 21

No notes.

