

Guide to the Elimination of Methicillin-Resistant Staphylococcus aureus (MRSA) Transmission in Hospital Settings



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Highly magnified electron micrograph depicting numbers of Staphylococcus aureus bacteria, found on the luminal surface of an indwelling catheter. (2005)

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Guide Overview

Purpose

The purpose of this document is to provide evidence-based practice guidance for the elimination of methicillin-resistant *Staphylococcus aureus* (MRSA) transmission in hospital settings.

Key Concepts

Effective efforts to eliminate MRSA transmission are guided by completion of a comprehensive, facility-specific risk assessment which describes current state and characteristics of the MRSA burden for that facility or setting. Knowledge obtained from the risk assessment drives the development of interventions that result in enhanced compliance with existing facility practices, or in implementation of appropriate additional interventions as described in this guidance document.

Background

It is estimated that more than 70% of hospital-associated infections are caused by organisms exhibiting multi-drug resistance. These infections contribute to significant patient morbidity and mortality and result in limited antimicrobial treatment options as compared to infections caused by non-resistant organisms.

Increasing Prevalence of Multi-drug Resistance:

For decades, MRSA has been the most commonly identified multidrug-resistant pathogen in Europe, Asia, Africa, the Middle East and the Americas. Increasing incidence of MRSA is a well-documented healthcare and community phenomenon of tremendous concern to medical, public health and lay communities around the world.² In the early 1990s, MRSA was reported to account for 20 – 25 % of

CDC Campaign to Prevent Antimicrobial Resistance in Healthcare Settings¹

Drug-resistant pathogens are a growing threat to all people, especially in healthcare settings:

- Each year nearly two million patients in the United States get an infection in a hospital.
- Of those patients, about 90,000 die as a result of their infection.
- More than 70% of the bacteria that cause hospital-associated infections are resistant to at least one of the drugs most commonly used to treat them.
- Persons infected with drug-resistant organisms are more likely to have longer hospital stays and require treatment with second or third-choice drugs that may be less effective, more toxic and/or more expensive.

Staphylococcus aureus isolates in hospitalized patients in the U.S. By the middle of the current decade, many hospitals experienced MRSA percentages in the range of 50-70 % of total *Staphylococcus aureus* isolates from clinical cultures.³ Similarly, National Nosocomial Infections Surveillance System (NNIS) data

analysis for 1992 to 2003 showed that the percentage of *Staphylococcus aureus* isolates that were methicillin-resistant increased from 35.9 % in 1992 to 64.4 % in 2003 in participating adult and pediatric ICUs.⁴

Changing Epidemiology of MRSA:

MRSA has a history of being frequently associated with healthcare, and conventional wisdom has categorized MRSA as a hospital problem until the late 1990s. But during that decade, data from the Canadian MRSA surveillance system showed that 5-7 % of reported MRSA infections occurred in individuals with no known healthcare-associated risk factors for acquisition.⁵ Concurrently, reports were being received by the CDC regarding MRSA infections in athletes,⁶ children,⁷ prisoners,⁸ military personnel⁹ and full-term newborn infants^{10, 11} that were both phenotypically and genotypically characterized as community-associated strains. Research from the veterinary community on MRSA infection and colonization of animals and pets has identified yet another reservoir of MRSA that is transmissible to humans.^{12, 13} Amplification of epidemiologic reservoirs of MRSA provides another incentive for aggressive action to eliminate transmission of MRSA in healthcare settings.

Cost Impact of Hospital MRSA Infections:

In a systematic audit of published hospital-associated infections reports, and interventions conducted by infection control professionals from 1990-2000, the mean cost attributable to an MRSA infection was \$35,367.¹⁴ A recent extensive literature search presented at the spring 2006 meeting of the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) estimated the annual cost to treat MRSA in hospitalized patients in the U.S. to be between \$3.2 billion to \$4.2 billion. These costs were associated with prolonged hospital stays (up to 10 days longer than patients who had methicillin-sensitive *Staphylococcus aureus* infections) and to the cost of critical care stays associated with these complications.¹⁵

Human Impact of Hospital MRSA Infections:

The human impact of hospital-associated MRSA infections makes efforts to eliminate MRSA transmission in healthcare settings compelling and necessary. Patient safety initiatives for hospital settings, whether facility derived or imported from national venues (Joint Commission National Patient Safety Goals, IHI's 5 Million Lives Campaign, etc.), are unanimous in the drive to prevent hospital-associated infections. In response to the huge human impact of hospital infections, actions are being taken in non-clinical arenas as well. There are many consumer groups that have instituted programs to educate patients and their families about the risks of hospital infections and about the risk-reduction steps that they should expect and demand from their healthcare providers (AARP, StopHospitalInfection.org, etc.). Legislation related to hospital infections has been introduced or is being developed, and in some states bills filed are specific to MRSA (visit the APIC legislative map at www.apic.org). Payers are looking at non-reimbursement strategies in relation to hospital infections. For example, in October 2008, reduction in Medicare DRG acuity payments for at least two conditions related to hospital-associated infections occurring during a hospital stay will be implemented.

Introduction to this Guide

The main components of the *APIC Guide on the Elimination of MRSA Transmission in Hospital Settings* are:

- MRSA risk assessment
- MRSA surveillance programs
- Compliance with basic infection prevention and control strategies: hand hygiene
- Compliance with basic infection prevention and control strategies: contact precautions
- Compliance with basic infection prevention and control strategies: thorough environmental and equipment cleaning and decontamination
- Enhanced infection prevention and control strategies (e.g., active surveillance cultures, etc.) when MRSA transmission rates are not decreasing
- Making the business case for eliminating MRSA transmission
- Cultural transformation and change management

The ancillary topics of antimicrobial stewardship and MRSA decolonization are also aligned with these components.

Support from hospital leadership is essential. Therefore, this guide also includes an overview of “making the business case” for developing and implementing a program to eliminate MRSA transmission in a hospital, and on addressing the cultural transformation that will support an elimination program. Without strong leadership support, reaching the goal of eliminating the transmission of MRSA will be difficult, if not impossible, to achieve. Leadership must support and facilitate the build up of personnel and supply resources (including infection prevention and control staff, laboratory, information systems, nursing, decision support, public relations, etc.), development of teams and communication pathways, physician and staff buy-in, board of directors’ involvement and community outreach.

Valuable resources have been accessed to assist in the development of this guide. Many of the components outlined in this document are also found in the following guidelines and can be readily accessed as needed in facility-specific program development.

[The Healthcare Infection Control Practices Advisory Committee \(HICPAC\) guideline “Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006,”](#) has outlined a comprehensive, two-tiered approach with a built-in flexibility designed to accommodate the variety of settings and situations in which healthcare professionals coordinate infection prevention and control programs. It outlines an approach to determine when an “active surveillance protocol” may be applied.

In 2003, the Society for Healthcare Epidemiology of America (SHEA) introduced the [“SHEA Guideline for Preventing Nosocomial Transmission of Multidrug-Resistant Strains of *Staphylococcus aureus* and *Enterococcus*.”](#) One component of this 2003 guideline was the recommendation for active surveillance cultures, in addition to contact isolation, in order to reduce the transmission of MRSA and VRE. While not all experts in the healthcare

community were in agreement regarding the role of universal active surveillance, this recommendation has been instrumental in generating research in this controversial area and has been used by some hospitals in successful MRSA elimination programs.

The Institute for Healthcare Improvement's (IHI) [“5 Million Lives” Campaign includes a “Getting Started Kit: Reduce Methicillin-Resistant *Staphylococcus aureus* \(MRSA\) Infection How-to Guide.”](#) The five components of care in this guide are hand hygiene, decontamination of the environment and equipment, active surveillance, contact precautions and device bundles. This 2006 guide recommends the Plan-Do-Study-Act strategy of action for key interventions and gives useful examples of changes that can be made to result in improvements.

Although components of this guide provide the “how-to” when applying “active surveillance” protocols, it is crucial to acknowledge there are multiple ways to eliminate MRSA and other sensitive and resistant organisms. The two-tiered CDC MDRO guidelines should be reviewed for their systematic approach to determining when to apply an “active surveillance” protocol as noted earlier for MRSA or other targeted resistant organisms. The Michigan Hospital Association's Keystone Center program is a statewide initiative that has focused on elimination of infections, citing “no infection, no resistance.” The success of this approach, using “bundling” of evidence-based practices to reach zero infections, has been recently published by Pronovost in the New England Journal of Medicine.¹⁶ The Veterans Administration, the Southwestern Pennsylvania Professionals in Infection and Control and Evanston Northwestern Medical Center in Illinois have each published success stories related to MRSA interventions (see the APIC webinar series on MRSA, “Designing a Program to Eliminate MRSA Transmission Part I: Making the Clinical Case.” Dr. Muto - December 6, 2006).

Cited References [\[Click on references in blue to access hyperlinks to articles\]](#)

1. Centers for Disease Control and Prevention. Campaign to Prevent Antimicrobial Resistance in Healthcare Settings. Available at <http://www.cdc.gov/drugresistance/healthcare/problem.htm>.
2. Grundmann H, Aires-de-Sousa M, Boyce J, Tiemersma E. Emergence and resurgence of methicillin-resistant *Staphylococcus aureus* as a public-health threat. *Lancet*. 2006;368:874-885.
3. Siegel JD, Rhineheart E, Jackson M, Linda C; Healthcare Infection Control Practices Advisory Committee. “Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006.” Available at <http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf>.
4. Klevens RM, Edwards JR, Tenover FC, McDonald LC, Horan T, Gaynes R; National Nosocomial Infections Surveillance System. Changes in the epidemiology of methicillin-resistant *Staphylococcus aureus* in intensive care units in US hospitals, 1992–2003. *Clin Infect Dis*. 2006; 42:389-391.
5. Canadian Committee on Antibiotic Resistance. *Canadian Communicable Disease Report Antibiotic Resistance Issue*, September 2003. Available at <http://www.ccar-ccra.com/english/pdfs/cdr2918.pdf>.
6. Kazakova SV, Hageman JC, Matava M, et al. A clone of methicillin-resistant *Staphylococcus aureus* among professional football players. *N Engl J Med*. 2005;352(5):468-475.

7. Centers for Disease Control and Prevention. Four pediatric deaths from community-acquired methicillin-resistant *Staphylococcus aureus*—Minnesota and North Dakota, 1997–1999. *MMWR*. 1994;48(32):707–710.
8. Centers for Disease Control and Prevention. Methicillin-resistant *Staphylococcus aureus* skin or soft-tissue infections in a state prison—Mississippi, 2000. *MMWR*. 2001;50:919–922.
9. Kallen AJ, Driscoll TJ, Thornton S, Olson PE, Wallace MR. Increase in community-acquired methicillin-resistant *Staphylococcus aureus* at a Naval Medical Center. *Infect Control Hosp Epidemiol*. 2000;21:223–226.
10. Herold BC, Immergluck LC, Maranan MC, et al. Community-acquired methicillin-resistant *Staphylococcus aureus* in children with no identified predisposing risk. *J Am Med Assoc*. 1998;279:593–598.
11. Eckhardt C, Halvosa JS, Ray SM, Blumberg HM. Transmission of methicillin-resistant *Staphylococcus aureus* in the neonatal intensive care unit from a patient with community-acquired disease. *Infect Control Hosp Epidemiol*. 2003;24:460–461.
12. Weese JS, Dick H, Willey BM, et al. Suspected transmission of methicillin-resistant *Staphylococcus aureus* between domestic pets and humans in veterinary clinics and in the household. *Vet Microbiol*. 2006;115:148–155.
13. Hanselman BA, Kruth SA, Rousseau J, et al. Methicillin-resistant *Staphylococcus aureus* colonization in veterinary personnel. *Emerg Infect Dis* [serial on the Internet]. 2006;12:1933–1938. Available at <http://www.cdc.gov/ncidod/EID/vol12no12/06-0231.htm>.
14. Stone PW, Larson E, Kavar LN. A systematic audit of economic evidence linking nosocomial infections and infection control interventions: 1990–2000. *Am J Infect Control*. 2002;30:145–152.
15. Pfizer Inc. New research estimates MRSA infections cost U.S. hospitals \$3.2 billion to \$4.2 billion annually. *Infection Control Today*. 2005. Available at <http://www.infectioncontrolday.com/hotnews/55h168584264313.html>.
16. Pronovost P, Needham D, Berenholtz S, et al. An intervention to decrease catheter-related bloodstream infections in the ICU. *N Engl J Med*. 2006;355:2725–2732.

Additional References

- Cosgrove SE, Qi Y, Kaye KS, Harbarth S, Karchmer AW, Carmeli Y. The impact of methicillin resistance in *Staphylococcus aureus* bacteremia on patient outcomes: mortality, length of stay, and hospital charges. *Infect Control Hosp Epidemiol*. 2005;26:166–174.
- Noskin GA, Rubin RJ, Schentag JJ, et al. The burden of *Staphylococcus aureus* infections on hospitals in the United States: an analysis of the 2000 and 2001 Nationwide Inpatient Database. *Arch Intern Med*. 2005;165:1756–1761.
- Coia JE, Duckworth GJ, Edwards DI, et al; Joint Working Party of the British Society of Antimicrobial Chemotherapy; Hospital Infection Society; Infection Control Nurses Association. Guidelines for the control and prevention of methicillin-resistant *Staphylococcus aureus* (MRSA) in healthcare facilities. *J Hosp Infect*. 2006;63 Suppl:S1–S44.
- Kuehnert MJ, Hill HA, Kupronis BA, et al. Methicillin-resistant *Staphylococcus aureus*-related hospitalizations, United States. *Emerg Infect Dis*. 2005;11:868–872.
- Rubin RJ, Harrington CA, Poon A, Dietrich K, Greene JA, Moiduddin A. The economic impact of *Staphylococcus aureus* infection in New York City hospitals. *Emerg Infect Dis*. 1999;5:9–17.

MRSA Risk Assessment

Purpose

Performance of a hospital-specific MRSA risk assessment will result in the baseline description of hospital MRSA incidence, prevalence and transmission, and will identify patient populations that are more likely to be colonized and/or infected with MRSA. The purpose of the MRSA assessment is to guide development of a surveillance, prevention and control program plan that is based on facility data and conditions. The plan will include consideration of local resources such as laboratory capabilities, administrative support, infection prevention and control department staffing, public health support, other support elements or roadblocks, current infection prevention and control interventions (e.g., hand hygiene, contact precautions, etc.) and the measurement parameters for the current interventions.

Additional interventions may be developed if the risk assessment data show that MRSA transmission rates are not decreasing in spite of good compliance with current interventions. Therefore, an important aspect of the plan is identification of endpoints or goals. A clear picture of what will be accomplished through implementation of the plan must be expressed and quantified as appropriate.

Examples of possible outcome measures include “decrease hospital-associated MRSA, central line-related bloodstream infections by X% in the next six months,” and “decrease MRSA transmission by X% in the next three quarters.”

Examples of possible process measures include annual increase in compliance with hand hygiene requirements to the 90% level as measured by gel and soap use through the “Partners in Your Care Program” or “increase compliance with Contact Precautions to the 95% level as measured by the quarterly isolation compliance monitor.”

Each of these specifies an element to be measured, how it will be measured and what success will look like.

Key Concepts

Past and current hospital surveillance data is at the core of the MRSA assessment. Relevant MRSA surveillance data available from local public health departments and published MRSA data from facilities of similar demographic and geographic characteristics may also be helpful in a hospital MRSA assessment. Evaluation of MRSA assessment data identifies patient care units, service lines or groups of individuals likely to be colonized or infected. This information is used to drive the hospital’s surveillance, prevention and control program for the elimination of MRSA transmission.

The CDC guideline “Management of Multi-drug Resistant Organisms (MDRO) in Healthcare Settings, 2006” recommends monitoring trends in the incidence of a target MDRO.

In addition, the CDC MDRO guideline recommends intensified interventions to prevent MDRO

V.A.4.e. Monitor trends in the incidence* of target MDROs in the facility over time using appropriate statistical methods to determine whether MDRO rates are decreasing and whether additional interventions are needed.

Category 1A

**number of new MDROs divided by the size of the population under consideration.*

transmission when incidence or prevalence of MDROs are not decreasing despite implementation of and correct adherence to the routine control measures (recommendation V.B.).¹ The MRSA assessment provides the information needed to identify whether MRSA is increasing, decreasing or staying the same in patient populations, patient care units or service lines being surveyed.² The goal of eliminating MRSA transmission in hospital settings requires ongoing monitoring and enhanced interventions when appropriate.

MRSA Risk Factors

General risk factors for MRSA acquisition, from hospital and from community settings, are well documented (see reference list at end of this section). Known risk factors include:

- Hospital admission in the previous year with at least one underlying chronic illness
- Admission to a nursing home in the previous year
- Previous receipt of antibiotics during an admission
- Diagnosis of skin or soft-tissue infection at admission
- HIV infection
- Injection drug use
- Previous MRSA infection or colonization
- Hemodialysis

This list is not inclusive. Hospital and facility MRSA assessments may identify risk factors specific to their geographic and demographic locations.

MRSA Risk Assessment Basics

An assessment of MRSA relies on the availability of culture results or a flagging system to identify patients with a laboratory confirmed history of MRSA. Clinical cultures from patients identified with MRSA will be a core component of surveillance in all hospitals. Hospitals that also utilize an active surveillance culture (ASC) program will be able to identify patients colonized with MRSA who have no available clinical culture results.

It is necessary for the MRSA risk assessment to be able to track MRSA-positive patients by location, patient population and/or clinical service. Processes used to capture the data must be consistent so that statistical evaluation is relevant and comparative over time. Hospitals will use prevalence surveillance of colonization and infection in high risk units or from high risk populations as part of baseline and follow-up MRSA risk assessments. (Prevalence can be defined as the number of patients colonized and infected with MRSA divided by the number of patients in the study population at a particular point in time.)

The MRSA risk assessment must include clear definitions for all measurements. MRSA acquisition is typically considered to be associated with the hospitalization if it is detected greater than 48 hours after admission or if it is linked to a previous admission within a given timeframe after discharge (e.g., one month). These criteria have inherent difficulties related to interpretation and, therefore, may be rationally adjusted based on hospital specific factors. Definitions from the CDC National Healthcare Safety Network (NHSN) may be available in the near future.

Using the hospital-specific MRSA assessment, the infection prevention and control staff will:

- Establish baseline incidence and/or prevalence MRSA rates for each surveyed patient care unit, patient population or service line
- Identify high risk populations, units or service lines based on incidence rates
- Evaluate MRSA transmission data over time in identified populations or units to characterize unit specific MRSA prevalence or transmission rates
- Identify clusters in MRSA transmission in patient populations and/or units over a specific time period for analysis to determine if enhanced interventions may be appropriate
- Compare MRSA transmission data over time to determine if there are trends within patient populations and/or units
- Focus data-driven interventions on specific patient care units or in specific patient populations
- Convene planning and improvement teams with enough key players to maximize support and participation (e.g. laboratory, nursing leadership, infectious disease professionals, physician champions, etc.)
- Finalize a plan in terms of time and interventions, allowing enough time to communicate the plan to staff for maximum participation.

Example 1: Utilizing MRSA surveillance data for the MRSA assessment

During a period of rising MRSA rates, the infection prevention and control department implements a program of surveillance for new cases of MRSA on each inpatient unit. Transmission of MRSA in the hospital setting is assumed if the new case of MRSA meets the hospital's case definition of hospital-associated MRSA.

A definition is developed to identify an MRSA case as “new”: MRSA isolated from clinical or surveillance culture obtained greater than 48 hours after admission to the unit in a patient that had no prior MRSA by culture or by history.

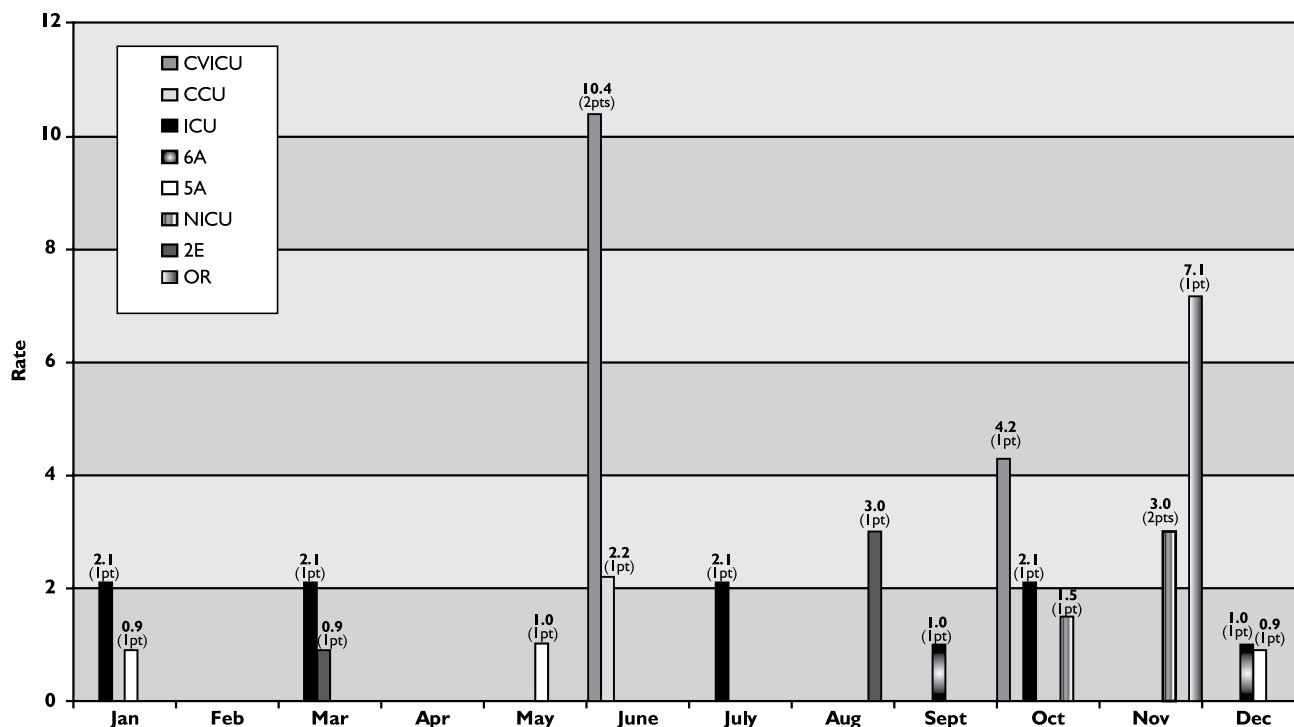
Data is analyzed in order to evaluate MRSA transmission by unit using the formula above. Statistical process control evaluation of the data can be used to identify trends and out-of-control situations that may require intervention. Data is obtained for all months during 2006 on all units. (See Figure 1.)

This type of analysis can be done to determine patient care units or patient populations at high risk.

$\frac{\text{\# of new MRSA patients on the unit/month}}{\text{\# of patient days on the unit/month}} \times 1,000 = \text{hospital-associated MRSA rate per 1,000 unit patient days}$
--

Surveillance is continued during the intervention and post intervention periods. An excellent process for follow-up is available in the IHI “5 Million Lives” campaign which includes a [“Getting Started Kit: Reduce Methicillin-Resistant *Staphylococcus aureus* \(MRSA\) Infection How-to Guide.”](#)³

Figure 1.1 Hospital-Acquired MRSA by Unit, January-October, 2006 Per 1,000 Patient Days

**Example 2: MRSA assessment and intervention (hypothetical scenario)**

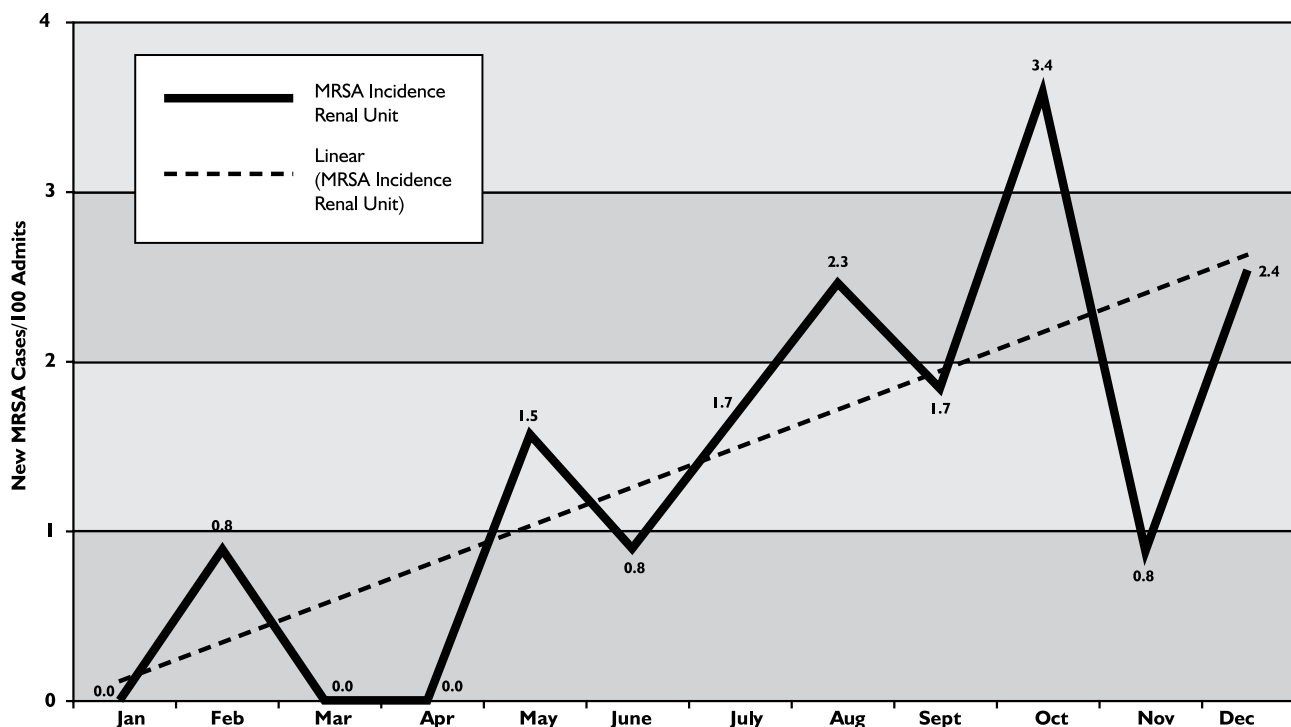
In this next example, a MRSA assessment reveals that the incidence of MRSA bacteremia in the inpatient renal unit is trending upward over time. Data is analyzed using a slightly different formula.

An analysis of data by the infection prevention and control staff confirms that most of the MRSA cases are related to new admissions (culture positive within 48 hours of admission with no prior hospitalization in the unit within 30 days). (See Figure 2.) Therefore, the increasing rate is not related to transmission on the unit. The number of MRSA-positive patients admitted to this unit may lead to a future MRSA problem if compliance with hand hygiene, contact precautions, environmental and equipment decontamination is inadequate.

$$\frac{\text{\# of new MRSA bacteremia/month on the unit}}{\text{\# of patient days on that unit/month}} \times 1,000 = \text{MRSA rate per 1,000 unit patient days}$$

Known risk factors in this population include central lines and peritoneal dialysis, frequent healthcare access, long-term care residence, diabetes and immunocompromised states. The analysis of data shows a significant trend in admitted dialysis patients on peritoneal dialysis, a known risk factor for dialysis-related infection, and an increase in patients admitted from long-term care facilities. Based on their analysis, the infection prevention and control team takes the following steps:

Figure I.2 MRSA Bacteremia - Renal Unit



- The infection prevention and control team communicates their original surveillance findings to the appropriate clinical services. In collaboration with nursing, laboratory and nephrology, the team institutes an active surveillance culture program (ASC) on this unit in order to collect additional data on the magnitude of the MRSA burden for this unit.
- The renal unit staff develops an educational program regarding the importance of equipment cleaning. They implement computer screen saver reminders, as well as enhanced audits for hand hygiene and contact precautions compliance.
- MRSA surveillance data and the results from the audits of hand hygiene and contact precautions compliance are communicated to the unit over the next six months. Based on the analysis of the enhanced MRSA interventions, the renal unit develops an intervention bundle that is hardwired into the contact precautions process for that unit. The success of the bundle leads to its adoption on other patient care units.
- A reduction in MRSA rates to less than 1.0 for three consecutive quarters is achieved. The ASC program is discontinued until and if the rates of MRSA bacteremia trend above the new baseline.
- MRSA incidence in the peritoneal dialysis patients population who receive dialysis in two of the three local outpatient dialysis centers is shown to be three times higher than the incidence in the long-term care facility population. Results are presented to nephrology groups (both hospital and outpatient based). The information is used to develop an educational program to facilitate patient acceptance of conversion from peritoneal dialysis to AV shunt access. Infection prevention and control staff provide assistance to the nephrology groups regarding implementation of hand hygiene

compliance monitors at the outpatient dialysis centers.

Cited References [\[Click on references in blue to access hyperlinks to articles\]](#)

1. Siegel JD, Rhineheart E, Jackson M, Linda C; Healthcare Infection Control Practices Advisory Committee. Management of multidrug-resistant organisms in healthcare settings, 2006. Available at <http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf>. Accessed February 27, 2007.
2. Wenzel RP, Reagan DR, Bertino JS, Baron EJ, Arias K. Methicillin-resistant *Staphylococcus aureus* outbreak: A consensus panel's definition and management guidelines. *Am J Infect Control*. 1998;26:102-110.
3. Institute for Healthcare Improvement (IHI) "5 Million Lives" campaign. "Getting Started Kit: "Reduce Methicillin-Resistant *Staphylococcus aureus* (MRSA) Infection How-to Guide" 2006. Available at <http://www.ihl.org/ihl> . Accessed February 27, 2007.

MRSA Risk Factors References [\[Click on references in blue to access hyperlinks to articles\]](#)

- Furuno JP, Harris AD, Wright MO, et al. Prediction rules to identify patients with methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococci upon hospital admission. *Am J Infect Control*. 2004;32:436-440.
- Jernigan JA, Pullen AL, Partin C, Jarvis WR. Prevalence of and risk factors for colonization with methicillin-resistant *Staphylococcus aureus* in an outpatient clinic population. *Infect Control Hosp Epidemiol*. 2003;24:445-450.
- Hidron AI, Kourbatova EV, Halvosa JS, et al. Risk factors for colonization with methicillin-resistant *Staphylococcus aureus* (MRSA) in patients admitted to an urban hospital: emergence of community-associated MRSA nasal carriage. *Clin Infect Dis*. 2005;41:159-166.
- Huang SS, Platt R. Risk of methicillin-resistant *Staphylococcus aureus* infection after previous infection or colonization. *Clin Infect Dis*. 2003;36:281-285.

MRSA Surveillance Methodology

Key Concepts

Data from a hospital's MRSA surveillance is the basis for the MRSA risk assessment. The risk assessment based on that current data determines the goals, actions/interventions, evaluations, etcetera of the surveillance program.

The surveillance program for MRSA provides the definitions, measurements and data analysis needed to evaluate the success of general infection prevention and control programs and of appropriate intensified interventions taken to eliminate the transmission of MRSA in the hospital setting.

HICPAC MDRO Guidelines¹

First Tier: General Recommendations for All Acute Care Settings

↓ *If endemic rates not decreasing* ↓

Second Tier: Intensified Interventions

MRSA Surveillance Basics

Surveillance is a dynamic, ongoing, essential element of any infection prevention and control program. Chapter 3 of the *2005 APIC Text of Infection Control and Epidemiology* outlines and explains the elements of a surveillance program. The elements are as follows:²

Chapter 3: Surveillance

- Select the Surveillance Methodology
- Assess and Define the Population(s) to be Studied
- Choose the Indicators (Events) to Monitor
- Determine Time Period for Observation
- Identify Surveillance Criteria
- Identify Data Elements to be Collected
- Determine Methods for Data Analysis
- Determine Methods for Data Collection and Management
- Identify Recipients of the Surveillance Report
- Develop a Written Surveillance Plan

APIC Text of Infection Control and Epidemiology, 2nd Edition; January 2005.

MRSA surveillance methodology is targeted (focused) surveillance. The population studied is identified and modified as directed by the MRSA risk assessment. The indicator to monitor is MRSA infection and colonization in the identified populations. The time period must be sufficient to accrue adequate number of cases for a valid analysis.

Surveillance criteria are the definitions of the numerator and denominator for the rate calculations. They must be clear and consistent throughout the surveillance period. If definitions do change, surveillance may be affected and rates may not be directly comparable to the historical data. Examples of changes that could affect surveillance include, institution of a new active surveillance culture program, introduction of a new patient population or service line, closure or merging of a patient unit, and/or change in the sensitivity or specificity of MRSA testing methods. Evaluation of MRSA surveillance must take into account any changes that have occurred.

Data elements collected include information that is useful in characterizing MRSA cases. This includes patient age and sex, admission date, patient location(s) during admission, prior MRSA history, dates of prior hospitalization, culture date(s), culture source(s), antibiotic susceptibility patterns and presence of known MRSA risk factors as published in the literature (see “Risk Assessment” section).

Additional information that may be collected for MRSA surveillance includes procedures or surgeries performed, use of invasive devices, underlying conditions and diseases, colonization status (if known), and clinical signs and symptoms of infection. Information related to known or suspected MRSA risk factors for a certain geographic region or demographic population (e.g., inmates of [correctional facilities](#),³ [veterinary clinic personnel](#),⁴ [hemodialysis patients](#),⁵ etc.) should also be collected.⁶

Methods of data collection may be real-time (data mining) or retrospective, but should always be a function of identification of MRSA from clinical culture and of MRSA from surveillance culture or PCR testing (i.e., routine surveillance or enhanced surveillance, if performed).

Surveillance Data Management

Methods of data management, analysis and report evaluation include the following essentials:

1. Define the data required for prevalence, incidence and transmission calculations.

Prevalence: number of patients infected/colonized with MRSA divided by the number of patients in the study population at a particular point in time

Incidence: number of new MRSA cases divided by the number of people being studied

MRSA transmission rate on a clinical unit: number of new MRSA positive patients divided by the number of patient days times 1,000 (MRSA cases / 1,000 patient days)

Examples of Numerator Data: number of new MRSA cases; number of MRSA-positive patients at a given point in time (e.g., on admission, on Mondays, on transfer out of a unit, etc); number of MRSA-positive infections (clinical culture); number of MRSA colonizations

(surveillance culture).

Examples of Denominator Data: number of patient days per week or month; number of MRSA cultures performed; number of admissions to a unit; number of patients admitted to unit from a high risk population.

The numerator must relate to the denominator so that the calculated rate relates to and describes the surveillance measure.

2. Set up a consistent and comprehensive system for retrieval of laboratory culture reports.

In some hospitals, a technologically advanced system such as data mining may be available. However, a very good surveillance system can be implemented with limited technological sophistication. Hard copy or computer-generated reports of microbiology culture or PCR results are sufficient for surveillance as long as the following is achievable:

- Microbiology reports that include all MRSA-positive cultures finalized per day
- MRSA-positive culture results which contain patient medical record number, date of specimen collection, source of specimen and date of patient admission
- MRSA culture reports in a format that facilitates development of retrievable database (computer-based data management system, line listing, data mining program, etc.)
- Duplicate isolates easily identified for exclusion from rate calculations
- Susceptibility results included or retrievable

3. Form a collaborative arrangement with the microbiology laboratory regarding the specifics of MRSA testing, MRSA isolate storage and MRSA reporting.

MRSA Testing:

Culture - Blood agar isolation with subsequent testing for oxacillin resistance is used by many hospital laboratories to detect MRSA. However, results by this method have a turnaround time of two to five days. Selective media for MRSA are now available and the microbiology laboratory can provide positive results in approximately 24 hours with a relatively small cost increase.

PCR tests - FDA-approved polymerase chain reaction (PCR) MRSA tests are now available for direct detection from a nasal specimen. PCR test results have very short turnaround times when compared to culture, but are more expensive and require additional instrumentation. Laboratories that do offer PCR for MRSA detection usually perform batch testing for most efficient use of resources. Even with batch testing, offering MRSA PCR test turnaround times in the range of two to twenty-four hours has great potential in efforts to eliminate MRSA transmission.^{7, 8}

Antibiotic Susceptibility of MRSA Isolates:

Susceptibility testing that is performed on MRSA isolates should include the d-test for inducible clindamycin resistance. The hospital microbiology laboratory should follow the Clinical and Laboratory Standards Institute (formerly NCCLS) guidelines for susceptibility

testing.

MRSA Isolate Storage:

Infection prevention and control staff should work with the laboratory to develop policies on isolate storage that are appropriate to the facility. If possible, it would be useful if the laboratory could keep isolates for at least six months so that isolates implicated in outbreaks may be retrieved from storage as needed for pulse-field gel electrophoresis (PFGE) or other advanced clonal testing useful in epidemiologic studies.

MRSA Reports:

Epidemiology should collaborate with the laboratory regarding the notification processes for MRSA. Laboratory reports of MRSA must clearly identify the isolate as MRSA and include a susceptibility report as appropriate. Examples of notification and communication processes that have been developed by some hospitals include the use of a comment on the MRSA-positive culture report regarding contact precautions for hospitalized patients who are positive for MRSA, and some hospital laboratories will call a positive MRSA result to the clinical unit when MRSA is present.

- 4. Communicate culture results to healthcare providers. Communicate MRSA surveillance results to health care providers. Communicate success stories to healthcare providers. As always, communication is a key component of any successful strategy.**

Don't Let MRSA Hide:

“Flagging” of MRSA-positive patients is an important component of MRSA surveillance programs. An immediate alert of MRSA history is essential at time of admission to the hospital and at the time of discharge of the patient to another service or another healthcare facility. Some electronic medical record programs can be set up so that an MRSA notice or flag is automatically displayed during the admission process. If electronic flagging is not possible, alternative systems must be arranged so that notification of the receiving unit or facility is made consistently and in a timely manner.

Tell the Story, Reward, and Recognize:

MRSA surveillance reports are valuable tools in efforts to eliminate MRSA transmission in hospital settings. Share reports and results with patient care units, patient care-related departments, administration, hospital board and medical staff. Communicate in a variety of ways to maximize visibility and highlight results. For example, reports may be discussed at staff meetings, posted on quality improvement bulletin boards, published in infection prevention and control newsletters, developed into grand rounds or CME presentations, and shared at physician meetings. Opportunities to reward and recognize successful units, staff and physicians will result from good compliance with MRSA transmission elimination measures. Certificates, pizza parties, award banners, presentations at meetings, publication of success stories at professional meetings and thank you notes are some of the ways to celebrate good efforts and results. Have fun with the successes...it is well deserved!

Example: MRSA Surveillance Performance

MRSA surveillance is performed in the surgical intensive care unit from July 2005 through

July 2006. A new MRSA case is counted when the case criteria is met (new MRSA-positive culture from patient in the unit for >48 hours with no prior MRSA history). Monthly MRSA

$$\text{Surgical ICU MRSA rate} = \frac{\text{number of new cases}}{\text{Surgical ICU patient days}} \times 1,000$$

transmission rates are calculated using the number of patient days in the surgical intensive care unit as the denominator and the number of new MRSA cases in the unit as the numerator.

An increasing trend in MRSA transmission is detected during the latter half of 2006. The 2006 CDC MDRO guideline recommends enhanced surveillance when MDRO rates are not decreasing so the infection prevention and control team decides to implement an active surveillance program to obtain information needed for intervention and follow-up.

In December 2006, the surgical intensive care unit implements an active MRSA surveillance trial.

$$\text{Surgical ICU MRSA incidence} = \frac{\text{number of new MRSA cases}}{\text{number of patients cultured}} \times 100 \text{ patients}$$

Patient nasal specimens are obtained within 24 hours of admission to the unit and all patients are cultured again on Tuesday of each week and at time of discharge from the unit. MRSA incidence rate calculation is added to the MRSA surveillance program.

MRSA transmission rate for the unit continues to be calculated for the unit as the number of MRSA cases per 1,000 patient days to compare with the data from 2005.

Based on evidence of ongoing transmission in this unit, an interdisciplinary team (nursing, infection prevention and control, respiratory therapy and environmental services) implements interventions (with monitors) for hand hygiene, environmental decontamination and compliance with contact precautions.

Concurrently, data is collected on the patient procedures, patient demographics, and underlying

$$\text{MRSA prevalence} = \frac{\text{number of positive MRSA surveillance cultures on admission}}{\text{number of admits to the unit}} \times 100$$

conditions to pinpoint high risk groups.

High risk groups identified included long-term care facility residents, patients with recent hospitalizations, and patients with skin and soft tissue infection present on admission.

MRSA prevalence is further broken down for the identified high risk groups. Based on the significant prevalence of MRSA in each of these groups, the decision is made to continue active surveillance cultures on admission to this unit.

The data also suggests a high MRSA prevalence in patients admitted to this unit from the general surgery unit. It is decided to implement active surveillance cultures on that unit as a trial and to take appropriate measures based on the results.

Cited References *[Click on references in blue to access hyperlinks to articles]*

1. Siegel JD, Rhineheart E, Jackson M, Linda C; Healthcare Infection Control Practices Advisory Committee. "Management of multidrug-resistant organisms in healthcare settings, 2006." Available at <http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf>. Accessed February 27, 2007.
2. Association for Professionals in Infection Control and Epidemiology (APIC). *Text of Infection Control and Epidemiology*. 2nd Edition. Washington, DC: Association for Professionals in Infection Control and Epidemiology, Inc; 2005.
3. Public health dispatch: Outbreaks of community-associated methicillin-resistant *Staphylococcus aureus* skin infections—Los Angeles County, California, 2002–2003. *MMWR*. 2003;52:88. Available at <http://www.cdc.gov/mmwr/PDF/wk/mm5205.pdf>. Accessed February 27, 2007.
4. Hanselman BA, Kruth SA, Rousseau J, et al. Methicillin-resistant *Staphylococcus aureus* colonization in veterinary personnel. *Emerg Infect Dis*. 2006;12:1933–1938. Available at <http://www.cdc.gov/ncidod/EID/vol12no12/06-0231.htm>. Accessed February 27, 2007.
5. Tokars JJ, Miller ER, Stein G. New national surveillance system for hemodialysis-associated infections: initial results. *Am J Infect Control*. 2002;30:288–295.
6. Klevens RM, Morrison MA, Fridkin SK, et al. Community-associated methicillin-resistant *Staphylococcus aureus* and healthcare risk factors. *Emerg Infect Dis*. 2006; 12:1933–1938. Available at <http://www.cdc.gov/ncidod/EID/vol12no12/06-0505.htm>.
7. Warren DK, Liao RS, Merz LR, Eveland M, Dunne WM Jr. Detection of methicillin-resistant *Staphylococcus aureus* directly from nasal swab specimens by a real-time PCR assay. *J Clin Microbiol*. 2004;42:5578–5581.
8. Huletsky A, Giroux R, Rossbach V, et al. New real-time PCR assay for rapid detection of methicillin-resistant *Staphylococcus aureus* directly from specimens containing a mixture of staphylococci. *J Clin Microbiol*. 2004;42:1875–1884.

Hand Hygiene

Hand hygiene is the cornerstone of any infection control program and plays an integral role in reducing the transmission and occurrence of infection. All hospitals must have comprehensive hand hygiene programs in place. The importance of hand hygiene in the elimination of MRSA transmission cannot be overstated.

Guidelines for implementing a hand hygiene program have been previously published. The “CDC Guideline for Hand Hygiene in Healthcare Settings, 2002” includes the following major components.¹

1. Implement a hand hygiene program including all levels of healthcare providers and other patient contact workers.^{4, 5, 7}
2. Ask visitors to wash or use an alcohol-based hand rub on entering and leaving the room.²
3. Wear gloves for all contact with blood, body fluids and moist body surfaces. Remove gloves after caring for patient, when moving from dirty to clean site on same patient, and before care of next patient care of more than one patient.
4. Wash hands or use an alcohol-based hand product after removing gloves.³
5. Perform hand hygiene before and after contact with a patient.
6. Perform hand hygiene before and after contact with the patient’s environment.
7. Monitor compliance with hand hygiene for all levels of staff. Provide feedback of rates based on observations or volume of hand hygiene products used.^{8, 9, 10, 11}
8. Hold health care providers and administrators accountable for implementing a culture that supports and promotes appropriate hand hygiene practices.^{12, 13}

There is no standardized method for monitoring hand hygiene compliance. There are many good resources for hand hygiene monitors that may be useful in designing the best monitor for a given facility. APIC is currently participating in a study led by the Joint Commission to identify methods for monitoring hand hygiene. The Institute for Healthcare Improvement has a hand hygiene guide that includes useful information on monitoring compliance. The [*“How-to Guide: Improving Hand Hygiene. A Guide for Improving Practices among Health Care Workers”*](#)⁶ is available on the IHI website.

HICPAC MDRO Guidelines

First Tier: General Recommendations for All Acute Care Settings

↓ *If endemic rates not decreasing* ↓

Second Tier: Intensified Interventions

Hand hygiene programs and excellent hand hygiene compliance will always be part of both the first tier and the second tier of programs, measures and interventions designed to eliminate the transmission of MRSA in hospitals.

Cited References *[Click on references in blue to access hyperlinks to articles]*

1. Boyce JM, Pittet D; Healthcare Infection Control Practices Advisory Committee; HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *MMWR Recomm Rep*. 2002;51(RR16):1-45. Available at http://www.cdc.gov/ncidod/dhqp/gl_handhygiene.html. Accessed February 27, 2007.
2. Gordin FM, Schultz ME, Huber RA, Gill JA. Reduction in nosocomial transmission of drug-resistant bacteria after introduction of an alcohol-based handrub. *Infect Control Hosp Epidemiol*. 2005;26:650-653.
3. Johnson PD, Martin R, Burrell LJ, et al. Efficacy of an alcohol/chlorhexidine hand hygiene program in a hospital with high rates of nosocomial methicillin-resistant *Staphylococcus aureus* (MRSA) infection. *Med J Aust*. 2005;183:509-514.
4. Pittet D, Hugonnet S, Harbarth S, et al. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. *Lancet*. 2000;356:1307-1312.
5. World Health Organization (WHO). *Guidelines on Hand Hygiene in Health Care (Advanced Draft): A Summary*. World Health Organization; 2005. Available at http://www.who.int/patientsafety/events/05/HH_en.pdf. Accessed February 27, 2007.
6. Institute for Healthcare Improvement (IHI). *How-to Guide: Improving Hand Hygiene. A Guide for Improving Practices among Health Care Workers*. Institute for Healthcare Improvement; 2002. Available at http://www.shea-online.org/Assets/files/IHI_Hand_Hygiene.pdf. Accessed February 27, 2007.
7. University of Geneva Hospitals, Geneva. Switzerland Hand Hygiene Campaign. Swiss-NOSO (Nosokomiale Infektionen und Spitalhygiene); 2006. Available at <http://www.hopisafe.ch/next.html>. Accessed February 27, 2007.
8. Pittet D, Allegranzi B, Sax H, et al. Evidence-based model for hand transmission during patient care and the role of improved practices. *Lancet Infect Dis*. 2006;6:641-652.
9. MacDonald A, Dinah F, MacKenzie D, Wilson A. Performance feedback of hand hygiene, using alcohol gel as the skin decontaminant, reduces the number of inpatients newly affected by MRSA and antibiotic costs. *J Hosp Infect*. 2004;56:56-63.
10. McGuckin M, Taylor A, Martin V, Porten L, Salcido R. Evaluation of a patient education model for increasing hand hygiene compliance in an inpatient rehabilitation unit. *Am J Infect Control*. 2004;32:235-238.
11. McGuckin M, Waterman R, Storr IJ, et al. Evaluation of a patient-empowering hand hygiene programme in the UK. *J Hosp Infect*. 2001;48:222-227.
12. Goldmann D. System failure versus personal accountability—the case for clean hands. *N Engl J Med*. 2006;355:121-123.
13. Gawande A. On washing hands. *N Engl J Med*. 2004;350:1283.

Contact Precautions for MRSA

Key Concepts:

- The elements of Contact Precautions are well-established for hospital settings.
- Contact Precautions is a recommended strategy for the prevention of transmission of MRSA and other multi-drug resistant organisms in the hospital setting.

Basic Components:

Guidelines and recommendations related to multi-drug resistant infections acknowledge a wealth of studies on hospital-associated MRSA. The studies cited in these guidelines document transmission directly from infected and/or colonized patients and/or indirectly from associated contaminated equipment, supplies, and environmental surfaces in the patient room.^{1,2,3} Current recommendations for contact precautions are detailed in the HICPAC guidelines, [“Management of MDRO in Healthcare Settings, 2006”](#) and [“Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings.”](#)^{1,2}

Contact Precautions in addition to standard precautions:

Standard Precautions must be used in order to prevent transmission from potentially colonized patients.

Hand Hygiene is an important component of Standard Precautions.

Contact Precautions are intended to prevent transmission risk of infectious agents when direct or indirect contact with the patient or the patient’s environment is anticipated.

Single-patient room is preferred for patients who require Contact Precautions. When a single-patient room is not available, evaluate infection risks of the alternative options (e.g. cohorting, keeping the patient with an existing roommate, placement of patient with roommate at lower risk for acquisition of MRSA and are likely to have short lengths of stay, etc.) to choose the best options

Gloves and gowns* are the standard personal protective equipment (PPE) used by healthcare personnel when it is anticipated that patient care may involve contact with the patient or potentially contaminated areas in the patient’s environment when the patient is in Contact Precautions. A common practice that ensures compliance with the intent of Contact precautions is to don gown and gloves upon room entry and discard them before exiting in order to contain pathogens to the patient room.

Contact precautions are both a routine (Tier 1) and an intensified (Tier 2) strategy of infection prevention and control processes for patients colonized or infected with MRSA. See Table 3 of HICPAC’s 2006 Guideline (pp.73-74).

* Note: The use of a mask for MRSA contact precautions remains controversial. Some hospitals require it for all MRSA-related isolation (reduce healthcare worker risk of nasal colonization), while other facilities require it only if the MRSA-positive patient is known to have MRSA infection of the respiratory tract.

Special Considerations: Contact Precautions and Active Surveillance Culture (ASC)

It would be ideal to know the MRSA “status” of a patient at the time of admission.^{2,3,4} Unfortunately, this is rarely possible unless there are available culture results from clinical or “screening” specimens that were obtained directly before admission. Therefore, hospitals may elect to have a process in place that directs decisions about room placement and use of ASC for patients based on local and hospital knowledge of MRSA risk, e.g. high-risk or at-risk for MRSA based on risk assessment. (see sections on Risk Assessment) The following questions should be considered when establishing criteria for preemptive Contact Precautions or ASC when an admitted patient is in a high-risk or at-risk group and when culture results are not yet known:

- Are there identified high-risk groups from endemic settings (patients from long-term care facilities, institutionalized living environments, etc)?
- Are there identified high risk groups based on clinical presentation (e.g. skin and soft tissue infections in athletes, veterinary personnel, IV drug users, etc.)
- Are ASC screens being done on admission to a clinical unit or service line?
- Are ASC screen results available in 24 hours, 48 hours, or longer?
- Are private rooms available on any or all units for patients identified by the MRSA risk assessment?

Room Placement for Patients Who are Candidates for ASC:

There is no “one-size-fits-all” solution for the question of who, how, and when to use contact precautions prior to culture results. There is very little research regarding how long it takes before the lack of isolation leads to significant risk of transmission of MRSA from an infected or colonized patient. Therefore, hospitals must start with a reasonable approach based on MRSA surveillance and risk assessment and adjust the approach if surveillance demonstrates MRSA transmission problems. Examples of possible options for patient placement on admission include the following:

Option 1. Use private rooms and contact precautions for all patients from identified high risk groups per MRSA risk assessment until ASC results are known. Additionally, use private rooms and contact precautions for all patients who have history of MRSA (“flagged” on admission) and have not met hospital-specific criteria for discontinuation of contact precautions. Discontinue contact precautions when MRSA ASC is resulted as negative.

Option 2. Use routine room placement assignments for all patients who are candidates for ASC unless they have known history of MRSA (“flagged” on admission). Make MRSA culture tests a priority for the laboratory and have positive results alerted immediately to the clinical units. Implement contact precautions as soon as a positive result from ASC or clinical culture is reported. If the positive patient has a roommate, obtain specimen for ASC from the roommate right away and at the time of discharge.

Either of these options, or others that hospitals may develop, will result in patient, resource, and staffing consequences. Before implementation of new processes related to contact precautions for the purpose of management of MRSA and other MDRO, address any of the following considerations that will apply.

Patient care:

The impact of contact precautions on patient care has been a subject of some controversy and much concern. Contact precautions used preemptively for a patient who ultimately is found not to harbor MRSA will be, at the very least, a dissatisfier for the patient and the patient's caregivers.

Staffing:

Staffing resources will be impacted if there is an increase in the number of contact precaution patients and if MRSA active surveillance culture (ASC) programs are implemented. Nursing care hours, culture collection and ordering hours, laboratory tech time, housekeeping time, surveillance hours, monitor hours, and reporting and communication hours will all increase.

Resources:

Additional resources related to contact precautions and ASC include supplies for contact precautions, specimen collection supplies, laboratory reagents and instrumentation, written patient/family information regarding MRSA ASC or contact precautions. If patient rooms in the hospital are not private or single occupancy, bed availability issues may result in the need to redistribute resources.

Basic strategies for successful outcomes:

Practical application of the contact precaution protocol will include all of the elements outlined above, and requires communication and compliance with elements of contact precautions for aspects of patient care throughout the facility and by all departments and services (X-ray, OR, PACU, etc.).

- Implement a “flagging” system or alert to identify patients previously diagnosed with MRSA so isolation may be initiated immediately on subsequent admissions.
- Develop a system for identifying MRSA-positive patients for receiving units and transport teams, to ensure proper management within the hospital setting.
- Develop a system for identifying MRSA-positive patients for receiving facilities and transport agencies outside of the hospital setting.
- Monitor adherence with hand hygiene and implement corrective actions as indicated.
- Monitor adherence with contact precautions and implement corrective actions as indicated. (*See Example 1*)
- Monitor adherence to environmental sanitation policies.
- Educate all staff on risks of transmission of MRSA and of prevention measures at time of orientation and during annual competencies.
- Communicate and re-educate when new processes related to eliminating transmission of MRSA are implemented.
- Communicate and re-educate when rates of compliance with processes related to eliminating transmission of MRSA show inadequate results.

- Communicate and re-educate when rates of MRSA transmission are not decreasing
- Communicate and celebrate when rates of MRSA transmission are decreasing.

A Note on Strategies to Discontinue Contact Precautions:

Many hospitals have developed protocols for discontinuing contact precautions for MRSA-positive patients when their infections have resolved and they have been “screened” by culture to demonstrate that they are not colonized with MRSA. For a variety of reasons, there are no definitive criteria that can be cited as specific recommendations for discontinuation of MRSA precautions. See *Duration of Contact Precautions* in the HICPAC MDRO guideline for further information.¹

Example 1: Sample monitoring tool for contact precautions

MRSA CONTACT PRECAUTIONS Daily Monitoring Tool									
Patient Care Unit/Dept.: _____					Day of Week: _____		Date: _____		
Initials of Monitor/Observer: _____					Time: _____ AM/PM to _____ AM/PM				
Healthcare Worker (HCW) Type: 1 = Physician 6 = patient transporter 2 = physician assistant 7 = PT/OT 3 = nurse 8 = housekeeping 4 = nursing assistant 9 = dietary 5 = respiratory therapy					Key: Y = Yes N = No N/A = Not Applicable				
HEALTH CARE WORKER TYPE (Use HCW Type Key Above)									
Compliance with Precautions									
Don gown before enter room									
Don gloves before enter room									
Remove gown on exiting room									
Remove gloves on exiting room									
Performed hand hygiene after glove removal									

Cited References *[Click on references in blue to access hyperlinks to articles]*

1. Siegel JD, Rhineheart E, Jackson M, Linda C; Healthcare Infection Control Practices Advisory Committee (HICPAC). Management of multidrug-resistant organisms in healthcare settings, 2006. Available at <http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf>. Accessed February 27, 2007.
2. Siegel JD, Rhineheart E, Jackson M, Chiarello L, and the Healthcare Infection Control Practices Advisory Committee, Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings 2007, June 2007, <http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/Isolation2007.pdf>
3. Muto CA, Jernigan JA, Ostrowsky BE, et al. SHEA guideline for preventing nosocomial transmission of multidrug-resistant strains of *Staphylococcus aureus* and *enterococcus*. *Infect Control Hosp Epidemiol*. 2003;24:362-386.
4. Institute for Healthcare Improvement (IHI). "5 Million Lives" campaign. "Getting Started Kit: Reduce Methicillin-Resistant *Staphylococcus aureus* (MRSA) Infection How-to Guide" 2006. Available at <http://www.ihl.org/NR/rdonlyres/F4D9DE7A-3952-4AE7-BBAC-4E4222084A03/0/MRSAHowtoGuide.doc> Accessed February 27, 2007

Additional Resources and Studies

1. Garner JS; Hospital Infection Control Practices Advisory Committee. Guideline for isolation precautions in hospitals. *Infect Control Hosp Epidemiol*. 1996;17:53-80, and *Am J Infect Control*. 1996; 24:24-52.
Part 1 <http://download.journals.elsevierhealth.com/pdfs/journals/0196-6553/PIIS0196655396900504.pdf>
Part 2 <http://download.journals.elsevierhealth.com/pdfs/journals/0196-6553/PIIS0196655396900516.pdf>
2. Safdar N, Marx J, Meyer NA, Maki DG. Effectiveness of preemptive barrier precautions in controlling nosocomial colonization and infection by methicillin-resistant *Staphylococcus aureus* in a burn unit. *Am J Infect Control*. 2006;34:476-483.
3. Manian FA, Ponzillo JJ. Compliance with routine use of gowns by healthcare workers (HCWs) and non-HCW visitors on entry into the rooms of patients under contact precautions. *Infect Control Hosp Epidemiol*. 2007;28:337-340.
4. Cunningham R, Jenks P, Northwood J, Wallis M, Ferguson S, Hunt S. Effect on MRSA transmission of rapid PCR testing of patients admitted to critical care. *J Hosp Infect*. 2007;65:24-28.
5. Afif W, Huor P, Brassard Paul, Loo VG. Compliance with methicillin-resistant *Staphylococcus aureus* precautions in a teaching hospital. *Am J Infect Control*. 2002;30:430-433.
6. Berhe M, Edmond MB, Bearman G. Measurement and feedback of infection control process measures in the intensive care unit: Impact on compliance. *Am J Infect Control*. 2006;34:537-539.
7. Roghmann MC, McGrail L. Novel ways of preventing antibiotic-resistant infections: what the future might hold. *Am J Infect Control*. 2006;34:469-475.
8. Karchmer TB, Durbin LJ, Simonton BM, Farr BM. Cost-effectiveness of active surveillance cultures and contact/droplet precautions for control of methicillin-resistant *Staphylococcus aureus*. *J Hosp Infect*. 2002;51:126-132.

Environmental and Equipment Decontamination

Key Concepts

- MRSA can survive in the hospital environment and on hospital surfaces.
- Patients and/or healthcare workers can transmit and/or acquire MRSA from contact with contaminated surfaces.
- Establishing and monitoring protocols for cleaning and disinfecting rooms that are occupied by patients infected and/or colonized with MRSA as well as areas of frequent hand contact can reduce the risk of MRSA transmission.

Survival of MRSA in the Hospital Environment

Staphylococci, including MRSA, can survive in the hospital environment. In studies by Neely³ and Huang⁴, staphylococci were recovered for at least one day and up to 56 days after contamination on common hospital materials, and two strains of MRSA survived for nine to 11 days on a plastic patient chart, a laminated tabletop, and a cloth curtain in a hospital.

Transmission of MRSA to Patients from the Hospital Environment

Not only has it been proven that MRSA can survive on common hospital surfaces, studies have implicated that patients can acquire MRSA from contact with those contaminated hospital surfaces.^{3, 4} In a study on environmental contamination conducted by Hardy⁵ et al, there was strong evidence to suggest that three of 26 patients who acquired MRSA while in the intensive care unit acquired the organism from the environment. In addition, the study revealed that MRSA was isolated from every environmental sample collected. In a study of environmental contamination in the rooms of patients who had MRSA, Boyce⁶ et al recovered MRSA from the rooms of 73 % of infected patients and 69 % of colonized patients. The authors of both studies concluded that inanimate surfaces in close proximity to infected or colonized patients commonly become contaminated and may become a source of transmission of MRSA. Healthcare workers, patients and visitors can pick up MRSA by touching contaminated room surfaces. This has major implications for any effort to eliminate transmission of MRSA in hospital settings.

Delineate Responsibility for Cleaning

Cleaning and disinfection protocols can be effective tools for the management of environmental contamination with antimicrobial resistant pathogens such as MRSA. Environmental services and housekeeping staff are extremely important to this process. Initial training, reinforcement, and competency of environmental staff on cleaning and disinfection procedures are important for the elimination of transmission of MRSA.

Policies and protocols must specify that environmental surfaces are cleaned with the proper dilution and amount of the standard hospital-approved disinfecting agents, and they must emphasize the appropriate contact time for germicidal agents. Daily cleaning of patient rooms by environmental staff is an essential

policy component. If applicable, dedicated environmental staff may be assigned to targeted patient care areas to provide consistency of appropriate cleaning and disinfection procedures. Areas experiencing high endemic MRSA rates warrant an increase in the frequency of cleaning and disinfection of surfaces that receive substantial hand contact.⁷

Patient care and ancillary department staff are responsible for disinfection of equipment between patient use. This aspect of cleaning and disinfection should be built into general protocols and procedures. Hospital-approved disinfectants must be readily available to all staff with cleaning responsibility at all points of use.

Monitoring Environmental Cleaning

A monitor to assess cleaning performance of environmental staff will ensure consistency in cleaning and disinfection procedures. Monitoring should include an assessment of the cleaning of surfaces in close proximity to the patient including bedrails, carts, doorknobs, bedside commodes, bedside tables, and faucet handles. Also, the use of an environmental cleaning checklist may increase efficacy of cleaning and may be helpful when monitors show that cleaning is inadequate. There is generally no need for environmental cultures unless there is epidemiologic evidence that an environmental source is associated with ongoing transmission of MRSA. Consider closing a unit for deep cleaning and disinfection if there is evidence of unchecked transmission.

Example of Cleaning Checklist

The Institute for Healthcare Improvement's (IHI) 5 Million Lives Campaign "How-to-Guide: Reduce MRSA Infection" includes a comprehensive review of decontamination of the environment and equipment. In the [Appendix](#) of this package (pp. 54- 55), there is an environmental services checklist audit for daily cleaning and discharge cleaning.

Cited References [\[Click on references in blue to access hyperlinks to articles\]](#)

1. Neely AN, Maley MP. Survival of enterococci and staphylococci on hospital fabrics and plastic. *J Clin Microbiol.* 2000;38:724-726.
2. Huang R, Mehta S, Weed D, Price CS, MD Methicillin-resistant *Staphylococcus aureus* survival on hospital fomites. *Infect Control Hosp Epidemiol* 2006;27:1267-1269.
3. Bhalla A, Pultz NJ, Gries DM, et al. Acquisition of nosocomial pathogens on hands after contact with environmental surfaces near hospitalized patients. *Infect Control Hosp Epidemiol.* 2004;25:164-167.
4. Carling PC, Briggs J, et al. An evaluation of patient area cleaning in 3 hospitals using a novel targeting methodology. *Am J Infect Control.* 2006;34:513-519.
5. Hardy KJ, Oppenheim BA, Gossain S, Gao F, Hawkey PM. A study of the relationship between environmental contamination with methicillin-resistant *Staphylococcus aureus* (MRSA) and patients' acquisition of MRSA. *Infect Control Hosp Epidemiol.* 2006;27:127-132.
6. Boyce JM, Potter-Bynoe G, Chenevert C, King T. Environmental contamination due to methicillin-resistant *Staphylococcus aureus*: possible infection control implications. *Infect Control Hosp Epidemiol.* 1997;18:622-627. (Electronic version not available. To order back issue: <http://www.journals.uchicago.edu/ICHE/back.html>)
7. Muto CA, Jernigan JA, Ostrowsky BE, et al. SHEA guideline for preventing nosocomial transmission of multidrug-resistant strains of *Staphylococcus aureus* and *enterococcus*. *Infect Control Hosp Epidemiol.* 2003;24:362-386.

Surveillance Cultures

Key Concepts

- Surveillance MRSA cultures are useful in epidemiologic studies of the prevalence, incidence, and/or transmission of MRSA.
- Clinical cultures will not identify the majority of MRSA-positive patients, especially in settings with high endemic MRSA rates.
- In contrast to the “passive” acquisition of MRSA information from clinical culture, surveillance MRSA cultures can be part of active data collection for MRSA risk assessments and for enhanced control efforts.
- Surveillance MRSA cultures may be performed as a component of the process to make decisions about discontinuing contact precautions.

Active Surveillance Cultures (ASC)

The 2006 MDRO guideline¹ recommends a two-tiered approach to the management of MDRO in healthcare settings. The first tier includes routine surveillance for MDRO such as MRSA to identify evolving problems (e.g., increased MRSA transmission) and provide support to routine infection prevention and control processes designed to safeguard against infection issues caused by unidentified MRSA carriers. The second tier of the MDRO guideline includes intensified control efforts that are to be implemented when transmission, incidence, or prevalence is not decreasing despite adequate compliance with routine, first tier infection control measures.

One recommended intervention is implementing an active surveillance culture (ASC) program.^{1, 5, 6} Hospitals experiencing an increase in MRSA transmission or MRSA-related admissions should consider

V.B.1.a. Indications for intensified MDRO control efforts should result in selection and implementation of one or more of the interventions described in VII.B.2 to VII.B.8 below. Individualize the selection of control measures according to local considerations. *Category IB*

V.B.5.b. Develop and implement protocols to obtain active surveillance cultures (ASC) for targeted MDROs from patients in populations at risk (e.g., patients in intensive care, burn, bone marrow/stem cell transplant and oncology units; patients transferred from facilities known to have high MDRO prevalence rates; roommates of colonized or infected persons; and patients known to have been previously infected or colonized with an MDRO). *Category IB*

V.B.5.b.i. Obtain ASC from areas of skin breakdown and draining wounds. In addition, include the following sites according to target MDROs:

V.B.5.b.i.1. For MRSA: Sampling the anterior nares is usually sufficient; throat, endotracheal tube aspirate, percutaneous gastrostomy sites and perirectal or perineal cultures may be added to increase the yield. Swabs from several sites may be placed in the same selective broth tube prior to transport. *Category IB*

using ASC as part of second tier interventions for intensified control efforts. The MDRO Guideline recommends the following in regard to utilizing ASC:

ASC Legislation

In recent years, legislation requiring active surveillance has been considered, debated, and even passed in some states. APIC and SHEA have jointly published a position paper regarding legislative mandates for the use of active surveillance cultures to screen for MRSA and VRE.²

ASC Specimens

Patients who are infected with MRSA will be positive for MRSA at the site of their infection but may also be colonized with MRSA on other areas of the body. Conversely, patients who do not have an outbreak of MRSA infection but are colonized with it will “carry” the organism in one or more sites including the nose, throat, groin, axilla, non-intact skin surfaces, and skin/tube interfaces (including tracheotomy sites and percutaneous feeding tubes). Colonization may be long-term or transient and may recur.

The minimal specimen requirements for ASC are the anterior nares and areas of active skin breakdown or draining wounds. The colonization site most often cultured to detect MRSA colonization is the anterior nares. Culturing additional sites such as the groin, axilla or throat will increase the sensitivity of MRSA screening. However, these additional screens may be unnecessary or impractical in terms of cost, time, and resources.³

Identifying Patients Who Should Have ASC Screens

A hospital “MRSA Risk Assessment” can identify patients or patient populations eligible for a MRSA ASC program. Studies of MRSA in many different healthcare settings and geographic locations have identified possible and probable MRSA risk groups or populations. These include patients who:

- Have a known history of MRSA
- Are in high risk groups or populations for healthcare associated MRSA (long-term care residents, patients with recent or frequent hospitalizations, dialysis patients)
- Have risk factors for community-associated MRSA infection, (have skin and soft tissue infections and are athletes in organized sports, veterinarians and others who have close contact with pets, have a history of being in jail or prison settings, have history of IV drug use)
- Are roommates of new MRSA positive patients
- Are admitted from a clinical unit or service with high endemic MRSA rates
- Are in a population identified by the hospital risk assessment

Admission Screening Process for MRSA ASC Eligible Patients

Once the hospital risk assessment is complete, the hospital must develop and implement a comprehensive process that will find the patients eligible for “MRSA ASC on admission.” Defining the logistics of the identification and notification process may require input from bed control, information systems, registration, laboratory, nursing, and other key stakeholders in the admission process. The ability of the process to accurately identify and assure prompt culture collection must be monitored.

Patient “flags” for ASC: Identification of patients for ASC at time of admission can be problematic. There must be a standardized, consistent process to identify patients and to ensure collection of the ASC specimen in the appropriate timeframe. “Flagging” of MRSA-positive patients is an important component of MRSA surveillance programs.¹ An immediate alert of MRSA history is essential at time of admission to the hospital and at the time of discharge of the patient to another service or healthcare facility. Electronic medical record programs can be set up so that an MRSA notice or flag is automatically displayed during the admission process. If electronic flagging is not possible, alternative systems must be arranged so that notification of the receiving unit or facility is made consistently and in a timely manner.

Universal ASC: Some hospitals have been able to justify a program of universal ASC (all admissions) based on risk assessment, availability of resources (supplies and personnel), medical and clinical staff support, and development of a strong business case for the program.⁸ One advantage to universal ASC is that it eliminates the need for the often complex process of identifying and promptly obtaining cultures from patients in populations targeted for ASC. If such an undertaking is contemplated, careful planning is required. All facets of such planning including management and cost allocation for needed resources are examined by Diekema and Edmond.⁷

Example 1: Nasal Specimen collection for MRSA ASC - Surgical Intensive Care Unit

ASC Team - SICU: nursing unit staff, infection prevention and control, housekeeping, laboratory

Process:

- The surgical intensive care unit (SICU) participates in ASC of all patients on the day of admission to the unit and on the day of discharge or transfer from the unit.
 - Ziploc bags labeled “MSRA ASC” containing two culture swabs are kept in the clean utility room.
1. Housekeeping staff puts MRSA ASC bag containing two culture swabs in plastic holder beside the door of every SICU room when room is cleaned after patient discharge
 2. While taking vital signs during admitting process to the unit, the patient’s nurse swabs patient’s nose
 3. The unit secretary puts in the order for the MRSA ASC and sends the specimen to the lab ASAP
 4. Patient Care Tech (PCT) makes sure that one culture swab has been removed from the door on the first day of the patient’s admit, and notifies nursing supervisor if the admission specimen has not been obtained
 5. When the patient is cleared for discharge or transfer, the patient’s nurse uses second nasal swab while giving discharge instructions
 6. The housekeeper verifies that both swabs are gone when cleaning room after patient discharge from room. If swab(s) are still in bag, the housekeeper notifies the charge nurse
 7. If possible, the charge nurse will call the receiving unit to obtain specimen within 24 hours of transfer to that unit

Monitor: MRSA liaison in the Infection Prevention and Control department keeps a line listing of all patients admitted to the SICU. Compliance with obtaining surveillance cultures is compiled weekly and posted on the SICU communication board. The ASC Team for SICU evaluates compliance with the process monthly, and adjusts the process as needed based on results.

Processes for Collection of ASC

Prior to implementing an ASC program, it is necessary to develop a process that has the potential for a high rate of compliance with collection. Use a team approach and include representative members from all departments that play a role. (*See Examples 1-3*)

Example 2: Line Listing – collect data on all patients admitted to SICU

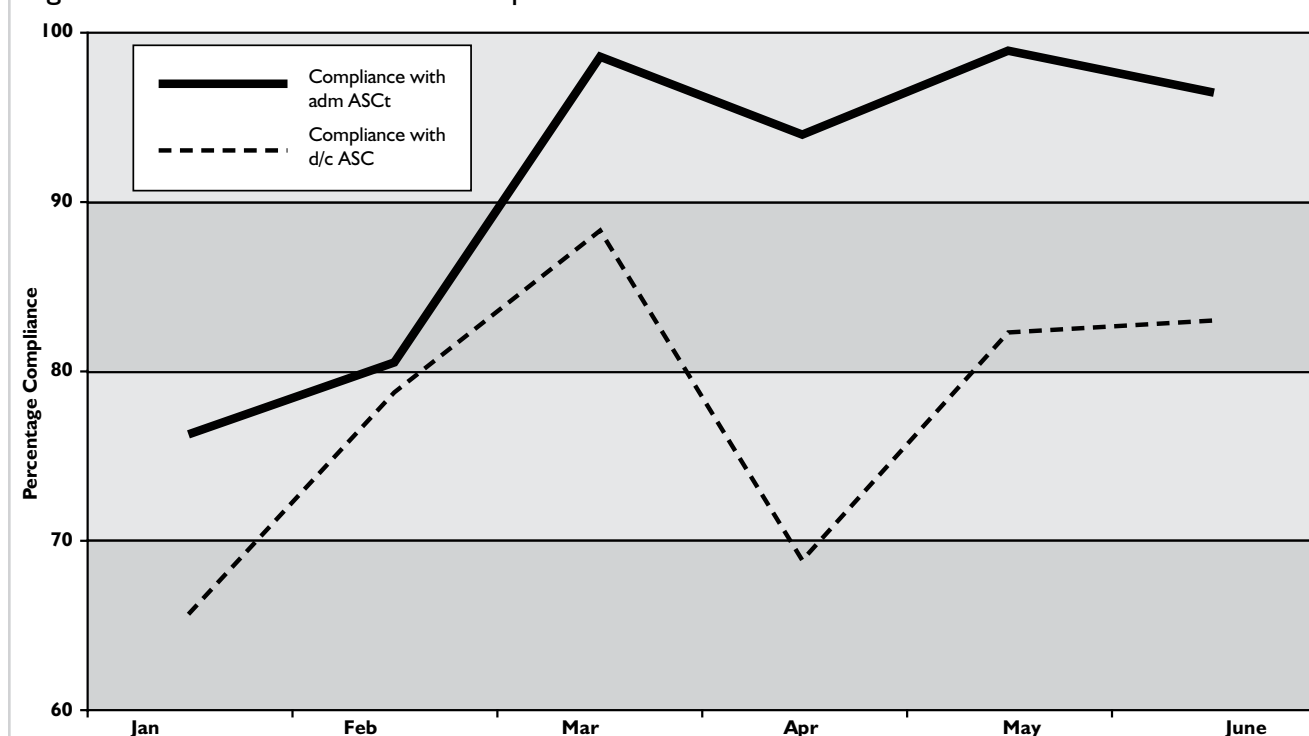
Figure 1. SICU Patient Data Form.

Patient identifier	Adm date SICU	Adm ASC date/results	Discharge / Transfer date from SICU	Discharge ASC date/results

Example 3: Compliance Report

Discussion: Team should work to improve compliance with obtaining discharge surveillance cultures.

Figure 6.1 SICU ASC Collection Compliance



Timing of Specimen Collection for ASC

There are many factors to take into account when establishing a routine ASC program. The following three options should be considered, keeping in mind that there may be other alternatives that better suit the

needs of a given ASC program. Timing of specimen collections should be customized to meet surveillance and/or intervention needs and to ensure the most efficient use of available resources.

Option 1 - Collect ASC specimens:

- At the time of admission to the hospital or unit
- At the time of discharge or transfer from the hospital or unit

Option 2 - Collect ASC specimens:

- At the time of admission to the hospital or unit
- At the time of discharge or transfer from the hospital or unit
- If discharge or transfer is delayed, collect specimen every “X” number of days after admission

This option is problematic unless a system of automatic orders (computer-generated) can be utilized to capture the “every X number of days” culture.

Option 3 - Collect ASC specimens (unit specific):

- At the time of admission to the hospital or unit
- At the time of discharge or transfer from the hospital or unit
- Collect ASC on every patient every Thursday (or pick a weekday that works best for the unit)

This captures important data when lengths of stays are extended.

Communication about ASC

Physicians and Healthcare Providers generally consider cultures to be tools used to manage a patient’s clinical condition. Surveillance cultures, however, are tools used in infection prevention and control efforts. Effective communication with medical and clinical staff about the infection prevention and control versus the clinical management implications of ASC is crucial to the success of the program. Administrative support for the program must be very visible and clear to the medical staff.

The results of the MRSA surveillance program and the goal of eliminating MRSA transmission in the hospital should be regularly shared in meetings, on process improvement bulletin boards, infection control newsletters, medical staff meetings, and/or by other means. Infectious disease physicians are valuable champions and should have up-to-date information so they can effectively support the ASC program.

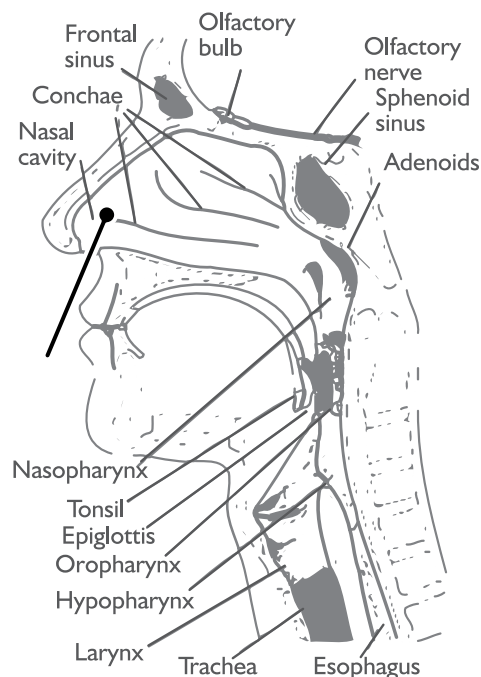
Patients and families have the right to know and understand the reasons for active surveillance cultures. A patient letter about surveillance cultures, scripts for patient caregivers, and MRSA fact sheets should be developed prior to implementing of the ASC program. Clear communication and honest, well-informed answers to questions will enhance patient and family satisfaction with the quality of care provided.

Nasal Specimen Collection Procedure

1. Use a sterile standard culturette to obtain the specimen.
2. Culture both anterior nares utilizing one culture swab.
3. Rotate moistened swab in each nares two to five times clockwise and counterclockwise. The process should gently rub across the nasal mucous membranes about three-fourths of an inch into the nasal passage (adult) so that squamous epithelial cells from the inside of the nose are obtained.

Courtesy of Marcia R. Patrick, RN, MSN, CIC Multicare Health Systems Tacoma, WA

Figure 6.2 Nasal Specimen Collection (adapted from *The Merck Manual online—Second Home Edition*)



Follow manufacturer's instructions specific to the MRSA test methodology for nasal specimen collection if available. (See *Figure 4*.)

MRSA Screen Laboratory Testing

Microbiology testing regimens currently available for MRSA nasal screens include:

1. Isolation of MRSA on blood agar and mannitol salt with follow-up confirmatory testing and susceptibility testing. Results are available in 48 hours if negative, but take as long as 3-4 days if staphylococci are present.
2. Selective media for MRSA (e.g., chromogenic agar) can be used for identification of MRSA nasal colonization in 24-48 hours and does not require any additional microbiology confirmatory tests.
3. Rapid MRSA assays that use FDA-approved, DNA detection-based polymerase chain reaction methodologies (PCR) have the potential for results in two hours if testing is done in "real-time." These tests may have higher sensitivity culture and feature relatively simple lab workflow. However, they cost more than conventional and selective culture methods. Many labs perform them as "batch" tests at intervals during a given day.

An important MRSA surveillance consideration when comparing these methodologies is the turnaround time (TAT). Decisions involving preemptive versus result-driven precautions are influenced by TAT of the results. (See "Contact Precautions" section.)

The most important resource considerations are financial and workload-related. The cost impact to the laboratory is related to the increased volume of ASC screens, reagent, and instrumentation costs as well as FTE requirements. The cost related to nursing tasks and supplies is related to collection of specimens and the possibility that more contact precautions will be implemented as ASC identifies more colonized patients. There will be cost considerations related to increased infection control surveillance, data analysis and reporting, information system needs, environmental services, disposable equipment, and personal protective equipment among other things.^{5,6,7,8}

The APIC MRSA webinar series describes these considerations in detail with many examples and cost analyses. See “Designing a Program to Eliminate MRSA Transmission Part I: Making the Clinical Case,” Dr. C. Muto – December 6, 2006;⁹ and “Designing a Program to Eliminate MRSA Transmission Part II: Making the Business Case,” Dr. Robicsek – January 10, 2007.¹⁰

Cited References [Click on references in blue to access hyperlinks to articles]

1. Siegel JD, Rhineheart E, Jackson M, Linda C; Healthcare Infection Control Practices Advisory Committee. Management of multidrug-resistant organisms in healthcare settings, 2006.” Available at <http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf>. Accessed February 27, 2007.
2. Weber SG, Huang SS, Oriola S, et al. Legislative mandates for use of active surveillance cultures to screen for methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococci: Position statement From the joint SHEA and APIC task force. *Infect Control Hosp Epidemiol*. 2007;28:249–260.
3. Loulergue J, de Giallully C, Morange V, Holstein A, van der Mee-Marquet N, Quentin R. Evaluation of a new chromogenic medium for isolation and presumptive identification of methicillin-resistant *Staphylococcus aureus* from human clinical specimens. *Eur J Clin Microbiol Infect Dis*. 2006.
4. Cunningham R, Jenks P, Northwood J, Wallis M, Ferguson S, Hunt S. Effect on MRSA transmission of rapid PCR testing of patients admitted to critical care. *J Hosp Infect*. 2007;65:24–28.
5. Siegel JD, Rhineheart E, Jackson M, Chiarello L, and the Healthcare Infection Control Practices Advisory Committee, Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings 2007, June 2007, <http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/Isolation2007.pdf>
6. Warren DK, Guth RM, Coopersmith CM, Merz LR, Zack JE, Fraser VJ. Impact of a methicillin-resistant *Staphylococcus aureus* active surveillance program on contact precaution utilization in a surgical intensive care unit. *Crit Care Med*. 2007;35:430–434.
7. Diekema DJ, Edmond MB. Look before you leap: Active surveillance for multidrug-resistant organisms. *CID* 2007;44 (15 April)
8. Jernigan JA, Clemence MA, Stott GA et al. Control of methicillin-resistant *Staphylococcus aureus* at a university hospital: one decade later. *Infect Control Hosp Epidemiol*. 1995;16:686–696.
(Electronic version not available. To order back issue: <http://www.journals.uchicago.edu/ICHE/back.html>)
9. Muto C. Designing a program to eliminate MRSA transmission part I: making the clinical case. APIC webinar; December 6, 2006. Available at http://www.apic.org/Content/NavigationMenu/Education/Webinars/061206_muto.pdf. Accessed February 27, 2007
10. Robicsek A. Designing a program to eliminate MRSA transmission part II: making the business case” APIC webinar; January 10, 2007. Available at http://www.apic.org/Content/NavigationMenu/Education/Webinars/070110_robicsek.pdf. Accessed February 27, 2007

Additional Resources [\[Click on references in blue to access hyperlinks to articles\]](#)

Toth M, Norstrand P. Workplace cultural transformation – using Positive Deviance to eliminate MRSA transmission. APIC webinar; January 24, 2007.

Ogle AM. “The Role of Surveillance in a Successful Program to Eliminate MRSA Transmission” APIC webinar; February 7, 2007

Success Story - ASC

Active (Universal) Surveillance for MRSA on Admission

Anna Marie Ogle, MPH CIC, Ari Robicsek, MD, and Lance Peterson, MD

Evanston Northwestern Healthcare (ENH) is committed to universal surveillance for MRSA on admission to their three hospitals. The purpose is to identify patients who are nasally colonized with MRSA early in their hospital stay, establish contact precautions immediately upon recognition of MRSA colonization, and reduce the number of days a colonized patient is not isolated. The goal is to reduce the number of hospital-acquired infections from MRSA. The results of the first 12 months demonstrated that 25,139 patients were screened on admission. The number of patient days occupied by MRSA patients was 10,309 days. This represented 8% of the total bed days occupied in all three ENH hospitals.

We chose universal surveillance because we were not able to detect a sufficiently high percentage of MRSA colonized patients using targeted surveillance. Our findings demonstrating this are in *Example 1*.

Example 1: Screening strategy comparison of ENH patient population in the first year.

	Patients Screened on Admission (% of total admits)	Patients Screened on Admission (% of total admits)	Admissions for Undetected MRSA (% of total admits)	Bed Days Occupied by Unisolated MRSA carriers (% of total bed days)
No strategy	0	0	5.9	7.9
Passive Surveillance	2	23.1	4.5	5.6
ICU targeted Active Surveillance	16.4	41.5	3.4	4.1
Universal Surveillance	100	100	0	0

Prior to implementation of universal surveillance for MRSA, we expanded molecular diagnostic testing so rapid PCR results would be available daily. We developed patient education information sheets and instructed patient care technicians and nurses on how to perform the PCR test. We distributed MRSA screening kits throughout the hospital system. The kits contained double-headed swabs and education sheets on how to perform PCR swabbing.

The first outcome measures we used to determine medical benefit was to track hospital-acquired MRSA bloodstream infections and respiratory infections. We defined a hospital-acquired MRSA bacteremia and respiratory infection as a positive culture obtained from a patient with a length of stay (LOS) greater than two days. The data results from the two reports shown in the figures below are statistically significant with a p value <0.05. The range for bacteremia was 26 to 20 in the previous three years. After implementation of universal screening, it was lowered to seven cases (*Figure 1*). Respiratory cases ranged from 62 to 54 in three previous years and lowered to 28 after implementation (*Figure 2*).

Figure 7.1 Hospital-acquired Bloodstream Infection.

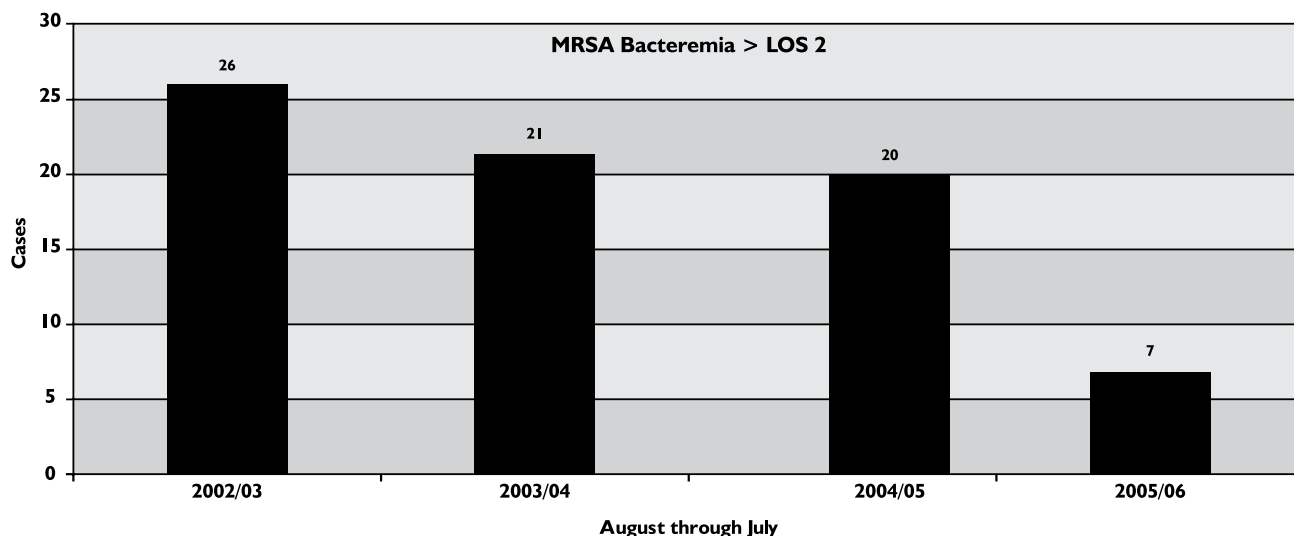
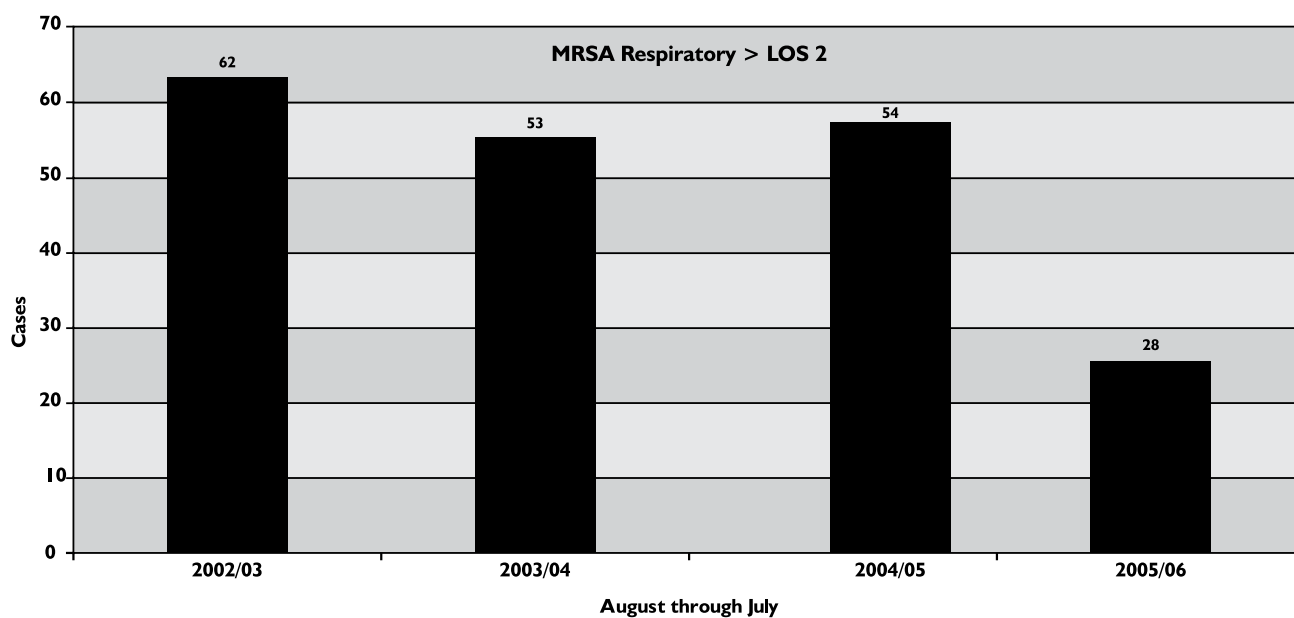
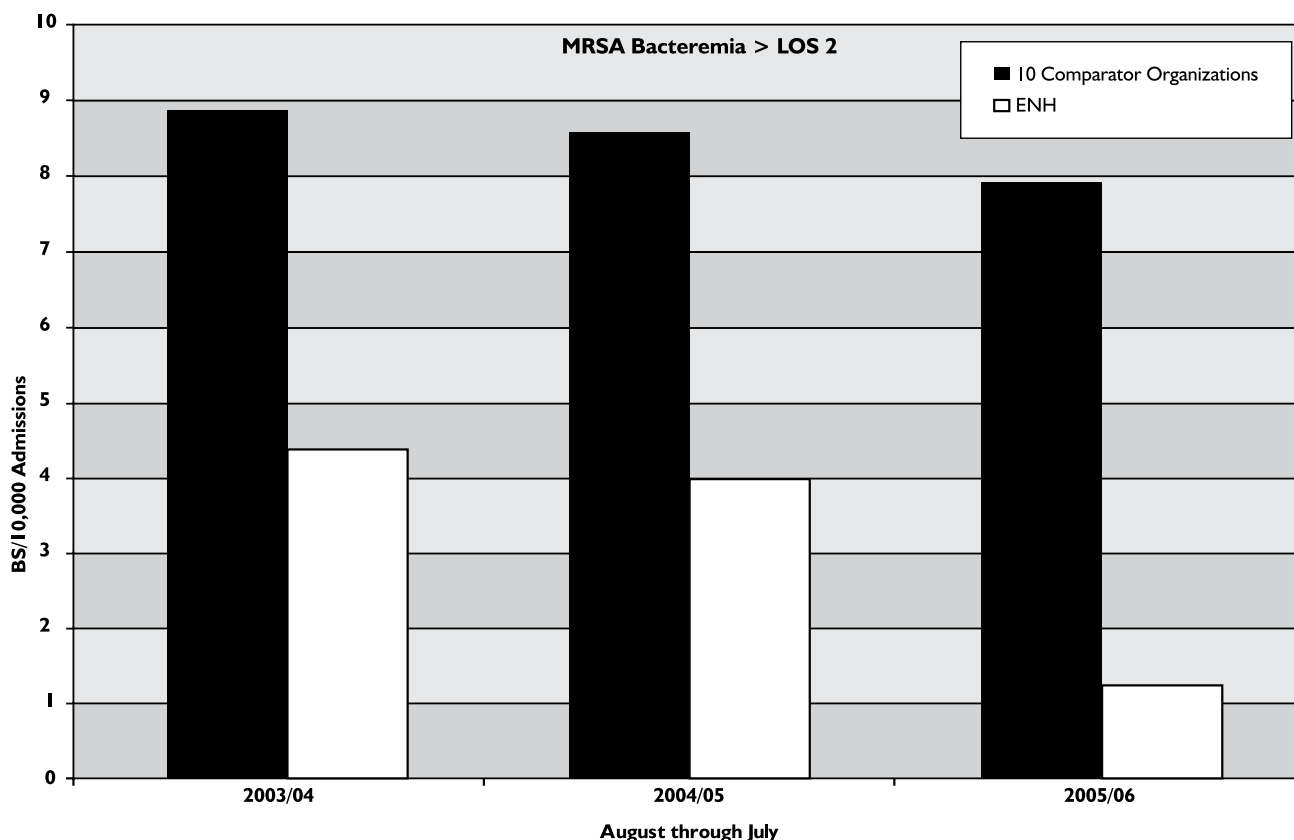


Figure 7.2 Hospital-acquired Respiratory Infection.



The following figure (*Figure 3*) is a three-year comparison between ten matching organizations and ENH. The report focused on MRSA bacteremia per 10,000 admissions. This represents nearly 950,000 patients. All organizations experienced a slight decrease in bacteremia per 10,000 admissions in all three years that was not statistically significant. ENH had a low rate in the first two years compared to the other organizations. In the third year, with implementation of universal surveillance at ENH, there was a dramatic drop in MRSA bacteremia rate ($p < 0.05$) at ENH.

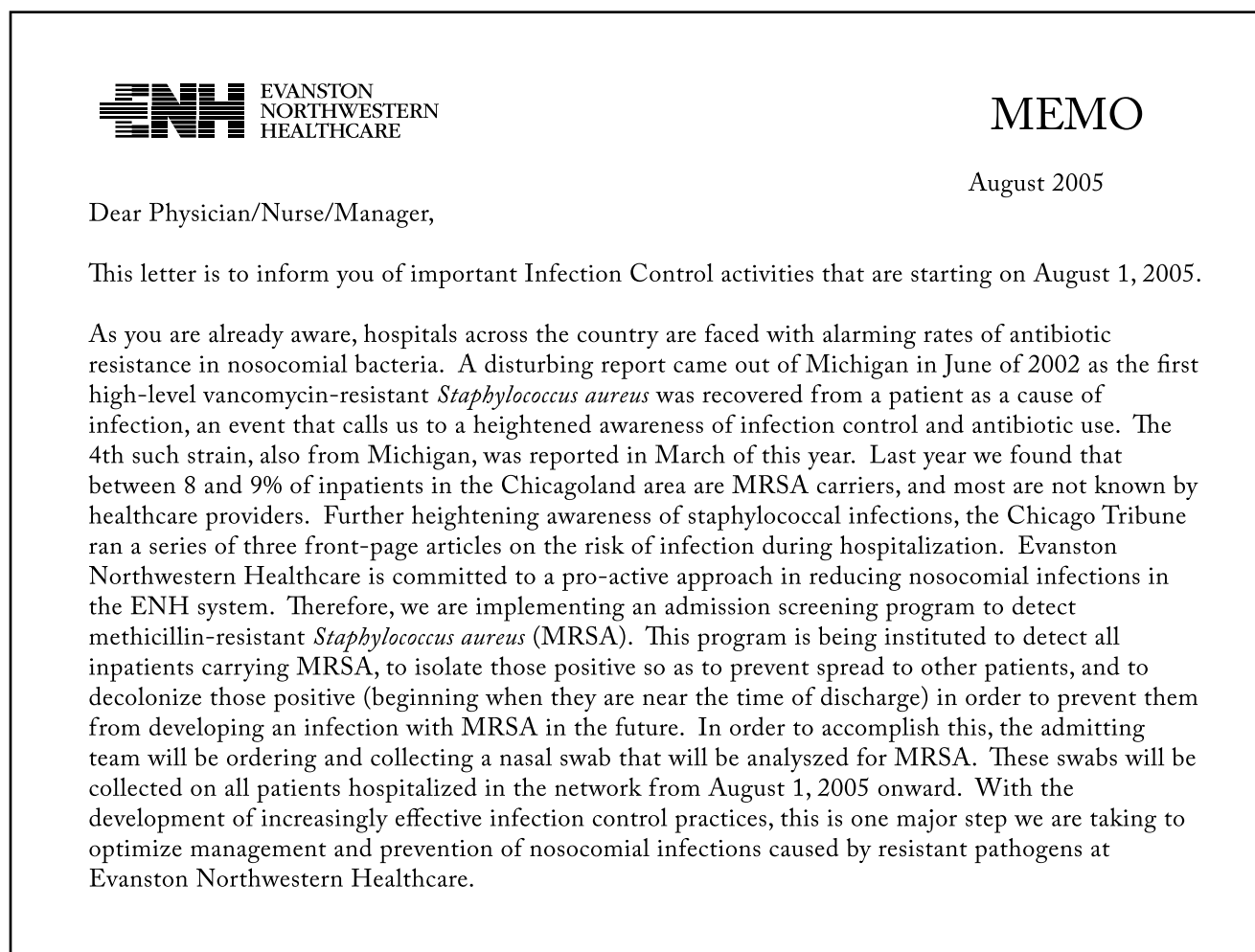
Figure 7.3 Comparison of Hospital-acquired Bloodstream Infection Rates at ENH versus 10 Other Hospitals with a Similar Population Case Mix.



Conclusion:

Expanded MRSA surveillance can be beneficial, even in a setting where the initial rate may be modest. The ENH intervention has now entered into the second year with the expectation that the improvement trend will continue and fewer patients will have hospital-acquired infections from MRSA. We hope to meet our goal of eliminating hospital-acquired MRSA at ENH in the near future.

Figure 7.4 Letter to hospital staff regarding MRSA surveillance program



(From APIC webinar: Ogle AM. The role of surveillance in a successful program to eliminate MRSA transmission. APIC webinar; February 7, 2007.)

Figure 7.5 MRSA Surveillance Culture Letter for Patients

Dear Patient,

At _____, we are committed to providing you with the best of care. Because your health and safety are important to us, _____ is taking part in state and national patient safety programs to reduce the risk of transmission of antibiotic-resistant bacteria.

There are bacteria, or germs, both inside and outside the hospital of special concern because they are resistant to antibiotic treatments and can cause infection while patients are receiving medical care. Antibiotic resistance is a growing worldwide problem.

People can carry these germs in or on their body without symptoms, and they can unknowingly be passed from patient to patient if important steps are not taken. A very important bacteria that may be resistant to many antibiotics most commonly used to treat it is methicillin-resistant *Staphylococcus aureus* (MRSA). MRSA is commonly found on the skin or in the nose.

It is important for your healthcare providers to know if you are carrying MRSA, so specimens will be collected for MRSA tests. The first specimen is collected by simply swabbing the inside of your nose with a small sterile swab. Additional specimens may be collected throughout your stay.

If you are found to carry MRSA, you will be placed in “contact precautions” to help us prevent the spread of MRSA in the hospital. This means that health care staff (doctors, nurses, lab, radiology personnel, etc.) will be wearing gowns and gloves while caring for you. The presence of these bacteria does not require treatment unless you have an infection.

Please ask your nurse if you have any questions or concerns regarding this information about MRSA. Within approximately ____ hours after the swabs are collected, your nurse and or physician will share the results with you. If you have any questions regarding the results of these tests, please don't hesitate to ask.

Our staff is working hard to protect you from infection while you are in the hospital as well as to protect you from infection after you go home. Information about **MRSA** is available, and you can ask your nurse for this information at any time.

Thank you for choosing _____ for your health care needs.

(Thanks to Sheri Dirrigl RN, CIC, Infection Prevention and Control, Southern Maine Medical Center in Biddeford, Maine for the template from which this letter was created.)

Making the Business Case

Support from hospital leadership is essential in order to make the elimination of transmission of MRSA an **organizational patient safety priority** that is aligned with a culture of intolerance for hospital associated infections.

Many hospitals and other healthcare facilities and organizations have successfully employed various infection prevention and control strategies in the effort to reach the goal of zero hospital-associated infections (HAI). Any endeavor that is successful in eliminating HAI can be a model for best practice in the prevention and control of MRSA. Sharing the success stories from other hospitals and collaboratives with one's facility leadership can strengthen the infection prevention and control case for interventions and much needed resources.

For example, the Veteran's Administration, the Southwestern Pennsylvania Professionals in Infection Prevention and Control, and Evanston Northwestern Medical Center in Illinois have published their success stories in prevention of MRSA transmission and have demonstrated decreased hospital-associated infections. As noted in the Introduction to this Guide, the Michigan Hospital Association's Keystone Center program, a statewide initiative which focused on the elimination of infections ("no infection, no resistance"), has achieved and sustained zero infection rates for over eighteen months, without using ASC. The New England Journal of Medicine recently published an article by Pronovost that outlines the success of this approach to reach zero infections, which used bundling of evidence-based practices.³

Support and Resources

Leadership support is needed for development of personnel and supply resources teams, including infection prevention and control staff, laboratory, information systems, nursing, decision support and public relations, communication pathways, physician and staff buy-in, Board of Directors involvement, and community outreach as appropriate. In order to gain the needed leadership support for the human and fiscal resources, infection control professionals will have to identify and provide administration with an understanding of any barriers or dysfunctional processes that are contributing to the risk of transmission of MRSA in the facility. Facility-specific barriers may include staffing considerations, availability and quality of consumable and durable supplies and equipment, education and training of staff, communication processes, policies and procedures and compliance with current policies surrounding hand hygiene, isolation and cleaning.

Hard data from the hospital's infection prevention and control surveillance program, from financial leaders, and from quality initiatives provides valuable support. Presentations to leadership should include:

- Prevalence and incidence rates of MRSA among patients and staff
- Identification of any upward trends
- Financial burden of the facility's hospital-associated infection
- Relevant published data

As action plans for interventions or improvements are developed and implemented, administration must be updated on progress and needs. This is especially important wherever there are upfront costs for interventions. One of the most common problems encountered in efforts to prevent and control MRSA is cost; isolating patients requires additional supplies such as gowns and gloves, takes up additional staff time, may result in lost revenue if a bed must be blocked in a semi-private room, and requires additional cleaning. It must be clear to administrators that costs of the interventions can be less than the cost of NOT making the commitment and taking action.⁵

Reported Facts and Figures

Despite the efforts of the infection prevention and control community, the incidence of hospital-acquired MRSA (HA-MRSA) continues to increase. MRSA infections increase patient morbidity and mortality as well as hospital costs.

- An analysis of 55 studies determined that the cost of a hospital-acquired infection (HAI) with a non-resistant pathogen was determined to be \$13,973 compared to \$35,367 for a MRSA HAI.¹
- The death rate attributed to MRSA infections was estimated at more than 2.5 times higher than those attributed to an MSSA infection: 21 % versus 8 %.²
- HA-MRSA infections may result in additional diagnostic tests, therapeutic procedures, additional antibiotic treatment and extended hospitalization.⁶
- There is the possibility of legal action on the part of the patient or the patient's family associated with hospital-acquired MRSA infections.
- Societal costs associated with MRSA infections include loss of productivity, long-term disability, lost wages and excess mortality.⁶
- There are financial costs associated with additional antibiotic treatments.
- There are financial costs associated with intensified control interventions.

For example, a modeling study by Rahoud found that when the costs of screening are from one-third to one-half of the cost of care for one MRSA infection, screening at admission is cost effective if it prevents one MRSA infection every two or three years (approximately one infection per 24,000 to 36,000 patient-days).⁴

The February 2007 APIC publication [*“Dispelling the Myths: The True Cost of Healthcare-Associated Infection”*](#)⁸ by Denise Murphy, RN, BSN, MPH, CIC; Joseph Whiting, MBA, FACHE; and Christopher S. Hollenbeak, PhD is a valuable resource and tool for making the business case for eliminating hospital-acquired infections (HAI). It is available on the APIC Web site along with a newly-developed “HAI Cost Calculator” for use by infection prevention and control professionals in association with their colleagues in the hospital finance department.

A final word from Dunagan, Murphy, Hollenbeak, and Miller in [*“Making the Business Case for Infection Control: Pitfalls and Opportunities,” 2002:*](#)⁷

“Never lose sight of the compelling ethical case for IC programs: preventing morbidity and mortality associated with the unfortunate consequences of health care. While not an economic argument, this ethical base provides a strong motivation for not being discouraged by the difficulties one may encounter in making the business case.”

Cited References [\[Click on references in blue to access hyperlinks to articles\]](#)

1. Stone PW, Larson E, Kavar LN. A systematic audit of economic evidence linking nosocomial infections and infection control interventions: 1990-2000. *Am J Infect Control*. 2002;30:145-152.
2. Rubin RJ, Harrington CA, Poon A, Dietrich K, Greene JA, Moiduddin A. The economic impact of *Staphylococcus aureus* infection in New York City hospitals. *Emerg Infect Dis*. 1999;5:9-17.
3. Pronovost P, Needham D, Berenholtz S, Sinopoli D, Chu H, Cosgrove S, Sexton B, Hyzy R, Welsh R, Roth G, Bander J, Kepros J, Goeschel C. An intervention to decrease catheter-related bloodstream infections in the ICU. *Engl J Med*. 2006 Dec 28;355(26):2725-32.
4. Raboud J, Saskin R, Simor A et al. Modeling transmission of methicillin-resistant *Staphylococcus aureus* among patients admitted to a hospital. *Infect Control Hosp Epidemiol*. 2005;26:607-15.
5. Diekema DJ, Edmond MB. Look before you leap: Active surveillance for multidrug-resistant organisms. *CID* 2007;44 (15 April)
6. Grundmann H, Aires-de-Sousa M, Boyce J, Tiemersma E. Emergence and resurgence of methicillin-resistant *Staphylococcus aureus* as a public-health threat. *Lancet*. 2006;368:874-885.
7. Dunagan WC, Murphy DM, Hollenbeak CS, Miller SB. Making the business case for infection control: pitfalls and opportunities. *Am J Infect Control*. 2002;30:86-92.
8. Murphy D, Whiting J, Hollenbeak CS. Dispelling the Myths: The True Cost of Healthcare-Associated Infections. APIC Briefing; February 2007. Available at: http://www.apic.org/Content/NavigationMenu/PracticeGuidance/Reports/hai_whitepaper.pdf. Accessed March 9, 2007.

Cultural Transformation

Hospital-associated colonization or infection with MRSA is not representative of a deficit in technology or knowledge but is primarily a cultural problem.

If viewed as a cultural problem, the solution must be to change or transform that culture. Historically, attempts at cultural change have utilized ideas imported from industrial models or enforced “best practices” either from within a facility or from another facility. Such attempts at cultural change produce a “natural professional immune response,” or more simply, rejection of a change imposed from an external source. As such, the change is not likely to be culturally appropriate.

Changing the attitudes and values of an organization requires supportive leadership and a committed and engaged workforce. Leadership must adopt new ways of doing business that allow staff to share in identification and resolution of system faults. By involving staff in discovering ways to implement change, the changes are always culturally appropriate for those staff.

Giving health care workers the freedom and the opportunity to create solutions, then implementing and amplifying those solutions, fosters cultural change from within. Discovering and identifying isolated ideas suggested by staff, and then amplifying those results in 100 small ideas or solutions produces 1,000 times the impact in the culture of the organization. This type of internally driven transformation is, therefore, culturally appropriate.

Positive Deviance (PD) is an approach to behavior and social change that uses such a dynamic. This cultural transformation occurs from the inside out. It is based on the observation that in most hospitals, there are individuals or groups of individuals (Positive Deviants) whose special practices enable them to find better solutions than their peers to seemingly impossible barriers, even though they all have access to the same resources.

Positive Deviance enables the community to discover existing successful yet uncommon behaviors/strategies and elicit new solutions or ideas from within. PD focuses on practice rather than knowledge. In the words of Jerry Sternin, a world expert in the application of Positive Deviance, “It’s easier to act your way into a new way of thinking, than to think your way into a new way of acting.” The presence of Positive Deviants demonstrates that it is possible to find successful solutions TODAY, before all the underlying causes are addressed.

Additional information about Positive Deviance and how to apply it at your organization can be found at www.positivedeviance.org.

Decolonization

Key Concepts

Although it is not routinely recommended to attempt MRSA decolonization, there are circumstances in which decolonization can be considered.

- Elimination of MRSA colonization (decolonization) has been suggested as a MRSA control and prevention measure when there is ongoing MRSA transmission in a well-defined cohort group having close contact.
- Decolonization has been suggested as a patient management strategy when a clinician determines that a patient may benefit clinically from decolonization.

MRSA colonization recurs in a significant number of decolonization attempts, and despite short-term benefits, long-term MRSA decolonization success is questionable.

Decolonization may lead to the selection of high- or low-level, mupirocin-resistant MRSA strains in treated patients and in patient populations.

Background

Decolonization strategies have been used with varying success in select patient or clinical situations including: 1) eradication of known MRSA colonization prior to select, elective surgeries,^{4, 5, 6} 2) MRSA decolonization of patients, residents, and/or healthcare staff implicated in transmission during outbreak situations, and 3) elimination of MRSA carriage in patients with recurrent MRSA infections.

The CDC guideline “Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006” states that MRSA decolonization is not sufficiently effective to warrant routine use.¹ (See section V.B.9. Decolonization) Guidance documents published on community-associated MRSA in the public health arena,² for military and correctional settings, and the IDSA guideline³ on treatment of skin and soft tissue infections, similarly recommend against routine decolonization. However, these guidelines do support the use of decolonization when there is ongoing MRSA transmission in a well-defined cohort group having close contact, or when a clinician determines that a patient may benefit clinically from decolonization and is at high risk for MRSA infection.

Decolonization Considerations for Hospitals

Infection Prevention and Control Strategy related to patient decolonization

In the **Tier 1** strategy of the CDC/HICPAC guideline “Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006,” decolonization is not considered a routine MRSA prevention and control intervention in hospital settings.

In **Tier 2**, when intensified MRSA control efforts are necessary, decolonization may be considered as part

of a control program for a limited time and for select colonized patients or healthcare workers on a case-by-case basis after consultation with infectious disease experts.^{7,9}

If a decolonization strategy is implemented in a hospital, monitors must be put in place to detect emerging mupirocin. Laboratory protocols for detecting mupirocin resistance must be developed and used with all *Staphylococcus aureus* isolates.¹⁰

Infection Prevention and Control Strategy Related to Healthcare Worker Decolonization

Healthcare worker decolonization is indicated only as a prevention and control intervention when a healthcare worker is chronically colonized with MRSA and has been epidemiologically implicated in ongoing transmission of MRSA to patients. See section V.B.9. “Decolonization” in CDC/HICPAC “Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006.”

MRSA Decolonization Regimens

In a hospital setting, decolonization may be attempted when a patient will benefit clinically (as determined by expert medical opinion), or as an intervention when there is an identified MRSA transmission problem in a patient unit or patient population. Therefore, a standardized regimen for decolonization should be established. Although optimal regimens have not yet been definitively established, expert opinion is that an MRSA decolonization regimen should include:

- Nasal decolonization with intranasal topical mupirocin (BID for 5 days) and/or,
- Oral antimicrobials (usually rifampin and trimethoprim-sulfamethoxazole or rifampin and doxycycline or rifampin and minocycline)
- Skin antisepsis (e.g., chlorhexidine baths) concurrently with the decolonization regimen⁸

Notes:

1. Rifampin should never be used singly to treat MRSA infection or colonization.
2. Recent studies from Sweden and Switzerland indicate that the throat may serve as a reservoir of MRSA and, therefore, may confound attempts to eradicate MRSA in any colonized patient.

Surveillance During the Intervention Period

During an intervention that includes decolonization, both MRSA transmission rates and *Staphylococcus aureus* mupirocin resistance must be monitored. The effectiveness of the decolonization intervention will depend on the ability to eliminate MRSA transmission while avoiding mupirocin resistance.

Discontinue the routine use of mupirocin nasal decolonization when MRSA transmission rates decrease significantly and consistently over time, or when mupirocin resistance and/or decolonization failures increase. Judicious use of mupirocin for decolonization will help to insure continued efficacy when it is medically indicated for patient management.

Practice Tools

The following (*Example 1*) is an example from the Navy Environmental Health Center of a decolonization regimen that may be used if clinically indicated.¹¹

Example 1: Regimen for Decolonization.

Mupirocin	<ul style="list-style-type: none"> • Apply approximately one-half of 2% calcium mupirocin ointment from the 1 gm single-use tube (Bactroban®) into one nostril and the other half of the ointment to the other nostril. • The individual should press the sides of the nose together and gently massage to spread the ointment throughout the inside of the nostrils. • Continue twice daily for 10 days, avoiding contact of the medication with the eyes. 24
Chlorhexidine*	<ul style="list-style-type: none"> • Rinse area thoroughly with water, avoiding excessively hot or cold water. • Wash gently from the neck down with the minimum amount of Hibiclens® as necessary. • Rinse thoroughly with warm water. • Continue one daily for 5 days.
<p>*Hibiclens®, containing 4% chlorhexidine gluconate, is known to be toxic. The manufacturer provides the following precautions when using Hibiclens®: Hypersensitivity reactions may occur, particularly in the genital area. Keep away from face and head, since middle ear contact has lead to deafness and permanent eye injury may occur following prolonged contact.</p>	

Cited References *[Click on references in blue to access hyperlinks to articles]*

1. Siegel JD, Rhineheart E, Jackson M, Linda C; Healthcare Infection Control Practices Advisory Committee. Management of multidrug-resistant organisms in healthcare settings, 2006." Available at <http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf>. Accessed February 27, 2007.
2. Borlaug G, Davis JP, Fox BC. Community Associated methicillin-resistant *Staphylococcus aureus*: guidelines for clinical management and control of transmission. Wisconsin Division of Public Health; October 2005.
3. Infectious Disease Society of America (IDSA). Practice guidelines for the diagnosis and management of skin and soft-tissue infections. *Clin Infect Dis*. 2005;41:1373-1406. Available at <http://www.journals.uchicago.edu/CID/journal/issues/v41n10/37519/37519.html>. Accessed February 27, 2007
4. Nicholson MR, Huesman LA. Controlling the usage of intranasal mupirocin does impact the rate of *Staphylococcus aureus* deep sternal wound infections in cardiac surgery patients. *Am J Infect Control*. 2006;34:44-48.
5. Perl T. Prevention of *Staphylococcus aureus* infections among surgical patients: Beyond traditional perioperative prophylaxis. *Surgery*. 2003;134:S10-S17.
6. Konvalinka A, Errett L, Fong IW. Impact of treating *Staphylococcus aureus* nasal carriers on wound infections in cardiac surgery. *J Hosp Infect*. 2006;64:162-168.
7. Loeb M, Main C, Walker-Dilks C, Eady A. "Antimicrobial drugs for treating methicillin-resistant *Staphylococcus aureus* colonization." Cochrane Library review of six decolonization studies: no evidence to support nasal or extra-nasal decolonization. <http://www.mrw.interscience.wiley.com/cochrane/clsysrev/articles/CD003340/frame.html> (Date of last substantial Update: August 25, 2003). Accessed February 27, 2007
8. Simor AE, Phillips E, McGeer A, et al. Randomized controlled trial of chlorhexidine gluconate for washing, intranasal mupirocin, and rifampin and doxycycline versus no treatment for the eradication of methicillin-resistant *Staphylococcus aureus* colonization. *Clin Infect Dis*. 2007;44:178-185.
9. Henderson DK. Managing methicillin-resistant staphylococci: a paradigm for preventing nosocomial transmission of resistant organisms. *Am J Med*. 2006;119(6 Suppl 1):S45-S52.
10. Deshpande LM, Fix AM, Pfaller MA, Jones RN; SENTRY Antimicrobial Surveillance Program Participants Group. Emerging elevated mupirocin resistance rates among staphylococcal isolates in the SENTRY Antimicrobial Surveillance Program (2000): correlations of results from disk diffusion, Etest and reference dilution methods. *Diagn Microbiol Infect Dis*. 2002;42: 283-290.
11. Navy Environmental Health Center. Guidelines for the Management of Community-Acquired Methicillin-Resistant *Staphylococcus aureus* (CA-MRSA) Infections in the U.S. Navy and Marine Corps. May 2005. Available at http://www-nehc.med.navy.mil/Downloads/prevmed/CPG_MRSA_20050516_final.pdf.

Antimicrobial Stewardship

Best practice programs for the management of MRSA in the hospital setting are comprised mainly of interventions that directly impact MRSA transmission. However, there is significant benefit from interventions that have indirect or supplemental impact on MRSA prevention and control. An essential supplemental strategy that will affect long-term, sustainable MRSA management is antimicrobial stewardship.

Antimicrobial stewardship may be defined as “the effective and responsible management of the use of antimicrobials in a given setting.” In the CDC’s Campaign to Prevent Antimicrobial Resistance, antimicrobial stewardship strategies are listed in steps five through 10 under the heading of “Use Antimicrobials Wisely.”¹

Step 5. Practice antimicrobial control Engage in local antimicrobial control efforts	Step 9. Know when to say “no” to vanco Treat infection, not contaminants or colonization Fever in a patient with an intravenous catheter is not a routine indication for vancomycin
Step 6. Use local data Know your antibiogram Know your patient population	Step 10. Stop antimicrobial treatment: When infection is cured When cultures are negative and infection is unlikely When infection is not diagnosed
Step 7. Treat infection, not contamination Use proper antisepsis for blood and other cultures Culture the blood, not the skin or catheter hub Use proper methods to obtain and process all cultures	
Step 8. Treat infection, not colonization Treat pneumonia, not the tracheal aspirate Treat bacteremia, not the catheter tip or hub Treat urinary tract infection, not the indwelling catheter	

Guideline Recommendations:

The CDC/HICPAC “Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006” does not make specific recommendations regarding antimicrobial stewardship. The relative importance of antimicrobial stewardship as a specific control measure for MRSA remains unclear. However, it does note that judicious antimicrobial use is crucial to the management of MDRO in hospitals.²

The 2007 guideline from the Infectious Diseases Society of America (IDSA) and the Society for Healthcare Epidemiology of America (SHEA) recommends two core strategies for hospital antimicrobial stewardship programs:³

- Prospective audit of antimicrobial use with direct interaction and feedback to the prescribing physician

- Formulary restriction and preauthorization for immediate and significant reductions in response to a nosocomial outbreak with monitors to assess and respond to unanticipated and unfavorable changes in resistance after implementing restrictions (B-III).

The core members of a comprehensive hospital antimicrobial management program are infectious diseases physicians, clinical pharmacists with infectious disease training, infection control professionals, hospital epidemiologists, clinical microbiologists, and information system specialists.

Additional strategies that will positively impact judicious antibiotic use include:

- Education related to clinical treatment strategies and related hospital processes
- Streamlining or de-escalating of empiric antibiotic therapy based on culture results
- Evidence-based practice guidelines derived from local organism-specific resistance patterns
- Antimicrobial order forms with automatic stops requiring physician justification for continuation
- Computer-assisted programs

There is insufficient evidence to recommend the following:

- Antibiotic cycling
- Combination therapy to prevent resistance

Role of Susceptibility Testing in Antibiotic Stewardship

Reported susceptibility patterns for each clinical isolate is essential and should be readily assessable by physicians and pharmacists to assure that the “right bug” is getting the “right drug” throughout the treatment regimen. The IDSA/SHEA guideline acknowledges that the clinical microbiology laboratory play a critical role in antimicrobial stewardship by providing patient-specific culture and susceptibility data by assisting infection control efforts in the surveillance of resistant organisms and in the molecular epidemiologic investigation of outbreaks.

Susceptibility testing results should be compiled into antibiograms for MRSA and for other significant pathogens. Antibiograms include local and up-to-date susceptibility/resistance information and are used to guide treatment decisions regarding appropriate empiric choices of antibiotics. Infection prevention and control professionals must support and facilitate the process of antibiogram development with the hospital laboratory and pharmacy teams.

An Antibiotic Stewardship Success Story

Fishman, N. “Antimicrobial Stewardship” in *Am J Infect Control*. 2006 Jun;34(5 Suppl 1):S55-63. “Comprehensive control: The Hospital of the University of Pennsylvania (HUP) program as a paradigm.”

Excerpted: “When the HUP program was used to prescribe antimicrobials, antibiotic use was more appropriate and there was an increased cure rate and a decreased failure rate. There was also a trend toward decreased emergence of resistance, although the sample size and duration of follow-up in this study was too short to draw any significant conclusions.”

The HUP program was also associated with significant economic advantages for the institution compared with usual practice. Annual savings (600 interventions per month) amounted to \$302,400 for antibiotic costs, \$533,000 for infection-related costs, and >\$4.25 million in total costs, measured from the time of the intervention to the time of hospital discharge. The majority of the cost savings may be attributable to a decreased length of stay in the intensive care unit (ICU), although the total hospital length of stay in the study was unchanged.

In order to ensure appropriate antibiotic use and to have a real impact on emergence of resistance, one would need to ensure that antibiotics are used appropriately in all settings, including long-term care facilities, community hospitals, the community in general (particularly in the ambulatory setting), and also in the animal industry.

Cited References *[Click on references in blue to access hyperlinks to articles]*

1. CDC's Campaign to Prevent Antimicrobial Resistance Available at http://www.cdc.gov/drugresistance/healthcare/ha/12steps_HA.htm. Accessed February 27, 2007.
2. Siegel JD, Rhineheart E, Jackson M, Linda C; Healthcare Infection Control Practices Advisory Committee. "Management of multidrug-resistant organisms in healthcare settings, 2006." Available at <http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf>. Accessed February 27, 2007.
3. Dellit TH, Owens RC, McGowan JE Jr; Infectious Diseases Society of America; Society for Healthcare Epidemiology of America. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clin Infect Dis*. 2007;44:159-177. Available at <http://www.journals.uchicago.edu/CID/journal/issues/v44n2/41270/41270.html>. Accessed February 27, 2007.
4. MacDougall C, Polk RE. Antimicrobial stewardship programs in health care systems. *Clin Microbiol Rev*. 2005; 18:638-656. Available at <http://www.pubmedcentral.nih.gov/articlerender.fcgi?tool=pubmed&pubmedid=16223951>. Accessed February 27, 2007
5. Fishman N. Antimicrobial stewardship. *Am J Infect Control*. 2006 Jun;34 (5 Suppl 1):S55-63; discussion S64-73.

Appendix

Environmental Services Checklist Audit Checkout Cleaning (Patient Discharge)

* Check for Isolation sign	Yes	No
1. High Dust		
a. Ledges: Shoulder and higher		
b. Vents		
c. Lights		
d. Lights (Bathroom)		
e. TV-- rotate all ledges		
f. TV cabinet		
g. Screen and wires		
h. Gi to ES cart and gently remove dust		
2. Damp Dust		
<i>Cloth (rag) and spray bottle of disinfectant-- damp wipe all surfaces in the room</i>		
a. Ledges (shoulder high)		
b. Door handles		
c. Door hinges		
3. Bed (top to bottom, head to foot, left to right)		
<i>Bring bed up to highest position</i>		
a. Raise mattress and disinfect top, sides, and bottom		
b. Disinfect exposed frame, springs, or bed panels		
c. Headboard: disinfect top, front, and back		
d. Disinfect side rails, undercarriage, and lower ledges		
e. Disinfect all bed controls		
f. Disinfect the footboard (top, front, back)		
g. Allow moisture to dry before placing linen on bed		

	Yes	No
4. <i>Over Bed Table</i>		
a. Disinfect surface and legs		
b. Two-layer table top		
c. Wipe out drawer		
d. Wipe off mirror		
5. <i>Bedside Table</i>		
a. Disinfect surface and legs		
b. Wipe out drawer		
6. <i>Glass Surfaces</i>		
a. Wall Spots		
7. <i>Bathroom (toilet bowl mop), All Surfaces</i>		
a. Use toilet chemical, allow to stay		
b. Run all hot water faucets for 5 minutes		
c. Ledges in bathroom		
d. Door handles		
e. Sink surfaces		
f. Wipe down toilet surface/ apply paper barrier		
8. <i>Shower Stall and Faucets</i>		
a. Run hot water for 5 minutes		
b. Leave showerhead dangling down (after running hot water)		
c. Wipe down walls, curtain, check for signs of mildew		
9. <i>Floor Disinfection-- Sign on Door</i>		
a. Wet mop head in disinfectant		
b. Mop (Farthest from door) 1/2 way room		
c. Bathroom shower floor		
d. Bathroom floor		
e. Flip mop head-- do remainder of room		