An APIC Guide

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

APIC

ASSOCIATION FOR PROFESSIONALS IN INFECTION CONTROL & EPIDEMIOLOGY, INC.

APIC's mission is to improve health and patient safety by reducing risks of infection and other adverse outcomes. The Association's more than 11,000 members have primary responsibility for infection prevention, control and hospital epidemiology in health care settings around the globe, and include nurses, epidemiologists, physicians, microbiologists, clinical pathologists, laboratory technologists and public health practitioners. APIC advances its mission through education, research, collaboration, practice guidance and credentialing.

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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 multidrug-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.

CDC Campaign to Prevent Antimicrobial Resistance in Healthcare Settings

http://www.cdc.gov/drugresistance/healthcare/problem.htm

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.

Increasing Prevalence of Multidrug 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

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 personnel[9] 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.
>
> http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf
>
> 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.

http://www.shea-online.org/Assets/files/position_papers/SHEA_MRSA_VRE.pdf

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.

http://www.ihi.org/ihi

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. A statewide initiative, the Michigan Hospital Association's Keystone Center program, 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. 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).

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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 Multidrug Resistant Organisms (MDRO) in Healthcare Settings, 2006" recommends monitoring trends in the incidence* of a target 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 IA
**number of new MDROs divided by the size of the population under consideration.*

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

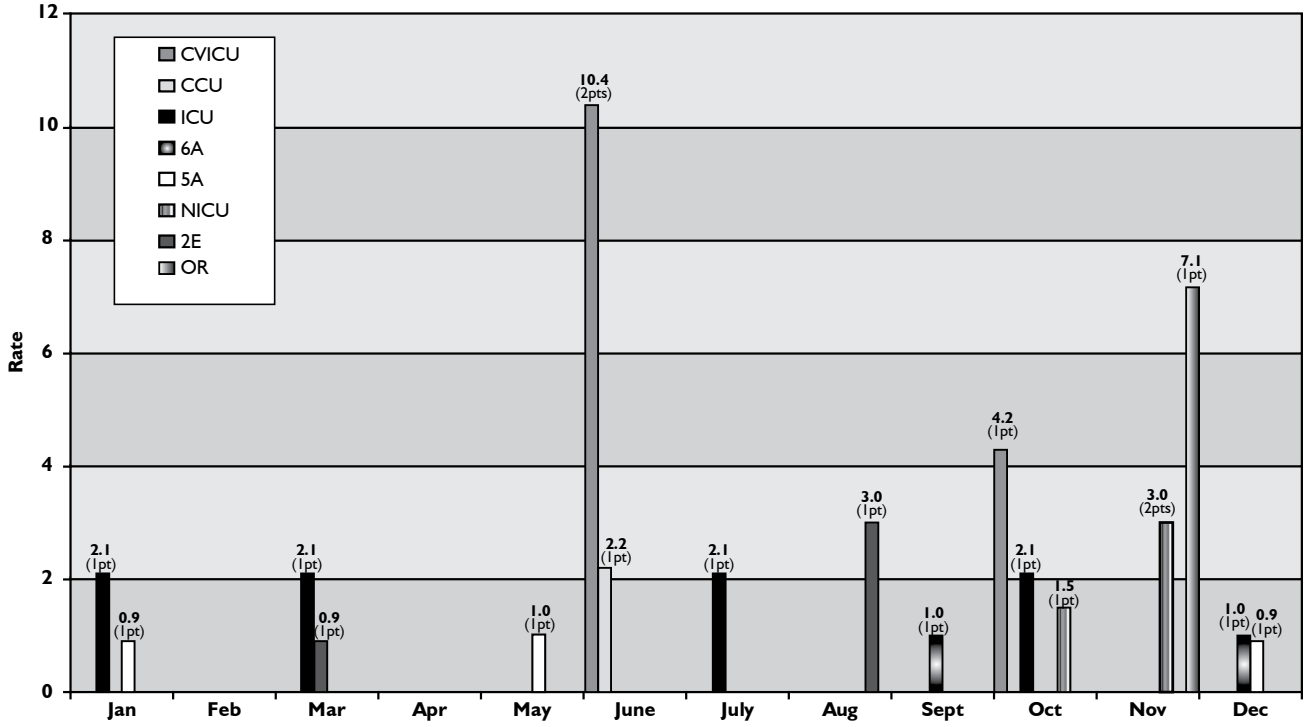
During a period of rising MRSA rates, the infection prevention and control department implements a program of surveillance for new cases of MRSA on each inpatient unit. Transmission of MRSA in the hospital setting is assumed if the new case of MRSA meets the hospital's case definition of hospital-associated 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. (*See Figure 1.*)

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

Data is analyzed in order to evaluate MSRA 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.

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



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

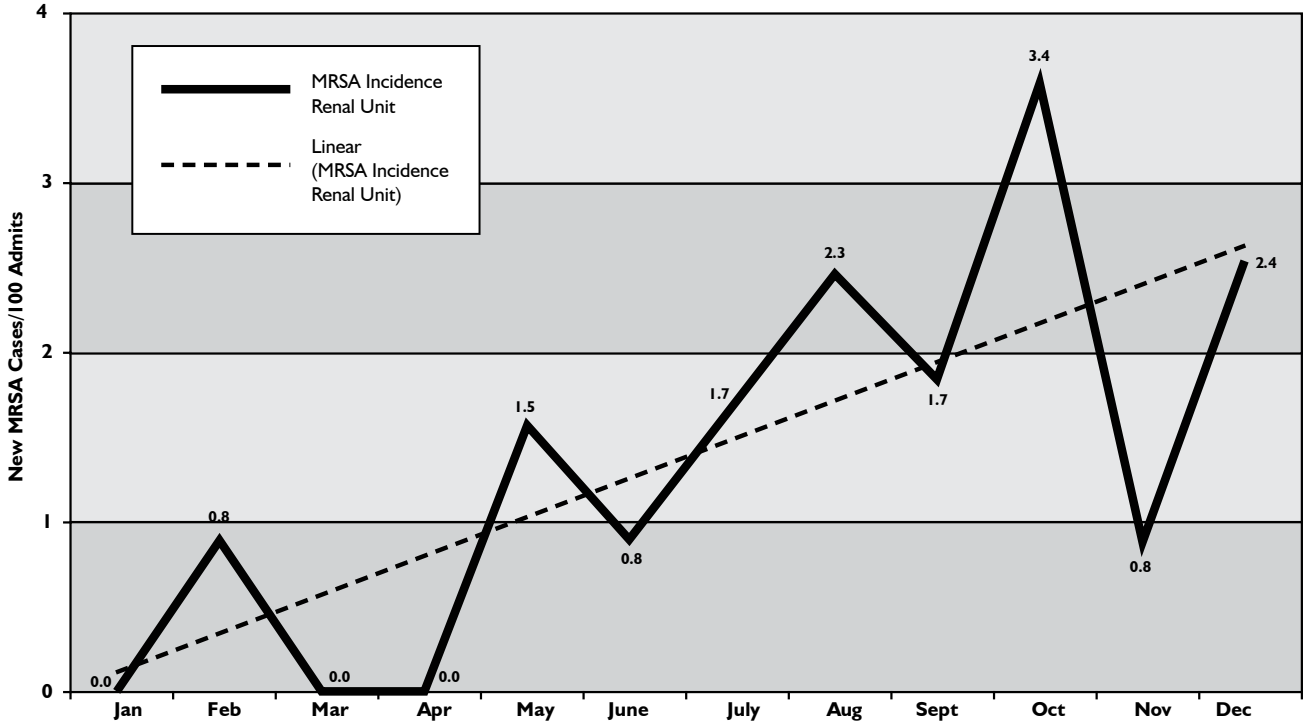
Example 2: MRSA assessment and intervention (hypothetical scenario)

In this next example, an MRSA assessment reveals that the incidence of MRSA bacteremia in the inpatient renal unit is trending upward over time.

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

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). 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. (*See Figure 2.*)

Figure 2. MRSA Bacteremia - Renal Unit



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 showed 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.

- 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.

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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 Guidelines

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. In Chapter 3 of the *2005 APIC Text of Infection Control and Epidemiology*, the elements of a surveillance program are outlined and explained.[1]

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,[2] veterinary clinic personnel,[3] hemodialysis patients,[4] etc.) should also be collected.[5]

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.[6,7]

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 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

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.

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

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. 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.

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

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 conditions.

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.

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

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, so it is decided to implement active surveillance cultures on that unit as a trial, with appropriate measure taken based on results.

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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. The importance of hand hygiene in the elimination of MRSA transmission can not 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. Implement a hand hygiene program including all levels of healthcare providers and other patient contact workers.
2. Ask visitors to wash or use an alcohol-based hand rub on entering and leaving the room.
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.
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. Hold health care providers and administrators accountable for implementing a culture that supports and promotes appropriate hand hygiene practices.

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"* is available at http://www.ihi.org/IHI/Topics/CriticalCare/IntensiveCare/Tools/HowtoGuideImprovingHandHygiene.htm

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.

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Contact Precautions for MRSA

Compliance with isolation precautions for patients colonized or infected with MRSA is essential to eliminate transmission of MRSA in the hospital setting. Many studies have documented the transmission risk of MRSA and other multidrug-resistant organisms from infected and/or colonized patients, and from contaminated equipment and supplies and the environment.

Basic Components:

The elements of Contact Precautions are well-established for hospital settings and are derived from the CDC Guideline for Isolation Precautions in Hospitals, 1996.

In addition to standard precautions:

- Place the patient in a private room. When a private room is not available, place the patient in a room with a patient(s) who has active MRSA infection but with no other infection (cohorting). *Category IB*
- Wear clean, non-sterile gloves when entering the room. Change gloves after having contact with infective material (fecal material and wound drainage). Remove gloves before leaving the patient's room and perform hand hygiene immediately. After glove removal and hand washing, ensure that hands do not touch potentially contaminated environmental surfaces or items in the patient's room to avoid transfer of microorganisms to other patients or environments. *Category IB*
- Wear a clean, non-sterile gown when entering the room to avoid contamination of clothing by contact with the patient or environmental surfaces. Remove the gown before leaving the patient's environment, and ensure that clothing does not become contaminated by environmental surfaces to avoid transfer of microorganisms to other patients or environments. *Category IB*
- Limit the movement and transport of the patient from the room to essential purposes only. If the patient is transported out of the room, take measure to prevent the risk of transmission of MRSA to other patients and environmental surfaces or equipment. *Category IB*
- Use dedicated non-critical patient-care equipment while patient is on contact precautions. Adequately clean and disinfect common equipment that is not dedicated to the patient before use with another patient. *Category IB*

Contact precautions are a routine (Tier 1) strategy of the CDC guidance document "Management of MDRO in Healthcare Settings, 2006" for patients colonized or infected with MRSA.[4,5,6,7]

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)

The ideal situation for a hospital that is admitting a patient is to know the MRSA status of the patient at the time of admission. Unfortunately, this is rarely possible unless there are current culture results available at the time of admission.

Hospitals must make decisions regarding room placements of patients who are in high risk groups or who are candidates for ASC as identified by the MRSA risk assessment. Many factors will have to be considered when establishing criteria for the timing of contact precautions:

- 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 all or any 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. When a patient who is not known to have MRSA is admitted to a hospital, there is very little research regarding how long it takes before the lack of isolation leads to significant risk of transmission of MRSA. 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. The following are a few examples of possible options for patient placement on admission.

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.
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 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 be increased.

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.[8]
- 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.[9,10,11]
- Monitor adherence with contact precautions and implement corrective actions as indicated.[9,10,11]
- Monitor adherence to environmental sanitation policies.[11,12]
- Educate all staff on risks of transmission of MRSA and of prevention measures at time of orientation and during annual competencies.[13]
- Communicate and re-educate when new processes related to elimination of transmission of MRSA are implemented.
- Communicate and re-educate when rates of compliance with processes related to elimination of transmission of MRSA show inadequate results.
- Communicate and re-educate when rates of transmission of MRSA are not decreasing and celebrate when rates are decreasing.
- Communicate and celebrate when rates of transmission of MRSA 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.

Sample monitoring tool for contact precautions:

MRSA CONTACT PRECAUTIONS

Monitoring Tool

Patient Care Unit/Dept.:_____ Day of Week: _____ Date: _____

Initials of Monitor: _____ Time: _____AM/PM to _____AM/PM

Healthcare Worker (HCW) Type:

1 = Physician
2 = physician assistant
3 = nurse
4 = nursing assistant
5 = respiratory therapy
6 = patient transporter
7 = PT/OT
8 = housekeeping
9 = dietary

Key:

Y = Yes
N= No
N/A = Not Applicable

HEALTH CARE WORKER TYPE									
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									

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Environmental and Equipment Decontamination

Survival of MRSA in the Hospital Environment

Staphylococci, including MRSA, can survive in the environment. In a study by Neely and Huang, 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 setting.

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 hospital surfaces in patient acquisition of MRSA in the hospital. In a study on environmental contamination conducted by Hardy 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, Boyce 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 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 the appropriate contact time for germicidal agents must be emphasized. 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. In areas experiencing high endemic MRSA rates, increasing the frequency of cleaning and disinfection for areas with substantial hand contact is warranted.

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 Appendix A of this package, there is an environmental services checklist audit for daily cleaning and discharge cleaning.

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Surveillance Cultures

Key Concepts

- Surveillance MRSA cultures are useful in epidemiologic studies of the prevalence, incidence and/or transmission of MRSA.
- Surveillance MRSA cultures may be done for the purpose of discontinuation of contact precautions.
- 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.

Active Surveillance Cultures (ASC)

The 2006 MDRO guideline recommends a two-tiered approach to the management of MDRO in healthcare settings. The first tier includes routine surveillance activities that can identify evolving MRSA problems (e.g., increased MRSA transmission) and safeguards for managing unidentified MRSA carriers. The second tier of enhanced control efforts is used when incidence or prevalence is not decreasing despite implementation of and correct adherence to the routine infection control measures.

One useful MRSA management intervention is active surveillance cultures (ASC). Most hospitals will use ACS as part of second tier of interventions when enhanced control efforts are needed.

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*

ASC Legislation

Although ASC may be indicated in a given hospital based on the risk assessment, surveillance results and prevention intervention strategies, legislation requiring active surveillance for all patients or select patients groups is not justified or desirable. (See the position paper "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.")

ASC Specimens

Patients who have MRSA infections will be positive for MRSA at the site of their infection as well as at other body sites that have become colonized. Patients who are colonized carry MRSA 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).

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 ASC screens. However, additional screens may be impractical in terms of cost, time, resources and results.

The minimal specimen requirements for ASC are the anterior nares and areas of active skin breakdown or draining wounds.

Identifying Patients Who Should Have ASC Screens

Patients or patient populations eligible for an MRSA ASC program will have been identified by the hospital risk assessment, and may 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

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. 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.

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. 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.

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.

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 day of admission to the unit and 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

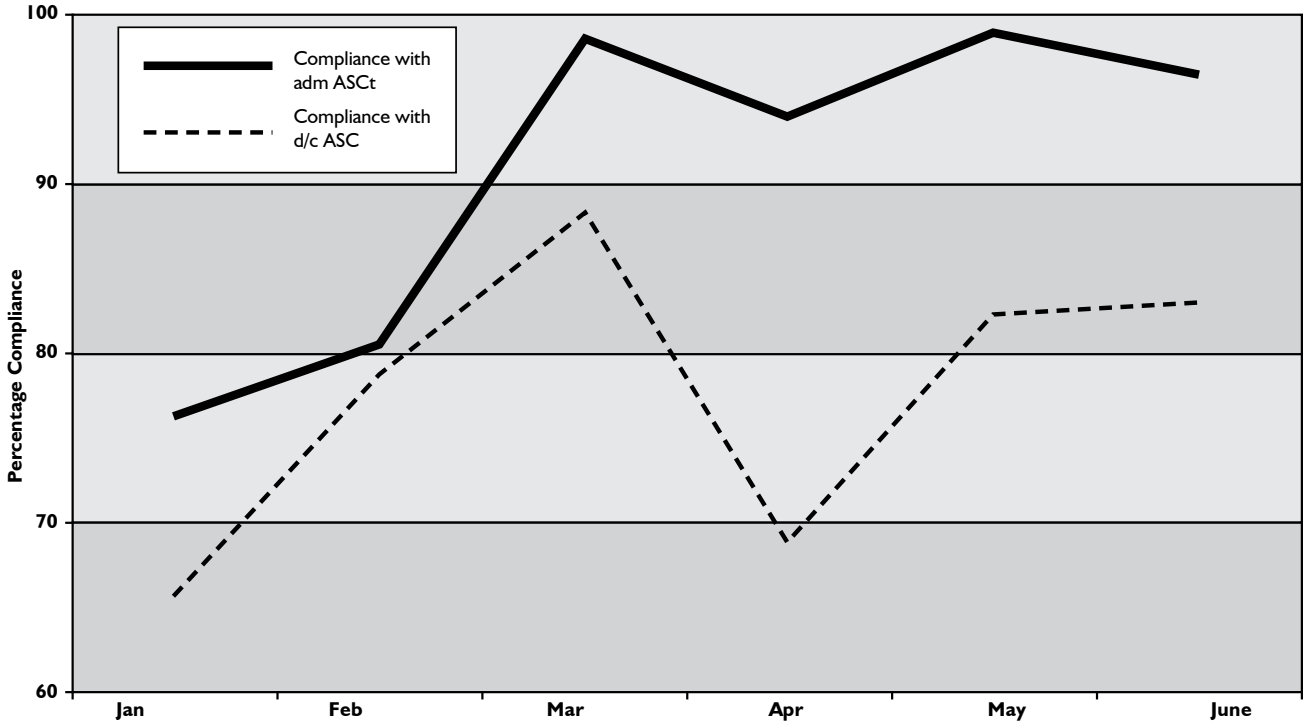
Monitor: MRSA liaison in the Infection Prevention and Control department keeps a line listing of all patients admitted to the SICU. Compliance with obtaining surveillance cultures is compiled weekly and posted on the SICU communication board. The ASC Team for SICU evaluates compliance with the process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

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

TABLE 1. SICU Patient Data.

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

Figure 3. SICU ASC Collection Compliance



Example 3: Compliance Report
Discussion: Team should work to improve compliance with obtaining discharge surveillance cultures.

Timing of Specimen Collection for ASC

A simple ASC program would include nasal swab of candidate patients at the time of admission to the hospital or unit and at the time of discharge or transfer from the hospital or unit.

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 (pick a weekday that works best for the unit)

This captures important data when lengths of stays are extended.

There may be other options that better suit the needs of a given ASC program. Timing of specimen collections should be customized to meet surveillance and/or intervention needs.

Communication about ASC:

Physicians and Healthcare Providers usually view cultures as tools in the management of a patient's clinical condition. Surveillance cultures, however, are tools used in infection prevention and control efforts. Therefore, effective communication and collaboration with medical and clinical staff 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 MRSA program surveillance and the goal of elimination of MRSA transmission in the hospital should be regularly shared in meetings, on process improvement bulletin boards, infection control newsletters 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.

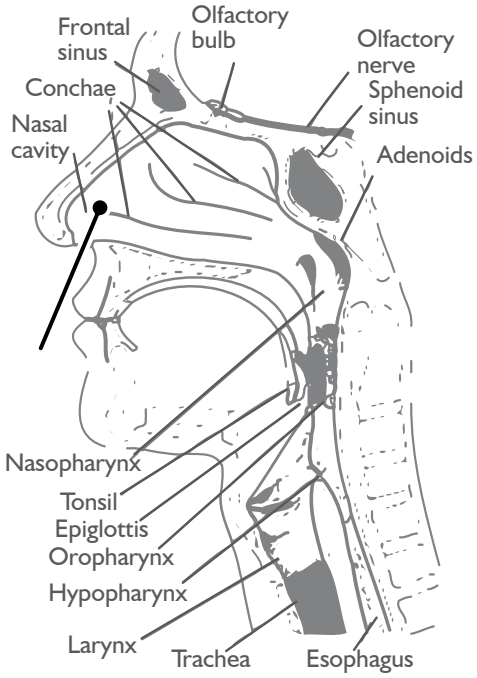
Patients and families also have the right to know and understand the reasons for active surveillance cultures. A patient letter about surveillance cultures, informational scripts for patient caregivers and MRSA fact sheets should be developed prior to the implementation of the ASC program. Patient and family satisfaction regarding care can be enhanced when the communication is clear and questions are honestly and correctly answered.

The 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.

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

Figure 4. Nasal Specimen Collection *(adapted from The Merck Manual online—Second Home Edition)*



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., CHROMagar Microbiology, Paris, France) can be used for identification of MRSA nasal colonization in 24-48 hours without requiring any additional 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.

An important MRSA surveillance consideration when comparing these methodologies is the length of time it takes to get results that will influence infection prevention and control interventions. (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 and FTE requirements.

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; and "Designing a Program to Eliminate MRSA Transmission Part II: Making the Business Case," Dr. Robicsek – January 10, 2007.

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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.

Universal surveillance was chosen because we were not able to detect a sufficiently high percentage of MRSA colonized patients using targeted surveillance. Our findings demonstrating this are in *Table 2*.

TABLE 2. 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, molecular diagnostic testing was expanded so rapid PCR results would be available daily. Patient education information sheets were developed. Patient care technicians and nurses were instructed on how to perform the PCR test. MRSA screening kits containing double-headed swabs and education sheets on how to perform PCR swabbing were distributed throughout the system.

The first outcome measures we used to determine medical benefit was to track hospital-acquired MRSA bloodstream infections and respiratory infections. A hospital-acquired MRSA bacteremia and respiratory infection was defined 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 5). Respiratory cases ranged from 62 to 54 in three previous years and lowered to 28 after implementation (Figure 6).

Figure 5. Hospital-acquired Bloodstream Infection.

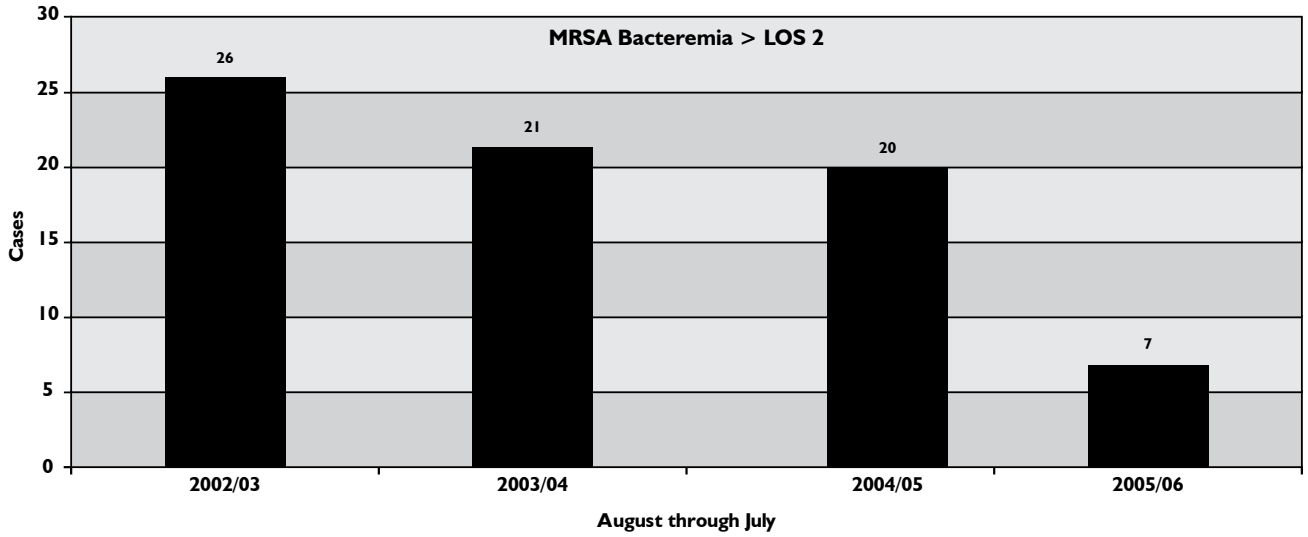
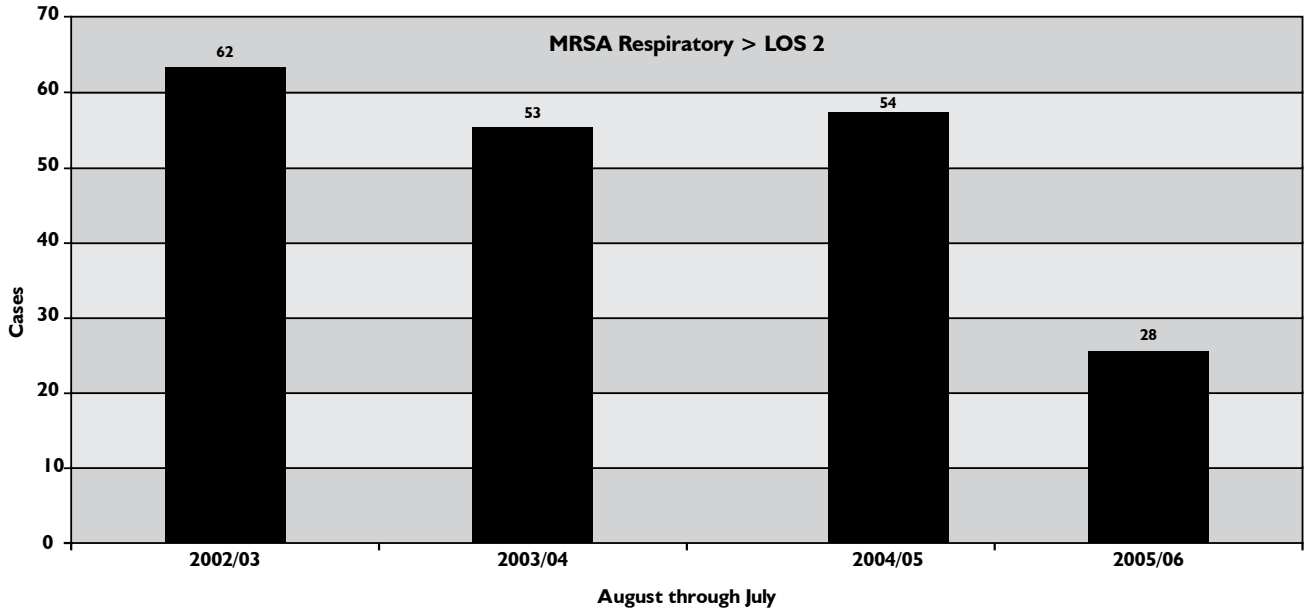
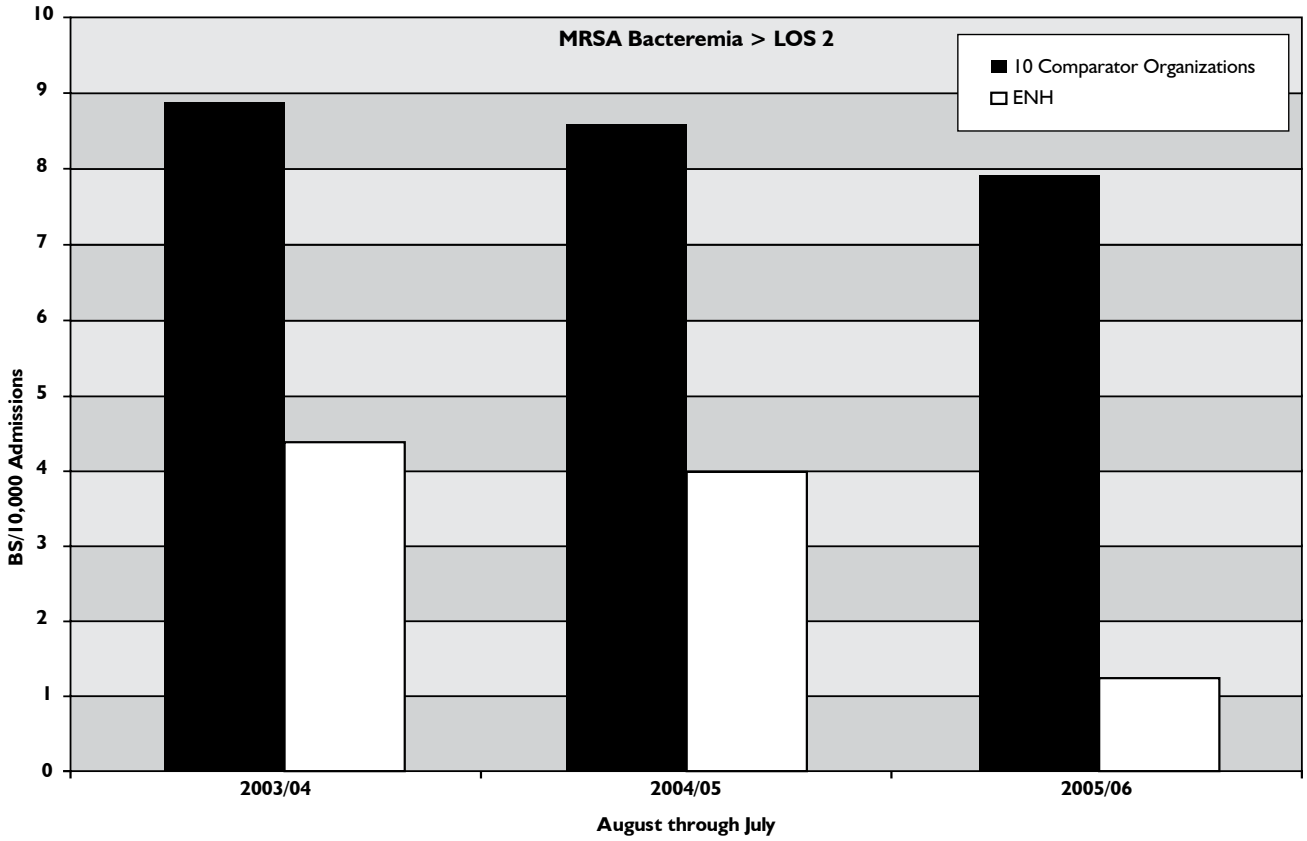


Figure 6. Hospital-acquired Respiratory Infection.



The following figure (*Figure 7.*) 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, a dramatic drop in MRSA bacteremia rate was observed (p<0.05) at ENH.

Figure 7. 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. Hopefully the goal of nearly eliminating hospital-acquired MRSA will be met there in the future.

Figure 8. From APIC webinar: Ogle AM. The role of surveillance in a successful program to eliminate MRSA transmission. APIC webinar; February 7, 2007.

EVANSTON NORTHWESTERN HEALTHCARE

MEMO

August 2005

Dear Physician/Nurse/Manager,

This letter is to inform you of important Infection Control activities that are starting on August 1, 2005.

As you are already aware, hospitals across the country are faced with alarming rates of antibiotic resistance in nosocomial bacteria. A disturbing report came out of Michigan in June of 2002 as the first high-level vancomycin-resistant *Staphylococcus aureus* was recovered from a patient as a cause of infection, an event that calls us to a heightened awareness of infection control and antibiotic use. The 4th such strain, also from Michigan, was reported in March of this year. Last year we found that between 8 and 9% of inpatients in the Chicagoland area are MRSA carriers, and most are not known by healthcare providers. Further heightening awareness of staphylococcal infections, the Chicago Tribune ran a series of three front-page articles on the risk of infection during hospitalization. Evanston Northwestern Healthcare is committed to a pro-active approach in reducing nosocomial infections in the ENH system. Therefore, we are implementing an admission screening program to detect methicillin-resistant *Staphylococcus aureus* (MRSA). This program is being instituted to detect all inpatients carrying MRSA, to isolate those positive so as to prevent spread to other patients, and to decolonize those positive (beginning when they are near the time of discharge) in order to prevent them from developing an infection with MRSA in the future. In order to accomplish this, the admitting team will be ordering and collecting a nasal swab that will be analyszed for MRSA. These swabs will be collected on all patients hospitalized in the network from August 1, 2005 onward. With the development of increasingly effective infection control practices, this is one major step we are taking to optimize management and prevention of nosocomial infections caused by resistant pathogens at Evanston Northwestern Healthcare.

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 health 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 infection prevention and control strategies have been successfully employed in the effort to reach the goal of zero hospital-associated infections (HAI). Any effort that is successful in eliminating HAI can be a model for best practice in the prevention and control of MRSA. Sharing with leadership the success stories from other hospitals and collaboratives can strengthen the infection prevention and control case for the interventions or resources required.

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 earlier, a statewide initiative the Michigan Hospital Association's Keystone Center program 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 success of this approach to reach zero infections, which used bundling of evidence-based practices, has been recently published by Pronovost in the New England Journal of Medicine.

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 provide 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.

Reported Facts and Figures

Despite the efforts of the infection prevention and control community, the incidence of 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 an MRSA HAI. (Stone, AJIC 2002)
- 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 %. (Rubin, EID 1999)
- HA-MRSA infections may result in additional diagnostic tests, therapeutic procedures, additional antibiotic treatment and extended hospitalization. (Grundmann, Lancet 2006)
- 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. (Grundmann, Lancet 2006)
- 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).[3]

The February 2007 APIC publication *"Dispelling the Myths: The True Cost of Healthcare-Associated Infection"* 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 associates 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:

> "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."

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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

It is not routinely recommended to attempt MRSA decolonization. There are circumstances, though, in which decolonization can be considered.

> Elimination of MRSA colonization (decolonization) has been suggested as an 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, 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. (See section V.B.9. Decolonization) Guidance documents published on community-associated MRSA in the public health arena, for military and correctional settings, and the IDSA guideline 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.

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.

Infection Prevention and Control Strategy Related to Healthcare Worker Decolonization

Healthcare worker decolonization is indicated only as a prevention and control intervention when a health care 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 regimen

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.

Guidelines

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Practice Tools

The following (*Table 3.*) is an example from the U.S. Navy and Marine Corps of a decolonization regimen that may be used if clinically indicated. It can be accessed in "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.

TABLE 3. Regimen for Decolonization.

Mupirocin	• Apply approximately one-half of 2% calcium muciprocin 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*	• 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.
*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 andhead, since middle ear contact has lead to deafness and permanent eye injury may occur following prolonged contact.	

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."

Step 5. Practice antimicrobial control
- Engage in local antimicrobial control efforts

Step 6. Use local data
- Know your antibiogram
- Know your patient population

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

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 10. Stop antimicrobial treatment:
- When infection is cured
- When cultures are negative and infection is unlikely
- When infection is not diagnosed

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.

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:

- 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."

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