An APIC Guide

2010

Guide to the Elimination of Methicillin-Resistant *Staphylococcus aureus* (MRSA) Transmission in Hospital Settings, 2nd Edition

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On the Cover:
Highly magnified electron micrograph depicting numbers of Staphylococcus aureus bacteria, found on the luminal surface of an indwelling catheter. (2005). Courtesy of CDC/ Rodney M. Donlan, Ph.D.; Janice Carr

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Foreword

The 2009 – 2010 update of the Guide to the Elimination of MRSA Transmission in Hospital Settings provides updates and enhancements to the original APIC guide published in March 2007. Additional references and resources, review of current research findings, and updated "level of evidence" guidance are integrated into the best practice recommendations for MRSA surveillance, risk assessment, and the effective hospital MRSA management program. Recent research on the role of environmental cleaning and disinfection provided additional focus on the importance of MRSA environmental decontamination section. Updates to the antimicrobial stewardship and laboratory components of effective an MRSA program are included to supply information on antibiogram development and laboratory testing methodologies. The role of MRSA decolonization in infection prevention and control strategy for eliminating reservoir of the organism continues to be investigated, and a review of recommendations in certain settings or patient populations (in critical care, for some surgical populations, during outbreaks), based on MRSA risk assessment is included. The section on cultural transformation has been expanded to develop more fully the importance of cultural change theory strategies to enhance MRSA prevention programs. A section on education plan for staff, other healthcare professionals, patients and visitors is a new section in the update of the MRSA guide.

MRSA Epidemiology and the Impact on Hospitals

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 the epidemiology of MRSA as defined by the comprehensive, facility-specific risk assessment which describes current state and characteristics of the MRSA burden for the 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. Some facilities may find no additional interventions are needed, thus indicating the importance of doing a careful risk assessment.

Background

The CDC Campaign to Prevent Antimicrobial Resistance in Healthcare Settings[1] has provided the estimate that more than 70% of all 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

MRSA refers to *Staphylococcus aureus* isolates that are resistant to all currently available B-lactam antibiotics (penicillins, cephalosporins and carbapenems). 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] In the Agency for Healthcare Research and Quality (AHRQ) report of July 2007, data from the Healthcare Cost and Utilization Project (HCUP) showed that the number of hospitalizations involving MRSA infection more than tripled between 2000 and 2005, which included a 30% increase seen between 2004 and 2005. In addition, it was noted that the costs and the lengths of stay for patients with MRSA infections were more than double in relation to all other hospital stays.[5]

MRSA Epidemiology and Transmission

The normal bacterial flora of humans often includes *S. aureus.* It has been estimated that nasal colonization in the general adult population is 20% to 40% and that carriage will be intermittent in 30% and prolonged in 50% of the nasal carriers.[6] A study of colonization stratified by multidrug resistance in a nationally representative survey conducted from 2001 through 2004 as part of the National Health and Nutrition Examination Survey found that the prevalence of colonization with *S. aureus* decreased from 32.4% in 2001-2002 to 28.6% in 2003-2004 however the prevalence of colonization with MRSA increased from 0.8% to 1.5%. In this study, colonization with MRSA was independently associated with healthcare exposure in males, age > or =60 years, diabetes, and poverty in females. In a subset of colonized people in 2003-2004, a total of 19.7% of MRSA-colonized persons carried a PFGE type associated with community transmission.[7]

S. aureus from a nasal colonization can be transferred to skin and other body areas. When an infection occurs after a breech of the body's defenses of the skin, the pathogen is often endogenous ("from the body"). Therefore the presence of endogenous *S. aureus*, especially MRSA, is a risk factor for infection, which has been well characterized in bloodstream infections.[8,9]

Colonization with MRSA often precedes infection by MRSA. The connection between transmission of MRSA from an exogenous (outside of the body) source via hands, equipment, and the hospital environment and subsequent endogenous carriage of MRSA is the primary infection prevention and control consideration for the elimination of MRSA transmission in hospital setting.

Changing Epidemiology of MRSA: Community-associated MRSA

MRSA has a history of being frequently associated with healthcare, and conventional wisdom had 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.[10] Concurrently, reports were being received by the CDC regarding MRSA infections in athletes,[11] children,[12] prisoners,[13] military personnel[14] and full-term newborn infants[15,16] 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.[17,18] Amplification of community reservoirs of MRSA provides another incentive for aggressive action to eliminate transmission of MRSA in healthcare settings.

In most community acquired MRSA (CA-MRSA) strains in the United States, methicillin resistance is encoded in a novel genetic elements, staphylococcal cassette chromosome *mec* type IV. Many of these strains have been resistant only to B-lactams and macrolides (eg. erythromycin) and retain susceptibility to many non-B-lactam antimicrobial agents such as lincomycins (eg. clindamycin), fluoroquinolones, rifampin, trimethoprim-

sulfamethoxazole, aminoglycosides and tetracyclines. CA-MRSA also produces several toxins not commonly found in healthcare associated strains, notably Panton-Valentine leukocidin, which causes leukocyte destruction and tissue necrosis. The predominant molecular genotypes that cause CA-MRSA infections are USA300 and USA400. The USA300 clone has emerged as the predominant cause of staphylococcal skin and soft tissue infections. In the majority of healthcare associated MRSA (HA-MRSA) strains in the United States, methicillin resistance is encoded in staphylococcal cassette chromosome *mec* type II. HA-MRSA are frequently resistant to many other classes of antibiotics and the Panton-Valentine leukocidin is rarely found. The predominant molecular genotypes that cause HA-MRSA infection are USA100 and USA200.[19,20,21]

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.[22] A recent extensive literature search presented at the spring 2005 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 the 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.[23]

Human Impact of Hospital MRSA Infections

The human impact of healthcare-associated MRSA infections makes efforts to eliminate MRSA transmission in healthcare settings compelling and necessary. Patient safety initiatives in hospital settings may be facility derived or imported from national venues (Joint Commission National Patient Safety Goals, IHI's 5 Million Lives Campaign, etc.). These patient safety initiatives are unanimous in promoting the use of science- based best practices to prevent hospital-associated infections.

Consumer and Legislative Responses

In response to the huge human impact of hospital infections, actions are being taken in non-clinical arenas as well. Various consumer groups have developed education and web-based information for 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 passed in many states and some bills filed are specific to MRSA. Several states now mandate either a MRSA control program, which may include reporting to the department of health or active surveillance testing for MRSA, regardless of the facility's risk assessment. For the most current legislation related to MRSA you may want to refer to the "MRSA map" located on the APIC website at: http://www.apic.org/am/images/maps/mrsa_map.gif.

Payers, including CMS and private insurers, are implementing non-reimbursement strategies in relation to hospital-associated infections, since several HAIs are considered a category of "hospital-acquired conditions. MRSA is expected to figure more specifically in future reimbursement policies.

Role of Hospital Leadership

Support from hospital leadership is essential in any initiative to reduce the impact of multidrug resistant organisms in the hospital setting. Without strong leadership support, to reach the goal of eliminating the transmission of MRSA will be difficult, if not impossible, to achieve. Leadership must support and facilitate the acquisition of supply and personnel resources. Essential support related to infection prevention and control staff, laboratory

resources, information systems upgrades including data mining capability, nursing support, decision support, and access to public relations will be needed. Effective leadership will also facilitate the development of teams and communication pathways, physician and staff buy-in, board of directors' involvement and community outreach.

Scope:

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 strategies: prevention of device-related hospital associated infections (e.g. CLABSI, VAP, UTI) via processes that ensure use and duration based on medical necessity, as part of best practice bundles or empowered teams[24,25]
- 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 testing, etc.) when MRSA transmission rates are not decreasing
- education of healthcare workers, patients, families, and the public
- cultural transformation and change management
- antimicrobial stewardship
- MRSA decolonization strategies

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

"Guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings, 2007" provides the guidance on patient placement and isolation considerations for multidrug resistant organisms and communicable diseases.
http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/Isolation2007.pdf

"Strategies to prevent transmission of methicillin-resistant *Staphylococcus aureus* in acute care hospitals" is one of the **HAI compendium guides** published in October 2008. This compendium of practice recommendations was sponsored and authored by the Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA). Partners in this work were the Association for Professionals in Infection Control and Epidemiology (APIC), the Joint Commission, and the American Hospital Association (AHA)
http://www.journals.uchicago.edu/doi/full/10.1086/591061

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 arena 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 resistance 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 the approach using "bundling" of evidence-based practices to reach zero infections has been demonstrated in healthcare improvement initiatives.[20,21]

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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.

Key Concepts

- Past and current hospital surveillance data is the core of the MRSA risk assessment.
- MRSA surveillance data includes demographic, geographic, and published MRSA data on risk populations.
- MRSA risk assessment is developed annually, whenever there is a change based on continuing surveillance, and when change of populations or services occurs.
- Information from the MRSA risk assessment drives improvement processes.

Background

Initiatives to prevent MRSA transmission include consideration of expert guidance and practice standards, and require local resources such as laboratory capabilities, administrative support, infection prevention and control department staffing, public health support, other support elements, current infection prevention and control interventions (e.g., hand hygiene, contact precautions, etc.) and the measurement parameters for the current interventions.

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.

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. It also aids the infection preventionist in determining when additional interventions may be needed, e.g. 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.

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 but are not limited to:

- previous 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
- others as defined by the MRSA risk assessment (increasing age, work with animals, incarceration, etc)

MRSA Risk Assessment Basics

An assessment of MRSA relies on the availability of test 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 testing (AST) program will be able to identify patients colonized with MRSA who have no available clinical culture results.

Prevalence surveillance* identifies colonization and infection in high risk units or from high risk populations. This data is used in baseline and follow-up MRSA risk assessments. The ability to track MRSA-positive patients by location, patient population and/or clinical service is essential for MRSA risk assessments. Standardized, consistent processes for capturing the relevant data ensure that statistical evaluation is relevant and comparative over time.

> * MRSA 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.

SHEA and HICPAC have issued a joint Position Paper on *Recommendations for Metrics for Multidrug-Resistant Organisms in Healthcare Settings*.[3] The document defines new terms and the time required from the time a patient is admitted for a MDRO to be considered hospital onset; basic metrics are also discussed.

The MRSA risk assessment must include clear definitions for all measurements. According to the position paper, MRSA is considered to be hospital onset if the organism is isolated after the third calendar day of hospitalization, with the first day being the day of admission (the admission date is determined as the date a patient occupies a room for an overnight stay, not the date of an outpatient and/or emergency department visit.

> Note: The National Healthcare Safety Network also uses this definition in the MDRO and *Clostridium difficile* modules; however this definition cannot be applied to the NHSN device or procedure associated modules because there is not a requirement for time to elapse from the insertion of a device or procedure to the infection outcome occurring.

The variety of suggested metrics are proxy measures and may be an underestimation of the true burden of MRSA. For example, the definition of hospital-onset MRSA does not include community-onset healthcare-associated MRSA (e.g. patient discharged from the hospital, is readmitted within 30 days from discharge and is positive for MRSA on readmission). A program that includes active surveillance testing will increase detection of patients who are colonized; whereas, a program that does not include AST may underestimate the prevalence of MRSA colonization in that facility.

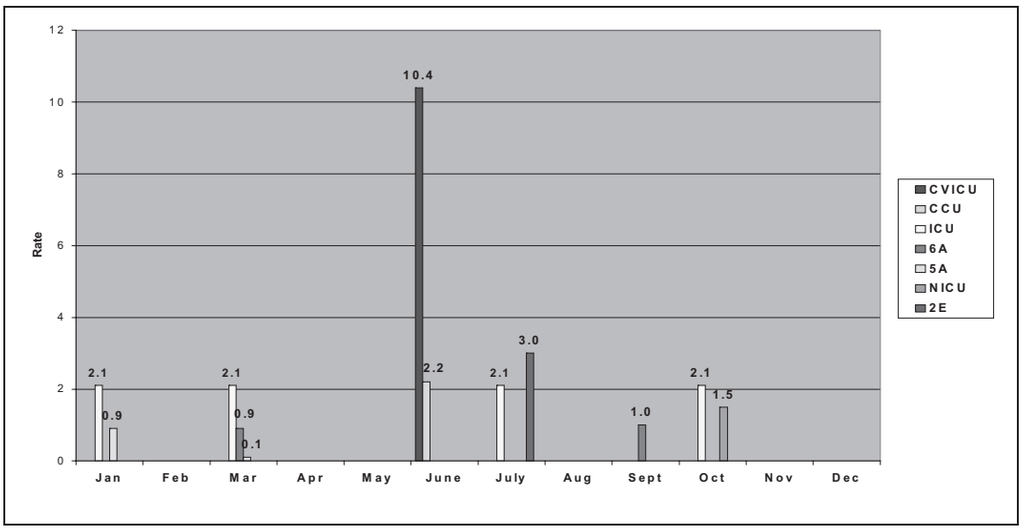
The hospital-specific MRSA assessment requires that the infection preventionist:

- 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
- establish the rate of compliance with hand hygiene and standard precautions
- 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.)
- identify gaps in staff knowledge for targeted educational interventions
- 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 control and prevention 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 after the third calendar day of admission to the unit in a patient that had no prior MRSA by culture, molecular test, or by history.

Hospital-Acquired MRSA by Unit, January-October, 2009
Per 1,000 Patient Days



$$\frac{\text{\# of new MRSA patients on the unit/month}}{\text{\# of patient days on the unit/month}} \times 1{,}000$$

= 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 2009 on all units.

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."[4] Additional information is also available in the SHEA/IDSA practice recommendation "Strategies to Prevent Transmission of Methicillin-Resistant *Staphylococcus aureus* in Acute Care Hospitals"[5]

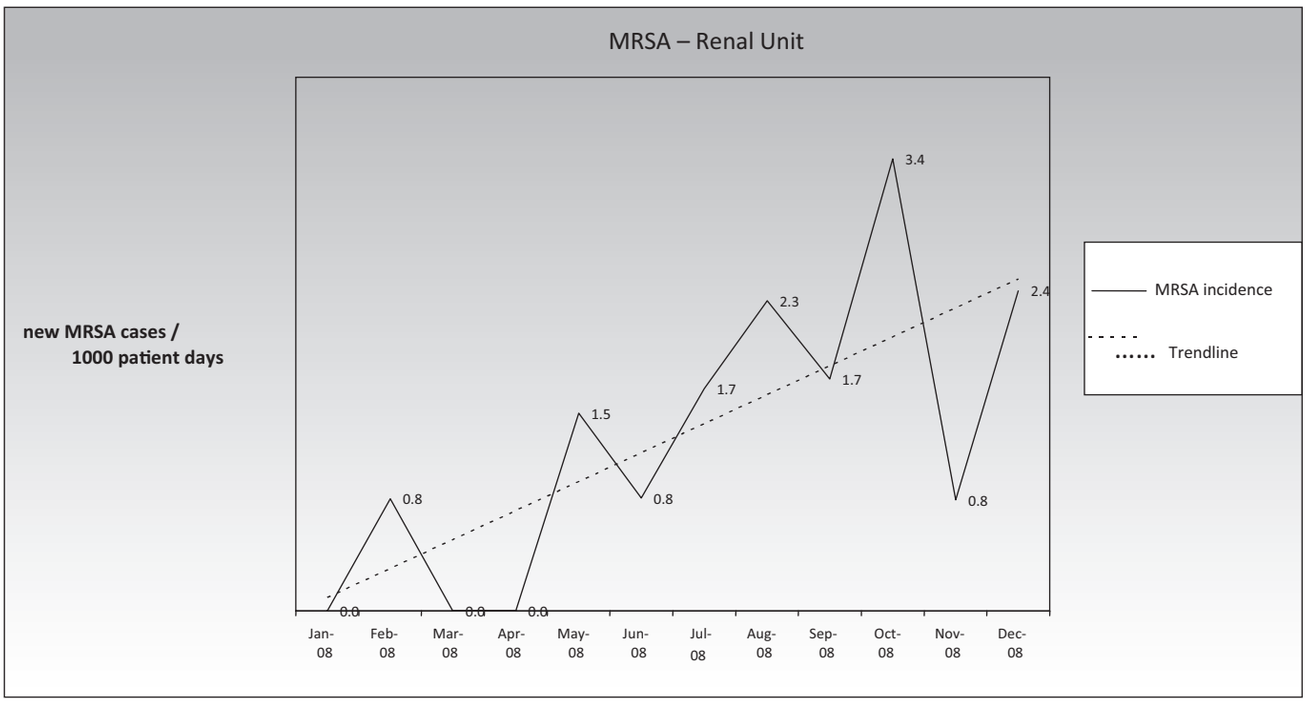
Example 2: *MRSA assessment and intervention (hypothetical scenario)*
In this next example, an MRSA assessment reveals that the incidence of MRSA bacteremia in the inpatient renal unit is trending upward over time.

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

= 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 the first three days 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.

MRSA Bacteremia - Renal Unit



Known risk factors in this population include central lines and peritoneal dialysis, frequent healthcare access, long-term care residence, antibiotic use, 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.
- The infection prevention and control team determines through observational measurements that compliance with hand hygiene, standard precautions are at expected high levels
- In collaboration with nursing, laboratory and nephrology, the team institutes an active surveillance testing program (AST) 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 AST program is discontinued until and if the rates of MRSA bacteremia trend above the new baseline.
- MRSA incidence in the peritoneal dialysis patient 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 communicate results of MRSA surveillance evaluation to both inpatient and outpatient dialysis groups and physicians. Infection prevention and control staff also provide assistance to the nephrology groups regarding implementation of hand hygiene compliance monitors at the outpatient dialysis centers.

What's next after you have achieved a sustained reduction of MRSA?

A report summarizing data compiled by the National Healthcare Safety Network in 2006-2007 details antimicrobial resistant pathogens associated with healthcare-associated infections.[6] The report states that 8% of the infections reported to NHSN were associated with MRSA, comprising half of the overall percentage (16%) of HAIs associated with a multidrug-resistant pathogen. The article further states, "Nationwide, the majority of units reported no HAIs due to antimicrobial-resistant pathogens." NHSN went on to report in 2009 that the incidence of MRSA central line–associated BSI has been decreasing in recent years in most ICU types reporting to the CDC8, except in pediatric units. Over seven percent (7.4%) of all central line-associated BSIs reported from 1,684 ICUs were MRSA during the period 1997-2007.[7]

However, a report published in 2007 based on 2005 data by the CDC states that 85% of MRSA infections that do occur, were associated with the delivery of healthcare.[6] Two thirds of healthcare-associated MRSA infections were community-onset, whereas one third was determined to be hospital onset. The article concludes that MRSA disease is still predominantly related to exposure to healthcare delivery but no longer confined to hospitals.

The above articles demonstrate that although MRSA continues to be a problem for healthcare facilities in the United States, significant progress has been made in the reduction of central line-associated bloodstream infections associated with MRSA and other HAIs. It is important that a risk assessment be performed at least annually, or more frequently if necessary, including assessment of basic preventive practices such as hand hygiene and standard precautions If interventions demonstrate a reduction of MRSA the same process of assessing risk can be applied to other MDROs or even sensitive pathogens, which may be problematic.

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MRSA Surveillance Methodology

Purpose

The purpose of surveillance is to identify trends, outbreaks and an increased incidence of MRSA in the patient population. Surveillance activities can identify risk factors for infection and complications among patients.

Key Concepts

- Surveillance methodology is based in sound principles of epidemiology and statistical principles.
- 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 when appropriate, of intensified interventions taken to eliminate the transmission of MRSA in the hospital setting.
- Data from a hospital's MRSA surveillance is the basis for the MRSA risk assessment.
- The risk assessment based on surveillance data determines the goals, actions/interventions, and evaluation of the surveillance program.
- Surveillance activities should be integrated into the organizations Quality improvement and Safety programs.

MRSA Surveillance Basics

Surveillance is a dynamic, ongoing, essential element of any infection prevention and control program.

Components of Infection Prevention and Control Surveillance Plan[1]

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

- 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

excerpted from: APIC Text of Infection Control and Epidemiology, 3rd Edition; January 2009

MRSA Surveillance Methodology

MRSA surveillance is targeted (focused), and is defined and developed from the MRSA risk assessment.[2]

- The populations may reside facility-wide, or may be unit specific. Studies have shown that certain populations such as dialysis patients, residents of long-term care facilities, and patients in the intensive care unit are at-risk populations for MRSA infections and colonization.
- The indicator (monitor) is MRSA infection or colonization in the identified populations, and may be further defined by procedure or devices (e.g. MRSA related to central lines).
- The time period of surveillance activities is based on the needs of the organization and the scope of activities, but must be long enough to accrue a sufficient number of cases for a valid analysis.

Population to be Studied

Surveillance may be focused on a particular patient care unit (intensive care unit, burn unit), on patients undergoing high risk procedures (dialysis, transplant), or on patients with significant medical conditions (elderly, neonates). The surveillance activities should focus on persons at greatest risk of adverse outcome should they become infected. The risk assessment will have identified the high risk patients who receive care in the healthcare facility.

Indicator Monitors

The indicator monitor may be broad, for instance "all patients with MRSA infection or colonization" or specific, such as patients with MRSA blood stream infection. The time period of monitoring may vary from a few months to a year, or may be measured over a period of years. The indicators will be based on population served, procedures performed and services provided.

Surveillance criteria

Surveillance criteria must be clear, concise and consistent throughout the surveillance period. Changes in definitions affect surveillance analysis, and will result in rates that may not be directly comparable to the historical data. Changes that could affect surveillance include instituting a new active surveillance testing 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, and in some cases may require discontinuing the old surveillance when the new process is implemented.

Caution According to NHSN a positive screening culture at admission does not mean that any subsequent infection with that organism is not a healthcare-associated infection (HAI). Many HAIs are due to organisms from endogenous patient sources. If the patient meets all of the CDC/NHSN criteria for a healthcare associated infection (see http://www.cdc.gov/nhsn/pdfs/pscmanual/17pscnosinfdef_current.pdf), and if that patient had no symptoms of infection present or incubating at the time of admission, then an HAI should be reported. A positive screening culture without evidence of infection represents colonization and does NOT imply or prove incubation.

Data Elements

Data elements useful in characterizing MRSA cases should be included in case identification or line listings. Typical elements are 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. Additional information that may be useful include

procedures performed, use of invasive devices, underlying conditions, colonization status, and clinical symptoms of infection. Information related to known or suspected MRSA risk factors[3] in a geographic region or demographic population (e.g., inmates of correctional facilities,[4] veterinary clinic personnel,[5,6] hemodialysis patients,[7] etc.) should also be collected.

Methods of data collection may be real-time, as in automated surveillance (data mining), ongoing surveillance report review, or rounding. Data collection is often retrospective, but should always be a function of identification of MRSA from clinical culture and active surveillance testing, if utilized

Surveillance Data Analysis and Management

Methods for Data Analysis

Before data collection is initiated, the statistical measures that will be used to analyze the data must be determined. If rates or ratios will be calculated, the values corresponding to each numerator and denominator must be defined. Whenever possible, data should be expressed as rates or ratios that are calculated using the same methodology as a nationally validated surveillance system. This allows an organization to compare its rates with another organization or a recognized benchmark. See Figure 1 for an example of a MRSA surveillance rate calculation.

New MRSA case = MRSA-positive test from patient in SICU for >72 hours with no prior MRSA history

Calculation requires:
the number of new MRSA cases in the unit
the number of patient days in the unit

$$\text{SICU MRSA rate per 1000 patient days} \quad \frac{\text{number of new MRSA cases}}{\text{SICU patient days}} \times 1000$$

Figure 1: MRSA Surveillance Performance in a Surgical ICU (SICU)

It is beyond the scope of this guide to cover all of the indications and data tools that may be useful in a MRSA surveillance program. The reader is encouraged to review the SHEA/HICPAC MDRO Metrics position paper[8] for a thorough review of metrics used to determine epidemiology of onset or association, hospital or community; incidence; prevalence; and susceptibility monitoring.

See **Resources** at the end of this section for published surveillance systems from NHSN, SHEA/IDSA HAI compendium, and SHEA/HICPAC MDRO Metrics position paper.

Written Surveillance Plan

A written surveillance plan should describe the following: the objectives, the indicators (monitors), the reason for selecting each indicator, the methodology used for case identification, data collection, analysis and the type of reports generated.

Surveillance Program Evaluation

The surveillance program should periodically evaluated, no less frequently than annually, to assess its usefulness and ability to meet the organization's objectives. Revisions should be made at time of annual review, or sooner when indicated by ongoing surveillance results if changes in incidence or outbreaks are identified.

Benchmark and Comparing Data

There are currently no national "benchmarks" for MRSA. Although it is very appealing to compare one's rates externally with others, comparisons should be made only after ensuring that the following conditions are met:

- Standardized case definition used in each comparison group.
- Criteria are consistent.
- The population and time period for study are the same in each comparison group.
- The same surveillance methodology is used in each comparison group.
- Rates and ratios are calculated using the same numerators and denominators.
- The facilities and populations being compared are similar.

Essential Features for Management of MRSA Surveillance Program

1. Consistently applied definitions[1,8]

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

Incidence: number of new MRSA cases divided by the number of people being studied in a particular period of time.

MRSA transmission rate: number of new MRSA positive patients divided by the number of patient days times 1,000 or by the number of admissions times 100 in a particular period of time.

2. Consistent and comprehensive system for retrieval of laboratory test results

Automated surveillance technology (data mining) for retrieval of MRSA surveillance data can be implemented to good effect for MRSA surveillance and analysis.[9] The APIC Position Paper on Surveillance Technologies of May 2009 provides a review of the benefits of automated surveillance technology, including to "streamline and facilitate efficient review of relevant data, promoting rapid identification of sentinel events and detection of outbreaks". (www.apic.org, Guidelines and Standards, Position Papers)

However it is possible, albeit more time intensive, to implement a good MRSA surveillance system with limited technological sophistication. Lab result retrieval, via hard copy or online review of reports, and maintained line listings are sufficient for surveillance as long as the following are achievable:

- access to all MRSA-positive microbiology reports
- access to patient information such as medical record number, date of specimen collection, source of specimen and date of patient admission for MRSA-positive patients
- duplicate isolates easily identified for exclusion from rate calculations
- susceptibility results included or available

3. Collaboration with the microbiology laboratory

MRSA Laboratory Testing

1. Routine culture using 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.
2. Culture by selective media for MRSA is an alternative to routine culture which can provide positive results in approximately 24 hours with a relatively small cost increase.
3. Polymerase chain reaction (PCR) FDA approved MRSA testing for direct detection from a nasal specimen and from blood culture is available. 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.[10,11]

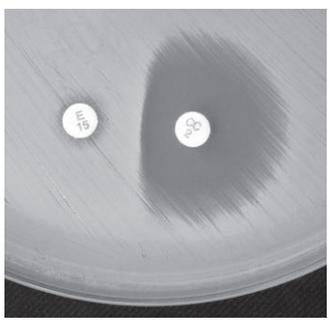
Antibiotic Susceptibility of MRSA Isolates

Susceptibility testing is performed on MRSA isolates to aid the clinician in the medical management of MRSA infection. The "D-test" for inducible clindamycin resistance should be included in the susceptibility test panel. The D-test may be positive on both MRSA and MSSA specimens, therefore it should not be considered a test for methicillin resistance in *S. aureus* strains.

The hospital microbiology laboratory staff should follow the Clinical and Laboratory Standards Institute (formerly NCCLS) guidelines for all susceptibility testing.

Clindamycin Inducible Resistance

Some MRSA isolates that appear erythromycin-resistant and clindamycin-susceptible by routine susceptibility testing exhibit in vitro resistance to clindamycin during therapy and is known as "inducible resistance". Inducible clindamycin resistance is not detected using standard susceptibility testing and can only be detected through a specialized laboratory test called the D-zone test. Clinical laboratories should test erythromycin resistant isolates for clindamycin inducible resistance. Strains with the inducible resistance phenotype, termed inducible macrolide-lincosamide-streptogramin B resistance (MLSB) may lead to clinical failure of clindamycin therapy.[12,13]



Clindamycin Inducible Resistance: "D" shape of the clindamycin zone adjacent to a standard 15-μg erythromycin disk in a conventional disk diffusion test http://wwwn.cdc.gov/nltn/pdf/2004/2_hindler_d-test.pdf

MRSA Isolate Storage

For purposes of outbreak characterization and management, it is desirable for the laboratory to have a policy for MRSA isolate storage. Storage of isolates for some time period (e.g. minimum of one month and up to six months) ensures that isolates implicated in outbreaks can be retrieved as needed for pulse-field gel electrophoresis (PFGE) or other advanced clonal testing that can help to characterize the epidemiology of an outbreak and manage the outbreak response.

MRSA Results Reporting

The Infection Preventionist should collaborate with the microbiology laboratory regarding the notification process for MRSA test results. Ensure that laboratory reports clearly identify an isolate as "MRSA", and include a susceptibility report when appropriate. There should be a mechanism in place to ensure that the Infection Preventionist receives a report of MRSA isolates in a timely manner.

The laboratory should notify the patient unit of a MRSA result from clinical culture. It may also be of value for the laboratory to include a comment on the MRSA-positive culture report regarding indications for contact precautions per infection prevention and control policy for hospitalized patients.

Patient with History of MRSA – Admission and Discharge Communications

"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.

4. Results of MRSA surveillance program – communications to key stakeholders

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. Tell the story, reward successes, and draw attention to opportunities for improvements. 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.

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- **National Healthcare Safety Network** (NHSN) is a voluntary, secure, internet-based surveillance system. A stated purpose of NHSN is to "assist facilities in developing surveillance and analysis methods that permit timely recognition of patient and healthcare personnel safety problems and prompt intervention with appropriate measures." Nonparticipating facilities can access the surveillance definitions for Multidrug Resistant Organism infections, select device-associated infections, and procedure associated infections. These definitions can be helpful when developing the facility MRSA surveillance plan. See http://www.cdc.gov/nhsn/index.html for more details.

- **SHEA/IDSA HAI Compendium:** The Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA) sponsored and authored a compendium of practice recommendations to prevent healthcare-associated infections in acute care hospitals in partnership with the Association for Professionals in Infection Control and Epidemiology (APIC), the Joint Commission, and the American Hospital Association (AHA). This

compendium offers "Strategies to Prevent Transmission of Methicillin-Resistant *Staphylococcus aureus* in Acute Care Hospitals," as well as guides related to procedures and devices. The compendium is available for download in the October 2008 Supplement of Infection Control & Hospital Epidemiology (Volume 29, Number S1). http://www.journals.uchicago.edu/toc/iche/2008/29/s1#SAAPracticeARecommendations7uqwe

- The **SHEA/HICPAC MDRO Metrics position paper** "Recommendations for Metrics for Multidrug-Resistant Organisms in Healthcare Settings" describes practical metrics and surveillance considerations Control and Hospital Epidemiology October 2008, vol. 29, no. 10, pp 901-913. http://www.journals.uchicago.edu/doi/pdf/10.10856/591741

MRSA Active Surveillance Testing (AST)

Key Concepts

- MRSA active surveillance tests are useful in epidemiologic studies of the prevalence, incidence and/or transmission of MRSA.
- MRSA active surveillance tests 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 addition to MRSA data from clinical culture, if MRSA active surveillance tests are available, the data becomes an element of the ongoing and annual MRSA risk assessment.
- MRSA active surveillance tests may be implemented per MRSA risk assessment, per legislative mandates, and/or when indicated as a component of enhanced control efforts.

Active Surveillance Testing (AST)

The 2006 MDRO guideline[1] 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, as well as monitoring adherence to practices known to prevent cross transmission such as adherence to hand hygiene and contact precautions recommendations. 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.

Active surveillance testing (AST) may be a useful MRSA management intervention in situations requiring enhanced control efforts. The MDRO Guideline recommends the following regarding AST:

> ***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 AST 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

MRSA bacteremia is declining in ICU when bacteremia is discussed on page 27. 7. D. C. Burton, J. R. Edwards, T. C. Horan, J. A. Jernigan, S. K. Fridkin. Methicillin-Resistant *Staphylococcus aureus* Central Line–Associated Bloodstream Infections in US Intensive Care Units, 1997-2007. *JAMA*. 2009;301(7):727-736.

AST Specimens

Patients who have MRSA infections will be positive for MRSA at the site of their infection and at colonized body sites. After infection has resolved, colonized patients may carry MRSA at 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 AST screens. However, adding alternate site screens may be impractical in terms of cost, time, resources and results.

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

Identifying Patients at risk of MRSA colonization for an AST program

Patients or patient populations eligible for an MRSA AST program will have been identified by the MRSA risk assessment, and may include patients who:

- have a known history of MRSA
- are in high risk groups or populations for healthcare associated MRSA (which may include long-term care residents, patients with recent or frequent hospitalizations, dialysis patients, diabetics injecting insulin, patients in critical care, patients undergoing select surgical procedures, etc.)
- have risk factors for community-associated MRSA infection, (athletes in organized sports, veterinarians and others who have close contact with pets, patients with a history of being in jail or prison settings, patient with history of IV drug use)
- are roommates of 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 AST:
Identification of patients for AST at time of admission can be problematic. There must be a standardized, consistent process to identify patients and to ensure collection of the AST 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 healthcare facility. Electronic medical record programs can be set up so that an MRSA notice or flag is automatically displayed during the admission process. If electronic flagging is not possible, alternative systems must be arranged so that notification of the receiving unit or facility is made consistently and in a timely manner.

Universal AST:
Some hospitals have implemented a program of universal AST (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 AST is that it eliminates the need for the often complex

process of identifying and promptly obtaining surveillance specimens from patients in populations targeted for AST. A recently published study relates a reduction in MRSA disease after the implementation of universal screening in a three hospital system.[2]

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, who conclude that "planning should recognize the following needs: preparing the laboratory and reducing the turnaround time for screening tests, monitoring and optimizing the contact precautions intervention, monitoring and ameliorating the known adverse effects of contact precautions, and measuring important outcomes that can evaluate the effectiveness of a program of active surveillance cultures and contact precautions".[3]

Processes for Collection of AST

Prior to implementing an AST 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.

Develop a monitor, e.g. a line listing, of all patients to be tested for MRSA colonization. Compliance with obtaining surveillance specimens can be compiled weekly and shared for appropriate stakeholders in the process. The compliance monitor should be compiled and evaluated at an appropriate interval. Adjustments to the process can then be made as needed.

Figure 1: SICU Patient Data Form.

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

Figure 1: Example of a monitor for MRSA surveillance testing patients admitted to SICU

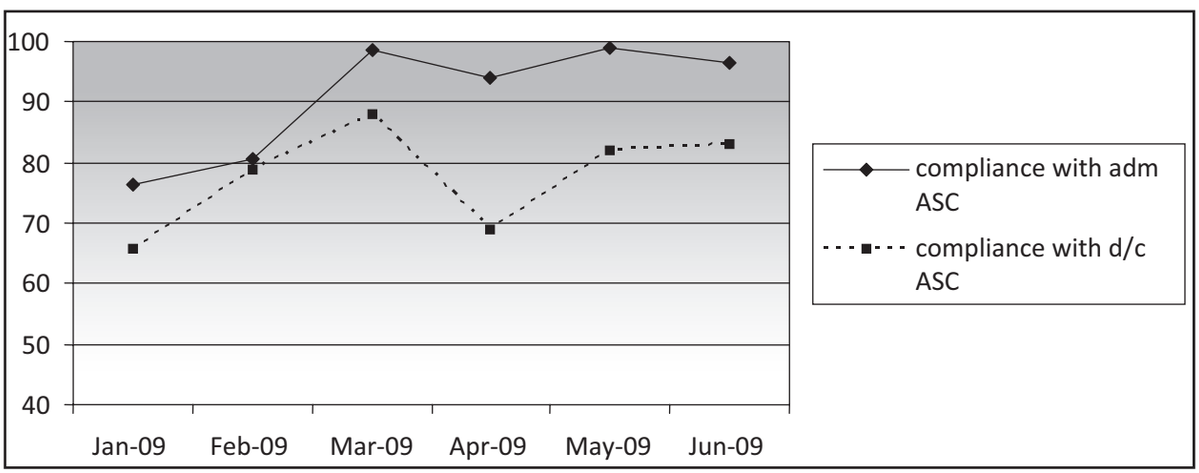

Figure 2: Compliance report compiled monthly

Improvement needed on compliance with obtaining discharge surveillance cultures.

Timing of Specimen Collection for AST

A simple AST 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 AST 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 AST 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 AST 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 AST 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 AST program. Timing of specimen collections should be customized to meet surveillance and/or intervention needs.

Communication about AST

Physicians and Healthcare Providers usually view patient testing as a tool in the management of the patient's clinical condition. Surveillance tests however, are tools used in infection prevention and control efforts. 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 AST program.

Patients and families should know and understand the reasons for active surveillance testing. A patient letter about surveillance tests, informational scripts for patient caregivers and MRSA fact sheets should be developed prior to the implementation of the AST program. Patient and family satisfaction regarding care can be enhanced when the communication is clear and questions are honestly and correctly answered. The infection preventionist should be able to assure the patient and family that the patient is not being charged for this AST if payment is non-capitated.

MRSA nasal specimen collection procedure

The anterior nares is the routine site of collection of the nasal specimen for MRSA AST. To obtain an adequate specimen, gently rotate the culture swab for 2 – 5 rotations after inserting about ¾ of an inch into the nasal passage (adult).

Follow manufacturer's instructions specific to the MRSA test methodology for nasal specimen collection.

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 for the confirmatory susceptibility testing to be completed.
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 feature relatively simple lab workflow using automated technology. 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 AST screens, reagent and instrumentation costs and FTE requirements.

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Hand Hygiene

Key Concepts

- Hand hygiene plays an integral role in reducing the transmission and occurrence of infection and is the cornerstone of any infection prevention program.
- All healthcare settings must implement a comprehensive hand hygiene program, periodically monitor compliance, and provide feedback to individuals and key stakeholders in the infection prevention program.
- All healthcare settings must maintain gains and facilitate improvements in hand hygiene compliance.

The importance of hand hygiene in the elimination of MRSA transmission cannot be overstated. Guidelines for implementing a hand hygiene program and monitoring compliance have been published by the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO).[1,2] Both guidelines recommend the following:

1. Implement a multidisciplinary, multimodal hand hygiene program that includes all levels of healthcare personnel, visitors, patients and patient's families.
2. Wash hands with soap and water when visibly dirty or visibly soiled with blood and body fluids and after using the toilet.
3. If hands are not visibly soiled, use an alcohol-based hand rub for routinely decontaminating hands in clinical situations.
4. Perform hand hygiene before and after contact with a patient.
5. Perform hand hygiene after contact with the patient's environment.
6. 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.
7. Wash hands or use an alcohol-based hand product after removing gloves.
8. Monitor health care personnel's adherence to recommended hand hygiene practices and provide them with performance feedback.
9. Provide educational and motivational programs for healthcare personnel.
10. Hold healthcare personnel and administrators accountable for implementing a culture that supports and promotes appropriate hand hygiene practices.

Monitoring hand hygiene practices. There is no standardized method for monitoring hand hygiene compliance; however, there are many good resources for monitoring practices. These include those provided by the WHO,[2,3] the Institute for Healthcare Improvement,[4] the Joint Commission,[5] and the University of Geneva Hospitals in Switzerland.[6] The Community and Hospital Infection Control Association-Canada provides an extensive list with links to resources posted on its website at http://www.chica.org/links_handhygiene.html.

Strategies to improve and monitor adherence to hand hygiene are important components in an MRSA control and elimination program.[7] Hand hygiene plays a critical role in standard and contact precautions discussed below.

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Standard and Contact Precautions to Prevent Transmission of MRSA

Key Concepts

- Transmission of MRSA directly from infected and colonized patients and indirectly via contaminated equipment, supplies, and environmental surfaces in patient rooms has been documented.[1-3]
- The use of standard precautions for all patients and contact precautions for patients colonized or infected with MRSA is recommended to eliminate transmission of MRSA and other multidrug-resistant organisms (MDROs) in the hospital setting.[1-2]
- The elements of standard and contact precautions are well-established for hospital settings.[1,2,4]

Basic Components of Standard and Contact Precautions

Because colonization with MRSA is frequently undetected, consistent use of standard precautions for all patients plays an integral role in interrupting the transmission of MRSA and other MDROs. Contact precautions are recommended in addition to standard precautions for patients colonized or infected with MRSA. The basic components of the Healthcare Infection Control Practices Advisory Committee (HICPAC) recommendations for standard and contact precautions are outlined in the Box 1; for detailed information, the reader is referred to the HICPAC documents.[1,2]

Standard precautions basic components:[1,2]
Standard Precautions includes hand hygiene (discussed in the section above), respiratory hygiene, and the following practices:

- **Gloves**: for touching blood, body fluids, secretions, excretions, contaminated items, mucous membranes and non-intact skin
- **Gown**: for procedures and patient-care activities when contact of clothing or exposed skin with blood/body fluids, secretions, and excretions is anticipated
- **Mask, eye protection (goggles), face shield**: during procedures and patient-care activities likely to generate splashes or sprays of blood, body fluids, and secretions, especially wound irrigation, oral suctioning, and endotracheal intubation
- **Soiled patient-care equipment and laundry**: should be handled in a manner that prevents transfer of microorganisms to others and to the environment, including use of gloves for visibly contaminated items
- **Environmental control**: there should be procedures for routine care, cleaning, and disinfection of environmental surfaces, especially frequently touched surfaces in patient-care areas.

Standard Precautions also includes Respiratory Etiquette. As part of respiratory etiquette, the HCW is advised to wear a mask when examining and caring for patients with signs and symptoms of a respiratory infection.

Contact precautions basic components:[1,2]

- **Patient placement:** Single-patient room preferred. When single-patient room not available, the various risks associated with other patient placement options must be evaluated (e.g., cohorting, keeping the patient with an existing roommate).
- **Gloves and gowns**: recommended for all interactions that may involve contact with the patient or potentially contaminated areas in the patient's environment. Requiring persons to don gown and gloves upon room entry and discard them before exiting promotes compliance with this recommendation; helps ensure that hands and clothing do not become contaminated; and disrupts transfer of microorganisms to other patients or environments.
- **Patient care equipment**: use of dedicated non-critical patient care equipment is recommended for patients on contact precautions. There should be mechanisms in place to ensure that common equipment that is not dedicated to the patient is adequately cleaned and disinfected before use with another patient.

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.

A Note on Strategies to Discontinue Contact Precautions: There are no definitive criteria that can be cited as specific recommendations for discontinuation of contact precautions for MRSA.[1,4] Many hospitals have developed protocols for discontinuing contact precautions when a patient's infection has resolved and there are several negative surveillance tests in the absence of antibiotics to demonstrate that the patient is no longer colonized with MRSA. Some hospitals choose to consider MRSA-colonized patients to be colonized indefinitely. See *Duration of Contact Precautions* in the HICPAC guideline on multidrug-resistant organisms for further information.[1]

Special Considerations: Timing of Contact Precautions if Active Surveillance Testing (AST)

Active surveillance testing (AST) is done to identify patients that are asymptomatically colonized with MRSA, as discussed in this guide's section on AST. Hospitals that conduct AST need a process in place to direct decisions about room placement and use of contact precautions that must be made prior to availability of test results. Decisions and protocols regarding room placement and use of contact precautions should be based on the hospital's MRSA risk assessment (See section on MRSA Risk Assessment). The following questions should be considered when developing these protocols:

- What is the risk that the patient is colonized with MRSA (e.g., does patient have a skin or soft tissue infection or belong to an identified high risk group)?
- What is the turn-around time for AST results (e.g., less than 24 hours, 24 hours, 48 hours)?
- Are private rooms available for patients identified as high-risk by the MRSA risk assessment?

Contact Precautions and Room Placement for Patients Screened with AST:

There is no definitive research regarding how long it takes before the lack of contact isolation precautions leads to significant risk of transmission of MDROs from an infected or colonized patient. Therefore, hospitals must start with a reasonable approach based on MRSA surveillance and risk assessment and adjust the approach if

surveillance demonstrates MRSA transmission is ongoing.[4,5] Examples of possible options for patient placement on admission for those patients who do not have a history of MRSA and are screened include the following:

Option 1. Use private room and implement contact precautions for all patients from identified high risk groups until AST results are known. If AST result is negative, discontinue use of private room and contact precautions.

Option 2. Use *routine* room placement assignments per infection control policy (standard precautions or empiric precautions as appropriate for large draining wounds, uncontrolled secretions, MRSA history etc.) until AST results are known. Make reporting of AST results a priority for the laboratory and implement a system to (1) report positive results immediately to the clinical units and (2) implement contact precautions and use of private room as soon as a positive result from AST or clinical culture is reported. If the positive patient has a roommate, obtain specimen for AST from the roommate without delay and again at the time of discharge.

Implementing an AST program will usually increase the use of contact precautions and will affect patients, staffing, and resources.[5] Before implementing new processes related to contact precautions for the purpose of management of MRSA and other MDROs, a hospital should address the following considerations:

Patient care: The impact of contact precautions on patient care has been a subject of some controversy and much concern.[5, 6] 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: Staff resources will be impacted if there is an increase in the number of patients on contact precautions and when AST programs are implemented. Personnel from nursing, the laboratory, infection prevention and control, and housekeeping will be most affected.[4]

Other Resources: Additional resources related to contact precautions and AST include supplies for contact precautions and specimen collection, laboratory reagents and instrumentation, and written patient/family information regarding AST or contact precautions. If patient rooms in the hospital are not private or single occupancy, lack of bed availability can adversely affect patient placement options.[4,5]

Contact Precautions in Settings Outside of In-patient Hospital Units

This APIC Guide focuses on MRSA infection prevention practices in hospital settings; however, information on the use of contact precautions in out-of-hospital settings can be found in the following publications: the HICPAC guidelines,[1,2] guidelines for management of MRSA in community settings developed by an expert panel,[8] and recommendations published by Matlow and Morris.[9]

Strategies for Success

The following strategies can be used by hospitals to implement standard and contact precautions to prevent the transmission of MRSA and other MDROs and ensure compliance with appropriate infection prevention practices:

- Implement a flag or alert system to identify patients diagnosed with MRSA and other epidemiologically significant organisms so that contact precautions may be initiated immediately on subsequent admissions.[4]
- Develop a system for identifying MRSA-positive patients when they are transported within the hospital so that transport teams and receiving units can implement proper precautions.
- Develop a system for identifying MRSA-positive patients when they are transported outside the hospital so that transport teams and receiving facilities can implement proper precautions. [4]
- Measure adherence to the following and implement corrective actions as indicated:
  - hand hygiene (See the Hand Hygiene section of this guide)[4-5,7]
  - standard and contact precautions [4,5] (See Figure 1, sample monitoring tool)

MRSA CONTACT PRECAUTIONS
Monitoring Tool

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

Initials of Monitor/Observer: _____ Time: _____ AM/PM to ____ AM/PM

Healthcare Worker (HCW) Type Key:

1 = Physician	6 = patient transporter	Y = Yes
2 = physician assistant	7 = PT/OT	N= No
3 = nurse	8 = housekeeping	N/A = Not Applicable
4= nursing assistant	9 = dietary	
5 = respiratory therapy		

HEALTH CARE WORKER TYPE → (Use HCW Type Key Above)										
Compliance with precautions										
Donned gown upon entry to room										
Donned gloves upon entry toroom										
Removed gown on exiting room										
Removed gloves on exiting room										
Performed hand hygiene after glove removal										

Figure 1: Sample monitoring tool for contact precautions

  - environmental sanitation policies[2]
  - MRSA active surveillance testing program protocols[4]
- Educate personnel on risks of transmission of MRSA and infection prevention measures at time of orientation and during annual training/competencies. [1,2,4]
- Provide training and education when new processes related to elimination of transmission of MRSA are implemented.[5]
- Communicate and re-educate when rates of compliance with processes related to elimination of transmission of MRSA show inadequate results.[7]
- Communicate and re-educate when rates of transmission of MRSA are not decreasing.[4]
- Communicate and celebrate when rates of transmission of MRSA are decreasing.

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Environmental and Equipment Cleaning and Disinfection

Key Concepts:

- MRSA can survive in the hospital environment and hospital surfaces.
- Patients and healthcare workers can transmit and/or acquire MRSA from contact with contaminated equipment and environmental surfaces.
- Effective environmental cleaning and equipment cleaning/disinfection will reduce the risk of transmission of MRSA.
- All staff must take responsibility for ensuring that the hospital environment is appropriately cleaned and that equipment is cleaned and disinfected between patient use.

Background

Survival of MRSA in the Hospital Environment:

Staphylococci, including MRSA, can survive in the hospital environment. In studies by Neely[1] and Huang[2], staphylococci were recovered for a 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. As noted by Dancer, both coagulase negative and positive staphylococci have the ability to survive in the environment regardless of temperature, humidity, and sunlight; and "when mixed with hospital dust, MRSA can still be revived more than 1 year after inoculation".[3] People colonized continually shed staphylococci into their environment. Since neither the environment nor equipment are self-cleaning, all reusable medical equipment that contacts patients and or their environment have the potential to become a vehicle for transmission of MRSA.

Transmission of MRSA to Patients from the Hospital Environment:

It been proven that MRSA can survive on common hospital surfaces, and some studies have implicated contaminated hospital surfaces in MRSA acquisition. Hardy et al[4] found 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, MRSA was isolated in every environmental room screening done per study protocol. In a study of MRSA environmental contamination in rooms of MRSA patients, Boyce et al[5] 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 contract MRSA by touching contaminated room surfaces. This has major implications for any effort to eliminate the transmission of MRSA in hospital settings.

There is an increasing body of evidence demonstrating that healthcare workers contaminate hands or gloves by touching inanimate objects in the immediate vicinity of patients who are colonized or infected with organisms that can survive for prolonged time periods in the environment.[6] It is a recognized principle of standard precautions that healthcare-associated pathogens are frequently spread from one patient to another via the transiently contaminated hands of healthcare workers.

Delineate Responsibility for Cleaning

All hospital staff have responsibility for maintaining a clean, safe patient environment. Patient care and ancillary department staff are responsible for disinfection of equipment between each 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. A system should be in place to ensure that reusable medical equipment is appropriately cleaned per manufacturer instructions, and to ensure that the equipment is cleaned before the next patient use. Cleaning and disinfection protocols can be effective tools for the management of environmental contamination with antimicrobial resistant pathogens such as MRSA. See the HAI compendium supplement "Strategies to Prevent Transmission of Methicillin-Resistant Staphylococcus aureus in Acute Care Hospitals" for a good review of methods to ensure cleaning and disinfection of equipment and the environment. (Reference from HAI compendium and the HICPAC CDC Guidelines for environmental infection control in health-care facilities are located in **Resources** at the end of this section)

The role of Environmental Services (EVS) staff in patient safety cannot be overstated. The overall maintenance of a clean, safe hospital environment is the responsibility of this department. Initial training on cleaning and disinfection procedures, reinforcement of best practice (checklists, monitors), and annual competency for EVS staff is important to the elimination of MRSA transmission.

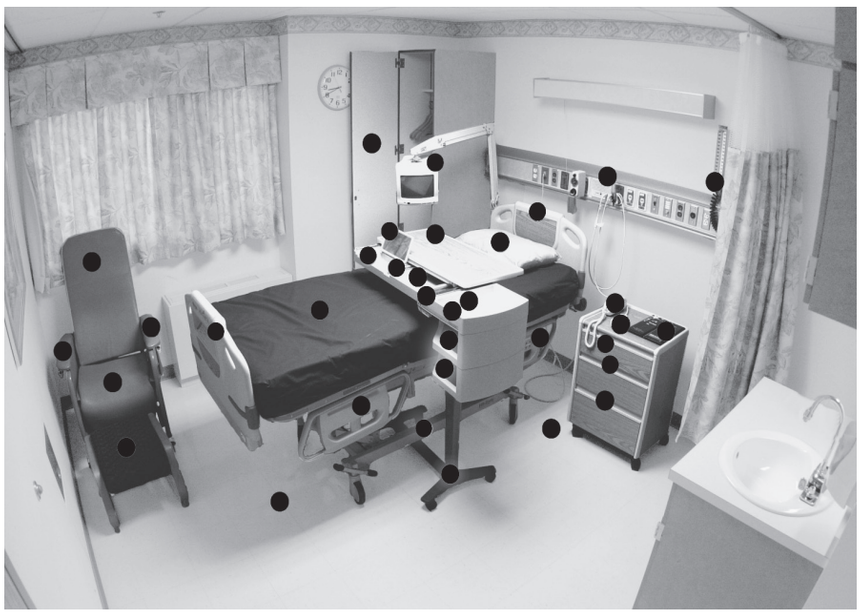
Policies and procedures must specify how, by whom, and when environmental surfaces are cleaned. This includes specifying the proper dilution of the standard hospital–approved disinfecting agents and the contact time for germicidal agents. Proper use of cleaning and disinfection products requires that manufacturer's instructions and contact times are carefully observed. Daily cleaning of occupied patient rooms is an essential component of the facility policy on cleaning. Frequent cleaning of patient care areas, e.g. the emergency department or units experiencing an outbreak, may be targeted for more frequent cleaning. Some facilities have found it beneficial to assign dedicated EVS staff in 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.

Monitoring Environmental Cleaning

Carling[6] et al, concluded that "significant improvements in disinfection cleaning can be achieved in most hospitals, without a substantial added fiscal commitment, by the use of a structured approach that incorporates a simple, highly objective surface targeting method, repeated performance feedback to environmental services personnel, and administrative interventions."

Initial and ongoing training as well as monitors to assess cleaning performance of all staff will ensure consistency. Monitors should include an assessment of the cleaning surfaces nearest to the patient, including bedrails, bedside tables–including under the handles, overbed tray tables, telephones, remote controls, call lights, doorknobs, bedside commodes, faucet handles, chairs, and curtains. The use of an environmental cleaning checklist may increase efficacy of daily and discharge 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.

Photographs of patient rooms with high impact areas identified can be a visual aid and cue to housekeeping employees. These photos also ensure consistency in room cleaning.



Example of Basic Cleaning Checklist
(modify to include additional high touch locations as appropriate)

Adapted from the *Evanston Northwestern Healthcare (Illinois) Checklist* published in the Institute for Healthcare Improvement (IHI) "5 Million Lives" campaign. "Getting Started Kit: "Reduce Methicillin-Resistant *Staphylococcus aureus* (MRSA) Infection How-to Guide" 2006. Available at http://www.ihi.org/ihi . Accessed February 27, 2007.

ENVIRONMENTAL SERVICES CHECK LIST AUDIT
DAILY CLEANING OF PATIENT ROOM

STEPS

1. High Dusting Performed	**Yes___**	**No___**
a. Use high duster/mop head: wipe ledges (shoulder high and above)	**Yes___**	**No___**
b. Vents	**Yes___**	**No___**
c. Lights	**Yes___**	**No___**
*Do not high dust OVER the resident *		
d. Dust TV: rotate and dust screen and wires	**Yes___**	**No___**
Remove dust over cart trash bag gently		

2. Damp Dust

Cloth (rag) and spray bottle of disinfectant – damp wipe:	**Yes___**	**No___**	
a. Ledges (shoulder high)	**Yes___**	**No___**	
b. Door handles	**Yes___**	**No___**	
3. Bedrails and Bedside Table	**Yes___**	**No___**	
4. Glass Surfaces	**Yes___**	**No___**	
a. Wall spots	**Yes___**	**No___**	**N/A___**
5. Bathroom (Toilet Bowl Mop) All Surfaces	**Yes___**	**No___**	
a. Weekly toilet chemical allow to stay	**Yes___**	**No___**	
b. Ledges in bathroom	**Yes___**	**No___**	
c. Door handles	**Yes___**	**No___**	
d. Sink	**Yes___**	**No___**	
e. Shower stall	**Yes___**	**No___**	
f. Finish toilet	**Yes___**	**No___**	
g. Damp wipe toilet seat	**Yes___**	**No___**	
h. Clean mirrors/chrome	**Yes___**	**No___**	
6. Empty Waste Basket	**Yes___**	**No___**	
a. Disinfect if wet	**Yes___**	**No___**	
b. Bags – close	**Yes___**	**No___**	
7. Isolation (Red Bag Waste) Empty	**Yes___**	**No___**	
a. Carry to soiled utility room	**Yes___**	**No___**	
b. Carry to Large Red Hazard trash	**Yes___**	**No___**	
8. Needle Boxes			
a. Check level of Sharps	**Yes___**	**No___**	
b. Replace if ½ to ¾ full	**Yes___**	**No___**	**N/A___**
c. To soiled Utility Room after securely closing	**Yes___**	**No___**	**N/A___**
9. Floor Disinfection – Sign on Door			
a. Wet mop head in disinfectant	**Yes___**	**No___**	
b. Mop (farthest from door) ½ way room	**Yes___**	**No___**	
c. Bathroom shower floor	**Yes___**	**No___**	
d. Bathroom floor	**Yes___**	**No___**	
e. Flip mop head – do remainder of room	**Yes___**	**No___**	

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Cultural Transformation

Key Concepts

- Healthcare-associated infections are a preventable patient safety concern.
- Infection Prevention is EVERYONE's business, not just clinicians.
- Strong Leadership and a "call to action" can engage maximum potential from all levels of workers.
- Workers who feel respected and empowered can effect positive change.
- Where compliance with strategies and behaviors known to prevent infection transmission is weak, cultural transformation can effect improvement in compliance and ultimately prevent infections.

Background

Hospital-associated colonization and infection was generally considered a necessary evil until the release in 1999 of the Institute of Medicine (IOM) report *To Err is Human: Building a Safer Health System.*[1] The report brought new attention to the fact that tens of thousands of people die in American hospitals each year due to preventable causes, including medical errors and healthcare-associated infections. Another IOM report in 2001, *Crossing the Quality Chasm*[2] described a healthcare system struggling to find a new direction in the aftermath of two decades of economic instability, shifts in governmental regulations and payment practices, and shortages in the workforce. The focus in many healthcare organizations seemed to have shifted from the historical mission of healing the sick to sheer survival.

In "Cultural Transformation in Health Care", a 2005 white paper authored for the Robert Woods Johnson Foundation, Bobbi Kimball describes the complex nature of organizational culture emerging from twenty years of chaos and change that is facing healthcare leaders and workers. Organization leaders and healthcare workers have described their situations as task-oriented, isolated, routine, and meaningless, and have the feeling of powerlessness to effect change—the epitome of bureaucracy, or "top-down" management style. Recognizing the stagnation, and supported by a growing body of literature suggesting that strong and deliberate Leadership could leverage culture transformation for positive changes in healthcare, some organizations began applying culture change theories from other industries to healthcare.[3]

At the time, leading oversight and accreditation bodies prioritized diverse preventable healthcare-associated problems such as medication errors and pressure ulcers.[4] Preventing healthcare-associated infections was a common theme. Even though infection prevention strategies, like hand hygiene and use of barrier isolation practices, were known to work and were recommended by infectious diseases experts, many studies reported inconsistent compliance with those strategies among healthcare workers.[5]

In the early 2000s, over half of the *Staphylococcus aureus* bloodstream isolates from patients in intensive care units reported to the CDC's National Nosocomial Infection Surveillance (NNIS) were resistant to methicillin.[6] Many healthcare organizations that were dealing with significant numbers of MRSA infections began to institute culture change theories in an effort prevent the spread of MRSA in their facilities. Most of these theories endorse similar common elements, including a leadership-driven effort to engage and empower frontline workers in change from the "bottom up".[7-13] By 2009, there were cautious reports of success controlling MRSA using a "MRSA Bundle" that included the application of culture change strategies.[14-15]

Applying Culture Change Theories to Healthcare

Culture transformation is usually a slow, evolving process, as small successes are recognized and slowly accepted by others, growing in popularity over time, and eventually becoming the status quo. It is important to understand that changing culture is generally not needed due to a deficit of knowledge, but rather because of failure to behave in a certain way—a failure to follow through on known best practices. MRSA has not become the huge healthcare problem because healthcare workers did not know how to stop transmission. It became a problem because, for many and varying reasons, the culture in healthcare organizations did not support behaviors associated with best practices.

When Leadership adopts new ways of doing business that facilitates staff involvement in identifying problems and resolving system barriers to best practices, staff discover ways to implement change. Staff-designed and -driven changes are always culturally appropriate for those staff, and this type of change minimizes the typical rejection and pushback when change is imposed from an external source. The role of Leadership is to invite participation, listen to staff problems and barriers, remove barriers to best practices, and support innovative ideas.

Giving health care workers the freedom and the opportunity to create solutions fosters cultural change from within. For example, when staff discover latent behaviors that are routine to coworkers who have managed to accomplish better outcomes with the same resources, they are more likely to implement these successful strategies since they are adopting the change as their own idea. By providing opportunities for staff to discover, identify, and practice those isolated behaviors from each other, the culture of the organization enjoys a huge opportunity to prevent healthcare problems.

Many culture change theories have been described in the literature, among them Six Sigma[12], Lean Six Sigma[16], Toyota Production System[17], and Positive Deviance[18] and CUSP-Comprehensive Unit-based Safety Program (See Resources). Although they each have succinct and individual detail in their theoretical frameworks, many of them have common themes associated with their application strategies:

- Leadership leads the effort, and engages frontline workers (can be a "kickoff" announcing a "new way of doing business")
- The problem is clearly defined, so everyone focuses on the same objective, e.g. eliminate healthcare-associated MRSA transmissions and infections
- **All levels** of the organization are actively engaged and contribute to problem identification and potential solutions
- Potential solutions are assessed for feasibility and usefulness
- Action Plans are developed and shared
- Successes and barriers are shared and transparent in the organization
- Outcomes are tracked and processes repeated or reevaluated and new strategies tried

Culture change is not linear. It requires dedication and perseverance to cope with the potential surprises and barriers, and time for the successes to emerge and show positive outcomes. The obstacles and successes will be unique to each organization, which will allow all levels to work together on the problems, developing their own meaning and unique path toward their unique objectives and organizational legacy.

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Resources (CUSP)

- The Patient Safety Group
  https://www.patientsafetygroup.org/program/index.cfm

- AHRQ – Ending Health Care- Associated Infections
  http://www.ahrq.gov/qual/haicusp.htm

- AHRQ Innovations Exchange On the CUSP: Stop Blood Stream Infections – Resources
  http://www.innovations.ahrq.gov/content.aspx?id=2685

MRSA Education Plan

Key Concepts

- Education is a critical component of every infection prevention and control program.
- Education about MRSA should be provided to healthcare personnel, patients and their families, and visitors as appropriate.
- Education activities should be based on a needs assessment of each group targeted for education.
- A MRSA education plan complements and supports Cultural Transformation in that everyone in the healthcare environment, including patients and visitors, has the opportunity to learn about MRSA, improve their own practice, and teach others to practice the strategies that prevent MRSA transmission, and other patient safety objectives.

Education is widely recognized as an important component of any program to eliminate hospital-associated infections and MDRO pathogens. The HICPAC 2006 MDRO guideline recommends routine MDRO education as a primary (Tier 1) control strategy, and recommends that additional education is implemented when indicated by the infection prevention risk assessment.[1] The MRSA guideline of the SHEA/IDSA HAI Compendium recommends that healthcare personnel receive education related to MRSA risk factors, transmission, prevention measures, and outcomes of hospital associated MRSA infections. The education is expected to meet needs of a wide range of personnel (targeted for specific groups) and result personnel behavior changes as appropriate.[2] The 2010 National Patient Safety Goal on hospital associated infection emphasizes annual staff and licensed independent practitioners education regarding health care–associated infections, multidrug-resistant organisms, and prevention strategies based on facility risk assessment, as well as education provided to patient and families related to MDRO infection and colonization.[3]

Educational Principles

The following tools and principles should be considered to develop any educational plan and activities.

- Base educational activities and plans on an educational needs assessment
  - Identify deficits in knowledge, attitude, or skills
  - Identify the learning needs and levels of a particular group.
  - Use a tool designed to measure the effectiveness of the education
- Learning occurs on three levels[4]
  - Cognitive learning increases knowledge
  - Affective learning changes attitudes and feelings
  - Psychomotor learning promotes behavior change
- The educator controls the learning experience by
  - Developing goals that clearly communicate the intent and direction of the education.
  - Writing clear, concise learning objectives that describe in measurable terms the knowledge or behavior outcome that is expected from the education program.
  - Using teaching methods that promote the appropriate skill levels identified in the education needs assessment.

- Adult learners prefer experiences that make sense to them and relate to their needs,
- A thorough discussion of these and many other principles of education can be found in the 2009 APIC Text of Infection Control and Epidemiology[5], Chapter 11, "Education and Training".

Components of Education Related to MRSA in Hospital Settings

A hospital's Infection Prevention program should include education for staff, patients and their families, other healthcare professionals, and visitors based on recognized best practice recommendations and regulatory requirements. The HICPAC 2006 MDRO Guideline[1] recommends the following regarding education: "Provide education and training on risks and prevention of MDRO transmission during orientation and periodic educational updates for HCP; include information on organizational experience with MDROs and prevention strategies. *(IB)*" The Joint Commission's National Patient Safety Goals[4], which includes an expectation that MDRO education is provided annually to staff, and to colonized or infected patients and their families as needed.

The annual infection prevention risk assessment should be used to identify educational needs regarding MRSA. The HICPAC 2006 MDRO Guideline[1] recommends intensifying the frequency of educational programs for HCP when MDRO (e.g. MRSA) rates are not decreasing, and provide unit-specific feedback when available.

Based on the MRSA infection prevention intervention being addressed and on the needs of the learners, some or all of the following topics may be included in MRSA education:

- What is an MDRO?
- What is MRSA?
- What is the difference between colonization and infection?
- Why is MRSA a problem?
- How do people get MRSA?
- What can be done to stop the spread of MRSA?
- How do you know if someone has MRSA?
- What are MRSA risk factors?
- What are the outcomes associated with MRSA infection?
- What is Active Surveillance Testing(AST)?
- Why is isolation used when someone is colonized or infected with MRSA?
- What are the components of contact precautions?
- How to don and remove PPE?
- Do people with MRSA have to stay in isolation forever?
- What practices can be done at home to prevent the spread of MRSA to other household members?
- Are there special cleaning products or laundering needs at home when a person has MRSA?
- What about cleaning of hands?
- What about cleaning the environment and "high touch" points?
- Can I get medicine to make MRSA go away?
- What other information about MRSA is important for me to know?
- What is MRSA decolonization and when is it used?
- Are hospital employees tested for MRSA?

- Is MRSA a problem in the community?
- What is done about MRSA in community settings?

Since staff will be responsible for documenting effective teaching of patients and families, a post-education evaluation should be conducted to assure that personnel have accurate comprehension of the topic. It may be helpful to allow time in the delivery of the education for staff to have group discussion and role-play in patient teaching scenarios, so that staff can learn to translate their higher-level information into language that the patient can understand.

Successful MRSA education programs for patients and family must stress the importance of preventing transmission of MRSA while in the hospital by adhering to the hospital's policy regarding Standard and Contact Precautions, with a major emphasis on hand hygiene. Nursing staff should assist patients and families in understanding the rationale for these prevention strategies and the importance of adherence to them. The role of environmental cleanliness and the concept of "high touch" points should also be emphasized. One example of a patient/family MRSA teaching sheet can be found in the "Patient Guide on MRSA" from the SHEA/IDSA 2008 HAI compendium accessed at: http://www.shea-online.org/Assets/files/patient%20guides/NNL_MRSA.pdf

The fact that MRSA is prevalent in the environment in public places should be stressed, so that patients and families understand that the strategies that prevent transmission of organisms are elements of sound personal hygiene. With the right blend of facts, education, sensitivity, and encouragement, patients and families can transfer hospital-learned safety strategies to make a safer life outside the hospital.

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Antimicrobial Management and Stewardship

Key Concepts

Antimicrobial misuse and overuse are associated with antimicrobial resistance. Antimicrobial resistance poses an ongoing and increasing challenge to clinical management and treatment of patients in hospitals

An essential strategy in prevention and control of antimicrobial resistance is a hospital antimicrobial stewardship program. Antimicrobial management and stewardship strategies result in:

- Appropriate evidence based clinical treatment and prophylactic use of antimicrobial agents.
- Treating infections, not colonization.
- Utilization of local antibiogram data and when available, genetic resistance markers, as well as local epidemiology, for empiric and patient specific treatment.
- Reduced antimicrobial resistance.
- Decreased incidence of infections due to and transmission of multidrug resistant (MDRO) strains.
- Reduced preventable adverse events due to inappropriate use of antimicrobial agents.
- Improved clinical outcomes and patient safety.

Antimicrobial management and stewardship integrates current evidence-based guidelines, including those established by the Centers for Disease Control and Prevention (CDC), Infectious Diseases Society of America (IDSA), Centers for Medicare and Medicaid Services (CMS) and associated endorsements by a number of professional associations including American Society for Health-System Pharmacists (ASHP), Society for Healthcare Epidemiology of America (SHEA) and the Joint Commission (TJC). The CDC 12 Step Campaign advocates for antimicrobial resistance prevention.

Background

Antimicrobial use and selection pressures have resulted in the development of methicillin and vancomycin resistance in *Staphylococcus aureus*. Recent publications have reported increasing rates of antimicrobial resistance and multidrug resistant microorganisms (MDRO), including methicillin resistant *Staphylococcus aureus*.[1,2] Antimicrobial resistance is identified as a contributing factor to infection related morbidity and mortality, increased lengths of stay, and increased expenditures.[3,4] The misuse, overuse, and underuse of antimicrobials contribute to increased resistance rates [Dellit, Cosgrove, Roberts]. A recent publication by the National Healthcare Safety Network (NHSN) reported on the burden and significance of MDRO's, including MRSA, in device associated and procedure related healthcare associated infections.[2]

Guidelines on Antimicrobial Stewardship

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 noted in both Tier 1 and Tier 2 recommendations of this guide that judicious antimicrobial use is crucial to the management of MDRO in hospitals.

Tier 1
In hospitals and LTCFs, ensure that a multi-disciplinary process is in place to review local susceptibility patterns (antibiograms), and antimicrobial agents included in the formulary, to foster appropriate antimicrobial use. *(IB)*

Implement systems (e.g., CPOE, susceptibility report comment, pharmacy or unit director notification) to prompt clinicians to use the appropriate agent and regimen for the given clinical situation. *(IB)*

Provide clinicians with antimicrobial susceptibility reports and analysis of current trends, updated at least annually, to guide antimicrobial prescribing practices. *(IB)*

In settings with limited electronic communication system infrastructures to implement physician prompts, etc., at a minimum implement a process to review antibiotic use. Prepare and distribute reports to providers. *(II)*

CDC/HICPAC "Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006

Tier 2
Review the role of antimicrobial use in perpetuating the MDRO problem targeted for intensified intervention. Control and improve antimicrobial use as indicated. Antimicrobial agents that may be targeted include vancomycin, third-generation cephalosporins, antianaerobic agents for VRE; third generation cephalosporins forbESBLs; and quinolones and carbapenems. *(IB)*

CDC/HICPAC "Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006

The 2007 guideline for developing an institutional program to enhance antimicrobial stewardship from the Infectious Diseases Society of America (IDSA) and the Society for Healthcare Epidemiology of America (SHEA) recommends implementation of a comprehensive hospital antimicrobial management program. The core members of a comprehensive hospital antimicrobial management program include infectious diseases physicians, clinical pharmacists with infectious disease training, infection control professionals, hospital epidemiologists, clinical microbiologists, and information system specialists. The reader is encouraged to refer to this guideline for specific measures that may be implemented in a facility wide antimicrobial stewardship program.

Antimicrobial Management Programs

Evidence based antimicrobial management has process and outcomes measures endorsed by the CMS and National Quality Forum Pneumonia and Surgical Care Improvement Project (SCIP) core measures initiatives.[5,6] Evidence based empiric therapeutic pathways treating infection, not colonization or contaminants reduce the overuse of antimicrobials and avoid treatment of asymptomatic bacteriuria or colonizations.[1,7,8] Antimicrobial

stewardship combined with a comprehensive infection and control program, decrease MDRO transmission and resistance rates while improving patient outcomes.[10] Figures 1 and 2 show examples of tools that can be used for specific antimicrobial management programs. These programs have specific MRSA antimicrobial prophylactic and treatment options.

Role of Infection Prevention and Control in Antimicrobial Management and Stewardship

The infection preventionist is a vital member of the multidisciplinary antimicrobial stewardship team.[1,9,11] The role of the infection prevention and control program related to antimicrobial stewardship is to:

- Establish timely communication systems to caregivers when MDRO's are identified
- Identify MDRO transmission in the acute care setting.
- Recognize MDRO resistance patterns.
- Monitor for and recognize novel resistance.
- Collaborate with laboratory, pharmacy, and other team members to plan and implement effective interventions.

Role of Clinical Microbiology and Susceptibility Testing in the Antimicrobial Management and Stewardship Program

The clinical microbiology laboratory plays an essential role by providing patient-specific culture and susceptibility data and in the molecular epidemiologic investigation of outbreaks. The clinical microbiology laboratory collaborates to ensure collection of appropriate clinical specimens, identification and when appropriate, susceptibility testing of clinically significant pathogens (not contaminants or colonizing microbes) using consensus standards. Clinical microbiology laboratories establish methods and algorithms to screen and confirm uncommon resistance. (See also Laboratory Section)

Figure 1 Example – Surgical Care Improvement Project Elective Total Hip Replacement Antimicrobial Prophylaxis Orders

Antibiotic Prophylaxis

❑ Cefazolin _____ IV within 60 minutes prior to incision

OR

❑ Cefuroxime _____ IV within 60 minutes prior to incision

OR

❑ *Vancomycin _____ IV within 2 hours prior to incision

****Vancomycin is acceptable *only* with physician/APN/PA, pharmacist, or Infection Control Practitioner documented justification for its use such as antibiotic allergy or documented MRSA. This must be documented pre-operatively.**

Rationale for use of Vancomycin

OR

If allergic to beta-lactams, give:

❑ Clindamycin _____ IV within 60 minutes prior to incision

OR

❑ Vancomycin _____ IV within 2 hours prior to incision

D/C antibiotic prophylaxis within 24 hours of surgery end time

courtesy of Julia Moody, MS, SM(ASCP) Clinical Services Group HCA Inc., Nashville, TN

Figure 2 Example – Initial Antimicrobial Selection Orderset for Community Acquired Pneumonia

MEDICATIONS

➲ **1ST DOSE OF ANTIBIOTIC TO BE GIVEN WITHIN 6 HRS OF ARRIVAL–IF FIRST DOSE GIVEN IN ER, RECORD DATE/ TIME HERE: _____**

➲ **ANTIBIOTICS– Non-ICU Admission** (check one)

❑ Levofloxacin 750 mg IV q 24 hr

❑ Levofloxacin 750 mg PO q 24 hr

❑ Ceftriaxone 1 gm IV q 24 hr **AND**

Azithromycin 500 mg IV q 24 hr (both meds must be given within 24 hrs of arrival)

➲ **ANTIBIOTICS–- ICU Admission** (check one—both meds must be given within 24 hrs of arrival)

❑ Ceftriaxone 1 gm IV q 24 hr and Levofloxacin 750 mg IV q 24 hr

❑ Ceftriaxone 1 gm IV q 24 hr and Azithromycin 500 mg IV q 24 hr

❑ Unasyn (ampicillin/sulbactam) 3 gm IV q 6 hr and Levofloxacin 750 mg IV q 24 hr

If patient is allergic to Beta lactams:

❑ Aztreonam 1 gm IV q 8 hr and Levofloxacin 750 mg IV q 24 hr

➲ **ANTIBIOTICS – Risk for *Pseudomonas*** (Structural lung disease AND repeated/frequent AB or chronic steroid use)

❑ Zosyn (piperacillin/tazobactam) 4.45 gm IV q 6 hr and Levofloxacin 750 mg IV q 24 hr

❑ Cefepime 2 gm IV q 12 hr and Levofloxacin 750 mg IV q 24 hr

❑ Zosyn (piperacillin/tazobactam) 4.45 gm IV q 6 hr and Levofloxacin 750 mg IV q 24 hr and Tobramycin 7 mg/kg IV q 24 hr

❑ Pharmacy consult for Tobramycin dosing

If patient is allergic tp Beta lactams:

❑ Aztreonam 1 gm IV q 8 hr and Levofloxacin 750 mg IV q 24 hr and Tobramycin 7 mg/kg IV q 24 hr

❑ Pharmacy consult for Tobramycin dosing

➲ **ANTIBIOTICS** – **MRSA Infection**

❑ Pick one of the above **PLUS** Vancomycin 15 mg/kg IV q 12 hr

❑ Pharmacy consult for Vancomycin dosing

courtesy of Julia Moody, MS, SM(ASCP) Clinical Services Group HCA Inc., Nashville, TN

Antimicrobial Susceptibility Testing and Antibiograms

Clinical microbiology laboratories use various testing methods to determine the effectiveness of antimicrobial agents against clinically significant pathogens from diagnostic specimens. The testing methods have been standardized to provide accurate reproducible qualitative and/or quantitative.[13] Quantitative results expressed as minimal inhibitory concentration (MIC) μg/ml values, are usually accompanied by an S, I, or R on the clinical microbiology laboratory report.

An antibiogram is a cumulative summary of antimicrobial susceptibility results over a prescribed time period. This summary is generated from the individual data of clinically significant pathogens tested against a set of systemic and urinary antimicrobial agents to guide treatment. An example of an antibiogram of gram positive organisms is shown in Table 1. The development and presentation of antibiograms should be a collaborative effort between the clinical microbiology laboratory, pharmacy, physicians, and hospital committees such as Infection Prevention and/or Pharmacy and Therapeutics. Antibiograms can be used by providers to guide decisions regarding appropriate

Table 1: Antibiogram example for gram positive cocci (including MRSA) from all specimen sources at "ABC Medical Center". Numbers in the antimicrobial columns reflect the number of susceptible isolates per 100 isolates. Numbers in ***bold italic*** reflect 10% increase in resistance over past year.

ABC Medical Center 2009 Gram Positive Cocci	Total # Isolates	Cefazolin	Ceftriaxone	Ampicillin	Oxacillin	Ampicillin/ Sulbactam	Erythromycin	Clindamycin	Tetracycline	Vancomycin	Trimeth/ Sulfa	Levofloxacin
Staphylococcus epidermidis	215	35	-	-	35	35	32	58	88	100	65	41
Staphylococcus aureus (MSSA)	300	100	-	-	100	98	65	85	93	100	99	89
Staphylococcus aureus (MRSA)	557	-	-	-	0	-	6	***51***	93	100	99	***43***
Streptococcus pneumoniae	32	-	87	49	-	-	52	-	72	100	83	97
Enterococcus faecalis	38	-	-	99	-	-	21	-	21	93	-	60
Enterococcus faecium	10	-	-	10	-	-	-	-	30	20	-	10

- Number of S. aureus isolates (no duplicates) = 857.
- % of S. aureus isolates that are MRSA = 65%.
- Numbers in red reflect an increase of 10% or greater in resistance over past year.
- Note: E. faecium isolates number <30, and although not statistically valid data, data is consistent with national rates of susceptibility.

empiric antimicrobial treatment choices when a definitive susceptibility report is not yet available. It is important for providers to gain a greater understanding as to how to use facility specific antibiogram data when making empiric decisions regarding antimicrobial therapy and promote prudent antimicrobial usage.[1] Antibiograms may be used to track antimicrobial resistance trends over time within a healthcare system.

Antibiograms can be used as evidence the hospital is collecting and aggregating data and information to support care and service delivery and operations for The Joint Commission requirements.[15]

Preparation of a cumulative antibiogram annually is recommended, however, some institutions are able evaluate susceptibility data more frequently. When suspected, unit specific antibiograms can be used to identify suspected healthcare associated outbreaks within defined areas of the hospital or in outpatient areas (i.e., dialysis centers).

CLSI M39-A3[13] **has** defined evidence based quality standards for antimicrobial susceptibility testing and reporting. CLSI suggests antibiogram data should be organized and presented as:

- Separate tables for Gram-positive and Gram-negative organisms;
- Total isolate number of each microorganism species tested;
- The first isolate per patient, eliminating duplicates (even if the patient has the same organism in multiple cultures);
- Pathogens from clinical cultures, not surveillance screening tests;
- The percentage of strains fully susceptible to each antimicrobial agent;
- Separate line listings for MRSA and methicillin susceptible *Staphylococcus aureus* (MSSA);
- Facility specific data for healthcare systems with multiple different facilities;
- Isolate data from defined unit or area specific locations (ie MICU, SICU) when possible;
- Urinary and non-urinary source pathogens when possible.

Facility factors influencing antibiogram data include antimicrobial use, patient population demographics and infection prevention practices. Analyze significant changes and trends in MRSA susceptibility patterns and other MDRO pathogens by reviewing:

- Compliance with infection prevention policies minimizing transmission risks[12];
- Changes to infection prevention practices, e.g. increased screening for MRSA nares colonization on admission to the hospital may have desirable impact on (reduction of) MRSA infection[14];
- Changing resistance patterns within the community;
- Entry of resistant pathogens or new resistant clones into the facility;
- Addition of medical services (ie oncology care, increased number of ICU beds);
- Changes to patient populations who are at risk for MRSA and MDROs.

For example when evaluating increasing or decreasing MRSA rates and trends at the hospital, consider evaluating these additional factors:

- Distribution of isolates among outpatient, ED, inpatient ICU vs nonICUunits and adult versus pediatrics populations;
- Proportion of community-acquired MRSA versus healthcare associated MRSA;
- Specimen sources (ie. blood, urine, sputum, skin and soft tissue);
- At risk patient populations (ie long term care, surgical procedures, dialysis);
- Burden of MRSA colonization which may have affect on infection rates;
- Comparison to national databases such as NHSN.[2]

For providers to make timely informed decisions on treatment and prophylaxis, reports of patient specific culture susceptibility results and published facility specific antibiograms are essential. In order to get the right drug to the right bug, clinicians can utilize antibiograms to guide empiric therapy and use clinical culture results to streamline or de-escalate therapy when antimicrobial susceptibility is available.

Antibiograms for designated significant pathogens are compiled from clinical culture susceptibility testing. The up to date antibiogram can be used to guide empiric treatment decisions, but are also important data for antimicrobial management programs. Awareness of local epidemiology of specific significant pathogens can help identify unusual and/or significant antimicrobial resistance. Infection prevention and control professionals must support and facilitate the process of antibiogram development with the hospital laboratory and pharmacy teams.

Figures 1 and 2 are examples of hospital programs or protocols that include antimicrobial stewardship as part of best practice initiatives.

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MRSA Decolonization Strategies

Key Concepts

Although routine decolonization of MRSA colonized patients is not recommended [1-4] decolonization strategies may be indicated:

- When MRSA positive patients are associated with ongoing transmission or in an outbreak situation.
- In colonized MRSA patients having a surgical procedure that has been identified as high risk for MRSA surgical site infection.
- In certain patient populations in an attempt to reduce the risk of subsequent MRSA and methicillin susceptible *Staphylococcus aureus* infections among colonized persons undergoing dialysis, patients with recurrent *S. aureus* infections, patients in intensive care and patients undergoing targeted surgical procedures where evidence has shown benefit.

Background

Short term MRSA decolonization strategies are utilized at the time of highest risk or to eliminate colonization. The goals are to:

- Interrupt the transmission of MRSA, not to permanently decolonize patients associated with MRSA outbreaks or ongoing transmission;
- Eliminate MRSA carriage in patients with recurrent MRSA infections;
- Prevent an MRSA or methicillin susceptible *S. aureus* surgical site infection in high risk surgeries; and
- Reduce the risk of infections in high risk populations such as intensive care patients.

MRSA decolonization therapy is the administration of topical antimicrobial or antiseptic agents, with or without systemic antimicrobial therapy to MRSA colonized persons for the purpose of eradicating or suppressing the carrier state. Most regimens are usually topical agents combined with an antiseptic skin agent. The regimens are very safe with allergic reactions being extremely rare. Thus far, chlorhexidine resistance is rare but rising mupirocin resistance, both low and high level resistance, has been reported in some[5], but not all studies.[6,7]

The Society of Thoracic Surgeons has a Class 1 recommendation to include universal mupirocin for all cardiac surgery patients unless there is proof by nares culture that the patient does not have *S. aureus* [8,9] based on evidence for this approach showing reductions in *S. aureus* cardiac surgical site infections.[10-12] Decolonization regimens may be indicated for both nasal MRSA and *S. aureus* colonization in patients undergoing vascular surgery with placement of a graft, total joint arthroplasty and neurosurgical procedures with implantation of hardware as well as other surgical procedures.[2,8,10-12,18]

Preoperative showering with agents such as chlorhexidine has been shown to reduce bacterial colonization of the skin.[2,15] Although the 1999 CDC Guideline for Prevention of Surgical Site Infections has a IB recommendation for presurgical bathing with an antiseptic agent[15], a recent Cochrane review evaluated the evidence for preoperative bathing or showering with antiseptics for SSI prevention.[16] Six randomized, controlled trials evaluating the use of 4% chlorhexidine gluconate were included in the analysis, with no clear evidence of benefit noted. Further studies are needed, because of the trial inconsistencies in how chlorhexidine gluconate bathing was performed, instructions for use and contact times (ie apply and wash off immediately, apply and wait 5 minutes prior to washing off, etc).

More recent studies using 2% chlorhexidine gluconate cloths look promising. The antiseptic is applied and not washed off affording a more effective antiseptic action with residual activity and penetration into the skin .[17]

A decolonization strategy has been shown to successfully decolonize MRSA carriers in the short term, which may be of benefit during the high risk period of an intensive care admission by preventing subsequent MRSA infection.[6] A cross-over intervention study of universal 2% chlorhexidine bathing for medical intensive care patients showed a reduction in bloodstream events including MRSA .[19] The concept of universal decolonization in other types of intensive care patients with or without MRSA colonization requires further evaluation.

Although healthcare workers can become colonized with MRSA, colonized healthcare workers are rarely the cause of MRSA outbreaks in acute care settings, and transmission of MRSA from colonized healthcare workers to patients is thought to be rare.[20,21] Instances associated with increased risk of MRSA transmission from colonized healthcare workers to patients have been noted when healthcare workers have chronic skin conditions, chronic otitis media, or when nasally colonized healthcare workers develop viral respiratory infections which result in increased shedding of MRSA. [22-26] Unless there is epidemiological evidence linking healthcare workers to ongoing MRSA transmission, screening healthcare workers for MRSA is not recommended.

Decolonization Strategy Considerations

Infection Prevention and Control Strategy Related to Patient Decolonization

Decolonization is not considered a routine infection prevention and control strategy unless:

- Implemented to interrupt MRSA outbreaks or ongoing transmission as part of an intervention for Tier 2 strategies, for a limited time in targeted patient populations[1]
- Implemented as part of an evidence based prevention bundle to reduce the risk of infections in selected surgical procedures; or
- In identified high risk populations or clinical cases, for clinical benefit and reduced risk of infection.

Decolonization of MRSA colonized patients is not considered a routine MRSA prevention and control intervention prior to transfer to another acute care or long term care facility.[1]

The most experience for MRSA decolonization[2] when deemed appropriate has been with the use of a variation of the following regimen for adults:

- Nasal decolonization with 2% mupirocin ointment applied to the nares twice a day for five days; AND
- Skin antisepsis with chlorhexidine or hexachlorophene for 5 days, applied per manufacturer's instructions.

For pre-surgical prophylactic decolonization protocols, the most experience has been with the use of the protocol described above. Starting mupirocin decolonization at least 5 days prior to surgery is preferred. When using chlorhexidine or hexachlorophene, avoid contact with eyes and mucus membranes and observe for allergic reactions and skin irritation.

The use of systemic antimicrobials for MRSA decolonization may be considered by the patient's healthcare provider if deemed clinically appropriate.

Infection Prevention and Control Strategy Related to Indications for Healthcare Worker Decolonization

Healthcare worker decolonization is indicated as an infection prevention and control intervention when a healthcare worker is colonized or infected with MRSA and has been epidemiologically implicated in ongoing transmission of MRSA to patients. The purpose of treating MRSA-colonized healthcare workers implicated in transmission is to interrupt MRSA transmission, not to permanently decolonize the healthcare worker. Healthcare workers implicated in transmission should be screened for MRSA colonization and colonized healthcare workers implicated in transmission are candidates for decolonization.[1] Retain MRSA isolates from healthcare workers and patients for molecular typing during epidemiologic investigations.

Employee health professionals and/or infectious disease physicians should be consulted regarding staff decolonization. When it is deemed appropriate, staff may be directed to also consult with their personal physician regarding the decolonization plan. Evaluate the work situation of the MRSA-colonized or infected healthcare workers associated with ongoing MRSA transmission to determine the need for furlough from patient contact during the decolonization process. The evaluation should take into consideration the location of MRSA infection/colonization, ability of draining MRSA skin infections to be contained and covered, patient population assignments, and healthcare worker compliance with infection prevention and control precautions.

Surveillance When Implementing Decolonization Strategies

Monitor MRSA transmission and infection rates to evaluate the effectiveness and outcomes of the decolonization strategies. Monitoring mupirocin resistance is an adjunctive measure to ensure continued efficacy and impact of use, especially when decolonization failures increase. [1,5] Discontinue the routine use of decolonization when implemented to interrupt ongoing transmission or control outbreaks and the intervention has resulted in sustained success.

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