SUPPLEMENT ARTICLE: SHEA/IDSA PRACTICE RECOMMENDATION

Strategies to Prevent Transmission of Methicillin-Resistant *Staphylococcus aureus* in Acute Care Hospitals

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PURPOSE

Previously published guidelines are available that provide comprehensive recommendations for detecting and preventing healthcare-associated infections (HAIs). Our intent in this document is to highlight practical recommendations in a concise format to assist acute care hospitals in their efforts to prevent transmission of methicillin-resistant *Staphylococcus aureus* (MRSA). Refer to the Society for Healthcare Epidemiology of America/Infectious Diseases Society of America "Compendium of Strategies to Prevent Healthcare-Associated Infections" Executive Summary, Introduction, and accompanying editorial for additional discussion.

SECTION 1: RATIONALE AND STATEMENTS OF CONCERN

1. Burden of HAIs caused by MRSA in acute care facilities

a. In the United States, the proportion of hospital-associated *S. aureus* infections that are caused by strains resistant to methicillin has steadily increased. In 2004, MRSA accounted for 63% of *S. aureus* infections in hospitals.[1]

b. Although the proportion of *S. aureus*–associated HAIs among intensive care unit (ICU) patients that are due to methicillin-resistant strains has increased (a relative measure of the MRSA problem), recent data suggest that the incidence of central line–associated bloodstream infection caused by MRSA (an absolute measure of the problem) has decreased in several types of ICUs since 2001.[2] Although these findings suggest that there has been some success in preventing nosocomial MRSA transmission and infection, many patient groups continue to be at risk for such transmission.

c. MRSA has also been documented in other areas of the hospital and in other types of healthcare facilities, including those that provide long-term care.

2. Outcomes associated with MRSA HAIs

MRSA HAIs are associated with significant morbidity and mortality.[3-5]

a. Compared with patients with bacteremia caused by methicillin-susceptible *S. aureus,* those with MRSA bacteremia have nearly twice the mortality rate,[3] significantly longer hospital stays,[5] and significantly higher median hospital costs.[6]

b. Compared with patients with a surgical site infection

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caused by methicillin-susceptible *S. aureus*, those with a surgical site infection caused by MRSA have a 3.4 times higher risk of death and almost 2 times greater median hospital costs.[4]

c. The higher morbidity and mortality rates associated with MRSA are not necessarily due to increased virulence of resistant strains but rather may be due to other factors, such as delays in the initiation of effective antimicrobial therapy, less-effective antimicrobial therapy for infection due to resistant strains, and higher severity of underlying illness among persons with infection due to resistant strains.

3. Risk of MRSA HAI among MRSA-colonized patients

A substantial proportion of MRSA-colonized patients will subsequently develop an MRSA infection.[7,8]

a. One study of persons in whom MRSA colonization had been identified during a previous hospital stay reported that the risk of developing an MRSA infection, such as bacteremia, pneumonia, or soft tissue infection, within 18 months after detection of MRSA colonization was 29%.[7]

4. Risk factors for MRSA colonization and HAI

Traditional risk factors for MRSA colonization include severe underlying illness or comorbid conditions; prolonged hospital stay; exposure to broad-spectrum antimicrobials; the presence of foreign bodies, such as central venous catheters; and frequent contact with the healthcare system or healthcare personnel.

a. Colonization pressure (the ratio of MRSA-carrier-days to total patient-days) has been identified as an independent risk factor for nosocomial acquisition of the organism.[9]

b. Community-associated MRSA, which is genetically and often clinically distinct from typical healthcare-associated strains, is now a significant and growing problem among persons without traditional healthcare-related risk factors.[10-12]

c. Transmission of community-associated MRSA can and does occur in hospitals. One recent study found that 15.7% of hospital-onset invasive MRSA infections were caused by USA300,[13] the strain type most frequently associated with community-associated MRSA.

5. Reservoir for MRSA transmission in acute care facilities

In healthcare facilities, antimicrobial use provides a selective advantage for MRSA to survive, and transmission occurs largely through patient-to-patient spread.

a. MRSA-colonized and -infected patients readily contaminate their environment, and healthcare personnel coming into contact with patients or their environment readily contaminate their hands,[14] clothing, and equipment.[15-19]

SECTION 2: STRATEGIES TO DETECT MRSA

1. Surveillance definitions

a. Standardized definitions should be used to classify each patient's first MRSA isolate as either hospital or community onset. Although no classification system provides complete accuracy, for purposes of MRSA surveillance, recommendations for classifying each patient's first MRSA isolate (regardless of whether the isolate represents clinical infection or asymptomatic colonization) have been made by the Society for Healthcare Epidemiology of America, using the following time-based definitions:[20]

i. Hospital-onset MRSA: A patient's first MRSA isolate is classified as a new case of "hospital-onset MRSA" if it is identified from a specimen obtained after the third calendar day of hospitalization, with the day of admission being counted as calendar day number 1. (The admission date is defined as the date that the patient occupies a room for overnight stay, not the date of outpatient or emergency department visit.) For example, if a patient who was not previously known to be colonized or infected with MRSA is admitted on Monday, an MRSA isolate would be considered to be hospital onset if the specimen was obtained from the patient on or after Thursday.

ii. Community-onset MRSA: A patient's first MRSA isolate is classified as "community-onset MRSA" if it is identified from a specimen obtained on or before the third calendar day of a patient's hospitalization, with the day of admission being counted as calendar day number 1. (For MRSA surveillance purposes, the term "community onset" is used to indicate that the MRSA isolate does not meet the surveillance definition for indicating hospital-onset MRSA. The MRSA isolate may be attributable to the community or to another healthcare facility.)

b. Clinical definitions can also be used to classify MRSA isolates and/or episodes of MRSA infection as healthcare associated or community associated.[20] Unlike the time-based definitions described above, which take into account only the time of specimen collection in relation to the time of hospital admission, these clinical definitions require evaluation of the patient's clinical history and prior healthcare exposures.

2. Methods for detection of patients with MRSA colonization or infection

The reservoir for transmission of MRSA is largely composed of 2 groups of patients—those with clinical MRSA infection and a much larger group of patients who are merely colonized. Various detection methods can be used to identify one or both of these groups.

a. Routine review of data from clinical specimens: Clinically infected patients and some asymptomatically colo-

nized patients can be detected when MRSA is isolated from a clinical specimen sent to the microbiology laboratory.

b. Review of active surveillance testing data: Active surveillance testing for MRSA is defined as performing diagnostic testing for the purpose of detecting asymptomatic MRSA colonization.

SECTION 3: STRATEGIES TO PREVENT MRSA TRANSMISSION

1. Existing guidelines and recommendations

a. Several governmental, public health, and professional organizations have published evidence-based guidelines and/or policies for prevention and control of MRSA transmission.[21-24] These guidelines include similar recommendations, differing primarily with regard to the routine use of active surveillance testing to identify patients asymptomatically colonized with MRSA.

b. The major recommendations of each of these guidelines are summarized in Table 1. Although these guidelines specifically recommend a number of prevention measures, guidance as to the implementation of these measures within hospitals is not provided.

c. The Institute for Healthcare Improvement and the Association for Professionals in Infection Control and Epidemiology have developed practical suggestions for implementation and monitoring of several of the prevention measures specified in evidence-based guidelines.[25,26]

2. Infrastructure requirements

a. Infrastructure requirements of an MRSA transmission prevention program include the following:

i. An active infection prevention and control program staffed by a sufficient number of trained personnel to allow implementation and continuation of MRSA surveillance and infection prevention efforts without compromising other infection prevention and control activities.

ii. Information technology systems to allow rapid notification of clinical personnel and infection prevention and control personnel of new MRSA isolates, collection of data needed for MRSA surveillance and rate calcu-

TABLE 1. Summary of Recommendations From Published Guidelines for Prevention and Control of Methicillin-Resistant *Staphylococcus aureus* (MRSA) and/or Other Multidrug-Resistant Organisms

Recommendation	SHEA (2003) [21]	WIP (2005) [24]	Joint Working Party (2006) [23]	CDC (2006) [22]
System to identify patients with MRSA colonization or infection	Y (IB)	ND	Y (IB)	Y (IB)
Feedback of information to clinicians	ND	ND	ND	Y (IB)
Education	Y (IB)	ND	ND	Y (IB)
Hand hygiene	Y (IA)	Y		Y (IB)
Environmental decontamination	Y (IB)	Y	Y (IB)	Y (IB)
Dedicated equipment	Y (IB)	Y	Y (IB)	Y (IB)
Contact precautions	Y (IA)	Y	Y (IB)	Y (IB)
Masks	Y (II)	Y	ND	N
Cohorting	Y (II)	ND		S (IB)
Antimicrobial stewardship	Y (IB)	Y	Y (IA-IB)	Y (IB)
Active surveillance testing	Y (IA-IB)	Y	Y (II)	S (IB)
Decolonization therapy	S (IB)	S	S (IB-II)	S (II)
Compliance with hand hygiene	Y (IB)	ND	ND	Y (IB)
Compliance with cleaning protocols	ND	ND	ND	S (IB)
Compliance with contact precautions	ND	ND	ND	Y (IB)
MRSA prevalence or incidence	ND	Y	ND	Y (IA)

NOTE. The Society for Healthcare Epidemiology of America (SHEA) guideline and the US Centers for Disease Control and Prevention (CDC) recommendations use the CDC/Healthcare Infection Control Practices Advisory Committee system for categorizing recommendations as follows: IA, strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies; IB, strongly recommended for implementation and supported by some experimental, clinical, or epidemiologic studies and a strong theoretical rationale; and II, suggested for implementation and supported by suggestive clinical or epidemiologic studies or a theoretical rationale. N, no (approach not recommended); ND, not discussed; S, approach recommended for use in certain subpopulations or specific circumstances; WIP, Dutch Workingparty on Infection Prevention; Y, yes (approach recommended).

lations, and identification of MRSA-colonized patients on readmission.

iii. Sufficient supplies for hand hygiene and contact precautions (eg, gowns and gloves)

iv. Resources to provide appropriate education and training to healthcare personnel, patients, and visitors

v. Adequate laboratory support

SECTION 4: RECOMMENDATIONS FOR IMPLEMENTING PREVENTION AND MONITORING STRATEGIES

Recommendations for preventing and monitoring MRSA transmission are summarized in the following section (also see Figure). They are designed to assist acute care hospitals in prioritizing and implementing their MRSA transmission prevention efforts. Criteria for grading of the strength of recommendations and quality of evidence are described in Table 2. These recommendations are primarily intended for the control of MRSA transmission in the setting of endemicity; however, they may also be appropriate for epidemic MRSA, with the exception of an accelerated time frame for implementation and the frequency at which outcomes are assessed. These recommendations are meant to be complementary to other general infection prevention measures, such as central line–associated bloodstream infection and ventilator-associated pneumonia "bundles."

I. Basic practices for prevention of MRSA transmission: recommended for all acute care hospitals

A. Components of an MRSA transmission prevention program

1. Conduct an MRSA risk assessment (B-III).

a. Conduct an MRSA risk assessment. This risk assessment provides a baseline for subsequent assessments and other data comparisons.

b. Types of data that can be useful in performing an MRSA risk assessment include the following:

i. The proportion of *S. aureus* isolates resistant to methicillin

ii. The number of new cases of MRSA colonization or infection over a given period of time (incidence)

iii. The number of new cases of 1 or more specific types of MRSA infection (such as bacteremia) over a given period of time (incidence)

iv. Point prevalence survey(s) of MRSA colonization or infection

Note: These and other MRSA metrics are discussed in greater detail below in the "Performance Measures" section of this document.

c. Use findings from the risk assessment to develop the hospital's surveillance, prevention, and control plan and to develop goals to reduce MRSA acquisition and transmission.

2. Implement an MRSA monitoring program (A-III).

a. A program should be in place to identify and track patients from whom MRSA has been isolated from any clinical or active surveillance testing specimen.

b. A common detection strategy used by infection control programs includes a daily review of laboratory results to identify patients from whom MRSA has been isolated.

c. A common method of tracking MRSA is a line list or case count. The line list includes the first MRSA isolate, regardless of body site, per patient and includes isolates identified by clinical culture and active surveillance testing, when available. These isolates should be classified as either hospital- or community-onset MRSA by use of prespecified definitions, as described above. In addition, patients known to be MRSA colonized or infected on the basis of testing performed at another healthcare facility may be included in the line list. Additional information contained in the line list may include patient identification, date of collection of specimen from which MRSA was isolated, site from which specimen was obtained, and hospital location at time of collection. Subsequent MRSA isolates from an individual patient may also be included in the line list but should be labeled to avoid being counted as additional new cases. The line list will allow MRSA isolates to be monitored and evaluated at the unit/ward and organizational levels.

d. Outcome measures related to MRSA in hospitals are discussed in more detail below in this document.

3. Promote compliance with Centers for Disease Control and Prevention or World Health Organization hand-hygiene recommendations (A-II).

a. Implement a hand-hygiene compliance program.

b. Patient-to-patient transmission of MRSA commonly occurs through transient colonization of the hands of healthcare personnel, and some investigators have attributed reduced rates of MRSA among hospital inpatients to efforts made to improve hand-hygiene practices.[28,29]

c. Hand-hygiene practices compliant with Centers for Disease Control and Prevention or World Health Organization guidelines are critical to MRSA transmission control and prevention. Evidence-based recommendations for implementation and assessment of hand-hygiene programs in healthcare settings have been published.[30] The 2005 World Health Organization Guidelines on Hand Hygiene in Health Care are available online.[31]

d. Information on promoting compliance with hand hygiene can be found in many published materials, such as the Institute for Healthcare Improvement's "How-To Guide: Improving Hand Hygiene."[32]

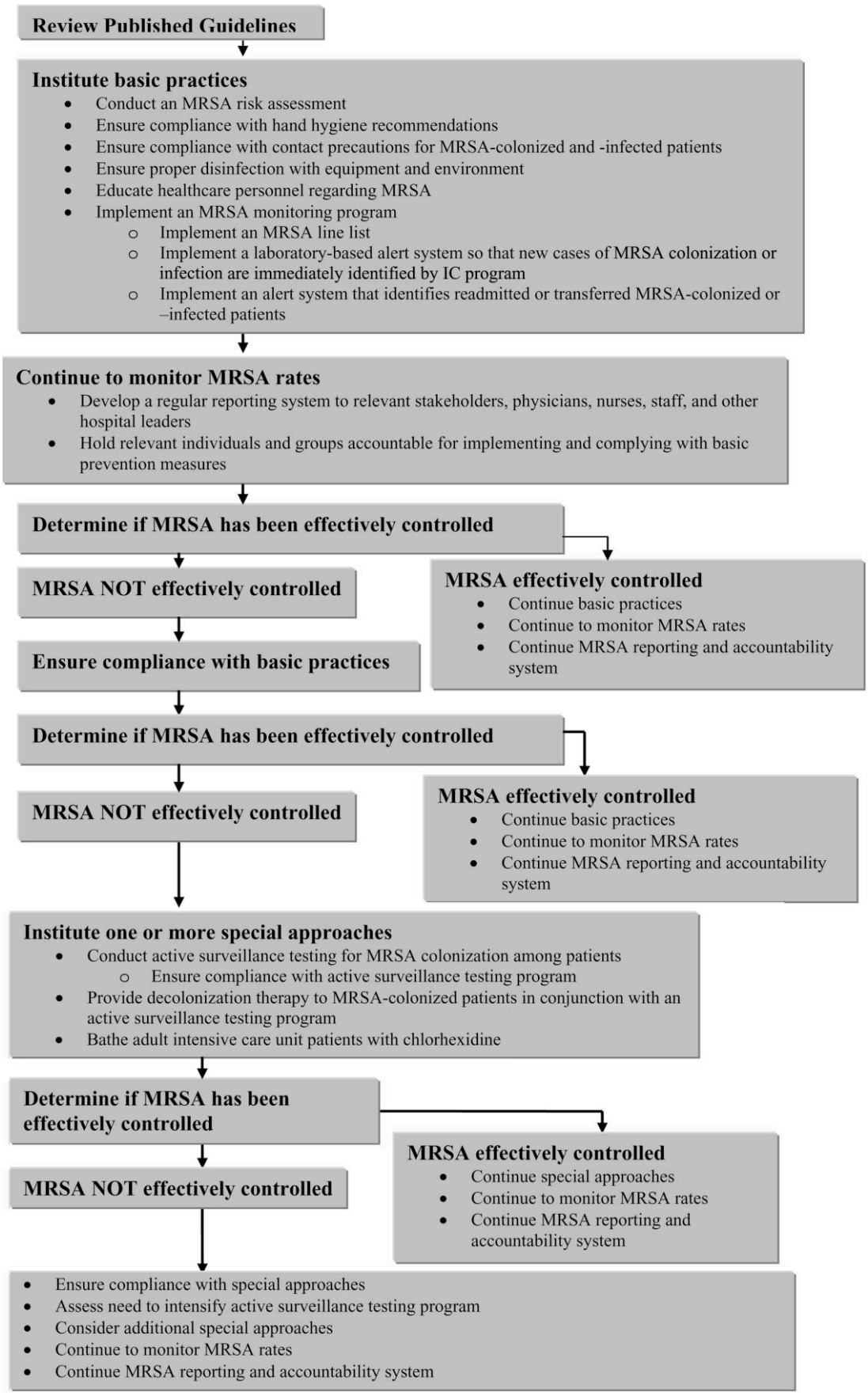

FIGURE. Approach to control and prevention of methicillin-resistant *Staphylococcus aureus* (MRSA) transmission. IC, infection control.

TABLE 2. Strength of Recommendation and Quality of Evidence

Category/grade	Definition
Strength of recommendation	
A	Good evidence to support a recommendation for use
B	Moderate evidence to support a recommendation for use
C	Poor evidence to support a recommendation
Quality of evidence	
I	Evidence from $\geqslant 1$ properly randomized, controlled trial
II	Evidence from $\geqslant 1$ well-designed clinical trial, without randomization; from cohort or case-control analytic studies (preferably from >1 center); from multiple time series; or from dramatic results from uncontrolled experiments
III	Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees

NOTE. Adapted from the Canadian Task Force on the Periodic Health Examination.[27]

4. Use contact precautions for MRSA-colonized or -infected patients (A-II).

a. Place patients with MRSA colonization or infection under contact precautions to help reduce patient-to-patient spread of the organism within the hospital.[22,33]

i. Place patients in a single or private room when available. Cohorting of patients with MRSA colonization or infection is acceptable when a single or private room is not available. Cohorting does not eliminate the need for compliance with hand-hygiene guidelines and other infection prevention measures.

ii. Wear a gown and gloves on entry into the patient's room.

iii. Remove the gown and gloves before exiting the room.

iv. Use appropriate hand hygiene on entering and exiting the patient's room. Wearing gloves does not eliminate the need for hand hygiene.

b. Address potential adverse events associated with contact precautions.

i. Educate healthcare personnel about isolation precautions, including the benefits and potential adverse effects associated with contact precautions.

ii. Several uncontrolled studies have reported that patients in isolation are examined less frequently and for shorter periods, compared with those not in isolation.[34-36] Some studies have reported significantly increased rates of depression and anxiety among these patients.[37]

iii. Patients isolated specifically for MRSA colonization or infection were more likely to experience preventable adverse events, such as pressure ulcers, falls, or electrolyte imbalances, compared with nonisolated patients without MRSA colonization or infection.[38]

iv. Authors of these studies emphasized that additional studies are needed to confirm their findings. Some have also suggested that hospitals monitor adverse events potentially attributable to contact precautions.[39]

v. These potential adverse events should not be considered justification to avoid the use of contact precautions but rather should serve as a reminder to ensure that patients under contact precautions receive adequate care.

vi. Ensure that hospital culture and leadership support the proper use of and enforce adherence to contact precautions for MRSA.

vii. Educate patients, families, and visitors about isolation precautions.

c. Criteria for discontinuation of contact precautions

i. The duration of contact precautions necessary for patients colonized or infected with MRSA remains an unresolved issue.

ii. Studies have suggested that patients may have persistent carriage of MRSA for prolonged periods (median duration, 8.5 months in one study[40]) and that MRSA shedding can be intermittent and thus may be missed if only a single surveillance culture is performed.

iii. With regard to the duration of contact precautions, Healthcare Infection Control Practices Advisory Committee guidelines recommend the following:

(a) When active surveillance testing is used to identify MRSA-colonized patients, contact precautions are to be continued throughout the duration of hospital stay; a reasonable approach to subsequent discontinuation would be to document clearance of the organism with 3 or more surveillance tests in the absence of antimicrobial exposure.[22] When to consider retesting patients to document clearance is debatable, but 3-4 months after the last positive test result is commonly used as the time frame. Some hospitals may choose to consider MRSA-colonized patients to be colonized indefinitely.

5. Ensure cleaning and disinfection of equipment and the environment (B-III).

a. MRSA contaminates the patient's environment (eg, over-bed tables, bed rails, furniture, sinks, and floors)[41-46] and patient care equipment (eg, stethoscopes and blood pressure cuffs).[15,16,47-49] Exposure to this contaminated environment has been associated with acquisition of MRSA.[50]

b. Develop and implement protocols for cleaning and disinfecting environmental surfaces.

i. Select appropriate cleaning and disinfecting agents for environmental surfaces. Recent guidelines have outlined environmental disinfection protocols.[51] Routine cleaning and disinfection of the patient environment with US Environmental Protection Agency–registered hospital disinfectants (eg, quaternary ammonium compounds, sodium hypochlorite, iodophors, and phenolics) used in accordance with the manufacturers' directions is adequate to reduce MRSA contamination.

ii. Develop written protocols for daily and terminal cleaning and disinfection of patient rooms.

c. Pay close attention to cleaning and disinfection of frequently touched ("high-touch") surfaces in patient-care areas (eg, bed rails, carts, bedside commodes, doorknobs, and faucet handles).

i. For terminal cleaning of rooms of patients colonized or infected with MRSA, pay special attention to ensuring adequate coverage of environmental surfaces with approved disinfectants at appropriate dilutions for the appropriate amount of contact time.

ii. A system for monitoring adherence to environmental cleaning and disinfection protocols is desirable.

iii. Develop and implement protocols for cleaning and disinfecting patient care equipment.

iv. To reduce MRSA contamination, disinfect portable healthcare equipment, such as stethoscopes and otoscopes, with a 70% isopropyl alcohol swab or other disinfectant after each use.

d. Dedicate noncritical patient care items, such as blood pressure cuffs and stethoscopes, to a single patient when they are known to be colonized or infected with MRSA. When this is not possible, ensure adequate cleaning and disinfection of items between patient encounters.

e. Provide appropriate training for personnel responsible for cleaning and disinfecting the environment and patient care equipment.

6. Educate healthcare personnel about MRSA, including risk factors, routes of transmission, outcomes associated with infection, prevention measures, and local epidemiology (B-III).

a. Modify healthcare personnel behavior: Several key components of an effective MRSA transmission prevention program involve modification of healthcare personnel behavior (eg, compliance with hand hygiene, contact precautions, environmental disinfection, and active surveillance testing protocols).

b. Provide an educational program to foster desired behavior changes[52] and include a discussion of MRSA risk factors, routes of transmission, outcomes associated with infection, prevention measures, local MRSA epidemiology (MRSA infection rates, etc.) and current data regarding healthcare personnel compliance with infection prevention and control measures.

c. Target educational programs on the basis of healthcare personnel needs (eg, professional or nonprofessional). Given the wide range of educational backgrounds among hospital personnel, several educational programs will be needed to provide the information necessary at the appropriate level for all relevant personnel. Subsequent educational sessions and written communications may be of more limited scope and may include data related to MRSA process and outcome measures.

d. Including opinion leaders and role models in the educational and behavioral modification program may be useful.

7. Implement a laboratory-based alert system that immediately notifies infection prevention and control personnel and clinical personnel of new MRSA-colonized or -infected patients (B-III).

a. To place patients with MRSA colonization or infection under contact precautions in a timely manner, an alert system should be developed among the laboratory staff, infection prevention and control staff, and clinical personnel caring for the patient.

b. This alert system should notify infection prevention and control staff when a patient is identified as positive for MRSA. This can be accomplished via fax, phone, pager, or automated secure electronic alerts.

8. Implement an alert system that identifies readmitted or transferred MRSA-colonized or -infected patients (B-III).

a. An alert system allows information regarding the MRSA status of the patient to be available at the time of admission, before bed assignment.

b. Information may come from prior testing by the hospital system or from information supplied by a referring facility. This information may be integrated into the computerized database used during admission and registration or may exist as a separate electronic or paper-based database.

c. The alert should remain in effect until clearance of MRSA has been documented by subsequent culture or other forms of testing. (See the discussion regarding the duration of contact precautions.)

d. Implement a system for communicating the MRSA status of a patient when transferring him/her to another hospital, so that appropriate precautions can be implemented at the accepting facility.

9. Provide MRSA data and outcome measures to key stakeholders, including senior leadership, physicians, and nursing staff (B-III).

a. The process and outcome measures outlined in the "Performance Measures" section of this document should be provided to appropriate hospital staff and administrators on a regular basis. The frequency with which these data are provided will depend on the hospital's existing reporting structure and the type of data collected. These data can be added to routine quality assessment and performance improvement reports.

10. Educate patients and their families about MRSA, as appropriate (B-III).

a. Education of the patient and the patient's family may help to alleviate patient fears regarding being placed into isolation.[53]

i. Include information about anticipated questions: General information about MRSA, colonization versus infection, the hospital's MRSA transmission prevention program, the components of and rationale for contact precautions, and the risk of transmission to family and visitors while in the hospital and after discharge. Helpful methods might include patient education sheets in appropriate languages, patient education channels, Web sites, or video presentations.

B. Accountability

1. The hospital's chief executive officer and senior management are responsible for providing a healthcare system that supports an infection prevention and control program that effectively prevents healthcare-associated infections and the transmission of epidemiologically significant pathogens.

2. Senior management is accountable for ensuring that trained personnel are assigned to the infection prevention and control program.

3. Senior management is accountable for ensuring that healthcare personnel, including licensed and nonlicensed personnel, are competent to perform their job responsibilities.

4. Direct healthcare providers (such as physicians, nurses, aides, and therapists) and ancillary personnel (such as housekeeping and equipment-processing personnel) are responsible for ensuring that appropriate infection prevention and control practices are used at all times (including hand hygiene, standard and isolation precautions, and cleaning and disinfection of equipment and the environment).

5. Hospital and unit leaders are responsible for holding personnel accountable for their actions.

6. The person who manages the infection prevention and control program is responsible for ensuring that an active program for identifying MRSA is implemented, that data on MRSA are analyzed and regularly provided to those who can use the information to improve the quality of care (eg, unit staff, clinicians, and hospital administrators), and that evidence-based practices are incorporated into the program.

7. Personnel responsible for healthcare personnel and patient education are accountable for ensuring that appropriate training and educational programs on preventing MRSA transmission are developed and provided to healthcare personnel, patients, and families.

8. Personnel from the infection prevention and control program, the laboratory, and information technology are responsible for ensuring that a system is in place to support the surveillance program.

II. Special approaches for the prevention of MRSA transmission

Special approaches are recommended for use in locations and/or populations within the hospital that have unacceptably high MRSA rates despite implementation of the basic MRSA transmission prevention strategies listed above. There are several controversial issues regarding prevention of MRSA transmission. As a result, implementation of the recommendations beyond the basic practices to prevent MRSA transmission should be individualized at each healthcare facility. Facilities may consider a "tiered" approach in which recommendations are instituted individually or in groups; additional "tiers" are added if MRSA rates do not improve, with implementation of basic practices as the first tier.

A. Active surveillance testing: MRSA screening program for patients

Active surveillance testing is based on the premise that clinical cultures identify only a small proportion of hospital patients who are colonized with MRSA and that asymptomatically colonized MRSA carriers serve as a substantial reservoir for person-to-person transmission of MRSA in the acute care hospital setting. Studies have shown that routine use of clinical cultures alone does not identify the full reservoir of asymptomatically colonized patients, underestimating the overall hospital-wide prevalence of MRSA by as much as 85%[54] and underestimating the monthly average prevalence of MRSA in ICUs by 18.6%-63.5%.[55] In addition, active surveillance testing can reduce misclassification of MRSA isolates by identifying patients who are already colonized at the time of admission, so that subsequent MRSA isolates are not falsely attributed to intrafacility acquisition.[55]

The effectiveness of active surveillance testing in the prevention of MRSA transmission is currently an area of controversy, and optimal implementation strategies (including

timing and target populations) are unresolved. Several published studies of high-risk or high-prevalence populations (including those in outbreak situations) have shown an association between the use of active surveillance testing to identify and isolate MRSA-colonized patients and the effective control of MRSA transmission and/or infection.[56-59] Two recent studies evaluated the impact of universal active surveillance testing performed at the time of hospital admission combined with administration of decolonization therapy to MRSA carriers and came to conflicting conclusions. One study used an observational cohort design and reported a significant reduction in hospital-associated MRSA disease after the introduction of active surveillance testing of all patients and decolonization of MRSA carriers.[60] The other study used a crossover cohort design and found no significant changes in the incidence of nosocomial MRSA infection among surgical patients.[61] There are several possible explanations for the differences in outcome observed in these 2 studies, including differences in study design, patient population, adherence to routine infection control measures, and adherence to decolonization therapy protocols. Of note, a multicenter, cluster-randomized trial investigating the impact of active surveillance testing on MRSA in ICUs has been performed, but the results have not yet been published (ClinicalTrials.gov identifier NCT00100386).

This was a very complex study. Preliminary analysis did not demonstrate a benefit from active surveillance testing during the 6-month study period under the specific study protocol. The authors have stated that those preliminary results should not be used to conclude that active surveillance testing is useless or that efforts to control MRSA are futile.[62] The final analysis and peer review of study methods, results, and conclusions are pending.

Because of conflicting results from these studies and the differences among acute care hospitals and their associated patient populations, a specific recommendation regarding universal screening for MRSA cannot be made. However, active surveillance testing as a single intervention in the absence of a multifaceted approach to MRSA transmission prevention (eg, the basic measures described above) is unlikely to be uniformly effective across healthcare institutions. Active surveillance testing may, however, be useful in facilities that have implemented and optimized adherence to basic MRSA transmission prevention practices but continue to experience unacceptably high MRSA rates.

1. Implement an MRSA active surveillance testing program as part of a multifaceted strategy to control and prevent MRSA transmission when evidence suggests that there is ongoing transmission of MRSA despite effective implementation of basic practices (B-II).

Assess MRSA transmission as the basis for determining if, when, and where active surveillance testing is to be used at an individual hospital. In general, active surveillance testing is considered appropriate in a facility where there is direct or indirect evidence of ongoing MRSA transmission despite adequate implementation of and adherence to basic practices. Although the use of serial active surveillance testing of hospital patients provides the most accurate measurement of MRSA transmission, other metrics may be used as surrogate markers for transmission when comprehensive active surveillance testing data are not available. Examples include the following:

- A high or increasing prevalence or incidence of hospital-onset MRSA infection or colonization
- An incidence of hospital-onset MRSA infection or colonization that is not decreasing despite the use of basic practices
- An increasing proportion of hospital-onset *S. aureus* isolates that are resistant to methicillin
- Identification of specific hospital units in which the colonization pressure (ie, the prevalence rate of MRSA) is above the level associated with an increased risk of transmission[9] (Such units may be identified with the use of point prevalence surveys.)
- Identification of specific patient populations at high risk for MRSA colonization or infection

a. Convene a multidisciplinary team to review the MRSA risk assessment and to plan and oversee the active surveillance testing program.

i. Because of the multidisciplinary nature of an active surveillance program, representatives from the microbiology laboratory, infection prevention and control personnel, nursing staff, medical staff, materials management, environmental services, and hospital administration should be involved in program development, implementation, and resource allocation. Careful consideration of the resources necessary for an active surveillance testing program is essential to ensure that the active surveillance testing program is implemented properly and that other important components of the hospital's infection control program are not disrupted.

ii. Consultation with a trained individual who has expertise in MRSA transmission control and prevention may be useful for program development and assessment if such a person is not available within the hospital.

iii. Pilot the program in one location before expanding to other locations. Select the pilot unit on the basis of the risk or prevalence of MRSA on the unit or the presence of motivated leadership and front-line personnel.

iv. Expand the program to additional units once the pilot program has been evaluated and adjusted and initial goals have been met (eg, more than 90% compliance with specimen acquisition).

b. Select and identify the patient population(s) to be screened.

i. Determine which patients to screen (eg, all patients versus high-risk patients or patients on high-risk units).

(a) Use the MRSA risk assessment to determine

whether all patients, patients admitted to specific high-risk units (eg, the ICU), or high-risk patient populations (regardless of location) will be included in the screening program.

(b) Patient-level risk factors for MRSA colonization (eg, recent admission to a hospital or skilled nursing facility, long-term hemodialysis, and recent antimicrobial therapy) may also be used to determine inclusion in the screening program.[63]

(c) Consider available infrastructure and hospital-specific characteristics (size; staffing for infection prevention and control, laboratory, and nursing; patient population; and information technology support) when selecting the patient population(s) to be screened.

ii. Develop and implement a system to identify and screen patients who meet the screening program criteria.

(a) A reliable system for identification of all patients meeting the criteria for inclusion in the screening program is necessary for the success of the program.

(b) Identification of patients who meet criteria for MRSA screening may be more difficult when patient-level risk factors, rather than patient care unit, are used to determine inclusion in the surveillance program. Take this into consideration during the planning stages of the screening program. Hospitals with well-developed electronic medical records and other computer databases may be able to identify such patients by use of a computer algorithm.

(c) Consider developing and implementing a checklist to be completed at admission to assist in identifying patients to be screened for MRSA.

(d) Determine how screening specimens will be ordered (eg, protocol admission order set or individual patient order), who will initiate the order (eg, physician or nurse) and who will obtain the specimens (eg, unit-based nursing personnel or designated MRSA monitoring program personnel). These decisions will need to take into account relevant hospital policies, staffing, and infrastructure.

c. Determine when to perform screening tests.

i. At a minimum, MRSA surveillance should be performed at admission to the hospital or to the specific unit in which surveillance is being performed.

ii. To detect transmission while in the hospital, additional testing of patients with initial negative surveillance test results can be done either at regular intervals (eg, weekly) or at discharge from the hospital or unit.

iii. Testing at regular intervals has the potential to detect patients who have acquired MRSA during their hospitalization earlier than testing only at discharge and thus allows implementation of contact precautions to prevent further transmission.

iv. When testing is to be performed at regular intervals, determine a specific day of the week when specimens will be collected. This will simplify the process and allow the microbiology laboratory to anticipate the increased volume of specimens and plan staffing and supplies accordingly.

d. Determine the anatomic sites to include in screening program.

i. Identify the anatomic site(s) to be tested.

(a) Anterior nares: The sensitivity of surveillance specimens obtained from a variety of sites has been evaluated in several settings and patient populations. Although testing of no single site will detect all MRSA-colonized persons, the anterior nares appear to be the most frequently positive site, with sensitivity ranging from 73% to 93%.[64-70] Because of this and the accessibility of the site, the anterior nares are generally considered to be the primary site for sampling in MRSA screening programs.

(b) Collection of samples from other sites, such as wounds, foreign body (eg, gastrostomy or tracheostomy tube) exit sites, the throat, the perianal area, and/or the umbilicus (in neonates)[71] will allow identification of additional colonized patients who would not be identified by testing of nasal specimens alone.

e. Determine laboratory methods and assess resource requirements.

i. Identify the screening test method to be used.

ii. MRSA can be detected using culture-based methods or molecular diagnostic testing methods, such as polymerase chain reaction (PCR). Many factors must be considered when determining which laboratory method(s) will be used in an MRSA screening program. These factors include but are not limited to the following:

(a) Performance characteristics of the test (eg, sensitivity and specificity)

(b) Turnaround time

(c) Capabilities of the laboratory (whether an in-house or reference laboratory) that will be providing the service

(d) Number of specimens that will be processed

(e) Facility-specific cost-benefit calculations

iii. A detailed discussion of the various laboratory methods for MRSA detection is beyond the scope of this document, but some of the key features of the most common methods are discussed below.

(a) Culture-based methods: Culture-based techniques have been used in the majority of MRSA screening programs. Numerous microbiological media and techniques have been described for use in the detection of MRSA colonization. One of the more commonly used selective media is mannitol salt agar with or without antimicrobial (eg, oxacillin or cefoxitin) supplementation to increase specificity for methicillin-resistant organisms. Additional enrichment

steps, such as overnight incubation in trypticase soy broth, can further increase the yield of standard culture-based methods.[72] The time required for detection of MRSA by use of most culture-based techniques is approximately 48 hours. More recently, several chromogenic agar media have been developed that allow more-rapid detection of MRSA, usually within 24 hours. Studies using established collections of isolates and clinical specimens have shown that these chromogenic media rival or outperform more conventional microbiological techniques.[73-81]

(b) Molecular testing methods: In recent years, there have been advances in molecular diagnostic testing methods, such as real-time PCR, for detection of MRSA colonization. At least 2 PCR assays for direct detection of MRSA in nasal specimens have been approved for use. These PCR assays have been shown to be highly sensitive (90%-100%) and specific (91.7%-98.4%), compared with standard culture-based methods.[82-85] Although it is more costly than culture-based techniques, one potential advantage of this technology is its ability to provide a result less than 2 hours from the time of specimen collection, although in actual practice the turnaround time may be longer because of batching of samples. Although at least 1 uncontrolled study[86] and a mathematical model[87] have suggested that rapid testing may allow for more effective use of isolation precautions and enhanced prevention of MRSA transmission, a recently published cluster-randomized crossover trial of universal screening in general wards failed to identify a difference in MRSA acquisition rates with the use of rapid testing, compared with the use of a culture-based method.[88] These data suggest that the clinical and economic benefits of rapid testing may vary among individual hospitals and settings.

f. Clarify how to manage patients while awaiting the results of screening tests.

i. Before implementing a screening program, a decision should be made as to how a patient will be managed while waiting for the result of the admission MRSA screening test. There are 2 common approaches:

(a) Await the screening test result and implement contact precautions only if the test result is positive.

(b) Place the patient under empirical contact precautions until a negative admission screening test result is documented.

ii. Implementing contact precautions at the time of receipt of a positive screening test result is a reasonable initial approach. Although empirical contact precautions minimize the risk of MRSA transmission from unrecognized sources and have been shown to contribute to effective control of MRSA,[58] logistical difficulties are associated with this approach. Empirical use of contact precautions substantially increases the need for single rooms and the amount of supplies needed to practice contact precautions. When only a small proportion of screened patients are colonized with MRSA and single rooms are of limited quantity, a large number of patients whose screening test results are negative will need to be moved so that their single room can be used for another patient. These room reassignments and the necessary cleaning before the vacated room can be reoccupied can slow down patient flow within the hospital. The empirical use of contact precautions for all tested patients while awaiting test results may be most feasible in hospitals in which a relatively large proportion of patient rooms are single rooms and in individual hospital units, such as many ICUs, in which each patient is in an individual room or bay. Despite its potential logistical difficulties, this approach should be considered if transmission continues despite introduction of a screening program in which contact precautions are implemented only after a positive MRSA screening test result is obtained.

g. Assess the availability of single rooms and, if needed, plan for cohorting colonized or infected patients.

i. When developing a screening program, address the availability of single rooms for MRSA-positive patients, including cohorting persons colonized or infected with the same organism, when single rooms are not available. Consider the following:

(a) Prioritize MRSA-positive patients who are at greater risk for transmission (eg, those with draining wounds) for a single room.

(b) Ensure that patients who are known or suspected to have other indications for isolation precautions (eg, colonization or infection with other multidrug-resistant organisms, influenza, or tuberculosis) are not cohorted with MRSA-positive patients.

(c) Cohorting does not eliminate the need for full compliance with hand hygiene and other basic prevention recommendations.

h. Assess the availability of personal protective equipment and other supplies.

i. Ensure that gowns, gloves, and hand-hygiene products (eg, alcohol-based hand rubs, soap, and paper towels) are consistently available to healthcare personnel. The screening program will not be effective if healthcare personnel are not able to comply with contact precautions because of a lack of supplies.

(a) Cooperation among the purchasing department, laundry/linen service (if reusable gowns are selected), and unit-based personnel is imperative.

(b) Infection prevention and control experts, particularly those familiar with the use of active surveillance, can serve as a resource to help hospitals estimate the number of patients likely to be found to be colonized with MRSA and, thus, the amount of supplies needed.

i. Assess compliance with the screening protocol.

i. Monitor compliance with the screening and contact precautions protocols, because suboptimal compliance will prevent the surveillance program from providing its maximal benefit. The monitoring program should ensure that the following measures are taken:

(a) Screening tests are collected and processed according to protocol.

(b) Infection prevention and control personnel are notified of positive results within the proper time frame.

(c) The clinical personnel caring for the patient are notified of positive results within the proper time frame.

B. Active surveillance testing for MRSA among healthcare personnel

Screening of healthcare personnel for MRSA is not routinely recommended in settings of endemicity unless they have been epidemiologically linked to new MRSA cases. Screening of healthcare personnel for MRSA should be considered in an outbreak setting.

1. Screen healthcare personnel for MRSA infection or colonization only if they are epidemiologically linked to a cluster of MRSA infections (B-III).

a. Healthcare personnel can become transiently or persistently colonized with MRSA, and this has been determined to be the source of several outbreaks in hospitals. Molecular testing (eg, pulse-field gel electrophoresis) to establish clonality of MRSA isolates has been useful in such situations.[89-93]

C. Routine bathing with chlorhexidine

Recent studies have demonstrated that the use of chlorhexidine for routine cleansing of adult ICU patients may decrease the incidence of patient acquisition of MRSA[94] and vancomycin-resistant *Enterococcus*[95] and may reduce the incidence of catheter-associated bloodstream infections.[96] The effect of chlorhexidine on transmission of bacterial pathogens is likely due to a reduction in the burden of organisms on the skin of colonized or infected patients, with a subsequent reduction in contamination of environmental surfaces and the hands of healthcare workers.[95] The use of chlorhexidine for routine patient cleansing outside of the adult ICU setting has not been studied.

1. Routinely bathe adult ICU patients with chlorhexidine (B-III).

a. Use chlorhexidine rather than regular soap and water or other nonmedicated cleansing regimens for routine patient cleansing.

b. A variety of chlorhexidine products that could be used for patient bathing are available. These include single-use bottles of aqueous chlorhexidine that can be added to a basin of water and 2% chlorhexidine-impregnated cloths. It should be noted that the use of undiluted 4% aqueous chlorhexidine solution for skin cleansing has been associated with a relatively high rate of reversible adverse skin effects (eg, skin fissures, itching, and burning of the skin).[97]

c. When using chlorhexidine, the manufacturer's recommendations should be followed. Care must be taken to avoid contact with the eyes and middle ear (eg, in patients with perforated tympanic membranes). Chlorhexidine is in US Food and Drug Administration Pregnancy Category C.

D. MRSA decolonization therapy for MRSA-colonized persons

MRSA decolonization therapy can be defined as 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. The use of MRSA decolonization therapy in conjunction with active surveillance testing may be a useful adjunctive measure for prevention of MRSA transmission within a hospital. For example, one group of investigators observed a 52% reduction in incident cases of MRSA colonization or infection among adult ICU patients after the introduction of a decolonization regimen for all MRSA-colonized patients.[98] Decolonization therapy has also been a component of several successful MRSA outbreak control programs.[99-101]

Decolonization therapy has also been used in certain patient populations in an attempt to reduce the risk of subsequent *S. aureus* infection among colonized persons. These populations have included patients undergoing dialysis,[102] patients with recurrent *S. aureus* infections, and patients undergoing certain surgical procedures.[103] Further discussion of this topic is beyond the scope of this document.

1. Provide decolonization therapy to MRSA-colonized patients in conjunction with an active surveillance testing program (B-III).

a. The optimal decolonization therapy regimen has not been determined. Most experience has been with the use of 2% mupirocin administered intranasally with or without chlorhexidine bathing. In the previously mentioned study that observed a reduction in incident cases of MRSA colonization or infection after the introduction of decolonization therapy, the decolonization regimen consisted of intranasal administration of 2% mupirocin twice daily for 5 days and chlorhexidine baths for 7 days.[98] In that study, bed baths were performed after adding a 4-oz bottle of 4% chlorhexidine gluconate to a 6-qt basin of warm water.

b. Complications of decolonization therapy are relatively uncommon; however, hospital personnel involved in the decolonization therapy program should be familiar with potential adverse effects, such as development of re-

sistance to the agents used (eg, mupirocin) and drug-related toxicities.

III. Unresolved Issues

There are a number of unresolved issues related to MRSA and its transmission. A full discussion of these issues is beyond the scope of this document, but a brief mention of some of these important topics is worthwhile. For example, the impact of antimicrobial stewardship efforts on the risk of MRSA infection and transmission has not been clearly defined. Also, further study of the epidemiology and prevention of MRSA transmission among family members and other close contacts of persons colonized or infected with MRSA is needed. Additionally, the emergence of community-associated MRSA has further complicated the epidemiology of MRSA in healthcare facilities and has generated new questions related to MRSA transmission prevention in hospitals. One such topic that requires further study is the approach to detection of carriers of community-associated MRSA. Current approaches that are largely based on the epidemiology of hospital-associated MRSA may be suboptimal, given differences in risk factors for colonization and the presence of some evidence that suggests that there are differences in the predominant sites of colonization, compared with hospital-associated MRSA. Differences in antimicrobial susceptibility and virulence between typical hospital-associated MRSA and community-associated MRSA suggest that the phenotypic characteristics (eg, antimicrobial susceptibility) of MRSA isolates from individual patients may need to be considered when it becomes necessary to cohort patients with MRSA colonization or infection. These and other aspects of MRSA transmission and control require further investigation.

SECTION 5: PERFORMANCE MEASURES

I. Internal reporting

These performance measures are intended to support internal hospital quality improvement efforts and do not necessarily address external reporting needs. The process and outcome measures suggested here are derived from published guidelines[20-22,30] and other relevant literature.[25] Additional information regarding the rationale for and significance of some of these measures is provided in the Appendix. A more detailed description of these and other outcome measures that may be useful for MRSA transmission prevention programs is provided in the Society for Healthcare Epidemiology of America/Healthcare Infection Control Practices Advisory Committee position paper on measurement of multidrug-resistant organisms in healthcare settings.[20] Process and outcome measures should be reported to senior hospital leadership, nursing leadership, and clinicians who care for patients at risk for MRSA infection or colonization.

A. Process measures important for all acute care hospitals

1. Compliance with hand-hygiene guidelines
   a. Monitor healthcare personnel compliance with hand-hygiene guidelines both before and after contact with the patient or environment.
   b. Preferred measure of hand-hygiene compliance
      i. Numerator: number of observed adequate hand-hygiene episodes performed by healthcare personnel.
      ii. Denominator: number of observed opportunities for hand hygiene.
      iii. Multiply by 100 so that the measure is expressed as a percentage.

2. Compliance with contact precautions
   a. This assessment should be performed only as an internal measure in institutions that use contact precautions as part of a MRSA transmission prevention program. This metric has not been validated for, and should not be used for, interhospital comparisons.
   b. Preferred measure of contact precautions compliance
      i. Numerator: number of observed patient care episodes in which contact precautions are appropriately implemented.
      ii. Denominator: number of observed patient care episodes in which contact precautions are indicated.
      iii. Multiply by 100 so that the measure is expressed as a percentage.

B. Process measures for settings where active surveillance testing for MRSA has been implemented

1. Compliance with the MRSA active surveillance testing program
   a. This assessment should be performed only as an internal measure in institutions that use active surveillance testing as part of a MRSA transmission prevention program. This metric has not been validated for, and should not be used for, interhospital comparisons.
   b. Preferred measure of compliance with the active surveillance testing program: Determine the percentage of persons from whom screening test specimens were appropriately collected.
      i. Numerator: number of persons from whom surveillance specimens were appropriately collected.
      ii. Denominator: number of persons meeting the selected criteria for surveillance testing.
      iii. Multiply by 100 so that the measure is expressed as a percentage.

C. Outcome measures important for all acute care hospitals

1. Methicillin resistance among *S. aureus* isolates
   a. The Clinical and Laboratory Standards Institute has

issued a consensus document to assist clinical laboratories in the preparation of this type of information.[104]

b. The proportion of inpatient *S. aureus* isolates resistant to methicillin is calculated as 1 minus the proportion of isolates susceptible to methicillin. The proportion of inpatient isolates susceptible to methicillin is calculated as follows:

i. Numerator: number of nonduplicate *S. aureus* isolates susceptible to methicillin recovered from inpatients.

ii. Denominator: total number of *S. aureus* isolates recovered from inpatients.

iii. Multiply by 100 so that the measure is expressed as a percentage.

2. Incidence or incidence density of hospital-onset MRSA bacteremia

a. How to calculate the incidence of hospital-onset MRSA bacteremia

i. Numerator: number of first bloodstream MRSA isolates per infection for each unit or facility that occur more than 3 calendar days after admission to the unit or facility during the surveillance period (eg, 1 month).

ii. Denominator: number of patient admissions for that unit or facility during the surveillance period (eg, 1 month).

iii. Multiply by 100 so that the measure is expressed as cases per 100 patient admissions.

b. How to calculate the incidence density of hospital-onset MRSA bacteremia

i. Numerator: number of first bloodstream MRSA isolates per infection for each unit or facility that occur more than 3 calendar days after admission to the unit or facility during the surveillance period (eg, 1 month).

ii. Denominator: number of patient-days for that unit or facility during the surveillance period (eg, 1 month).

iii. Multiply by 1,000 so that the measure is expressed as cases per 1,000 patient-days.

c. With regard to the numerator used in the calculation of hospital-onset MRSA bacteremia incidence and incidence density, a single patient could be counted more than once in a surveillance period (eg, 1 month) if the positive blood culture results are from samples collected at least 14 days apart. Similarly, multiple bloodstream MRSA isolates from the same patient should not be counted as unique infections if the samples are collected within 14 days after a previous positive culture sample, even if it spans 2 surveillance periods. Note that this metric includes both primary and secondary bloodstream infections as defined by the National Healthcare Safety Network, Centers for Disease Control and Prevention.

3. Incidence or incidence density of hospital-onset MRSA (See section 2.1, "Surveillance Definitions," for the definition of "hospital-onset MRSA.")

a. How to calculate the incidence of hospital-onset MRSA

i. Numerator: number of first MRSA isolates (from colonization or infection), regardless of source, per patient for each unit or facility from specimens obtained more than 3 calendar days after admission to the unit or facility detected during the surveillance period (eg, 1 month). This includes MRSA identified from clinical culture and active surveillance testing, if performed. This excludes historically MRSA-positive patients (ie, patients with a known history of MRSA positivity).

ii. Denominator: number of patient admissions for that unit or facility during the surveillance period (eg, 1 month).

iii. Multiply by 100 so that the measure is expressed as cases per 100 patients.

b. How to calculate the incidence density of hospital-onset MRSA

i. Numerator: number of first MRSA isolates (from colonization or infection), regardless of source, per patient for each unit or facility from specimens obtained more than 3 calendar days after admission to the unit or facility detected during the surveillance period (eg, 1 month). This includes MRSA identified from clinical culture and active surveillance testing, if performed). This excludes historically MRSA-positive patients (ie, patients with a known history of MRSA positivity).

ii. Denominator: number of patient-days for that unit or facility during the surveillance period (eg, 1 month).

iii. Multiply by 1,000 so that the measure is expressed as cases per 1,000 patient-days.

D. Special/advanced outcome measures

The basic outcome measures included in the previous section are designed to provide estimates of those outcomes (eg, patients with new acquisition of MRSA) that may be most rapidly influenced by an effective MRSA transmission prevention program. The prevalence measures listed here provide estimates of the overall burden of MRSA colonization and infection in a hospital, including those patients already known to be colonized with MRSA. This may allow a hospital to estimate the amount of exposure that patients in that hospital have to other patients who are either colonized or infected with MRSA and who could therefore potentially transmit MRSA. Such information may be useful in determining the need for and designing certain components of an MRSA transmission prevention program, such as an active surveillance testing program.

1. Overall prevalence or prevalence density of MRSA colonization and/or infection

a. How to calculate the overall prevalence of MRSA colonization and/or infection

i. Numerator: total number of patients during a given surveillance period (eg, month) who were known to be colonized or infected with MRSA (includes all patients with MRSA as determined by medical history, previous clinical cultures, and, if available, active surveillance testing).

ii. Denominator: number of patient admissions during surveillance period (eg, 1 month).

iii. Multiply by 100 so that the measure is expressed as a percentage.

2. Admission prevalence of MRSA colonization and/or infection

a. How to calculate admission prevalence of MRSA colonization and/or infection

i. Numerator: number of first MRSA isolates (from colonization or infection), regardless of source, per patient for each unit or facility from specimens obtained less than 3 calendar days after admission to the unit or facility, detected during the surveillance period (eg, 1 month). This includes MRSA identified from clinical culture and, if available, active surveillance testing plus the number of historically MRSA-positive patients (ie, patients with a known history of MRSA positivity).

ii. Denominator: number of patient admissions for that unit or facility during the surveillance period (eg, 1 month).

iii. Multiply by 100 so that the measure is expressed as a percentage.

3. Point prevalence of MRSA colonization and/or infection

a. Point prevalence surveys typically involve performing active surveillance testing on all patients in the population of interest (eg, all patients with a specific risk factor, all patients in a specific hospital unit or units, or all patients in the hospital) at a specific point in time. In the absence of an ongoing MRSA active surveillance testing program, point prevalence surveys may be useful in identifying populations or locations in which there is a high level of endemic MRSA or, when performed serially, in monitoring the impact of MRSA transmission prevention activities.

b. How to calculate the point prevalence of MRSA colonization and/or infection

i. Numerator: total number of MRSA isolates (from colonization or infection), regardless of specimen source (eg, clinical culture or active surveillance testing), per patient for each unit or facility at the time of the survey.

ii. Denominator: total number of patients on the unit or in the facility at the time of the survey.

iii. Multiply by 100 so that the measure is expressed as a percentage.

4. Incidence or incidence density of MRSA infection(s)

a. Surveillance for hospital-associated MRSA infections (eg, device-associated or procedure-associated infections) may be useful to assess the burden of specific MRSA infections and to monitor the impact of prevention activities within a facility or population. Further discussion of this type of surveillance is beyond the scope of this document. Additional information and guidance related to performing this type of surveillance is available from the National Healthcare Safety Network.[105]

E. Outcome measures for settings where active surveillance testing for MRSA has been implemented

1. MRSA transmission incidence

a. This assessment should be performed only as an internal measure in institutions that use active surveillance testing as part of a MRSA transmission prevention program. This metric has not been validated for, and should not be used for, interhospital comparisons.

b. How to calculate MRSA transmission incidence

i. Numerator: number of patients without a history of MRSA colonization or infection and with a previously negative MRSA surveillance test result who subsequently have a positive MRSA surveillance test result or clinical culture result during the surveillance period (eg, 1 month).

ii. Denominator: total number of patients or number of patients without a history of MRSA with a negative MRSA surveillance test result during the surveillance period (eg, 1 month).

iii. Multiply by 1,000 so that the measure is expressed as transmissions per 1,000 patients.

II. External reporting

Many challenges exist in providing useful information to consumers and other stakeholders and in preventing unintended consequences of public reporting of HAIs.[106] Recommendations for public reporting of HAIs have been provided by the Hospital Infection Control Practices Advisory Committee,[107] the Healthcare-Associated Infection Working Group of the Joint Public Policy Committee,[108] and the National Quality Forum.[109]

Given the current absence of standardized definitions and standardized surveillance methodology and the difficulties in ascertaining the specific time and location when MRSA was acquired (in the absence of hospital-wide screening at admission and periodically throughout hospitalization and/or at discharge), specific recommendations for external reporting of process and outcome measures cannot be made.

A. State and federal requirements

1. Hospitals in states that have mandatory reporting requirements for MRSA must collect and report the data required by the state.

2. Hospitals in states that require active surveillance cultures for MRSA must implement a program that complies with state requirements.

3. For information on state and federal requirements, check with your state or local health department.

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For Potential Conflicts of Interest statements and information on financial support, please see the Acknowledgments in the Executive Summary, on page S20 of this supplement.

APPENDIX

PERFORMANCE MEASURES RATIONALE

Process Measures

Compliance With Hand Hygiene

Although several measurements of compliance with hand hygiene have been described, there is currently no standardized method of measurement, and each method is associated with certain advantages and disadvantages.[110] Guidelines for hand hygiene in healthcare settings describe 2 indicators for use in measuring improvements in hand hygiene among healthcare personnel.[30] The first is a direct measurement of adherence, calculated as the number of hand-hygiene episodes performed by healthcare personnel divided by the number of observed opportunities for hand hygiene. The result is then multiplied by 100 to determine the percentage of opportunities in which hand hygiene is performed. Ideally, the goal for compliance should be 100%. These data should be collected on a regular basis by use of a standardized data collection form. Collection and analysis of observation data at the unit-specific and job category–specific (eg, physician, nurse, or respiratory therapist) level should be considered, especially in larger hospitals, so that education and enforcement resources can be allocated appropriately. The other suggested performance indicator for hand hygiene calculates the volume of alcohol-based hand rub (or soap for hand washing) used per patient day. Further dividing this by the average volume of hand-hygiene product used per hand-hygiene episode provides an estimate of the number of hand-hygiene episodes performed per patient day. Although this second indicator can be a useful and, in many instances, much less resource-intensive method for monitoring trends over time, the data may not be as meaningful to healthcare personnel and do not provide the detail and opportunity for immediate feedback that direct observation provides.

Compliance With Contact Precautions

Hospitals should periodically monitor healthcare personnel adherence to contact precautions (ie, proper use and removal of gown and gloves) when providing care to patients colonized or infected with MRSA (or to other patients for whom contact precautions have been implemented). Adherence to contact precautions is a direct measurement, calculated as the number of observed patient care episodes in which contact precautions are appropriately implemented divided by the number of observed patient care episodes in which contact precautions are indicated. The result is then multiplied by 100 to give the percentage of opportunities in which contact precautions are appropriately implemented. The frequency of observation and the number of opportunities that should be observed will vary among hospitals but must be sufficient to allow meaningful interpretation of the data. These data should be collected on a regular basis by use of a standardized data collection form. As with hand hygiene, collection and analysis of data at the unit/ward- and job category–specific level is recommended, especially in larger hospitals, so that education and enforcement can be targeted appropriately. Ideally, the goal for compliance should be 100%.

Compliance With Active Surveillance Testing

When active surveillance testing is included in MRSA transmission prevention activities, compliance with the screening protocol should be monitored. This is calculated as the number of persons from whom surveillance specimens were obtained divided by the number of persons meeting the selected criteria for surveillance. Ideally, this statistic should be calculated at the level of the individual unit, so that identification of barriers to specimen collection can be determined and appropriate interventions can be made. This is especially important if different individuals are responsible for ordering and/or collecting specimens on different units. It is unlikely that 100% compliance would be routinely achievable, because of uncontrollable events such as the transfer of a patient to another location (eg, an operating room or ICU), the death of a patient without sufficient time for sampling, or a patient's refusal to undergo testing. A goal of 90% or greater may be more reasonable.

Outcome Measures

When comparing trends in outcome measures over time, one must be aware of changes in detection techniques (eg, change to a more sensitive detection method or addition or expansion of a screening program) so that data can be interpreted appropriately. For instance, the addition of a screening program for MRSA will most likely result in a notable increase in the number of new MRSA cases identified. If this change in surveillance techniques is not considered during data analysis, an increase in identified cases could be incorrectly interpreted as evidence of increased transmission. A more detailed description of outcome measures that may be useful for MRSA transmission prevention programs is provided in the Society for Healthcare Epidemiology of America/Healthcare Infection Control Practices Advisory Committee position paper on metrics for multidrug-resistant organisms in healthcare settings.[20]

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