Recommendations for Prevention and Control of Methicillin-Resistant *Staphylococcus aureus* (MRSA) in Acute Care Facilities

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Executive Summary

An estimated 1.7 million healthcare-associated infections occur each year in the United States resulting in over 98,000 deaths [1]. A recent study conducted by the Centers for Disease Control and Prevention estimated that there were 94,000 invasive MRSA infections in the United States in 2005, 86% of which were healthcare-associated [2]. Furthermore, the proportion of all *S. aureus* isolates that are resistant to methicillin has been increasing each year and MRSA now accounts for over 60% of all *S. aureus* isolated from intensive care unit patients [3].

This report serves as the Minnesota Department of Health (MDH) Recommendations for Methicillin-Resistant *Staphylococcus aureus* (MRSA) Control in Acute Care Facilities (hereafter referred to as The Recommendations) as required under Minnesota Statutes, section 144.585. The purpose of this document is to provide a standard set of recommendations for the prevention and control of MRSA in acute care facilities in Minnesota. It is expected that facilities will implement The Recommendations by January 1, 2009.

This document was created to enhance rather than duplicate existing published recommendations and guidelines for MRSA control in acute care settings. Extensive literature reviews, expertise from the MDH MRSA Recommendations Task Force (MDH-MRTF) and discussions with national content experts served as the basis for the Recommendations. MDH will review The Recommendations annually and modify them as needed to reflect new scientific developments concerning effective MRSA prevention and control.

Public comments were solicited on a draft version of The Recommendations. The MDH MRSA Recommendations Task Force (MDH-MRTF) reviewed and evaluated the public comments and made revisions to the draft version in creating the final Recommendations.

Minnesota Statutes, section 144.585 states: "In developing the MRSA recommendations, the Department of Health shall consider the following infection prevention and control practices: 1) identification of MRSA-colonized patients in all intensive care units (ICU) or other at-risk patients identified by the hospital; 2) isolation of identified MRSA-colonized or MRSA-infected patients in an appropriate manner; 3) adherence to hand hygiene requirements; and 4) monitor trends in the incidence of MRSA in the hospital over time and modify interventions if MRSA infection rates do not decrease."

Infection prevention and control practices two through four in the statute are included in The Recommendations as standard MRSA infection prevention and control practices for acute care facilities. The statute also calls on MDH to consider active surveillance cultures in a subset of patients (practice 1 in the statute). The MDH-MRTF carefully considered this practice and concluded that requiring identification of MRSA-colonized patients through active surveillance cultures in a pre-defined subset of patients for all admissions, at all times, in all acute care facilities in Minnesota is not the ideal approach to decrease healthcare-associated MRSA and other healthcare-associated infections. The main factor behind this decision is that acute care facilities, the populations they serve (including populations with varying degrees of risk for MRSA) and the services they provide vary across the state. Rather than requiring active surveillance cultures in a pre-defined subset of patients, The Recommendations require acute care facilities to conduct an annual MRSA risk assessment using active surveillance cultures to identify patients at high risk for MRSA colonization or units with high rates of MRSA transmission. This process will allow acute care facilities to identify, target and monitor interventions to their individually identified high-risk populations and/or units creating the potential for greater reduction in transmission of MRSA. Under The Recommendations, acute

care facilities must also consider the standard use of active surveillance cultures in targeted populations or units as a part of an enhanced infection prevention and control program when routine infection prevention and control practices do not result in decreased MRSA infection rates.

The Recommendations are comprised of three sections: General infection prevention and control recommendations, Tier One Recommendations and Tier Two Recommendations. The general infection prevention and control recommendations will prevent the transmission of MRSA and be useful in decreasing transmission of other healthcare-associated infections including *Clostridium difficile*, extended-spectrum beta-lactamase producing Gram-negative bacteria, and vancomycin-resistant enterococci. Transmission of MRSA within acute healthcare facilities is of great concern, although it is estimated that MRSA is responsible for less than 15% of all healthcare-associated infections [4].

General infection prevention and control measures include administrative support, process measures and infection prevention and control measures. Administrative support for infection prevention and control activities (e.g. adequate funding and staffing) is critical to the success of programs aimed at reducing healthcare-associated infections. Process measures involve implementing a group of interventions that, when used together, have been shown to achieve better healthcare-associated infection prevention outcomes than if implemented alone such as interventions for preventing ventilator-associated pneumonia, central-line associated bloodstream infections and surgical site infections [5]. Infection prevention and control measures include hand hygiene, Standard Precautions and Transmission-Based Precautions.

In addition to general infection prevention and control measures, The Recommendations adopt a two-tiered approach for preventing and controlling MRSA transmission in acute care

facilities. Tier One Recommendations for MRSA control in acute care settings include core MRSA infection prevention tools such as strict adherence to Contact Precautions, adherence to recommended hand hygiene practices and thorough environmental cleaning. In facilities not performing facility-wide active surveillance cultures, Tier One Recommendations require acute care facilities to conduct an annual MRSA risk assessment using active surveillance cultures to determine populations or units at risk for MRSA colonization and/or to determine MRSA transmission rates. This annual assessment will assist facilities in determining when Tier Two Recommendations are indicated.

Tier Two Recommendations are indicated when hospital-acquired MRSA infection rates are not decreasing despite implementation of and adherence to the general infection prevention and control measures and Tier One Recommendations. Tier Two Recommendations call for monitoring healthcare worker compliance with infection prevention and control measures in identified high-risk units or populations, intensified environmental measures and active surveillance cultures for all admissions to identified high-risk units or of high-risk populations.

Prevention and control of MRSA necessitates that healthcare facilities implement an antimicrobial stewardship program to augment their infection prevention and control program. Antibiotic misuse, including overuse of broad-spectrum antibiotics, is the biggest driver of antimicrobial resistance and contributes appreciably to the development of resistant organisms including MRSA. Effective antimicrobial stewardship programs are necessary to optimize therapeutic outcomes while minimizing unintended consequences of antimicrobial use [6].

Facility-wide commitment to antimicrobial stewardship and infection prevention and control practice measures are essential to prevent healthcare-associated infections. An

institutional philosophy that supports these elements is critical to achieving success in decreasing transmission of MRSA and other healthcare-associated infections.

Relationship to Currently Published Recommendations

This document was created to enhance rather than duplicate existing published recommendations and guidelines for MRSA control in acute care settings (e.g. guidelines developed by the Healthcare Infection Control Practices Advisory Committee [HICPAC], Institute for Healthcare Improvement [IHI], Association for Professionals in Infection Control and Epidemiology [APIC] and Society of Healthcare Epidemiology of America [SHEA]) [7-10]. Additional guidance can be found in guidelines developed by experts in specialty care areas (e.g. Association of Perioperative Registered Nurses [AORN] and the American College of Cardiology) [11-14]. Acute care facilities should work with their various departments and units, including specialty care areas (e.g. operating rooms, peri-operative areas, anesthesia, and cardiac catheter laboratories) to determine how best to implement this document.

Background

Staphylococcus aureus

Staphylococcus aureus bacteria are Gram-positive cocci that are both coagulase and catalase positive and have long been recognized as important pathogens in human disease. *S. aureus* can cause a wide range of infections from non-invasive skin and soft tissue infections to invasive infections of the bone, joint, and blood; but it can also colonize the human body without causing disease. Up to 30% of the population at any point in time is colonized with *S. aureus*, most often in the anterior nares [15]. Until the development of penicillin for use as an antibiotic in the 1940s, up to 50% of serious *S. aureus* infections resulted in death. Unfortunately, shortly after the introduction of penicillin, *S. aureus* strains resistant to penicillin were isolated [16].

A similar pattern was seen with *S. aureus* resistant to methicillin. Methicillin was first introduced in 1960 and *S. aureus* isolates that demonstrated resistance to methicillin were isolated in 1961 [17]. MRSA was first identified as a hospital-acquired pathogen in United States hospitals in 1968 [18]. Since then, MRSA infections have increased such that in 2004 more than 60% of *S. aureus* isolates from intensive care unit patients were resistant to methicillin [3]. Additionally, a recent nationwide point-prevalence study looking at MRSA colonization or infection in hospitalized patients found that 46.3 out of every 1,000 hospitalized patients (30.7 out of every 1,000 hospitalized patients in Minnesota) were colonized or infected with MRSA [19].

MRSA infections have been shown to result in longer lengths of hospital stays, increased costs and increased mortality compared to methicillin-susceptible *Staphylococcus aureus* (MSSA) infections [20-27]. Additionally, it has been shown that patients colonized with MRSA

are more likely to develop MRSA infections when compared to patients colonized with MSSA who develop MSSA infections [22, 28]. Furthermore, a study conducted in a surgical intensive care unit found that MRSA may be transmitted between patients and healthcare workers more easily than MSSA [29].

MRSA infections were initially seen in patients with frequent exposures to healthcare settings, including patients with a history of recent surgery, hospitalization, dialysis, or residence in a long-term care facility [30]. MRSA infections in patients with healthcare exposures are termed healthcare-associated (HA) MRSA. In the 1980's, MRSA infections were seen in patients who lacked healthcare risk factors [31-33]. MRSA infections in patients lacking traditional healthcare risk factors are termed community-associated (CA) MRSA infections.

Isolates from patients with traditional HA-MRSA infections tend to be different than isolates from CA-MRSA patients. HA-MRSA isolates are resistant to more classes of non-beta-lactam antibiotics and possess different toxin profiles than CA-MRSA isolates [34]. CA-MRSA isolates are more likely to possess Panton-Valentine leukocidin (PVL) and certain other staphylococcal enterotoxins than HA-MRSA isolates [34, 35]. The presence of these toxins in CA-MRSA strains has been associated with increased virulence of the organism [36-38]. This is of concern, as recent reports have described CA-MRSA strains causing infections in acute care facilities [39-43].

Increases in methicillin-resistance among community-associated staphylococcal isolates have been reported [44-46]. In some regions more than half of all community-associated staphylococcal infections reported are methicillin-resistant [47]. Minnesota has conducted prospective surveillance on CA-MRSA infections in 12 sentinel hospital laboratories located throughout the state since 2000. The number of CA-MRSA infections reported from the 12

sentinel sites has increased dramatically over the 7 years of study, from 131 cases (12% of total MRSA infections) reported in 2000 to over 1,400 cases (42% of total MRSA infections) reported in 2006 [32, 45, 48].

A recently published study describing the burden of invasive MRSA in the United States in 2005 calculated an average invasive MRSA infection rate of 31.8 per 100,000 people nationally and a rate of 19.2 per 100,000 people in Minnesota [2]. Using the national incidence rate, approximately 90,000 invasive MRSA infections and 18,000 deaths occurred in 2005 [2]. When the calculated incidence rate of invasive MRSA infections in Minnesota (19.2 per 100,000) is applied to the population of Minnesota, 1,000 invasive MRSA infections occurred in Minnesota in 2005 [2]. Using hospital discharge data for the Midwestern United States, it was estimated that MRSA was coded in the discharge diagnosis at a rate of 7.23 per 1,000 patient discharges and the rate of MRSA-associated hospitalizations doubled from 1999 to 2005 [49].

The increasing incidence and prevalence of MRSA in United States healthcare facilities is alarming and highlight the importance of MRSA infection prevention and control strategies.

Infection Prevention and Control

The Centers for Disease Control and Prevention (CDC) has developed guidelines for infection prevention and control precautions for use by healthcare personnel. The infection prevention and control precautions are divided into two main categories: Standard Precautions and Transmission-Based Precautions. Standard Precautions assume that all blood, body fluids, secretions, excretions, non-intact skin, and mucous membranes contain transmissible infectious agents. Standard Precautions apply to all patients in healthcare facilities, regardless of suspected or confirmed infection status. Standard Precautions include: hand hygiene; use of gloves, gown, mask, eye protection or face shield depending on anticipated exposure to blood or body fluids;

and safe injection practices. Standard Precautions require the use of gloves if contact with patient blood or body fluids/secretions is anticipated; gown use if it is anticipated that healthcare worker clothing will become contaminated with potentially infectious material; mask, goggles and/or face shields or combinations of each for use during splash-generating procedures, when caring for patients with open tracheostomies and the potential for projectile secretions exists, and in circumstances where there is evidence of transmission from heavily colonized sources [7, 50].

In addition to Standard Precautions, Transmission-Based Precautions are used when the route(s) of transmission is (are) not completely interrupted using Standard Precautions alone. There are three categories of Transmission-Based Precautions: Contact Precautions, Droplet Precautions and Airborne Precautions. Contact Precautions are recommended for patients with MRSA infection or colonization. For diseases that have more than one route of transmission, multiple types of Transmission-Based Precautions are required [7, 50].

Contact Precautions are intended to prevent transmission of infectious agents transmitted by direct or indirect contact with the patient or the patient's environment. Examples of infectious agents/conditions that require the use of Contact Precautions include MRSA, certain other antimicrobial-resistant organisms, and *Clostridium difficile*-associated diarrhea. Patients on Contact Precautions should be placed in a single-patient room and healthcare providers caring for these patients should wear a gown and gloves for all interactions that may involve contact with the patient or potentially contaminated areas/items in the patient's environment [7, 50].

Several published documents address infection prevention and control practices for antimicrobial-resistant organisms including MRSA. These documents include: 1) Management of Multidrug-Resistant Organisms (MDROs) in Healthcare Settings, 2006, Healthcare Infection Control Practices Advisory Committee (HICPAC); 2) Getting Started Kit: Reduce Methicillin-

Resistant *Staphylococcus aureus* (MRSA) How-to Guide, Institute for Healthcare Improvement (IHI); 3) Guide to Elimination of Methicillin-Resistant *Staphylococcus aureus* (MRSA) Transmission in Hospital Settings, Association for Professionals in Infection Control and Epidemiology (APIC), and; 4) Society for Healthcare Epidemiology of America (SHEA) Guideline for Preventing Nosocomial Transmission of Multidrug-Resistant Strains of *Staphylococcus aureus* and *Enterococcus* [7-10].

Infection prevention and control staff should be aware of and utilize the published recommendations for the control of MRSA and other MDROs (HICPAC, APIC, SHEA, IHI) and stay current with published literature describing new information regarding best practices for controlling MRSA. [5, 7, 8, 10, 50]

Administrative Support

Administrative support is vital to the success of MRSA control and other infection prevention activities. Control of MRSA requires the participation and support of the acute care facility administration. Additionally, a commitment of financial and human resource assets must be made available for infection prevention and control staff and activities [51-53]. It has been shown that administrative and organizational leadership support for infection prevention and control programs has been associated with improvements in healthcare provider acceptance and adherence to recommended infection prevention and control practices [51].

Review of Specific Infection Prevention and Control Interventions

Patient Placement of the MRSA-Colonized or -Infected Patient

Patients colonized or infected with MRSA are to be placed in a private (single-patient) room and on Contact Precautions when admitted to acute care facilities [7].

Although placing MRSA-colonized or -infected patients on Contact Precautions has been shown to decrease transmission, this practice can have negative effects on patients and their care. Patients in isolation have been found to have higher anxiety and depression scores than non-isolated patients [54, 55]. Several studies have documented that healthcare providers are less likely to examine patients on Contact Precautions and spend less time in direct contact with patients during exams [56, 57]. When compared to non-isolated patients, isolated patients are less likely to have their vital signs recorded, have fewer physician progress notes, are more likely to complain about their care and are more likely to experience an adverse event [58]. Facilities must be aware of the potential care disparities and compensate through staff education and awareness campaigns.

Cohorting MRSA-Colonized or -Infected Patients

Cohorting is the practice of grouping patients infected or colonized with the same infectious agent together or confining them to one patient care area to prevent contact with susceptible patients. If single-patient rooms are not available, MRSA-colonized or -infected patients may be cohorted with other patients under some circumstances. This can include placing MRSA patients in rooms with other MRSA patients or with patients with no history of MRSA and who are at low risk for acquisition of MRSA and associated adverse outcomes from infection and who are likely to have short lengths of stay [7, 50].

There are few data on the efficacy of patient cohorting as a stand-alone infection prevention and control strategy. Most studies describe patient cohorting as one part of a combination of infection prevention and control strategies for MRSA transmission prevention [59-63]. Host factors in the MRSA-infected or -colonized patient that influence the risk of MRSA transmission must be considered when evaluating cohorting candidates. These patient factors include draining wounds or other uncontained body fluids, presence of invasive devices, ability to perform basic hygiene and ability to understand and cooperate with instructions [64]. In general, patients with fewer risk factors for MRSA transmission are better candidates for cohorting.

To reduce the risk of cross-contamination while cohorting patients, it is necessary to maintain the integrity of each isolation space [8]. Each patient's bed area must be considered a separate isolation space. Healthcare workers must perform hand hygiene and change personal protective equipment between providing care to patients cohorted in one room. Where feasible, separate equipment (e.g. blood pressure cuff, stethoscope, tourniquet and computer) should be dedicated to the use of one patient. When the use of separate equipment is not possible, equipment must be thoroughly disinfected between patients [7, 8].

Personal Protective Equipment

The hands of healthcare workers can become contaminated with infectious organisms (e.g. MRSA) without the worker having direct contact with the colonized or infected patient as a result of environmental contamination of frequently touched surfaces in the patient room (bedrails, countertops, etc.) [65-68]. For this reason, HICPAC requires gloves to be worn to enter a room where a patient is on Contact Precautions regardless of anticipated contact with the

patient or the patient's environment [50]. Glove use has also been shown to increase healthcare worker hand hygiene compliance [69].

For patients colonized or infected with MRSA, healthcare workers are required to don a gown prior to patient room entry [7]. Studies have suggested that universal gowning upon room entry may help to increase healthcare worker compliance with infection prevention and control practices overall. A study looking at rates of patient colonization with another MDRO, vancomycin-resistant enterococci (VRE), found no difference in VRE colonization with universal use of gowns and gloves; however, compliance with infection prevention and control recommendations increased 17% when universal gowning was required for room entry [70]. A second study also demonstrated an increase in compliance with precautions, although there was no decrease in MDROs in the hospital during the study period [71]. Several studies noted a decrease in VRE colonization rates when universal gown and glove use were required compared to glove and gown use only when contact with the patient or the patient's environment was anticipated [72-75].

As a part of Standard Precautions, masks are required when performing splash-generating procedures, when caring for patients with open tracheostomies and the potential for projectile secretions exists, and in circumstances where there is evidence of transmission from heavily colonized sources (e.g. draining wounds) [7, 9]. One study suggested that mask use for activities that involved intensive patient contact or manipulation of colonized or infected sites during MRSA outbreaks may result in decreased transient healthcare worker nasal, hand, and throat colonization with MRSA [76]. Some hospitals have chosen to implement this infection prevention and control measure.

Hand Hygiene

Transient contamination of healthcare worker hands can occur in the process of caring for patients with MRSA or after contact with the environment of patients with MRSA [65, 77, 78]. MRSA was found on uniforms and gowns of 65% of healthcare workers performing care activities for patients with MRSA and 42% of healthcare workers having contact only with the environment in an MRSA patient's room had MRSA on their gloves [79]. Another study found that 13% of healthcare worker hands were contaminated with the same organisms present on the outside of their gloves [80]. Additionally, a study demonstrated VRE present on the hands of 29% of healthcare workers who also had VRE present on the outside of their gloves [81]. Multiple studies have shown that improvements in healthcare worker's hand hygiene compliance have been associated with decreases in MRSA transmission [82-85].

Reported rates of hand hygiene compliance among healthcare workers is low, ranging from 5% to 81% with an average of 40% [86-88]. Barriers to appropriate hand hygiene include facility design issues (lack of easy access to soap and sinks or alcohol-based hand sanitizer), staffing issues (nursing shortages, time constraints or lack of role models for hand hygiene), lack of education (belief that glove use substitutes for hand hygiene, belief that there is a low risk of acquisition of infectious organisms from patient, lack of knowledge on hand hygiene guidelines and protocols) and skin irritation (harsh soaps causing skin breakdown) [89].

Strategies to increase healthcare worker hand hygiene compliance include hand hygiene education efforts, providing healthcare workers with feedback on hand hygiene performance, administrative support, and introduction of an alcohol-based hand sanitizer [51, 82, 87, 90-95]. Sustained increases in hand hygiene compliance have been reported when multifaceted

interventions, such as those that include education and feedback activities, are implemented [82, 87].

Monitoring hand hygiene practices among healthcare workers is essential to assess baseline compliance rates and provide information on changes in adherence to hand hygiene recommendations after implementation of interventions. Monitoring of hand hygiene compliance can be done by direct observation (healthcare worker observation or patient assessment) and indirect observation (monitoring consumption of products or electronic monitoring of hand cleaning stations) [82, 88, 90, 92, 96, 97]. While direct observation is the most reliable method of assessing hand hygiene compliance, it is also the most labor-intensive [96]. Some combination of direct and indirect measurements may be used to monitor hand hygiene compliance rates. Examples of hand hygiene compliance monitoring tools can be found at www.handhygiene.org or from the Institute for Healthcare Improvement website at www.ihi.org.

Guidelines for hand hygiene in healthcare settings are available including: 1) "Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force" and 2) "WHO Guidelines on Hand Hygiene in Healthcare" [88, 96]. Facilities should follow these guidelines' recommendations for hand hygiene.

Visitors of Patients on MRSA Contact Precautions

Visitors to patients on Contact Precautions should be instructed about basic infection prevention and control practices, including hand hygiene, to reduce the risk of disease transmission [7, 50]. Although several studies have included visitor use of gloves and gowns for room entry to patients on Contact Precautions, the studies did not specifically analyze the impact of this practice on disease transmission [74, 98, 99]. The routine use of personal protective

equipment (e.g. gowns, gloves) for visitor room entry is not necessary; however, visitors assisting in the direct care of patients should follow Standard Precautions for the use of personal protective equipment.

Environmental Cleaning

MRSA can persist on surfaces for extended periods of time ranging from 1 to 56 days [100, 101]. Personnel and patients can acquire MRSA by coming into contact with a contaminated environment or objects in the environment [65, 79, 102-105]. Thorough, regular cleaning and disinfection of patient rooms and equipment is a vital component of preventing MRSA transmission in the healthcare setting, regardless of the patient's known MRSA status [79, 103]. Up to 25% of patients without known MRSA infection or colonization were found to have objects in their environment (over-bed table, door handles, etc.) contaminated with MRSA [106, 107]. Administration, infection prevention and control, environmental services and nursing leadership must collaborate to ensure thorough cleaning, education and training of staff, and adequate staffing levels [8]. Education must be tailored to the education level and language preferences of all staff, including, environmental services staff. Checklists may be helpful to ensure that appropriate cleaning procedures are being followed; sample checklists are available at www.ihi.org [8].

Screening Patients for MRSA

Several populations have been identified as being at increased risk for ongoing MRSA colonization. The most commonly identified risk groups include elderly patients, long-term care facility residents, patients with chronic skin lesions, patients with a history of recent hospitalization, dialysis patients, patients transferred or released from correctional facilities or patients with a recent history of antibiotic use [30, 108-123].

The groups with the highest MRSA colonization rates may vary among institutions, depending on the populations served by the facility. Conducting a point prevalence survey (e.g. collecting nasal cultures on every person admitted to a unit or facility over a period of time, from one to several days) may help to identify groups at risk for MRSA in individual facilities. This approach also helps facilities appropriately target resources to areas that have the most potential to benefit from decreased MRSA transmission [7, 124].

Surgical patients colonized with MRSA may be at an increased risk for MRSA surgical site infections (SSI). Some researchers have noted increased rates of MRSA SSI among cardiothoracic and orthopedic surgical patients colonized with MRSA [125, 126]. Results of implemented pre-surgical screening and treatment for MRSA have been varied, with some studies demonstrating decreased MRSA SSI rates with pre-surgical treatment of MRSA-colonized patients [126, 127] while others found no difference in MRSA SSI rates in treated versus non-treated patients [125]. SSI prevention measures, including good preoperative practices such as appropriate timing for antimicrobial administration and skin preparation practices, may have greater impacts on reducing MRSA SSI. Screening and treatment may be considered if MRSA SSI rates are not decreasing despite adherence to SSI prevention measures (SSI prevention measures available from: www.ihi.org).

Patients in intensive care units may be at increased risk for MRSA infection compared to non-intensive care unit patients because many are receiving antibiotics and have at least one indwelling invasive or medical device (e.g. on a ventilator, presence of a central line). Intensive care unit patients colonized with MRSA are almost four times more likely to develop MRSA bacteremia compared to patients colonized with MSSA that develop MSSA bacteremia [128]. In critically ill patients, MRSA bacteremia has been found to result in a higher attributable

mortality rate than MSSA [25]. Additionally, one study demonstrated that MRSA spread more easily to patients than did MSSA in a surgical ICU and the ease of spread was attributed to antimicrobial selective pressures or intrinsic factors within MRSA [29].

Recent reports describing outbreaks of MRSA among infants in newborn nurseries suggest that pregnant woman may be another high-risk group due to increasing CA-MRSA rates. Additionally, studies of vaginal/rectal MRSA colonization among pregnant women have found colonization rates of up to 10 percent [129-131].

Screening patients to identify those colonized with MRSA can be an important tool in MRSA infection prevention and control. Colonized persons are generally asymptomatic and can remain colonized with MRSA for extended periods of time, ranging from months to years [77, 132, 133]. Because clinical cultures are generally used only in symptomatic patients, the majority of patients colonized with MRSA go undetected and can act as a reservoir in the MRSA transmission cycle [108, 112, 134-137].

MRSA colonization has been reported from the anterior nares, hands and other skin sites (intact and non-intact), throat, urine, perineum, and stool [138-142]. However, the anterior nares is the most common site of MRSA colonization and is the preferred anatomical site for MRSA screening if only one site is used [138, 142].

Active Surveillance Cultures

Active surveillance cultures (ASCs) are cultures obtained for the purpose of screening patients (typically by collecting a culture from the anterior nares) to test for the presence or absence of MRSA.

There have been no published randomized, controlled trials to study the efficacy of ASCs alone in decreasing the rate of MRSA infection, colonization or transmission within acute care

facilities. In part, this is due to the difficulty of separating the impact of ASCs on MRSA transmission rates from the impact attributable to other infection prevention and control practices (e.g. hand hygiene, Contact Precautions and environmental cleaning) that are components of routine patient care.

Current literature indicates that ASCs, performed among identified high-risk patient populations or high-risk patient care units, in conjunction with routine infection prevention and control practices, have demonstrated decreasing MRSA infection rates [136, 143-148]. High-risk units vary between facilities and may include general intensive care units, burn units, post-surgical units (e.g. orthopedic or cardiac), or other units to which patients with increased MRSA risk factors (e.g. invasive lines, receiving antimicrobial therapy, compromised skin integrity) are cared for [136, 137, 143, 145]. When used properly, the practice of collecting ASCs with isolation of patients found to be carrying MRSA has demonstrated financial benefits to the healthcare facility in most instances [136, 144, 145, 147-151].

A retrospective interrupted time series study of four major infection prevention and control interventions (maximally sterile central vascular catheter placement, introduction of alcohol-based hand sanitizer, hand hygiene campaign, and intensive care unit ASCs for MRSA) found that only the use of intensive care unit ASCs was associated with decreases in the incidence of MRSA bacteremia [143]. Active surveillance culture collection from intensive care unit patients decreased the incidence density of bacteremia by 75% in the intensive care unit where ASCs were collected. Of significance, the researchers also noted a 67% decrease in the incidence of MRSA bacteremia hospital-wide when ASCs were collected from intensive care unit patients [143].

Conversely, other studies in intensive care unit patients using ASCs have not shown decreased MRSA transmission rates [152-154]. This suggests that other infection prevention and control strategies such as increased hand hygiene adherence, adherence to Contact Precautions, cohorting of nursing staff and decreasing patient bioload may control transmission just as effectively as the use of ASCs [152, 153, 155].

In summary, the use of ASCs, particularly in conjunction with other infection prevention and control practices (e.g. hand hygiene, Contact Precautions, environmental cleaning), has been found to decrease MRSA transmission rates among high-risk units or populations. However, at this time, the optimal use of ASCs is not clear and consensus about how to use ASCs has not been achieved among published guidelines or organizations.

Discontinuing Contact Precautions

Healthcare facilities struggle with the decision about when to remove patients that have had a positive MRSA culture from Contact Precautions. The HICPAC guidelines categorize discontinuation of Contact Precautions as an unresolved issue, although the background discussion does describe taking a "reasonable" approach. More recent studies acknowledge the problem, noting that increased use of ASCs will increase the use of Contact Precautions dramatically. As a result, the question of when to discontinue precautions is quickly becoming more pressing.

One factor that impacts when to remove a patient from Contact Precautions is the duration of MRSA colonization. The duration of MRSA colonization in a patient can vary and studies have demonstrated MRSA colonization ranging from 3 months to greater than 2 years [77, 132, 133]. Persistence of carriage was influenced by both modifiable and non-modifiable risk factors [7, 132, 133, 156, 157]. Risk factors associated with persistent carriage included

breaks in the skin, indwelling devices, receipt of immunosuppressive therapy, and receipt of hemodialysis [132, 133, 156, 157]. One study also showed a trend toward an association between admission to the hospital from a chronic care institution and persistent MRSA carriage [133].

Although not explicitly done for the purpose of developing a protocol to discontinue Contact Precautions, the studies of MRSA carriage provide background for developing a protocol for discontinuation of Contact Precautions.

Screening Healthcare Workers for MRSA

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 [158, 159]. 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 [160-164]. Unless there is epidemiological evidence linking healthcare workers to ongoing MRSA transmission, screening healthcare workers for MRSA is not recommended. Healthcare worker screening may result in identifying transient MRSA carriage not associated with transmission [140, 165], disruption of staff routine and stigmatization of colonized healthcare workers [7, 166]. Factors to consider in managing an outbreak include strain type of the MRSA isolate (matching outbreak pattern), location of MRSA colonization (nares, hands, groin), and whether ongoing transmission to patients persists [167].

Healthcare workers implicated in transmission should be screened for MRSA colonization and colonized healthcare workers implicated in transmission are candidates for decolonization [7]. The purpose of treating MRSA-colonized healthcare workers implicated in

transmission is to interrupt MRSA transmission, not to permanently decolonize the healthcare worker. Facilities should evaluate MRSA-colonized healthcare workers associated with transmission to determine if they need to be furloughed from patient contact while undergoing decolonization.

Management of MRSA Colonization

There are no standard recommendations for management of persons colonized with MRSA. Most published studies report on patients or healthcare workers with nasal colonization and very little information is available on successful decolonization strategies for colonization at non-nasal sites [168-171]. The most common nasal decolonization regimes use mupirocin ointment alone or in combination with antimicrobial body washes and/or systemic antimicrobials.

Several different decolonization regimens have been described in the literature with initial success rates of over 90% [168, 170, 172]; however, long-term decolonization success has not been adequately researched. One paper reported that 61% of patients remained decolonized at 90 days post treatment [170] while a second study reported that 54% of patients remained decolonized after 8 months [168]. In another study where 85% of the patients had MRSA in more than one body site, only 6% of patients were successfully decolonized despite using a decolonization protocol that included body wash with an antimicrobial soap, mupirocin for patients nasally colonized with MRSA and systemic antimicrobials when clinically indicated [173].

Systemic antimicrobials may be more useful when dealing with non-nasal sites of colonization although there is a lack of published data on this subject. Use of systemic

antimicrobials should be weighed against the risks of patient side effects and of adding to overall antimicrobial pressure that can contribute to antimicrobial resistance.

Care is needed when using a decolonization protocol that uses mupirocin, as prolonged use of mupirocin has been associated with emergence of mupirocin resistance [174-176]. A study of Canadian MRSA isolates over a 10-year period found a five-fold increase in mupirocin resistance [177]. Consultation with an infectious disease physician is recommended prior to initiating a widespread decolonization protocol for patients.

Antibiotic Stewardship

There is a strong correlation between antimicrobial use and antimicrobial resistance [178]. Antimicrobial selection pressure, as a result of antimicrobial misuse, contributes to the emergence of resistant organisms [179]. Studies have shown that antibiotic use is associated with an increased risk of colonization and/or infection with resistant organisms [180, 181]. Specifically, studies have reported an association between antibiotic use and the development of MRSA colonization and/or infection [113, 114, 117, 155, 182-186].

As much as 50% of all antimicrobial use is inappropriate [187]. Misuse encompasses the use of broad spectrum agents when narrow-spectrum agents would be effective, antimicrobial prescribing for infections with a viral etiology, and prescribing clinically unnecessary doses and extended duration of treatment [188, 189]. Misuse of antimicrobial agents jeopardizes the utility of these drugs and threatens the successful treatment of all infections.

More than 70% of the bacteria that cause hospital-acquired infections are resistant to at least one of the drugs most commonly used to treat them [4]. Furthermore, infections caused by multidrug-resistant bacteria are increasing. These infections, formerly seen primarily in hospital intensive care units, now occur in other inpatient settings as well as in ambulatory care. Persons

infected with drug-resistant organisms are more likely to have a longer hospital stay and require treatment with more expensive and more toxic antibiotics than persons infected with non-resistant organisms [190, 191]. As a result, antimicrobial-resistant infections place increasing financial burden on the healthcare system, with treatment costs for patients infected with resistant organisms estimated to be $4 to 7 billion annually in the United States [179].

Antimicrobial stewardship is critical to the management of antimicrobial resistance, including MRSA. Judicious antimicrobial use programs, combined with a comprehensive infection prevention and control program, have been shown to curb the emergence and transmission of antimicrobial resistant bacteria [192, 193].

Antimicrobial stewardship entails the optimal selection, dosage, and duration of antimicrobial treatment that results in the best clinical outcome for the treatment or prevention of infection [187]. Antimicrobial stewardship in acute care facilities incorporates practices such as automatic stop orders, antibiotic cycling, authorization systems, formulary restriction, mandatory consultation and peer review and feedback [7]. Effective antimicrobial stewardship programs are multifaceted and focus on all levels of the healthcare delivery system including direct care providers, healthcare administration, ancillary staff, patients and payers [6, 194].

Education and Training of Healthcare Workers

An important aspect of effective infection prevention and control strategies is assuring that all parties (e.g. healthcare workers, patients, visitors, environmental service staff, etc.) are informed of recommended infection prevention and control practices. Infection prevention and control programs that include healthcare worker education, accountability, and feedback have been shown to have higher rates of healthcare worker adherence to infection prevention recommendations and lower rates of MRSA or VRE transmission [195-197]. Healthcare

providers are more receptive and adherent to the recommended control measures when organization leaders participate and are seen as supportive of infection prevention and control programs [51]. Resources must be allocated for infection prevention education for patient care and patient care support staff.

Recommendations for Prevention and Control of MRSA in Acute Care Settings

Category Ranking Descriptions

The following system was used for categorizing recommendations (When MDH Recommendations were based on CDC/HICPAC recommendations, the CDC/HICPAC categories were used):

Category IA - Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies

Category IB - Strongly recommended for implementation and supported by some experimental, clinical, or epidemiologic studies and a strong theoretical rationale.

Category IC - Required for implementation, as mandated by federal and/or state regulation or standard

Category II - Suggested for implementation and supported by suggestive clinical or epidemiological studies or a theoretical rationale

MDH-MRTF Consensus Statement - MDH-MRTF recommendation. This category was used for infection prevention practices that the MDH-MRTF thought were essential to MRSA infection prevention and control but were practices not addressed by CDC/HICPAC. These infection prevention practices were not listed in current HICPAC documents or were listed in HICPAC documents but given no category ranking or a Category II ranking. The MDH-MRTF came to a group consensus when addressing issues not covered by the aforementioned existing recommendations and guidelines for MRSA control by conducting extensive literature review and holding in-depth discussions on current standards of practice.

A. General Infection Prevention and Control Recommendations

1. Administrative support for infection prevention and control (MDH-MRTF Consensus Statement)
    a. Administration should provide support, both financial and human resources, (e.g. empower front-line multi-disciplinary teams, provide necessary supplies, resources, and personnel such as Infection Prevention and Control, microbiology, and environmental services) to prevent and control MRSA transmission within the healthcare facility including: IB [7, 8, 50-52, 61, 62, 82, 105, 198, 199]
        i. Enforcement of infection prevention and control programs as a measure of accountability (i.e. Administration and managers held accountable for infection prevention and control lapses in areas under their supervision).
        ii. Collaboration between infection prevention and control, medical and nursing staff, ancillary services, and environmental services.
        iii. Patient and family/visitor education regarding infection prevention and control programs.
        iv. Inclusion of infection prevention and control duties into the job description of every hospital employee and contract staff.
        v. All staff (employed and credentialed) will be expected to know and be held accountable for following facility infection prevention and control policies.
        vi. Adequately fund infection prevention and control programs, including staffing and software needs. Acute care facilities without appropriate resources should identify outside staff and resources to assist as needed.
        vii. Assure funding for annual MRSA risk assessments and Tier Two supplies as described in sections B and C.
        viii. Promote a culture that supports adherence to infection prevention protocols.
    b. Administration should support programs aimed at promoting the judicious use of antimicrobial agents and ensure that systems are in place to promote optimal treatment of infections and appropriate antimicrobial use. IB [7]
    c. Administration should provide funding for contracts with experts that can provide consultation if the facility does not have expertise for analyzing epidemiologic data, recognizing MRSA problems, or devising effective control strategies.

2. Antimicrobial stewardship (MDH-MRTF Consensus Statement) [4, 6, 7]
    a. Acute care facilities should consider the development of a multidisciplinary antimicrobial stewardship team, which includes at a minimum a physician and a clinical pharmacist with infectious disease training or interest. Additional members may include: clinical microbiologists, information system specialists, infection prevention and control professionals and hospital epidemiologists.
    b. Facilities should consider having a mechanism to review antimicrobial utilization and ensure judicious antimicrobial use which could include:
        i. Antimicrobial use audits and feedback to the subscriber.
        ii. Development of antimicrobial formularies and preauthorization requirements for antimicrobial use.

c. Additional functions of the antimicrobial stewardship team may include combinations of the following:
    i. Provider education regarding the need for appropriate antimicrobial use
    ii. Development of guidelines and clinical pathways for treatment incorporating local microbiology and resistance patterns
    iii. Antimicrobial cycling
    iv. Antimicrobial order forms
    v. Streamlining or de-escalation of therapy on the basis of culture results
    vi. Dose optimization
    vii. Parenteral to oral conversions when patient condition allows
d. Facilities where staff or other resources for antimicrobial stewardship are not available should consider establishing cooperative relationships or consultations with facilities that have the resources and expertise to assist in antimicrobial stewardship.

3. General infection prevention and control recommendations for acute care facilities
    a. Implement a comprehensive hand hygiene program and monitor compliance. IA Guidelines for hand hygiene and improving hand hygiene practices have been published. [7-9, 50, 96]
    b. Provide education and training on risks and prevention of MRSA and other multi-drug resistant organism (MDRO) transmission during orientation and provide ongoing educational training for healthcare personnel; include information on the facility's experience with MDROs and prevention strategies. IB [7]
    c. Follow Standard Precautions during all patient encounters in all settings in which care is delivered. IB [7, 50, 114, 200-202]
    d. Implement Contact Precautions routinely for all patients known or suspected to be colonized or infected with MRSA. IA [7, 50, 61, 63, 203]
    e. Use published guidelines as a basis of practice (HICPAC, APIC, SHEA, IHI), stay current with literature describing new information regarding best practices for control of MRSA, and implement practice parameters that are known to reduce the risk of hospital-acquired infections where appropriate. (MDH-MRTF Consensus Statement) [5, 7-10, 50]
    f. Healthcare facilities without expertise for analyzing epidemiologic data, recognizing MRSA problems, or devising effective control strategies, should contract with experts who can provide consultation as needed. (II, MDH-MRTF Consensus Statement) [7]

4. Hand hygiene IA [7, 8, 10, 50, 96, 97]
    a. Healthcare workers should follow hand hygiene requirements outlined in the Guideline for Hand Hygiene in Health-Care Settings or the WHO Guidelines on Hand Hygiene in Health Care. [88, 96, 97] Hand hygiene must be performed:
        i. Before and after direct contact with patients IB
        ii. After removing gloves IB
        iii. Before handling an invasive device for patient care IB
        iv. After contact with body fluids or excretions, mucous membranes, non-intact skin, or wound dressings IA

v. When moving from a contaminated body site to a clean body site during patient care IA
vi. After contact with inanimate objects in the immediate vicinity of the patient IB

b. Monitor healthcare worker compliance with hand hygiene and provide them with performance feedback. Tools, including knowledge assessment questionnaires, checklists, and monitoring forms, have been developed and are available from IHI, WHO and various other sources. IA [97, 204-206]
c. If hand hygiene compliance is low, develop an action plan designed to improve healthcare worker adherence to recommended hand hygiene practices. IB Factors to consider when developing an action plan include: number and location of sinks and alcohol-based hand sanitizer dispensers, clear hand hygiene policies, culture regarding hand-hygiene compliance on units or in facility and availability of educational materials. [88, 96]

5. Identification of patients with current or historical MRSA infection or colonization [7]
    a. There should be a reliable method of identifying and tracking new and previously positive MRSA patients (e.g., computer based "flagging" system or visual cue placed on patient's paper chart). IB
    b. Patients may have MRSA flags removed when they meet the criteria outlined in section B8. (MDH-MRFT Consensus Statement)

6. MRSA surgical site infection prevention (MDH-MRTF Consensus Statement) [10-12, 126, 127, 207-209]
    a. Facilities should monitor their MRSA post-operative infection rates and consider pre-surgical screening of patients having major surgical procedures who are at increased risk of MRSA post-operative infections. Identification of at-risk patients can be done based on post-operative MRSA infection rates, rates of surgical site infection prevention compliance, or other risk factors as determined by the facility.
    b. Consider decolonization of patients nasally colonized with MRSA scheduled to have a surgical procedure that has been identified by the facility as high risk for MRSA surgical site infection.
    c. Follow published guidelines for selecting preoperative surgical antimicrobial prophylaxis agents for patients colonized with MRSA or at high risk for MRSA colonization. [12, 210]

7. Microbiology procedures (MDH-MRTF Consensus Statement) [7, 64, 211, 212]
    a. Methods for MRSA colonization detection
        i. Culture methods
            1. When screening for MRSA, a full culture work up is not necessary. Do oxacillin sensitivity testing (or equivalent) to determine presence or absence of MRSA.
            2. Conventional culture methods involve isolation of *S. aureus* on blood agar or mannitol salt agar with follow-up confirmatory testing and susceptibility testing. A negative result is usually

available in 48 hours, but it may take as long as 3-4 days to finalize the MRSA result.

3. Rapid media detection (e.g. CHROMagar, MRSAselect, or mannitol salt agar with oxacillin) allows positive results in as early as 24 hours with final results in 24 to 48 hours.

ii. Molecular testing: FDA approved rapid tests probing for genetic sequences unique to MRSA are available (e.g. GeneOhm™, and GeneXpert®) and can reduce the time from screening to result, allowing for more rapid patient placement into Contact Precautions. However, they are more expensive than conventional and rapid media culture methods.

iii. Antimicrobial sensitivity testing should be periodically performed on a subset of colonization isolates to monitor resistance trends.

b. Clinical cultures
   i. Cultures being processed for a clinical work-up should have full sensitivity testing, as per laboratory protocol.

c. Notification of newly positive cultures
   i. There should be a procedure for the microbiology laboratory to notify the appropriate facility staff when a new MRSA isolate is identified. IB [7]

d. Periodic testing for mupirocin sensitivity is recommended. Although Clinical and Laboratory Standards Institute sensitivity breakpoints are not currently available, published literature provides some guidance for breakpoint interpretation. [213, 214]

e. Microbiology labs should attempt to save MRSA isolates for a period of time (one to three months, or another length of time as determined by infection prevention and control) in the event additional isolate testing is needed. IB [7, 105]

f. Microbiology labs should prepare facility-specific antimicrobial susceptibility reports as recommended by the Clinical and Laboratory Standards Institute. IB/IC [7]

g. In healthcare facilities that outsource microbiology laboratory services, specify by contract that the laboratory provide facility-specific susceptibility data or local or regional aggregate susceptibility data in order to identify MRSA susceptibility trends. II [7]

8. Specialty-care areas within acute care facilities (MDH-MRTF Consensus Statement)
   a. Infection Prevention and Control should work with the various specialty-care areas within their facility (e.g. operating rooms, peri-operative areas, dialysis units, behavior health units, cardiac catheter laboratories, radiology) to assure that MRSA infection prevention and control recommendations are implemented. [11-14]
   b. Hospital-based Ambulatory Settings [50, 215]
      i. Hospital-based ambulatory settings should have protocols in place for MRSA control including consideration of the following:
         1. At a minimum, Standard Precautions should be implemented in outpatient service areas.

2. Gloves and gowns should be used for contact with uncontrolled secretions, pressure ulcers, draining wounds, stool incontinence, and ostomy tubes and bags. II [7]
3. MRSA positive patients may wait in common waiting areas for outpatient services.
4. Cleaning and disinfecting of exam rooms and patient equipment between patient use, as per Standard Precautions.
5. When feasible, infection prevention and control and administrative personnel from hospitals and clinics should work together to develop protocols to screen patients for continued MRSA colonization/infection, implement decolonization protocols when indicated, and discontinue precautions when results are negative (see section B8). A protocol should also be developed to communicate results and progress.

B. Tier One Recommendations for MRSA control in acute care settings

1. Infection prevention and control practices for reducing risk of MRSA transmission [7, 10, 81, 216, 217]
    a. Standard Precautions should be used in the care of all patients, regardless of MRSA status. Patients with any of the following must be placed on Contact Precautions:
        i. Patients with MRSA infection, any anatomical site IA [7]
        ii. Patients with MRSA colonization, any anatomical site IA [7]
        iii. Patients with a history of MRSA colonization or infection (see section B8). (MDH-MRTF Consensus Statement)
    b. Consider placing patients presenting with suspect MRSA skin infection on Contact Precautions. (MDH-MRTF Consensus Statement)
    c. Healthcare workers should follow hand hygiene recommendations. IA (See section A4)
    d. Personal protective equipment requirements for healthcare workers taking care of MRSA patients:
        i. Gloves
            1. Required for all healthcare workers entering the patient room/area. IB [7, 50, 65, 69]
        ii. Gowns
            1. Required for all healthcare workers entering the room/area regardless of anticipated patient contact. IB [7, 50, 70, 72-75]
        iii. Surgical Masks
            1. Masks should be used when required by Standard Precautions. Standard Precautions require mask use when performing splash-generating procedures (e.g. wound irrigations, oral suctioning, intubation); when caring for patients with open tracheostomies and the potential for projectile secretions; and in circumstances where there is evidence of transmission from heavily colonized sources (e.g. burn wounds). IB [7, 9, 50, 63, 76, 105]

e. Monitoring of healthcare worker Contact Precaution compliance: (MDH-MRTF Consensus Statement)
    i. Consider periodic monitoring to assess healthcare worker compliance with Contact Precautions. [9, 218]
    ii. Report summarized Contact Precaution compliance rates back to healthcare workers. [9]
f. Contact Precaution room [7, 50, 217]
    i. Private (single-patient) rooms should be used for all MRSA-positive patients, whether infected or colonized, whenever possible. If a private room is not available, the cohorting of MRSA patients can be considered. See section B5 for cohorting recommendations. IB [7, 50, 79, 105]
    ii. Signage should be posted at the entrance to inpatient rooms that states the patient is on Contact Precautions and provides details regarding procedure for room entry. (MDH-MRTF Consensus Statement) [50]
        1. Special consideration may be given for posting signs on behavioral health units or other non-acute inpatient units. If Contact Precaution signs are not posted in these units, another means of communicating patient Contact Precaution needs must be determined. (MDH-MRTF Consensus Statement)
    iii. Implement patient-dedicated or single-use disposable non-critical equipment, instruments and devices when possible. IB [7]
        1. In facilities utilizing electronic medical records: Consider having dedicated electronic medical record computers for each patient on Contact Precautions to prevent possible spread of MRSA via keyboards, mouse, etc. When having a dedicated electronic medical record computer is not feasible, the facility should develop and implement a policy for computer use in an effort to minimize the potential for transmission. The policy should include whether or not gloves should be worn during computer use and list procedures and frequency for cleaning computer equipment. (MDH-MRTF Consensus Statement)
    iv. Patients should be restricted to their room, except when in need of diagnostic or therapeutic services, or when leaving is deemed beneficial for patient. (MDH-MRTF Consensus Statement)
        1. Establish ranges of permitted ambulation, socialization, and use of common areas based on the risk of transmission to other patients and on the ability of the patient to comply with infection prevention and control measures. (II, MDH-MRTF Consensus Statement) [7]
    v. Procedure for patient coming out of room for psycho-social activities (MDH-MRTF Consensus Statement) (See section B6 for patient transport for diagnostic services and section B1fvi for therapeutic activities. See section B7 for caregiver requirements for patients who have caregiver assistance.):

1. At a minimum, patient's clothing/gown must not be visibly soiled and patient must have performed hand hygiene prior to exiting the room.
    a. Any patient with draining wounds or skin lesions should be dressed in a clean gown before leaving the room.
2. Body substances must be contained (wounds covered, incontinent patients diapered, coughing patient secretions contained).

vi. Procedure for patients coming out of room for therapeutic activities (e.g. physical therapy [PT] or occupational therapy [OT]) (MDH-MRTF Consensus Statement)
    1. Patient must don clean gown and perform hand hygiene prior to exiting the room.
    2. Body substances must be contained (wounds covered, incontinent patients diapered, coughing patient secretions contained).
    3. Healthcare worker must don gown and gloves prior to room entry and must remove personal protective equipment and perform hand hygiene prior to leaving patient room.
    4. Acute care facilities should develop protocols for PT and OT providing care to patients outside of the patient room. Factors to consider when developing a policy include:
        a. Personal protective equipment should not routinely be used by PT or OT staff outside of the patient room but can be considered for use if anticipating contact with blood or body fluid that cannot be contained or patient's inability to change into a clean gown.
        b. Environmental cleaning of PT/OT equipment after patient use.
        c. Description of any limitations to patient interactions with other patients during PT/OT sessions.

2. Environmental measures
    a. Administration, infection prevention and control, environmental services and nursing leadership should work together to ensure thorough education and training of environmental services staff. (MDH-MRTF Consensus Statement)
    b. Administration should ensure adequate staffing for environmental services staff based on industry standards. (MDH-MRTF Consensus Statement) [8]
    c. Environmental services staff are considered healthcare workers and should don personal protective equipment for room entry as described in B1d. (MDH-MRTF Consensus Statement)
    d. Use facility-approved disinfectants and follow manufacturers' instructions for recommended dilutions and contact time. (MDH-MRTF Consensus Statement)
    e. Clean and disinfect surfaces and equipment that may be contaminated with MRSA (items in close proximity to the patient and frequently touched surfaces in the patient room) on a more frequent schedule compared to that for minimal touch surfaces. IB [7, 65, 79, 107, 219] At a minimum, patient rooms and frequently touched surfaces should be cleaned at least once per day.

f. Consider designating cleaning responsibilities for all items in a patient care room to determine what items are being cleaned by environmental versus nursing staff to make sure no items are being missed. (MDH-MRTF Consensus Statement)
g. Infection prevention and control should provide guidance to determine how patient care supplies located inside the patient rooms are managed for patients on Contact Precautions. (MDH-MRTF Consensus Statement)
h. Monitor cleaning performance to ensure consistent cleaning and disinfection of surfaces in close proximity to the patient and those likely to be touched by the patient and healthcare workers. IB [7]
    i. Cleaning checklists for environmental services staff may help to ensure consistent cleaning practices. The IHI MRSA guideline provides examples of cleaning checklists. [8]
i. At a minimum, patient privacy curtains should be cleaned when visibly soiled. II, (MDH-MRTF Consensus Statement) [220]
j. Clean and disinfect equipment used for patients on Contact Precautions before their use on other patients, including vital sign machines and computers. IB [7]
k. Clean and disinfect contact precaution rooms after patient discharge per standard terminal room cleaning procedures. IB [7]

3. Monitoring MRSA rates
    a. Acute care facilities should monitor trends in hospital-acquired MRSA incidence rates over time using appropriate statistical methods to identify high-risk patients/units. When possible, distinguish colonization from infection. IA [7, 9, 59, 138, 221-224]
    b. Hospital-acquired MRSA incidence rates and results from annual MRSA risk assessments should be used to determine facility MRSA management strategies. References for determining rates have been previously published. IB [7, 9, 61, 62, 203]

4. MRSA risk assessment: Acute care facilities should develop a plan to conduct an MRSA risk assessment at least yearly. (MDH-MRSA Consensus Statement)
    a. Annual MRSA assessment
        i. Facilities collecting Active Surveillance Cultures (ASCs) on all patients should monitor MRSA infection and colonization rates as described in B3. (For more information on ASCs, see the ASC section in the Background section of the Recommendations)
        ii. Facilities not collecting ASCs on all patients must conduct a yearly MRSA risk assessment to help identify MRSA risk groups or assess MRSA transmission rates [7, 9, 59, 61, 63, 108, 224]. Examples of risk assessments include:
            1. A point prevalence study (whole house or targeted to high risk populations/units) to determine risk groups/units that should be considered for ASC.
            2. A transmission study obtaining admission and discharge cultures for a period of time to evaluate MRSA transmission rates (cultures

can be taken from all patients or targeted to high risk populations/units).

3. Potential groups to target for MRSA screening may include:
    a. Patients admitted to intensive care units (e.g. medical, surgical, or neonatal) [135, 136, 143, 144, 150, 225]
    b. Patients admitted to high risk wards/units (e.g. burn, bone marrow/stem cell transplant, and oncology units) [146]
    c. Long-term care facility residents [108, 112, 113, 182, 226-228]
    d. Patients transferred from other acute care facilities [182, 229]
    e. Renal (dialysis) patients [229]
    f. Re-admission to the hospital less than 30 days from previous discharge [108, 109, 114, 182, 226, 227]
    g. Residents of assisted living facilities
    h. Pregnant women: nasal and/or vaginal/rectal colonization prior to delivery [131, 230]
    i. Surgical patients [11, 12, 126, 127, 207-209]
4. Potential culture sites for surveillance cultures to determine colonization rates IB [7]:
    a. Anterior nares (usually sufficient to sample only anterior nares but other sites can be added) [110, 138, 142]
    b. Areas of skin breakdown and draining wounds [109, 113, 138]
    c. Throat [141]
    d. Invasive devices [182]
    e. Peri-rectal or perineal cultures [139, 142]

5. Cohorting positive patients (MDH-MRTF Consensus Statement) [7, 50]
    a. It is recommended that MRSA patients be placed in a private (single-patient) room. IB If a private room is not available MRSA patients may be cohorted. [59, 61, 62, 75]
    b. Consider the following risk factors for each patient before cohorting:
        i. Open, draining wounds that require complex wound care
        ii. Uncontained body fluids (including active coughing or upper respiratory secretions)
        iii. Patients with indwelling vascular access device (excluding peripheral lines) or on a ventilator
        iv. Inability to perform basic hygiene or be assisted with basic hygiene
        v. Inability to cooperate with infection prevention and control measures
        vi. On a protocol for removal from Contact Precautions as described in B8
        vii. On Contact Precautions for “presumed” or “rule out” MRSA prior to lab confirmation
        viii. Have a history of infection or colonization with other antimicrobial resistant organisms (e.g. vancomycin-resistant enterococci)

c. If no MRSA patient meets the cohorting criteria described above and a private room is not available, consult with Infection Prevention and Control or refer to facility Infection Prevention and Control Policies prior to cohorting patients.
d. In extreme circumstances, MRSA colonized or infected patients may be placed in the same room as a patient without MRSA. However, patients with history of colonization or infection with other antimicrobial resistant organisms are not eligible for cohorting with MRSA patients. Consult with Infection Prevention and Control or refer to facility Infection Prevention and Control Policies prior to cohorting patients.
    i. Infection Prevention and Control may consider the following risk factors for transmission in the MRSA patient:
        1. Active infection with MRSA
        2. Uncontained drainage requiring frequent dressing changes or uncontained body fluids
        3. Unwilling or unable to cooperate with infection prevention and control measures
    ii. Infection Prevention and Control may consider the following host risk factors in the non-MRSA patient:
        1. Non-intact skin, open wounds, stasis ulcers, or decubitus ulcers
        2. Invasive devices (e.g. indwelling urinary catheters, tracheostomy or tracheal tubes, chest tubes, gastrostomy tubes, vascular access devices [excluding perpherial lines])
        3. Risk factors for infection (e.g. chemotherapy, history of transplant, chronic or high dose cortiocosteriod therapy or has other immune-compromising conditions)
        4. Inability to cooperate with infection prevention and control measures
    iii. Infection prevention and control should develop protocols to reduce the risk of MRSA transmission when a non-MRSA colonized or infected patient is roomed with an MRSA patient including consideration of:
        1. Maintaining separate supplies for the MRSA patient
        2. Assigning different nursing staff to each patient
        3. Determining need for assigning the bathroom to one patient and a commode to the other. If bathroom is to be shared, determine frequency of cleaning and disinfecting.
e. Patients with no or unknown MRSA infection or colonization history that are preemptively placed on Contact Precautions while awaiting surveillance culture results should not be roomed with known or suspect MRSA colonized or infected patients.
f. Newborns of mothers with MRSA colonization or infection should be placed on Contact Precautions and roomed with the mother. If not possible to room infant with mother, place infant on Contact Precautions in the nursery. MRSA colonized or infected infants in the nursery should be at least three feet from other infants. [231]

6. Transporting and receiving MRSA-positive patients (MDH-MRTF Consensus Statement) [50, 64, 217]
    a. Transporting MRSA patients (Note: personal protective equipment is not routinely needed during patient transports but can be considered for use if anticipating contact with blood or body fluid.) (II, MDH-MRTF Consensus Statement)
        i. Acute care facilities must have protocols for transporting MRSA patients when personal protective equipment is not required. A suggested process for MRSA patient transport when personal protective equipment is NOT required:
            1. Notify the receiving department of patient's need for Contact Precautions prior to their arrival in the department (This could be accomplished via a flag in the patient's chart, noting the Contact Precautions needs on patient transport passport ("ticket to ride", or via other means). [8]
            2. Contain body substances before transport (wounds covered, incontinent patients diapered, coughing patient secretions contained) II
            3. Patient should perform hand hygiene or have hand hygiene done for them prior to leaving their room.
            4. At a minimum, the patient's gown/robe should not be visibly soiled. A clean sheet should be placed on patients being transported in a bed.
                a. Any patient with a draining wound or skin lesions should be dressed in a clean gown before leaving the room.
            5. Patient transport personnel follow instructions on Contact Precaution sign when entering patient room.
            6. Use a clean wheelchair/gurney for patient transport. Disinfect wheelchair/gurney if wheelchair/gurney handgrips or handles are contaminated during the process of patient loading. Disinfect other contaminated equipment that will be transported with patient.
            7. Remove personal protective equipment and perform hand hygiene after patient has been transferred to wheelchair/gurney. Transporters may carry clean gloves in their pockets to use if patient contact is required during transport.
            8. Upon arrival at destination, transporter performs hand hygiene and puts on clean personal protective equipment if s/he will be assisting with moving patient.
            9. Perform hand hygiene after delivering patient OR after removing personal protective equipment worn to assist patient at destination.
            10. Clean and disinfectant wheelchair/gurney before it is used to transport another patient.
        ii. Transporting an MRSA patient when personal protective equipment IS required. Examples include: 1) when transporting a patient in his/her existing bed; 2) when exposure to blood or body fluids is likely.

a. The MDH-MRTF recognizes that personal protective equipment may be required for patient transport in some instances. Facilities should develop a procedure for MRSA patient transport when personal protective equipment is required that takes the following into consideration in addition to the transport steps described in B6ai:
    i. Education of transport personnel regarding importance of minimizing environmental contamination with MRSA.
    ii. Transport personnel personal protective equipment should not be visibly soiled when leaving room.
    iii. Consider requiring a clean healthcare worker (i.e. healthcare worker with no contact with the patient and who does not wear gown and gloves) during all transports where gown and gloves will be worn. The clean healthcare worker will be responsible for opening doors and pressing elevator buttons to limit environmental contamination.

b. Receiving MRSA patients
    i. Patient history of MRSA and need for Contact Precautions must be communicated to receiving staff.
    ii. Receiving area must follow Contact Precautions for patient interactions in all areas of the facility (including pre-op, operating rooms, post-operative areas, CT/radiology, and dialysis areas).
    iii. Contact Precaution patients should be brought back to room/testing area as soon as possible to limit time in waiting rooms.
    iv. Receiving staff should wear gloves and gown for contact with patient.
    v. Surfaces that the patient or healthcare worker had contact with during the procedure should be disinfected after MRSA patient has left.
    vi. Receiving staff should perform hand hygiene after glove/gown removed and after cleaning room/equipment.

c. Transporting patients between facilities
    i. Implement a system to notify inter-facility transportation and receiving healthcare facilities and personnel of patient colonization or infection status. IB [7]

7. Visitors of patients on Contact Precautions (MDH-MRTF Consensus Statement) [50, 64, 217]
    a. Visitors should be informed of infection prevention and control practices and the importance of following the practices. MRSA informational pamphlets for patients and family members are available in appendix c and at http://www.health.state.mn.us.
    b. Facilities should assess patients and patient population of their facility and implement more comprehensive infection prevention and control practices as deemed necessary. (For example, a hospital burn unit may choose to implement

more stringent infection prevention and control practices for visitors than a rehabilitation unit located in the same facility.)

c. Visitors should be instructed to perform hand hygiene before entering and after leaving the patient's room (regardless of patient contact).
d. Establish ranges of care/contact based on visitor's ability to comply with infection prevention and control procedures (visitor must understand the need for and agree to adhere to hand hygiene and personal protective equipment requirements).
e. Visitors should wear personal protective equipment while providing direct physical care to a patient with MRSA:
    i. Visitors should be instructed on how to properly put on and remove personal protective equipment (gloves/gowns/mask).
    ii. Gloves
        1. Required for visitors providing direct care to the patient. [7, 65, 69]
    iii. Gowns:
        1. Required for visitors providing direct care to the patient. [7]
    iv. Masks:
        1. Masks should be used when required by Standard Precautions. Standard Precautions require mask use when performing splash-generating procedures (e.g. wound irrigations, oral suctioning, intubation); when caring for patients with open tracheostomies and the potential for projectile secretions; and in circumstances where there is evidence of transmission from heavily colonized sources (e.g. burn wounds). IB [7]
f. Visitors planning to see multiple patients should don personal protective equipment as described for health care providers in section B1d to prevent MRSA transmission to other patients in the facility.

8. Discontinuing Contact Precautions/removing patient flags for MRSA (MDH-MRTF Consensus Statement)
    a. Patients with the following risk factors are not eligible for discontinuing Contact Precautions during their hospital stay:
        i. Reside in an acute or chronic long-term care facility [112, 113, 133, 226]
        ii. Receive hemodialysis [132]
        iii. On antimicrobials active against MRSA [7, 114, 232]
        iv. Admitted for a suspect staphylococcal infection
        v. Have areas of chronic open wounds or skin breakdown (e.g. decubitus ulcers) [7, 113, 132, 133, 157]
        vi. Have long-term invasive devices (e.g. gastrostomy tube, endotrachial tube) [157]
        vii. Recurrent infection or colonization with MRSA (patients previously cleared and presenting with new infection or colonization)
        viii. Have other MRSA risk factors as identified by the admitting facility
    b. Patients may come off Contact Precautions when the following criteria have been met:

i. There is documentation of a minimum of three consecutive negative nares cultures and a minimum of three consecutive negative cultures from previously positive sites(s) (where applicable, note B8a). [7, 157]
ii. Consecutive cultures should be at least 7 days apart. [7, 9]
iii. Cultures should be obtained no sooner than one week after completion of decolonization and/or clinical treatment. [7]
iv. Cultures do not need to be obtained during one hospitalization; cultures obtained during multiple hospitalizations or from outpatient visits may count towards the three negative cultures needed provided the patient does not fall into the categories outline in B8a at time of culture collection. [7]

9. Recommendations for decolonization and management of patients colonized with MRSA (MDH-MRTF Consensus Statement) [10, 126, 127, 171, 208]
    a. When to Decolonize
        i. Routine decolonization of MRSA colonized patients is not recommended. IB [7]
        ii. Decolonization may be indicated:
            1. When patients with MRSA positive nares are associated with ongoing transmission in an outbreak situation.
            2. In nasally colonized MRSA patients having a surgical procedure that has been identified by the facility as high risk for MRSA surgical site infection.
    b. Goal of decolonization
        i. The goal of a decolonization regimen in patients associated with outbreaks is to interrupt the transmission of MRSA, not to permanently decolonize the patient.
        ii. The goal of a decolonization regimen in high-risk pre-operative patients is to prevent an MRSA surgical site infection. As such, the decolonization protocol should be started several days prior to surgery.
    c. Decolonization protocols for patients colonized in nares (patients with MRSA colonization at sites other than nares should not be routinely decolonized). Although several papers have described various decolonization protocols, there are no optimal regimens for MRSA decolonization [233, 234]. When possible, Infectious Disease medical consultation should be sought prior to beginning any decolonization therapy. [7] When decolonization has been deemed appropriate, the following regimens have been suggested:
        i. Mupirocin ointment applied to the nares twice a day for five days
        ii. In addition to nasal mupirocin, the addition of chlorhexidine or hexachlorophene baths/showers/wipes every day for 5 days (as tolerated) can be added to the decolonization regimen. If used, contact with eyes and mucus membranes should be avoided and patients should test the product on a small area of skin as the products can cause allergic reactions and skin irritation.
        iii. The use of systemic antimicrobials may be considered on a case-by-case basis. When possible, obtain Infectious Disease medical consultation prior to beginning a systemic antimicrobial decolonization regimen.

d. Re-culturing patients for MRSA following completion of a decolonization protocol is not routinely recommended. If warranted, re-testing for MRSA carriage should occur no sooner than 7 days after completion of decolonization protocol(s) (see section B8 on when to discontinue Contact Precautions).

10. Management of healthcare workers with MRSA (MDH-MRTF Consensus Statement) [7, 140, 208]
    a. Healthcare workers with MRSA infection or colonization not associated with MRSA transmission to patients should have their care managed through their healthcare provider.
        i. Facilities should develop a policy to determine if healthcare workers infected or colonized with MRSA need to be furloughed from direct patient contact. [160-164] Factors to consider in developing such a policy include:
            1. Location of MRSA infection/colonization
            2. Ability of draining MRSA skin infections to be contained and covered
            3. Healthcare worker compliance with infection prevention and control precautions
    b. Routinely culturing healthcare workers for MRSA colonization is not recommended, as this practice is generally not effective in controlling transmission of MRSA IB [7, 59]
        i. Attempts to identify healthcare workers colonized with MRSA should be considered in the presence of noted outbreaks and/or clusters of MRSA (as defined by pulsed-field gel electrophoresis or other biotyping method) where healthcare workers have been epidemiologically linked in disease transmission and where traditional outbreak control measures have not been successful in interrupting transmission.
        ii. Some facilities require mask use in an attempt to reduce healthcare workers risk of nasal colonization during outbreak situations. [76]
    c. Screening cultures (anatomical sites that may be considered for culturing healthcare workers for MRSA colonization/infection during an outbreak investigation):
        i. Bilateral anterior nares IB [7, 110, 138, 142]
        ii. Open skin lesions and draining wounds IB [7, 109, 113, 138]
            1. If multiple skin lesions/draining wounds present, sample maximum of four lesions/wounds prioritizing by level of severity.
        iii. Hands [208, 235, 236]
    d. Nasal decolonization of MRSA colonized healthcare workers
        i. Decolonization objectives
            1. When a healthcare worker is found to be colonized or infected with an MRSA strain linked to the investigation, decolonization can be considered as a tool to interrupt MRSA transmission during outbreaks where traditional control measures have not been successful in ending the outbreak. The goal of healthcare worker

decolonization is to interrupt transmission, not to permanently eradicate colonization.

ii. Nasal decolonization protocol
    1. Although several papers have described various decolonization protocols, there are no optimal regimens for MRSA decolonization [233, 234]. When possible, Infectious Disease medical consultation should be sought prior to initiation of any decolonization therapy [7]. When decolonization has been deemed appropriate, the following regimens have been suggested:
        a. Mupirocin ointment applied to the nares twice a day for five days
        b. In addition to nasal mupirocin, the addition of chlorhexidine or hexachlorophene baths/showers every day for 5 days (as tolerated) can be added to the decolonization regimen. If used, contact with eyes and mucus membranes should be avoided and healthcare workers should test the product on a small area of skin as the products can cause allergic reactions and skin irritation.
        c. The use of systemic antimicrobials may be considered on a case-by-case basis. When possible, obtain Infectious Disease medical consultation prior to beginning a systemic antimicrobial decolonization regimen.

iii. Facilities should develop a policy to determine if MRSA colonized or infected healthcare workers associated with MRSA transmission need to be furloughed from direct patient contact [237, 238]. Factors that can be considered when evaluating colonized healthcare workers include:
    1. Strain type of MRSA isolate (matching outbreak pattern)
    2. Location of MRSA colonization (nares, hands, groin)
    3. Ongoing transmission to patients

C. Tier Two Recommendations – Intensified interventions to prevent MRSA transmission in acute care settings.

1. Rationale (MDH-MRTF Consensus Statement)
    a. The interventions described in section C have been utilized in various combinations to reduce transmission of MRSA in healthcare facilities. Neither the effectiveness of individual components nor that of specific combinations of these control measures has been assessed in controlled trials. Nevertheless, various combinations of these control elements selected under the guidance of content experts have repeatedly reduced MRSA infection and transmission rates in various healthcare settings. [7-9, 50, 135, 136, 143-152]
    b. The intervention or combination of interventions used should be determined by infection prevention and control staff based on infection prevention and control practices already in place and possible factors contributing to ongoing MRSA transmission.

i. Tier One Recommendations with no additional Tier Two Recommendations should continue to be implemented as standard infection prevention and control recommendations.

2. Indications for Tier Two Recommendations (MDH-MRTF Consensus Statement)
    a. When the incidence or prevalence of hospital-acquired MRSA infections is not decreasing despite implementation of and correct adherence to routine infection prevention and control measures outlined in Tier One.
        i. References for determining rates have been previously published. IB [7, 9, 61, 62, 203] When incidence or prevalence of hospital-acquired MRSA infections is not decreasing, the facility should evaluate potential causes (i.e. unidentified patient colonization, inadequate environmental cleaning, non-compliance with infection prevention and control policies) and select the Tier Two infection prevention and control practices needed to target interventions aimed at suspected causes for non-decreasing rates.
    b. Facilities with few/sporadic cases of hospital-acquired MRSA infections in their institutions should use judgment to determine if implementation of Tier Two Recommendations is warranted.
    c. Facilities may consider implementing Tier Two Recommendations when institutions determine that healthcare workers are non-compliant with routine control measures described in Tier One.

3. Infection prevention and control practices to reduce MRSA transmission-Tier Two – See Tier One Recommendations

4. Monitoring healthcare worker compliance with infection prevention and control practices (MDH-MRTF Consensus Statement)
    a. Monitor healthcare worker compliance with Contact Precautions, especially use of personal protective equipment and hand hygiene. Provide individual or unit-specific feedback on adherence.

5. Environmental measures (MDH-MRTF Consensus Statement)
    a. Administration, infection prevention and control, environmental services and nursing leadership should work together to ensure thorough education and training of environmental services staff.
    b. Administration should ensure adequate staffing for environmental services staff based on industry standards. [8]
    c. Intensify and reinforce training of environmental staff that work in areas targeted for enhanced MRSA control and monitor adherence to cleaning protocols.
    d. Consider dedicating staff to targeted patient areas to ensure consistency of proper environmental cleaning and disinfection. IB [7, 84, 105, 224, 239, 240]
    e. Environmental services staff are considered healthcare workers and should don personal protective equipment for room entry as described in B1d.
    f. Clean and disinfect surfaces and equipment that may be contaminated with MRSA (items in close proximity to the patient and frequently touched surfaces in the patient room) on a more frequent schedule compared to that for minimal touch

surfaces. IB [7, 65, 79, 107, 219] At a minimum, patient rooms and frequently touched surfaces should be cleaned at least once per day.

g. Consider obtaining environmental cultures when there is epidemiologic evidence that an environmental source is associated with ongoing MRSA transmission. Consult facility microbiology laboratory supervisors and MDH for assistance in developing an environmental screening protocol as needed. IB [7, 241]
h. Designate cleaning responsibilities for all items in a patient care room to determine what items are being cleaned by environmental versus nursing staff to make sure no items are being missed.
i. Infection prevention and control should provide guidance to determine how patient care supplies located inside the patient rooms are managed for patients on Contact Precautions.
j. Monitor cleaning performance to ensure consistent cleaning and disinfection of surfaces in close proximity to the patient and those likely to be touched by the patient and healthcare workers. IB [7]
    i. Cleaning checklists for environmental services staff may help to ensure consistent cleaning practices. The IHI MRSA guideline provides examples of cleaning checklists. [8]
k. Consider changing patient privacy curtains after Contact Precautions patient discharge.
l. Clean and disinfect equipment used for patients on Contact Precautions before their use on other patients, including vital sign machines and computers. IB [7]
m. Clean and disinfect Contact Precaution rooms after patient discharge per standard terminal room cleaning procedures. IB [7]
n. Vacate the units or sections of the unit for environmental assessment and intensive cleaning when previous efforts to eliminate environmental reservoirs have failed and environmental contamination is implicated in continued microbial transmission. II [7, 147, 224]

6. Active surveillance cultures (ASCs) (MDH-MRT Consensus Statement)
    a. Consider collecting ASCs from patients identified as high risk for MRSA colonization or infection by your facility MRSA risk assessment. Examples of patients that may be candidates for ASCs include: 1) patients found to be at risk for MRSA colonization; 2) patients admitted to units where rates of MRSA transmission are not decreasing; 3) patients admitted to high-risk units such as intensive care units, burn or bone marrow/stem cell transplant and oncology units. Cultures may be taken on admission or on admission and at pre-determined time periods after admission to monitor possible MRSA transmission.
    b. Preemptive Precautions – facilities collecting surveillance cultures on admission may consider isolating patients on admission until results of surveillance cultures are known. This may be implemented for every patient with surveillance cultures obtained or a portion of those patients based on facility-defined risk factors and availability of patient rooms.
    c. Screening cultures (anatomical sites) [7, 10, 64]
        i. Minimal requirement: bilateral anterior nares, utilizing one (1) culturette for both nares IB [7, 110, 138, 142]

ii. Additional recommended sites: any open skin lesions or draining wounds noted on admission (including surgical sites) IB [7, 109, 113, 138]
    1. If multiple skin lesions/draining wounds present, sample maximum of four lesions/wounds prioritizing by level of severity.

7. Education
    a. Increase MRSA educational programs for healthcare workers. Provide individual or unit-specific feedback on adherence to Contact Precautions and MRSA infection rates when possible. IB [7]

8. Administrative support (In addition to Tier One administrative support recommendations) (MDH-MRTF Consensus Statement)
    a. Administration should provide necessary leadership, funding, and oversight to implement interventions selected. IB
    b. Evaluate healthcare system factors for their role in assisting or perpetuating transmission of MRSA, including staffing levels, education and training, availability of consumable and durable resources, communication processes, and policies and procedures. Develop, implement, and monitor action plans to correct system failures. IB [7, 8]
    c. If MRSA infection rates do not decrease, assign dedicated nursing and ancillary service staff to the care of MRSA patients only. IB [7]
    d. If MRSA transmission continues despite implementation of enhanced control measures, stop new admits to the unit. IB [7]

9. Cohorting patients with MRSA- See Cohorting in B5.

10. Transporting and receiving MRSA positive patients – See transporting and receiving MRSA positive patients in B6

11. Visitors of patients on Contact Precautions (MDH-MRTF Consensus Statement) [50, 64, 217]
    a. Visitors should be informed of infection prevention and control practices and the importance of following the practices.
    b. Visitors should be instructed to perform hand hygiene before entering and after leaving the patient's room (regardless of patient contact).
    c. Establish ranges of care/contact based on visitor's ability to comply with infection prevention and control procedures (visitor must understand the need for and agree to adhere to hand hygiene and personal protective equipment requirements).
    d. Visitors should wear personal protective equipment to enter patient room.
        iii. Visitors should be instructed on how to properly put on and remove personal protective equipment (gloves/gowns/mask)
        iv. Gloves
            1. Required for visitors entering patient room.
        v. Gowns:
            1. Required for visitors entering patient room.
        vi. Masks:

1. Masks should be used when required by Standard Precautions. Standard Precautions require mask use when performing splash-generating procedures (e.g. wound irrigations, oral suctioning, intubation); when caring for patients with open tracheostomies and the potential for projectile secretions; and in circumstances where there is evidence of transmission from heavily colonized sources (e.g. burn wounds). IB [7]

e. Visitors should remove personal protective equipment and perform hand hygiene after leaving patient room.

12. Discontinuing Contact Precautions/removing patient flags for MRSA – See discontinuing Contact Precautions/removing patient flags for MRSA in B8

13. Recommendations for decolonization and management of patients colonization with MRSA – See Recommendations for decolonization and management of patients colonization with MRSA in B9

14. Management of healthcare workers with MRSA – See management of healthcare workers with MRSA in B10

MRSA Risk Assessment and Surveillance Definitions

The following definitions have been developed for use in monitoring MRSA incidence in a hospital or other healthcare facility.

Hospital-acquired (nosocomial) MRSA – 1) Infection/colonization that was not present or incubating on admission in a patient hospitalized >48 hours; 2) Infection/colonization identified in a patient <48 hours after hospital discharge; 3) Infection meeting other established criteria for hospital-acquired infections (e.g. Infections meeting the National Healthcare Safety Network [NHSN] definition for surgical site infection). Facilities should combine MRSA colonization and MRSA infection to monitor overall MRSA burden. However, in addition to monitoring combined infection and colonization data, facilities may decide to monitor infection rates alone. *Note: An MRSA infection in a patient previously identified as colonized with MRSA should not be counted as hospital-acquired.

Non-hospital-acquired MRSA –Infection/colonization not meeting the hospital-acquired definition. Facilities may choose to further define their non-hospital-acquired MRSA infection/colonization into healthcare-associated and community-associated. Whenever possible, distinguish MRSA colonization from MRSA infection.

> Healthcare-associated MRSA – 1) Infection/colonization that was present or incubating on admission to the hospital in a patient with a history of healthcare exposure as defined below OR infection/colonization presenting in a patient hospitalized <48 hours in a patient with a history of healthcare exposure as defined below.
>
> Healthcare exposure is defined as: hospitalization, surgery, dialysis or residence in a chronic or acute care facility in the year prior to culture date or presence of a percutaneous indwelling medical device or catheter at time or culture collection (e.g. tracheotomy, gastrostomy, foley or supra-pubic catheter, PICC line, etc. but excluding internal devices that do not have access to the exterior of the body [e.g. pacemakers, etc.]).
>
> Community-associated MRSA – Infection/colonization that was present or incubating on admission to the hospital in a patient with no healthcare exposure as defined above OR infection/colonization presenting in a patient hospitalized <48 hours in a patient with no history of healthcare exposure as defined above.

Common Abbreviations

APIC	Association for Professionals in Infection Control and Epidemiology
ASCs	Active Surveillance Cultures
CA-MRSA	Community-associated MRSA
HA-MRSA	Healthcare-associated MRSA
HICPAC	Healthcare Infection Control Practices Advisory Committee
IDSA	Infectious Disease Society of America
IHI	Institute for Healthcare Improvement
MDH	Minnesota Department of Health
MDH-MRTF	Minnesota Department of Health-MRSA Recommendations Task Force
MDROs	Multi-drug Resistant Organisms
MRSA	Methicillin-resistant *Staphylococcus aureus*
MSSA	Methicillin-susceptible *Staphylococcus aureus*
SHEA	Society of Healthcare Epidemiology of America
SSI	Surgical Site Infections
VRE	Vancomycin-resistant Enterococcus

Glossary

Active Surveillance Culture – A surveillance culture obtained for the purpose of actively identifying patients colonized with MRSA so they can be placed on Contact Precautions. Cultures can be taken on facility admission or on facility admission and at other pre-determined time points (e.g. every 7 days, at discharge from unit/hospital, etc.)

Clinical Culture – Culture taken from tissue, bone, or body fluid that is taken for diagnostic purposes

Contact Precautions – Standard Precautions plus placing the patient in a private room (or cohorting if a private room is not available), wearing gloves and gown upon room entry and designating patient supplies and equipment whenever possible.

Cohorting – The practice of grouping patients infected or colonized with the same infectious agent together to confine their care to one area and prevent contact with susceptible patients

Colonization – The presence of microorganisms at a body site that are not causing adverse clinical manifestations of illness or infection

Community-associated MRSA – See definition under Non-hospital-acquired MRSA

Hand Hygiene – Washing hands with antimicrobial hand soap and warm water for at least 15 seconds or the application of an alcohol-based hand sanitizer if hands are not visibly soiled

Healthcare worker – All paid and unpaid persons who work in a healthcare setting (e.g. any person who has professional or technical training in a healthcare-related field and provides patient care in a healthcare setting or any person who provides a service that supports the delivery of healthcare such as dietary, housekeeping, engineering, and maintenance personnel).

Healthcare-associated MRSA – See definition under Non-hospital-acquired MRSA

Hospital-acquired (nosocomial) MRSA – 1) Infection/colonization that was not present or incubating on admission in a patient hospitalized >48 hours; 2) Infection/colonization identified in a patient <48 hours after hospital discharge; 3) Infection meeting other established criteria for hospital-acquired infections (e.g. infections meeting the National Healthcare Safety Network [NHSN] definition for surgical site infection). Facilities should combine MRSA colonization and MRSA infection to monitor overall MRSA burden. However, in addition to monitoring combined infection and colonization data, facilities may decide to monitor infection rates alone. *Note: An MRSA infection in a patient previously identified as colonized with MRSA should not be counted as hospital-acquired.

Infection – The pathological state resulting from the invasion of the body by pathogenic microorganisms that produce disease. Examples of infections for surveillance purposes have been developed by the National Healthcare Safety Network [NHSN] and can be found at http://www.cdc.gov/ncidod/dhqp/nhsn_documents.html.

Non-hospital-acquired MRSA –Infection/colonization not meeting the hospital-acquired definition. Facilities may choose to further define their non-hospital-acquired MRSA infection/colonization into healthcare-associated and community-associated. Whenever possible, distinguish MRSA colonization from MRSA infection.

> Healthcare-associated MRSA – 1) Infection/colonization that was present or incubating on admission to the hospital in a patient with a history of healthcare exposure as defined below OR infection/colonization presenting in a patient hospitalized <48 hours in a patient with a history of healthcare exposure as defined below.
>
> Healthcare exposure is defined as: hospitalization, surgery, dialysis or residence in a chronic or acute care facility in the year prior to culture date or presence of a percutaneous indwelling medical device or catheter at time or culture collection (e.g. tracheotomy, gastrostomy, foley or supra-pubic catheter, PICC line, etc. but excluding internal devices that do not have access to the exterior of the body [e.g. pacemakers, etc.]).
>
> Community-associated MRSA – Infection/colonization that was present or incubating on admission to the hospital in a patient with no healthcare exposure as defined above OR infection/colonization presenting in a patient hospitalized <48 hours in a patient with no history of healthcare exposure as defined above.

Standard Precautions – A group of infection prevention practices that apply to all patients, regardless of suspected or confirmed diagnosis or presumed infection status. Standard Precautions are a combination and expansion of Universal Precautions and body Substance Isolation. Standard Precautions are based on the principle that all blood, body fluids, secretions, excretions except sweat, nonintact skin, and mucous membranes may contain transmissible infectious agents. Standard Precautions includes hand hygiene, and depending on the anticipated exposure, use of gloves, gown, mask, eye protection, or face shield. Also, equipment or items in the patient environment likely to have been contaminated with infectious fluids must be handled in a manner to prevent transmission of infectious agent, (e.g. wear gloves for handling, contain heavily soiled equipment, properly clean and disinfect or sterilize reusable equipment before use on another patient.) Standard Precautions defines the need for personal protective equipment:

> Gloves – Wear gloves (clean, nonsterile gloves are adequate) when touching blood, body fluids, secretions, excretions, and contaminated items. Put on clean gloves just before touching mucous membranes and nonintact skin. Change gloves between tasks and procedures on the same patient after contact with material that may contain a high concentration of microorganisms. Remove gloves promptly after use, before touching noncontaminated items and environmental surfaces, and before going to another patient, and wash hands immediately to avoid transfer of microorganisms to other patients or environments.
>
> Gown – Wear a gown (a clean, nonsterile gown is adequate) to protect skin and to prevent soiling of clothing during procedures and patient-care activities that are likely to

generate splashes or sprays of blood, body fluids, secretions, or excretions. Select a gown that is appropriate for the activity and amount of fluid likely to be encountered. Remove a soiled gown as promptly as possible, and wash hands to avoid transfer of microorganisms to other patients or environments.

Mask – Wear a mask and eye protection or a face shield to protect mucous membranes of the eyes, nose, and mouth during procedures and patient-care activities that are likely to generate splashes or sprays of blood, body fluids, secretions, and excretions.

Surveillance Culture – A culture performed to identify colonization that is obtained from the site of interest, most often the anterior nares.

Minnesota Statute 144.585

Sec. 15. [144.585] METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS CONTROL PROGRAMS.

In order to improve the prevention of hospital-associated infections due to methicillin-resistant Staphylococcus aureus ("MRSA"), every hospital shall establish an MRSA control program that meets Minnesota Department of Health MRSA recommendations as published January 15, 2008. In developing the MRSA recommendations, the Department of Health shall consider the following infection control practices:

(1) identification of MRSA-colonized patients in all intensive care units, or other at-risk patients identified by the hospital;

(2) isolation of identified MRSA-colonized or MRSA-infected patients in an appropriate manner;

(3) adherence to hand hygiene requirements; and

(4) monitor trends in the incidence of MRSA in the hospital over time and modify interventions if MRSA infection rates do not decrease.

The Department of Health shall review the MRSA recommendations on an annual basis and revise the recommendations as necessary, in accordance with available scientific data.

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Appendices

Appendix A – List of Resources

Instructions for Nasal Swab Culture Collection

- Available in the "Guide to the Elimination of Methicillin-Resistant *Staphylococcus aureus* (MRSA) Transmission in Hospital Settings" from the Association for Professionals in Infection Control and Epidemiology (pg. 36) at www.apic.org

Making the Business Case for Infection Control Activities

- Available in the "Guide to the Elimination of Methicillin-Resistant *Staphylococcus aureus* (MRSA) Transmission in Hospital Settings" from the Association for Professionals in Infection Control and Epidemiology (pages 43-45) at www.apic.org
- Dunagan WC, Murphy DM, Hollenbeak CS, Miller SB. Making the business case for infection control: pitfalls and opportunities. Am J Infect Control. 2002;30:86-92
- Scheckler WE, Brimhall D, Buck AS, Farr BM, Friedman C, Baribaldi RA, et.al. Requirements for infrastructure and essential activities of infection control and epidemiology in hospitals: A consensus panel report. Infect Control Hosp Epidemiol 1998;19:114-124

Hand Hygiene

- "How-to Guide: Improving Hand Hygiene. A Guide for Improving Practices Among Health Care Workers". Available from www.ihi.org http://www.ihi.org/IHI/Topics/CriticalCare/IntensiveCare/Tools/HowtoGuideImprovingHandHygiene.htm
- Boyce JM, Pittet D. Guideline for Hand Hygiene in health-care settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Infect control hosp epidemiol. 2002;23:S3-S40
- World Alliance for Patient Safety. WHO Guidelines on Hand Hygiene in Health Care (Advanced Draft). Available from www.who.int

Environmental Services Cleaning Checklists

- Available in Appendix A and B of "Getting Started Kit: Reduce methicillin-resistant *Staphylococcus aureus* (MRSA) infection. How-to Guide" by the Institute for Healthcare Improvement at www.ihi.org (http://www.ihi.org/IHI/Programs/Campaign/MRSAInfection.htm)

Surveillance Methodology/Data Analysis

- Available in the "Guide to the elimination of methicillin-resistant *Staphylococcus aureus* (MRSA) transmission in hospital settings" from the Association for Professionals in Infection Control and Epidemiology (pages 16-21) at www.apic.org
- Association for Professionals in Infection Control and Epidemiology (APIC). Text of Infection Control and Epidemiology. 2nd Edition. Washington, D.C.: Association for Professionals in Infection Control and Epidemiology, Inc; 2005. (Chapters 3, 5, 6, 7, 8)
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MRSA fact sheets for patients and families

- "Learning about MRSA: A guide for patients" available from www.health.state.mn.us (http://www.health.state.mn.us/divs/idepc/diseases/mrsa/index.html)
- Appendix C

Appendix B - Script for nursing staff when collecting surveillance cultures:

"As a part of XXXXXX hospital's commitment to reduce antibiotic-resistant bacteria and keep patients safe, a culture will be collected from your nose to determine if you are carrying bacteria called MRSA (methicillin-resistant *Staphylococcus aureus*). If your culture comes back positive, nurses, doctors, and other healthcare staff will wear gowns and gloves when they come into your room. If your culture comes back positive, you will receive more information about MRSA."

Methicillin-Resistant *Staphylococcus aureus* (MRSA)

What is *Staphylococcus aureus*?

Staphylococcus aureus, often called "staph", are bacteria commonly carried on the skin or in the noses of healthy people. Staph bacteria are one of the most common causes of skin infections in the U.S. Most of the infections are minor (such as pimples or boils) and most can be treated without antibiotics.

Staph bacteria can also cause serious infections (such as blood steam infections or pneumonia). In the past, most serious staph infections were treated with a certain type of antibiotic (medicine) related to penicillin. Over the past 50 years, treatment of these infections have become more difficult because staph bacteria have become resistant to some types of antibiotics, this means the antibiotics do not kill the bacteria. Some of the staph bacteria that are resistant to antibiotics are called methicillin-resistant Staphylococcus aureus (MRSA).

Where is MRSA found?

MRSA can be found on the skin and in the noses of some people without causing illness. When MRSA is on the body but not causing an infection it is called colonization. Infection occurs when the MRSA bacteria enter the body and cause disease.

What type of infections are caused by MRSA?

MRSA most often causes skin infections, such as pimples or boils. MRSA can also cause infections of the bone, blood, or urinary tract.

Who usually gets an MRSA infection?

MRSA most often occurs among people in hospitals and health care facilities (such as nursing homes or dialysis centers) who have weakened immune systems.

People who have not been in a hospital or healthcare care facility can also get MRSA. This is known as community-associated MRSA.

How is MRSA spread?

MRSA is spread by skin-to-skin contact or by contact with items that have become contaminated with MRSA, such as bandages, bed sheets, towels and washcloths.

What are the symptoms of MRSA?

The type of symptoms you have will depend on where the MRSA will depend on the site of infection. If MRSA is in a wound, the area around the wound may be red, warm, swollen, and have pus-like drainage.

How do you test for MRSA infections?

A test of your skin or area of the body that might be infected will show if there is an MRSA infection. Sometimes this may be done using a swab to test for MRSA in your nose or on your skin. If you have had an MRSA infection in the past, you may be tested from time to time to see if you still have MRSA.

How do you treat MRSA infections?

Many MRSA skin infections will heal on their own, without the need for additional treatment. Some MRSA infections will need to be treated with medicine (antibiotics)

How can you prevent the spread of MRSA at home?

- Clean your hands well and often with soap and warm water or use an alcohol-based hand rub, especially after changing bandages or touching the infected area.
- Use gloves when touching any wounds or touching body fluids
- Keep your wounds or sores covered
- Avoid sharing personal items (such as towels, washcloths, razors, or clothing)
- Clean frequently used household surfaces (sinks, bathtubs/showers, tables, countertops, light switches, doorknobs) with a household cleaner

Can an MRSA infection come back?

It is possible for an MRSA infection to come back. To prevent this from happening, follow your healthcare provider's directions while you have the infection, and follow the prevention steps listed above.

Appendix D – Letter to patient regarding MRSA positive surveillance culture result (if discharged before result is known)

Date

Dear Patient Name

When you were admitted to XXXXX Hospital on XXXXX, you had a culture collected from your nose to determine if you were carrying bacteria called MRSA (methicillin-resistant *Staphylococcus aureus*). The results of that culture showed that MRSA was found in your nose. We are sending you this letter to provide you with some information about MRSA.

Staphylococcus aureus (staph) bacteria are often found in the nose or on the skin. People who have MRSA in their nose with no symptoms of infection are "carriers of" or "colonized with" MRSA. Most of the time, staph bacteria found in the nose or on the skin do not cause problems.

MRSA can cause infection if it gets inside the body. Most of the time, MRSA causes skin infections. MRSA skin infections can look like:

- large, red, painful bumps under the skin (boils or abscesses)
- a cut that is swollen and filled with pus
- a blister that is full of pus (impetigo)
- a sore that looks or feels like a spider bite.

It is also possible for MRSA to cause infections in other areas of the body such as the blood, lungs, joints, open wounds or urine. Symptoms of MRSA infection in other areas of the body can include fever, pain, chills, shortness of breath, and pain or difficulty urinating. It is important to recognize symptoms of MRSA infection. If you ever have symptoms of MRSA infection, you should notify your healthcare provider as soon as possible. Early treatment can prevent MRSA infections from getting worse.

Anyone can get MRSA. MRSA can be spread by touching someone or something that has the MRSA bacteria on it. In your home, simple measures such as washing your hands and not sharing personal items help prevent the spread of MRSA. In the hospital, extra precautions to prevent the spread of MRSA are taken. If you are admitted to XXXXXX Hospital, your caregivers will wear gloves and a gown when caring for you. Extra precautions are needed in hospitals because healthcare workers touch many patients throughout the day, and they do not want to spread MRSA from person to person.

The enclosed fact sheet has more information on MRSA, including how to prevent the spread of MRSA. We hope this information helps you understand that:

1. MRSA in the nose usually does not cause problems
2. MRSA can cause infections and it is important to recognize symptoms of MRSA infection
3. Keeping hands clean by washing with soap and water or using an alcohol based hand rub product is very important in preventing the spread of MRSA.
4. Hospitals take extra steps to prevent the spread of MRSA.

If you have questions about MRSA you can call XXXXXXXX.

Sincerely
XXXXXXXXX