Reducing Methicillin-Resistant *Staphylococcus Aureus* (MRSA) In the Hospital Setting

By

Amy Woolwich, RN, BSN

A Master’s Paper submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Master of Public Health in the Public Health Leadership Program.

Chapel Hill

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Glossary of Terms

**Association for Professionals in Infection Control (APIC):** A board of professionals elected to improve health and patient safety by reducing risks of infection and other adverse outcomes. Its members include nurses, epidemiologists, physicians, quality and patient safety professionals, healthcare executives, microbiologists, clinical pathologists, laboratory technologists, and public health practitioners. APIC advances its mission through education, research, consultation, collaboration, public policy, practice guidance and credentialing.

**Centers for Disease Control and Prevention (CDC):** A division of the Department of Health and Human Services collaborating to create the expertise, information, and tools that people and communities need to protect their health through health promotion, prevention of disease, injury and disability, and preparedness for new health threats.

**Healthcare Infection Control Practices Advisory Committee (HICPAC):** A federal advisory committee made up of 14 external infection control experts who provide advice and guidance to the Centers for Disease Control and Prevention (CDC) and the Secretary of the Department of Health and Human Services (HHS) regarding the practice of health care infection control, strategies for surveillance and prevention and control of health care associated infections in United States health care facilities.

**Institute for Healthcare Improvement (IHI):** An independent not-for-profit organization helping to lead the improvement of health care throughout the world. Founded in 1991 and based in Cambridge, Massachusetts, IHI works to accelerate improvement by building the will for change, cultivating promising concepts for improving patient care, and helping health care systems put those ideas into action.

**Methicillin-Resistant Staphylococcus aureus (MRSA):** A bacteria prevalent in many hospitals and communities that is resistant to many antibiotics and difficult to treat.

**Multidrug Resistant Organism (MDRO):** A bacterium such as MRSA that is resistant to many antibiotics.

**Society for Healthcare Epidemiology of America (SHEA):** Organized in 1980 to foster the development and application of the science of healthcare epidemiology. SHEA focuses on a variety of disciplines and activities directed at prevention and control of infections and adverse outcomes, as well as enhancing the quality-of-care.

**World Health Organization (WHO):** The directing and coordinating authority for public health within the United Nations system. The WHO is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries and monitoring and assessing health trends.
Abstract

One third of all people in America walk around with staphylococcus germs in their noses. Two and a half million people carry the strain of staphylococcus called methicillin-resistant *Staphylococcus aureus* (MRSA) that most antibiotics can’t kill. MRSA is one of the fastest growing pathogens known today. The United States has the world’s second highest rate of MRSA infections, and it continues to rise. As awareness and incidence of MRSA has increased, a call for mandatory test cultures has grown. While these tests are crucial to controlling MRSA, mandating them puts undue burden on hospitals when a well-tested series of steps has proven extremely effective in preventing the spread of the deadly bacteria. With the increase of healthcare associated MRSA infections, much of the research over the past ten years has been devoted to uncovering strategies to reduce the incidence within the healthcare setting. Studies have shown that healthcare institutions can greatly reduce the incidence of MRSA by instituting the following five components of care: 1) Hand hygiene 2) Decontamination of the environment and equipment 3) Active surveillance 4) Contact precautions for infected and colonized patients 5) Central line and ventilator device bundles. Many researchers and organizations are also evaluating whether mandatory active surveillance cultures (ASCs) will reduce its incidence. Leaders in infection control organizations do not support mandating ASCs, but do support the practice as an effective way to reduce the transmission of MRSA. As infection control leaders it is imperative to recognize the differences in needs and resources within healthcare institutions throughout the United States. By mandating ASCs many healthcare institutions are obligated to utilize resources on ASCs that might be better used in education of staff and the community. Research has proven the effectiveness of the five components of care in the reduction of MRSA. However, to what extent and how these five components of care are implemented should be left
up to each individual healthcare institution as to how it best fits their needs. This paper will
discuss the evidence-based five components to reduce MRSA and give healthcare providers the
knowledge to implement them within their individual healthcare institutions.
What is MRSA?

Bacteria have existed for billions of years. Whether it’s the result of naturally occurring antibacterials in the human body or the new generation of manmade antibiotics, bacteria have found ways to survive, mutate, multiply and evolve, and in turn have become resistant to many available treatments.

Researchers believe that bacteria began developing resistance to antibiotics in the 1940s, just a few years after Alexander Fleming’s discovery of penicillin. After the introduction of methicillin in the 1960s, staphylococcus (staph) bacteria began developing increasing resistance. Its path is similar to that of penicillin: In 1950 penicillin was effective against 100 percent of staph strains. By 1985 it was effective against less than five percent of staph strains (Institute for Healthcare Improvement, 2007). Today MRSA, also known as a multidrug-resistant organism (MDRO), is not only resistant to penicillin, but to many other antibiotics as well. As a result of its resistance to multiple antibiotics MRSA has been labeled a super bug. According to the Centers for Disease Control and Prevention (CDC) (2007), the proportion of healthcare-associated staph infections due to MRSA rose from two percent in 1974 to 22 percent in 1995 to 64 percent in 2004 in US Intensive Care Units (ICUs).

Once MDROs are introduced into the healthcare setting, transmission and persistence of the resistant strain is determined by the availability of vulnerable patients, selective pressure exerted by antimicrobial use, increased potential for transmission from larger numbers of colonized or infected patients, and the impact of implementation and adherence to prevention efforts (CDC, 2006, p. 8).
MRSA colonization occurs when colonies of the bacteria grow in the nasal passages and folds of the skin, but the person is asymptomatic. Other common areas of colonization are the perineal or inguinal areas, the axillae, trunk, and upper extremities (CDC, 2002). Some patients come into the hospital already colonized with MRSA having acquired it in the community or from previous contact with the healthcare system—whether it’s another hospital, nursing home, or rehabilitation facility. Patients colonized with MRSA are at greater risk of developing a clinical infection. This includes those with severe disease, especially those who are immunocompromised; those with invasive devices such as central lines and ventilators; and patients who have undergone recent surgery (CDC, 2006). Nearly one-third of patients newly colonized with MRSA in an ICU setting developed invasive disease within 18 months, with approximately 50 percent of these infections occurring after discharge, often resulting in readmission (Huang et al., 2006).

Community-acquired MRSA (CA-MRSA) has become a global problem of epidemic proportions. The CDC reports that eight to 20 percent of MRSA infections are found in the community (Holcomb, 2006). The populations most affected by CA-MRSA are children, parenteral drug users, men who have sex with men, military personnel, prisoners, and certain ethnic populations (Cohen, 2007). Recently, athletes that participate in competitive contact sports have also been identified to be at greater risk of developing CA-MRSA. Historically, the strains of MRSA found in the community setting are epidemiologically distinct from those found in the healthcare setting. The community isolates are resistant to fewer antibiotics than its healthcare acquired counterparts. This decrease in multidrug resistance has been attributed to a novel mecA gene found in CA-MRSA strains (Rihn, Michaels, & Harner, 2005). CA-MRSA most commonly presents as a minor skin and soft tissue infection, and is most often described to the
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physician as a spider bite. At times, particularly in children, CA-MRSA can result in admission to a healthcare facility, introducing these unique CA-MRSA strains to the healthcare community and furthermore increasing the risk of transmission throughout the hospital setting.

Inevitably, with an increase in community-acquired MRSA there has been an increase in MRSA in healthcare institutions with more and more patients admitted to the hospital already infected or colonized with MRSA. Now, with Medicare withholding reimbursement for many hospital acquired infections it is imperative that healthcare institutions differentiate between MRSA infections and colonizations that were acquired in the hospital as opposed to pre-existing conditions. As a result, many healthcare institutions are performing ASC’s upon admission to determine if it is a pre-existing condition. In addition, healthcare institutions are instituting five components of care to reduce the incidence of acquiring MRSA while in the hospital.

The Five Components of Care

In 2006, The Institute for Healthcare Improvement (IHI) launched its 5 Million Lives Campaign. Its objective/goal is to protect patients from five million incidents of medical harm from December 2006 to December 2008.

The IHI defines “medical harm” as the unintended physical injury resulting from or contributed to by medical care (including the absence of indicated medical treatment), that requires additional monitoring, treatment or hospitalization, or that results in death. Such injury is considered harm whether or not it is considered preventable, resulted from a medical error, or occurred within a hospital (IHI, n.d.).

This campaign challenges American hospitals to adopt twelve changes that save lives and reduce patient injury. One of these changes is to reduce MRSA infection by implementing scientifically proven infection prevention practices. The IHI believes that the prevention of MRSA
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transmission requires a multifaceted approach comprised of five components of care: 1) hand hygiene 2) decontamination of the environment and equipment 3) active surveillance 4) contact precautions for infected and colonized patients 5) central line and ventilator device bundles. Each plays a key role in controlling the spread of the bacteria.

Hand Hygiene

For many generations hand washing has been considered a measure of good personal hygiene. As a result of early studies conducted by Ignaz Semmelweis and Oliver Wendell Holmes, the CDC, the World Health Organization (WHO), the Association for Professionals in Infection Control (APIC), and the Healthcare Infection Control Practices Advisory Committee (HICPAC) have written hand hygiene guidelines. Despite subtle differences, all of the above organizations are in agreement that hand hygiene is the most important measure to reduce the spread of infection in healthcare facilities.

Normal human skin is colonized with transient and resident bacteria. Transient flora, which colonize the superficial layers of the skin and are most frequently related to healthcare associated infections, are often acquired by HCWs during direct contact with patients or contaminated surfaces close to patients. These bacteria are easily removed by routine hand hygiene. Resident flora within the deeper layers of skin, are more difficult to remove, and are less likely associated with healthcare associated infections (Centers for Disease Control and Prevention, 2002).

The transmission of MRSA from one patient to another most often occurs via the contaminated hands, clothing, and equipment of health care workers (HCWs) (Institute for Healthcare Improvement, 2008). Hands are easily contaminated during patient care by coming in contact with the colonized or infected patient, or the environmental surfaces the patient has
Reducing MRSA can survive for days and sometimes even months on inanimate objects such as phones, computer keyboards, bedside tables, and bed rails.

Hospitalized patients are colonized with MRSA most frequently in their nose, but other body sites with high concentration are their skin, throat, rectum, and ostomies (Institute for Healthcare Improvement, 2008). Between 30 to 60% of healthy adults are colonized with Staphylococcus aureus and 10% to 20% are chronically colonized, mostly in their nares (Henderson, 2006). The risk of transmission of MRSA can be greatly decreased through proper hand hygiene, either hand washing with soap and water or utilizing a waterless, alcohol-based hand rub.

The CDC defines hand hygiene as either washing with soap and water or using a waterless, alcohol-based hand rub. There are certain indications for handwashing over an alcohol-based hand rub. These include when hands are visibly soiled, when caring for a patient with Clostridium difficile, before eating, and after using the restroom. Otherwise, alcohol-based hand rubs should be the product of choice for hand hygiene.

Over the last several years many studies have proven that alcohol-based products are more effective in reducing MRSA from the hands of HCWs than soap and water because they are rapidly active and have a broad antimicrobial spectrum (Henderson, 2006). However, compliance rates of hand hygiene by HCWs often fall below 50% in many healthcare institutions. There are many factors that have been attributed to low compliance rates by HCWs including skin irritation associated with frequent handwashing, inaccessibility to hand hygiene supplies such as the waterless alcohol-based hand rubs, lack of hand hygiene facilities, lack of education about the importance of hand hygiene and how hands become contaminated, high workloads and understaffing (not enough time), and lack of commitment to hand hygiene by
Many of these factors can be reduced by using alcohol-based hand rubs because not only are they more effective, but they require less time to use, are easy to make accessible during patient care, and cause less skin irritation and drying (Institute for Healthcare Improvement, 2006).

It is important to emphasize that failure to use an appropriate volume of alcohol-based hand rub or soap for a sufficient length of time will result in an ineffective reduction of pathogens from HCWs’ hands. A sufficient amount of alcohol-based hand rub will allow for hands to be rubbed together with friction for at least 15 seconds before they are dry or before rinsing (Institute for Healthcare Improvement, 2006).

According to the IHI (2006), instituting a multifaceted hand hygiene program to improve compliance that includes increasing the accessibility of alcohol-based hand rubs and implementing educational and behavioral initiatives will decrease incidence rates of MRSA. Many institutions have found that placing alcohol-based hand rub dispensers adjacent to patient beds has increased hand hygiene compliance. Educational and behavioral initiatives can include programs demonstrating proper hand hygiene technique, encouraging patients and families to advocate for their safety by asking staff to perform hand hygiene before and after caring for them, providing interactive lectures given by knowledgeable professionals about the importance of hand hygiene, and hanging posters and distributing buttons to staff which will serve as a constant reminder. All of these initiatives will help make hand hygiene a part of an institution’s culture and make compliance the social norm. A hospital in Geneva, Switzerland had an increase in hand hygiene compliance from 48% in 1994 to 66% in 1997 after initiating a campaign that included posters on hand hygiene and installation of alcohol-based hand rub dispensers by the patient’s bedsides (Institute for Healthcare Improvement, 2008).
Decontamination of the Environment and Equipment

MRSA survives well in the hospital environment, which creates concern over the state of its cleanliness. Times have changed over the years; there are differences in the types of patients and the clinical environments in which they are cared for. Today, patients are older, immunologically weaker, and are subjected to more invasive procedures and devices (Dancer, 2007). Also, over the past several decades there has been a large increase in the amounts and types of electronic equipment that patients come in contact with that require a greater degree of disinfection and cleaning. Staphylococcus has become the most common bacterial pathogen worldwide, which creates concern with the increase of resistant staphylococcus and the decrease in the amount of antimicrobial agents there are to treat it (Dancer, 2007).

The transmission cycle of MRSA most often occurs via the hands of healthcare workers either from direct contact with a patient colonized or infected with MRSA or the surfaces the patient touches. The potential for MRSA to be transmitted to patients via environmental surfaces depends on many factors, including its ability to remain viable on a variety of dry surfaces, the frequency in which these surfaces are touched by HCWs and patients, and how high the levels of contamination are (Boyce, 2007). Environmental contamination usually occurs during routine patient care. Direct contact with the infected or colonized patient does not have to occur to contaminate the hands of healthcare workers. In fact, studies have demonstrated that MRSA can survive on room surfaces for days, weeks, and months, even after discharge cleaning (Goodman et al, 2008). It can remain virulent and capable of causing infection after exposure to dry surfaces for at least 10 days (Boyce, 2007). There is much evidence that supports the contaminated hands of HCWs from the environment are a common mode of transmission to other patients. Studies have also proven MRSA contaminated environments as the main cause of outbreaks, which were
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not brought under control until the environment was thoroughly cleaned. According to Hardy et al (2006) MRSA was isolated from the environment at every environmental screening within an ICU setting. Overall, MRSA was present in 21.8% of the environmental samples with the highest level of contamination found underneath the beds followed by workstations, monitors, and ledges behind the beds. The sites underneath the beds have been noted in various studies to have the highest level of contamination because it is not far from the floor (Hardy et al, 2006).

Although hands infrequently touch the floors, the transmission of MRSA occurs through the movement of dust in the air to the more frequently touched surfaces (Shiomori et al, 2002). Another study by Otter et al, (2006) showed the highest level of MRSA was recovered most frequently from the bedside rails (100% of those cultured); followed by blood pressure cuffs, television remotes, bedside tables, toilet seats, door handles, and intravenous pumps. Whenever possible, equipment used on patients with MRSA should be disposable. However, when that is not an option, disinfection of such equipment with 70% isopropyl alcohol has been shown to significantly decrease bacterial counts (Society for Healthcare Epidemiology of America, 2003).

Regardless of where the highest level of contamination occurs, it is evident that MRSA survives on surfaces making the disinfection and cleaning of patient care areas essential in preventing the transmission of MRSA.

Adequate cleaning requires the removal of pathogens to minimize patients’ risks of acquiring MRSA through the hospital environment. Although sterilization of the environment is not the goal, certain measures help increase the removal of MRSA. Bed curtains are usually the first to be touched after examining a patient and before performing hand hygiene. Therefore, exchanging bed curtains after discharging patients with MRSA becomes a critical measure to reduce MRSA transmission. However, many hospitals today often utilize off-site laundry
services and have a paucity of extra bedside curtains, making this measure challenging in the current state of healthcare. Another critical measure to increase the removal of MRSA is the use of pour bottles instead of spray bottles, which will ensure that larger quantities are applied to surfaces (Goodman et al., 2008). According to the IHI (2008) standard, EPA approved environmental disinfectants are recommended for the removal of MRSA. What may be more important than the type of disinfectant used is the actual physical scrubbing and wiping of the surface (Healthcare Infection Control Practices Advisory Committee, 2003).

With hospitals under tight budget restrictions it is not realistic to hire more environmental services people to enhance hygiene. Instead, hospitals should be using training and education as a means to increase the knowledge base of the employees they already have. The Society for Healthcare Epidemiology of America (SHEA) guidelines advocate for staff education, checklists, and frequent, scheduled cleaning times. Evanston Northwestern Hospital in Illinois currently uses a checklist instead of asking staff to rely on memory (Appendix A).

Active Surveillance Cultures & Contact Precautions

Patients colonized with MRSA serve as a major reservoir for its spread within the healthcare environment and are as likely to contaminate the environment as those who are infected (Clancy et al., 2006). Colonization can occur in a hospital, another healthcare facility such as a nursing home or long term care facility, or even in the community. Patients from long term care, rehab, or a chronic care facility are most at risk for colonization of MRSA. In 2003, SHEA published guidelines for preventing the transmission of MRSA. The primary recommendation of these guidelines stated that all patients with a high risk of carrying MRSA should be tested using active surveillance cultures (ASCs) upon admission to a healthcare facility to prevent patient-to-patient transmission and then implement contact precautions (Society for
Reducing MRSA Healthcare Epidemiology of America, 2003). SHEA also notes that the countries that have had the most success in controlling MRSA are ones that have instituted ASCs and the strict application of contact precautions. In Denmark, the prevalence of MRSA peaked to 30% in the 1960s, but has maintained at less than one percent for 25 years after the introduction of a policy to control transmission. In Finland and the Netherlands, the prevalence of MRSA has maintained at lower than one-half percent (Hall & Flayhart, 2006).

The anterior nares are the most sensitive body site for assessing MRSA colonization and remain the preferred site for ASCs (Furuno et al, 2007). According to the IHI (2008), ASCs of the nares will identify 80% of colonized patients. It is imperative to differentiate between MRSA colonization and active infection when discussing the importance of ASCs. MRSA is often found on the skin and mucosal surfaces of humans without producing signs and symptoms of infection. This is known as colonization. However, when there is a breakdown in the defenses of the host, whether physical or immunological, these colonizing bacteria become capable of producing infection, sometimes even death. In fact, various studies have demonstrated a 10-30% incidence of MRSA colonization resulting in infection, which is higher for those severely ill than non-acute illness patients (Weber et al, 2007). Patients with active MRSA infections are only a small percentage of the millions of people who are colonized and without symptoms- the Iceberg Effect (Buscell, 2006). Due to the large population of colonized and asymptomatic patients, it is critical to identify upon admission and properly isolate them with the appropriate precautions to prevent transmission to other patients.
Any plan to institute ASCs should be done in consultation with the laboratory. The financial impact on the laboratory will be determined by the extent to which the healthcare institution implements ASCs—whether they perform them on all patients admitted to the facility or just the high risk patients or patients admitted from long term care facilities. The cost to the facility will also depend on the type of test they choose. A test with a two-hour turnaround time is much more costly to the institution than one with a 48-hour turnaround time. However, since ASCs are designed to guide the intervention of implementing contact precautions for colonized patients, the chosen screening test should have a turnaround time of 24 hours or less (Diekema & Edmond, 2007). Whether an institution chooses a test with a two-hour turnaround time or one with a 24-hour turnaround time, the overall savings as a result of early detection of MRSA and the further prevention of infection and transmission to other patients outweighs the added expense of the ASC program itself (Weber et al., 2007). A study conducted by Karchmer, Durbin, Simonton, & Farr (2002) demonstrated that the prevention of nosocomial MRSA bloodstream infections ultimately cost less than the ASCs.
After identifying MRSA colonization the institution must decide whether or not to decolonize the patient. The purpose of decolonization is to eradicate the carriage of the pathogen to prevent infection in the colonized patient and prevent the transmission of MRSA to others. The decolonization process includes a topical mupirocin either alone or in combination with an oral antibiotic and antimicrobial soap for bathing, usually chlorhexidine (Centers for Disease Control and Prevention, 2006). Currently, the CDC and APIC do not support the decolonization of patients due to the fact that over time decolonized persons often become recolonized.

Contact precautions is the physical separation of colonized or infected patients from other patients plus HCWs wearing a gown to serve as a barrier between them and the patient. HCWs are at risk for contaminating their clothes when they have substantial contact with colonized or infected patients, and then in turn could contaminate their hands when they touch their clothes. This could increase the risk of transmission of MRSA from HCWs to patients. Wearing gowns and gloves when caring for a MRSA colonized or infected patient is an essential component of preventing transmission and is recommended by HICPAC. In fact, patients who are colonized or infected with MRSA but do not have contact precautions in place are 16 times as likely to transmit MRSA to other patients and healthcare workers (Clancy et al, 2006). In addition to gowns and gloves, placing patients in a private room will make it less likely that a HCW will move from a colonized or infected patient to an uncolonized patient before performing hand hygiene. Cohorting patients with MRSA is an acceptable practice when private rooms are not available. Failure to follow contact precautions could potentially undo the benefit of an active surveillance program (Institute for Healthcare Improvement, 2008).

The question of when to implement and discontinue contact precautions remains an unresolved issue. There are two options when implementing contact precautions- they can be
preemptive-implemented upon admission and continued until the culture comes back negative for MRSA, or they can be implemented only after receiving a positive culture result, which could take up to one to two days depending on the test. In a study done at the Brigham and Women's Hospital in Boston, Massachusetts, Huang et al. (2006) found that even with a two-day delay for cultures to return, their surveillance had a significant impact on MRSA transmission and infection. It is often logistically challenging for healthcare institutions to implement preemptive precautions due to bed management issues, so if they are unable to do this utilizing an ASC with a two-hour turnaround time would decrease the exposure time if the culture is positive.

Currently, there are no official recommendations from HICPAC and experts tend to disagree on when to discontinue precautions because it is possible for patients to remain colonized with MRSA for months to years. However, in the context of an outbreak, it is recommended that contact precautions be used indefinitely for all infected and colonized patients (Center for Disease Control and Prevention, 2006). The IHI has made recommendations for three negative cultures on separate days before discontinuing precautions in addition to being off antibiotic therapy (Institute for Healthcare Improvement, 2008).

Patients who are on contact precautions deserve the same level of care as any other patient in the hospital. However, some studies have shown a 50% reduction in contact between patients on precautions and HCWs, including a reduction in physician examinations (Diekema & Edmond, 2007). Patients in isolation can also have increased feelings of isolation and loss of control, which can ultimately result in anxiety and depression. Involving the patient in decisions about their treatment plans and providing extra social support through social work, psychology, and physical and occupational therapy may reduce this effect (Diekema & Edmond, 2007).

Device Bundles
Invasive devices such as central venous catheters (CVCs) and ventilators are historically known to predispose already critically ill patients to infections. Furthermore, patients who are colonized with MRSA are at even more risk of developing a bloodstream infection or pneumonia. The IHI has developed information about “bundles” which are groupings of evidenced-based best practices that individually improve care, but when applied together result in even more improvement (Institute for Healthcare Improvement, 2008). Through the implementation of these “bundles” the incidence of hospital-acquired infections associated with invasive devices can significantly be reduced as well as the associated costs and prolonged hospitalizations. Many hospitals that are currently using these Central Line and Ventilator Bundles have seen a significant reduction in central line bloodstream infections and ventilator-associated pneumonias (Griffin, 2007).

Central venous catheters are being used more and more in the hospital setting. According to the IHI (n.d.) 48% of ICU patients have CVCs resulting in approximately 5.3 central line infections per 1,000 catheter days and an 18% mortality rate. This amounts to about 14,000 deaths per year as a result of central line infections. The central line bundle has five key components: 1) hand hygiene 2) maximal barrier precautions 3) chlorhexidine skin antisepsis 4) optimal catheter site selection, with subclavian vein being the preferred site for non-tunneled catheters 5) daily review of line necessity, with prompt removal of unnecessary lines (Institute for Healthcare Improvement, n.d.).

As continually discussed throughout this paper, hand hygiene is a major component to decreasing central line infections. When caring for central lines, practitioners should be sure to perform hand hygiene before and after palpating the insertion site and inserting or replacing the catheter as well as performing dressing changes (Institute for Healthcare Improvement, n.d.).
In regards to maximal barrier precautions, the person inserting the catheter as well as anyone assisting should be wearing a cap, mask, sterile gown, and gloves. In addition, the patient should be covered with a sterile drape from head to toe, with only a small opening for the insertion site.

Chlorhexidine skin antisepsis has been proven to be more effective in reducing central line bloodstream infections than povidone-iodine solutions. In fact, in 2002 a meta-analysis reviewed eight studies and found a 49% reduction rate in catheter-related bloodstream infections whose skin was prepped with chlorhexidine (Milstone, Passaretti, & Perl, 2008).

The site of the catheter placement is a risk factor in relation to catheter-associated infections. Studies have shown a decrease in infection rates with the use of the subclavian site over the femoral or jugular. When not contraindicated, the subclavian site is the preferred site for central line insertion over any other (Institute for Healthcare Improvement, n.d.).

Lastly, the longer a central line is in, the greater risk of developing an infection as a result of that line. Therefore, a daily review of its need should be done to prevent delays in removing the line when it is no longer indicated, therefore decreasing the risk of developing a central line infection. In addition, CDC guidelines (2002) do not support the arbitrary replacement of central lines, as it has not proven to reduce central line infections.

Ventilator-associated pneumonia (VAP) is the leading cause of death among patients with hospital-acquired infections, even surpassing central line infections in death rates. In addition to increased mortality, VAP has a huge financial impact on healthcare institutions as a result of an increase in patient stay. Similarly to the central line bundle, the ventilator bundle consists of four evidence-based components that have proven to reduce the incidence of VAP: 1) elevation of the head of the bed between 30 and 45 degrees 2) daily “sedation vacation” and a
daily assessment of a patient’s readiness to extubate 3) Peptic Ulcer Disease (PUD) prophylaxis 4) deep venous thrombosis (DVT) prophylaxis (Institute for Healthcare Improvement, n.d.).

The aspiration of infected oral and gastric secretions plays a large role in the development of VAP. Many studies have found that placing the head of bed of ventilated patients at a 45-degree angle can significantly reduce the incidence of VAP (Keeley, 2007). In addition to reducing the risk of aspiration, elevating the head of bed 30 to 45 degrees improves ventilation, which can also decrease the risk of VAP. Daily “sedation vacations” and assessing a patient’s readiness to extubate play a significant role in the reduction of VAP. Decreasing sedation not only reduces the risk of VAP, but it also helps the patient to be more awake and alert and able to participate in the extubation process.

Ventilated patients are at increased risk of aspiration and aspirating acidic gastric contents can result in pneumonia, which can be prevented by instituting PUD prophylaxis. The Surviving Sepsis Campaign Guidelines has stated that H2 receptor inhibitors are more effective in fighting Peptic Ulcer Disease than sucralfate, and are the treatment of choice (Dellinger et al, 2004).

Currently, it is important to point out that some practices included in the prevention bundles, such as instituting DVT prophylaxis and head of bed elevation, have not been proven in the literature to improve patient outcomes. A systematic review of the evidence that supports bundle practices, published by the Stanford-UCSF Evidence-based Practice Center in 2001, evaluated a number of such infection control practices. According to this review, the practice of the use of maximal sterile barriers during central line insertions was assessed to have the strongest evidence base, while further research is needed for many other infection control
Reducing MRSA recommendations (Yokoe & Classen, 2008). However, the IHI believes that including these practices in the bundles can only positively affect the outcome of patients.

*To Mandate or Not Mandate-- A Legislative Debate*

The mandate of public reporting and active surveillance cultures (ASCs) for MRSA has been said to be incentive for healthcare institutions to provide better care and provide consumers with the necessary knowledge to choose safe and quality healthcare. Furthermore, the concern about the rising incidence of MRSA in healthcare institutions has prompted lawmakers in many states to push hospitals to institute ASCs to facilitate early diagnosis and prevent further transmission. Currently, three states- Illinois, New Jersey, and Pennsylvania- have passed laws mandating hospitals perform ASCs upon admission and similar laws have been proposed in seven other states and the District of Columbia. This has led to much debate amongst professional organizations such as APIC and SHEA and consumer groups such as the Consumers Union and the Committee to Reduce Infection Deaths, with the latter groups being the push for legislative mandates.

The Commonwealth of Massachusetts is conducting a two-part point prevalence study in 2008 to capture a snapshot of the current MRSA situation in its ICUs. During two designated weeks set by the state, ICUs across the Commonwealth are to perform ASCs on every patient in the ICU at that time. Infection Prevention Coordinators across the Commonwealth must then relay their facility’s results to the Department of Public Health. With these results the Commonwealth will be able to set standards and guidelines for hospitals to reduce the prevalence of MRSA.

According to SHEA, the high rate of morbidity and mortality associated with MRSA infections in the hospital may not be attributed to increased virulence of resistant strains, but to
Reducing MRSA delays in the appropriate antimicrobial therapy (Calfee et al., 2008). Early detection through ASCs enables healthcare providers to provide the appropriate antimicrobial therapy and institute contact precautions and isolation to prevent further transmission.

While APIC and SHEA believe ASCs are a vital component to reducing MRSA transmission, at this time, they do not support legislation to mandate them. Both organizations are concerned that states will not allocate additional resources to hospitals to support the added responsibilities from implementing an ASC program. Without additional support, infection prevention professionals and healthcare epidemiologists will be obligated to commit themselves to this process, which could lead to worsening rates of other healthcare-associated infections (Weber et al., 2007). Additionally, it would remove the needed expertise of infection prevention professionals from the risk assessment and resource allocation processes needed to meet the epidemiological challenges of each individual healthcare institution (Weber et al., 2007).

Logistically, hospitals could potentially find themselves with a patient placement dilemma since most facilities are not equipped with all single patient rooms. Hospitals will experience an increase in MRSA patients as a result of ASCs, which will require proper isolation, usually in a private room. Although cohorting patients is an alternative, this too can pose problems logistically by delaying hospital admissions, transfers within the facility, and discharges to outside facilities such as rehabilitation or long term care.

Both organizations support the use of ASCs but believe that mandating them and using them as the only intervention to control the transmission of MRSA is unlikely to be effective. It needs to be a decision made by each individual facility with a multifaceted/multidisciplinary approach that includes timely notification from the laboratory once patients are identified with MRSA, placing the patient on contact precautions and in isolation, and proper hand hygiene and
disinfection of equipment and the environment. The “one-size fits all” approach of legislation does not provide the flexibility needed to respond to epidemiological trends or changes in the understanding of transmission.

Many states are also mandating hospitals report monthly statistics related to hospital-acquired infections to the CDC through the National Healthcare Safety Network (NHSN). The National Healthcare Safety Network (NHSN) is a secure, internet-based surveillance system that integrates patient and healthcare personnel safety surveillance systems managed by the Division of Healthcare Quality Promotion (DHQP) at CDC. This reporting will allow the states to estimate the magnitude of adverse events among patients and HCWs and recognize trends. Although this system provides important data on the magnitude of adverse events among patients and HCWs and trends, it requires Infection Preventionists to manually import data into the system, which takes up valuable time that could be used to educate staff and implement new strategies to reduce infections.

**Recommendations**

1. Form a multidisciplinary Hand Hygiene Task Force comprised of staff from nursing, dietary, and environmental services to conduct surveillance on patient care units and determine current compliance rates. Make hand hygiene a positive part of the culture. Conduct educational sessions with staff to demonstrate correct technique and emphasize the importance of hand hygiene.

2. Show the CDC’s Hand Hygiene Saves Lives video to patients during their hospitalization.
3. Educate environmental services and nursing staff on proper decontamination of the environment and equipment. Utilize a checklist to eliminate performance by memory. Perform cleaning with an EPA approved disinfectant daily and upon patient discharge. Replace bedside curtains upon discharge.

4. Increase staff access to waterless alcohol-based hand hygiene products.

5. Implement contact precautions and isolation for all patients with a known history of MRSA for the duration of their hospitalization.

6. Initiate the central line and ventilator bundles into patient care.

7. Conduct ASCs upon admission on all ICU patients and patients from long term care facilities, rehabilitation facilities, and chronic care hospitals. Utilize a medium with a 24-hour turnaround time for rapid diagnosis.

8. Do not decolonize patients.

Conclusion

The emergence of MRSA in healthcare has occurred rapidly and continues to be on the rise. The reduction of transmission within a healthcare institution will not occur with a single intervention, rather a combination of all interventions mentioned in this paper. Infection Prevention leaders must decide how and to what degree to implement these strategies in their facilities because each healthcare institution is unique and has different financial and educational needs. Often, healthcare institutions cannot implement all five components recommended in this paper at the same time due to financial constraints, but research has shown that each component plays a significant role in reducing infections and should be implemented at some point. Therefore, a good leader will do a risk assessment of the facility to determine its needs, and
convene a group with representatives from Environmental Services, Medical Staff, Staff Nursing, Nursing Administration, Hospital Administration, and Quality. It is also important in every aspect of implementation to recruit a Physician Champion - a medical leader that will actively support the mission of the group. Then, based on evidence-based practice and research, this group will work to implement the interventions necessary to reduce the incidence of MRSA, whether it's done one by one or simultaneously.

As a result of Medicare’s decision to not reimburse facilities for many healthcare-acquired infections, infection prevention has become a top priority for many hospital administrators. Finally they are listening, and in many facilities are allocating the necessary resources to reduce infections. Infection Preventionists must take this opportunity to determine the priorities for their institutions and implement the necessary interventions to reduce MRSA infections.
Appendix A

ENVIRONMENTAL SERVICES CHECK LIST AUDIT
DAILY CLEANING OF PATIENT ROOM

Steps

1. **High Dusting Performed**
   
   a. Use high duster/mop head: wipe ledges (shoulder high and above)
      
      | Yes | No |
      |-----|----|
      |     |    |

   b. Vents
      
      | Yes | No |
      |-----|----|
      |     |    |

   c. Lights
      *Do not high dust OVER the patient*

      | Yes | No |
      |-----|----|
      |     |    |

   d. Dust TV: rotate and dust screen and wires
      *Remove dust over cart trash bag gently*

      | Yes | No |
      |-----|----|
      |     |    |

2. **Damp Dust**
   Cloth (rag) and spray bottle of disinfectant—damp wipe:

   a. Ledges (shoulder high)
      
      | Yes | No |
      |-----|----|
      |     |    |

   b. Door handles
      
      | Yes | No |
      |-----|----|
      |     |    |

3. **Bedside Table – Disinfect Surface**
   
<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. **Glass Surfaces**
   a. Wall spots
      
      | Yes | No |
      |-----|----|
      | N/A |    |

5. **Bathroom (Toilet Bowl Mop) All Surfaces**
   a. Weekly toilet chemical allow to stay
      
      | Yes | No |
      |-----|----|
      |     |    |

   b. Ledges in bathroom
      
      | Yes | No |
      |-----|----|
      |     |    |

   c. Door handles
      
      | Yes | No |
      |-----|----|
      |     |    |

   d. Sink
      
      | Yes | No |
      |-----|----|
      |     |    |
e. Shower stall
   Yes___   No___

f. Finish toilet
   Yes___   No___

g. Damp wipe toilet seat
   Yes___   No___

h. Clean mirrors/chrome
   Yes___   No___

6. Empty Waste Basket

   Yes___   No___
a. Disinfect if wet
   Yes___   No___
b. Bags – close
   Yes___   No___

7. Isolation (Red Bag Waste) Empty

   Yes___   No___
a. Carry to soiled utility room
   Yes___   No___
b. Carry to Large Red Hazard trash
   Yes___   No___

8. Needle Boxes

   Yes___   No___
a. Check level of Sharps
   Yes___   No___
b. Replace if ½ to ¾ full
   N/A___
c. To soiled Utility Room after securely closing
   N/A___

9. Floor Disinfection – Sign on Door

   Yes___   No___
a. Wet mop head in disinfectant
   Yes___   No___
b. Mop (farthest from door) ½ way room
   Yes___   No___
c. Bathroom shower floor
   Yes___   No___
d. Bathroom floor
   Yes___   No___
e. Flip mop head – do remainder of room
   Yes___   No___
References


Reducing MRSA


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Resistant Strains of *Staphylococcus aureus* and *Enterococcus*. *Infection Control and Hospital Epidemiology*, 24(5), 362-386.


