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Getting Started Kit:

Reduce Methicillin-Resistant *Staphylococcus aureus* (MRSA) Infection

How-to Guide

A national initiative led by IHI, the 5 Million Lives Campaign aims to dramatically improve the quality of American health care by protecting patients from five million incidents of medical harm between December 2006 and December 2008. The How-to Guides associated with this Campaign are designed to share best practice knowledge on areas of focus for participating organizations. For more information and materials, go to www.ihi.org/IHI/Programs/Campaign.

This How-to Guide is dedicated to the memory of David R. Calkins, MD, MPP (May 27, 1948 – April 7, 2006) -- physician, teacher, colleague, and friend -- who was instrumental in developing the Campaign's science base. David was devoted to securing the clinical underpinnings of this work, and embodied the Campaign's spirit of optimism and shared learning. His tireless commitment and invaluable contributions will be a lifelong inspiration to us all.

The Institute for Healthcare Improvement (IHI) is a not-for-profit organization leading the improvement of health care throughout the world. IHI helps accelerate change by cultivating promising concepts for improving patient care and turning those ideas into action. Thousands of health care providers participate in IHI's groundbreaking work.

Campaign Donors

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BlueCross BlueShield Association
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Cardinal Health Foundation

This initiative builds on work begun in the 100,000 Lives Campaign, supported by Blue Cross Blue Shield of Massachusetts, the Cardinal Health Foundation, the Rx Foundation, the Gordon and Betty Moore Foundation, The Colorado Trust, the Blue Shield of California Foundation, the Robert Wood Johnson Foundation, Baxter International, Inc., The Leeds Family, and the David Calkins Memorial Fund.

Scientific Contributors

Several organizations have generously offered advice and have made scientific contributions to this document. They include:

Association for Professionals in Infection Control and Epidemiology
Centers for Disease Control and Prevention
Society for Healthcare Epidemiology of America
Society of Critical Care Medicine

Goal:

Significantly reduce methicillin-resistant *Staphylococcus aureus* (MRSA) infection by reliably implementing the five components of care recommended in this Guide.

The Case for Reducing Methicillin-Resistant *S. aureus* Infection

Health care-associated infections remain a major cause of morbidity, mortality, and excess health care cost despite concerted infection control efforts over nearly a half-century. Recently, treatment of these infections has become more complex due to an alarming rise in antibiotic resistance. Infections caused by methicillin-resistant *S. aureus* (MRSA) are particularly problematic: their incidence has increased inexorably over the past decade, and, compared to methicillin-susceptible staphylococcal infections, they are more lethal. According to the Centers for Disease Control and Prevention (CDC), MRSA now accounts for greater than 50% of hospital-acquired *S. aureus* infections and 63% of *S. aureus* infections acquired in intensive care units (ICUs) in the United States in 2004. The very rapid emergence of community-acquired MRSA (CA-MRSA) in patients with no prior exposure to health care institutions or other risk factors poses a serious new challenge to the nation's hospitals. Patients with CA-MRSA are presenting to hospital emergency departments and outpatient clinics in increasing numbers, and in-hospital spread has been documented following their admission.

The human and financial impact of MRSA is high:

- Over 126,000 hospitalized persons are infected by MRSA annually.
    - 3.95 MRSA infections occur per 1,000 hospital discharges.
- Over 5,000 patients die as a result of these infections.*
- Over $2.5 billion excess health care costs are attributable to MRSA infections.

On average, for each patient with MRSA infection this means:

- 9.1 days excess length of stay (LOS)*
- Over $20,000 in excess cost per case (range $7,000 – $32,000)
- 4% in excess in-hospital mortality*

*These data are based on a multivariate analysis matching for potential confounders, and apply to *all* staphylococcal infections, not just hospital-acquired infections or MRSA infections. However, sub-analyses by the authors suggest that the mortality rate for hospital-acquired infections is similar, and other studies document higher mortality for MRSA than methicillin-susceptible *Staphylococcus aureus* (MSSA).

Infection control efforts directed at MRSA may also have an impact against other antibiotic-resistant pathogens, such as vancomycin-resistant *Enterococci* (VRE), which are spread principally from person to person on the hands of health care providers and inanimate objects. The intensive antibiotic therapy used to treat MRSA, VRE, and other antibiotic-resistant pathogens predisposes to *Clostridium difficile* (*C. difficile*) infection. *C. difficile* itself can then be transmitted from patient to patient via the hands of health care staff and the environment. Not surprisingly, the incidence of health care-associated *C. difficile* has been increasing, and a new, more virulent strain that produces high levels of toxin is circulating internationally.

Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006. Healthcare Infection Control Practices Advisory Committee (HICPAC). http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf

Grundmann H, Aires-de-Sousa M, Boyce J, Tiemersma E. Emergence and resurgence of methicillin-resistant *Staphyloccocus aureus* as a public-health threat. *Lancet*. 2006; 368:874-885.

Klevens RM, Edwards JR, Tenover FC, McDonald LC, Horan T, Gaynes R, and National Nosocomial Infections Surveillance System. Changes in the epidemiology of methicillin-resistant *Staphylococcus aureus* in intensive care units in US hospitals, 1992–2003. *Clin Infect Dis*. 2006; 42:389-391.

Kuehnert MJ, Hill HA, Kupronis BA, Tokars JI, Solomon SL, Jernigan DB. Methicillin-resistant *Staphylococcus aureus*-related hospitalizations, United States. *Emerg Infect Dis*. 2005;11:868–872.

Noskin GA, Rubin RJ, Schentag JJ, et al. The burden of *Staphylococcus aureus* infections on hospitals in the United States. *Arch Intern Med*. 2005;165:1756-1761.

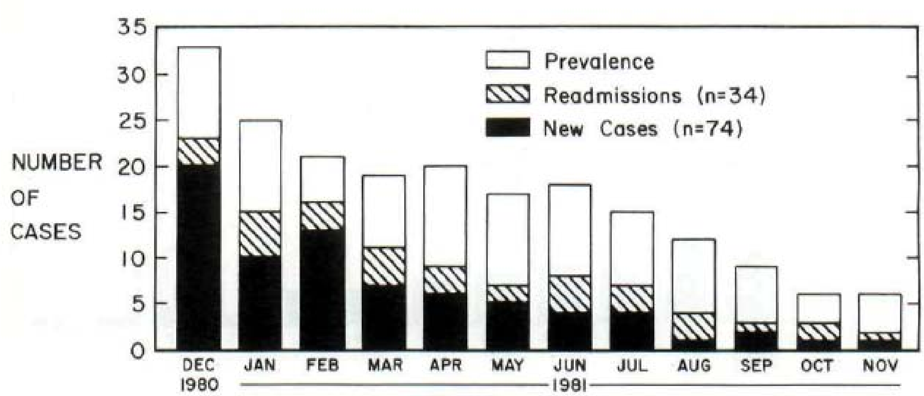
Rubin RJ, Harrington CA, Poon A, Dietrich K, Greene JA, Moiduddin A. The economic impact of *Staphylococcus aureus* infection in New York City hospitals. *Emerg Infect Dis*. 1999;5:9-17.

What Is Possible?

> "If prevention is primary, action is imperative."
> – William Jarvis
> *Infect Control Hosp Epidemiol*. 2004;25(5):369-372.

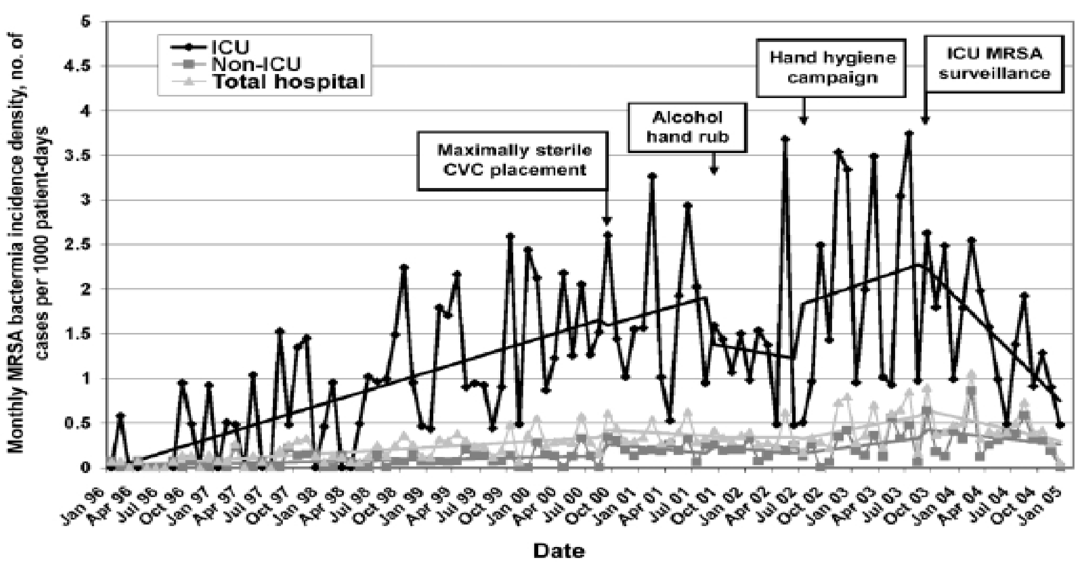
A number of US hospitals have taken aggressive action to reduce hospital-acquired MRSA colonization and infection, and some have reported impressive results. Successful programs have made MRSA control a strategic imperative and generally have implemented a combination of interventions rather than relying on a single approach.

In the early 1980s, the University of Virginia Medical Center implemented control measures in response to increasing rates of MRSA. Interventions included daily monitoring of clinical cultures for recovery of MRSA, active surveillance of high-risk patients for MRSA colonization, and contact precautions for all colonized or infected patients. The infection control team reported a "gradual but progressive decline" in MRSA, as noted in their published graph:



Thompson RL, Cabezudo I, Wenzel RP. Epidemiology of nosocomial infections caused by methicillin-resistant *Staphylococcus aureus*. *Ann Intern Med*. 1982;97(3):309-317.

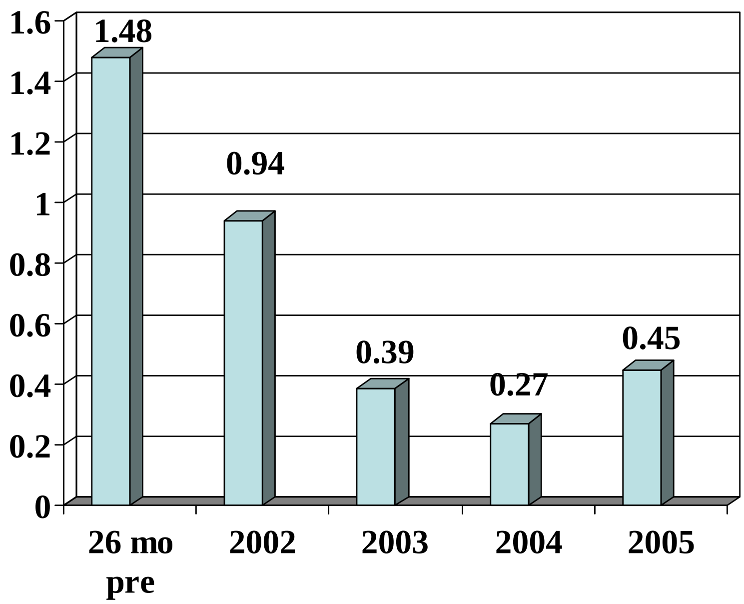
At the Brigham and Women's Hospital in Boston, Huang et al. focused MRSA improvement efforts on ICU patients over an eight-year period. Interventions were implemented in stages, including barrier precautions for placement of central venous catheters, hospital-wide promotion of alcohol hand rubs, and a hand hygiene campaign. These measures had little impact on the rate of MRSA bloodstream infection. Sustained improvement was not achieved, although hand hygiene compliance was suboptimal. Finally, active surveillance cultures were introduced in all of the hospital's ICUs on admission and weekly thereafter, with contact precautions for all MRSA-positive patients. Interrupted time-series analysis revealed that a significant reduction in MRSA bloodstream infection occurred only after introduction of active surveillance. Overall, the rate of MRSA bloodstream infection decreased 75% in the ICUs. Even though control measures were focused on the ICUs, there was a 40% reduction in non-ICUs, in part due to a decrease in MRSA infections in readmitted patients who had acquired MRSA in the ICU on previous hospitalizations.



Huang SS, Yokoe DS, Rego VH, et al. Impact of MRSA surveillance on bacteremia. *Clin Infect Dis*. 2006:43(8);971-978.

Organizations in the Pittsburgh region have collaborated in efforts to control MRSA, including the VA Pittsburgh Health System (VAPHS) and the University of Pittsburgh Medical Center Presbyterian (UPMC-P). At VAPHS, a "bundle" of interventions was implemented, including standard precautions, hand hygiene, active surveillance cultures, contact precautions, and an emphasis on culture change using briefings on patient care units, leadership involvement, and other strategies. There was a 70% decrease in MRSA infection on one patient care unit:

VAPHS 4-West Hospital-Acquired MRSA Infection Rate
(per 1,000 days of care)



Source: "Eliminating Hospital-Acquired Infections" presentation slides from Jon Lloyd, MD, FACS, from VHA's Best Practice Symposium, September 18, 2006. Downloaded November 26, 2006, from: https://www.vha.com/portal/server.pt/gateway/PTARGS_0_2_4708_271_0_43/http%3B/remote.vha.com/public/productsservices/clinical/docs/20718_6.Lloyd_-_Staff_vs_Staph_-_MRSA_1.ppt

A similar approach is being tested in a small VA Collaborative, with the eventual goal of system-wide spread.

At UPMC-P, initial efforts began in the medical ICU with active surveillance for all patients on admission and weekly thereafter on a standard day of the week, plus contact precautions for all positive patients. The microbiology laboratory provided immediate electronic notification of positive results. The rate of hospital-acquired

MRSA infections fell 90% in the medical ICU and 55% hospital-wide. This aggressive approach to control has been spread across all ICUs in the UPMC system.

> Source: "Strategies for Preventing Nosocomial Transmission of Methicillin-Resistant *Staphylococcus aureus* (MRSA)" presentation slides from Carlene Muto, MD, MS, at 2006 Patient Safety Symposium. Downloaded November 26, 2006, from: http://www.haponline.org/downloads/Strategies_For_Preventing_Nosocomial_Transmission_of_MRSA_Muto_Mar2006.pdf

General Considerations for Reducing MRSA Infection

Focused, committed hospital leadership is a prerequisite to achieving breakthrough control of an intractable problem such as MRSA. Leadership commitment has the following major elements:

- Acknowledgment that the MRSA problem is serious, causes needless morbidity and mortality, and is associated with real costs that go to the hospital's bottom line
- Intolerance of the status quo, and a sense that major reductions in the rate of MRSA infection—even "getting to zero"—is possible
- Empowerment of front-line multidisciplinary teams to get the job done, including provision of necessary supplies, personnel, and infection control, microbiological, and environmental services resources
- Accountability for reliable performance of basic infection control practices such as hand hygiene, once appropriate systems of care and supplies are in place
- Engagement of clinical staff
- Regular review of data and prompt removal of barriers to success

Initiation of a robust MRSA control program almost certainly will require up-front allocation of additional resources. This fundamental principle was reinforced by the recently published Hospital Infection Control Practices Advisory Committee (HICPAC) Guidelines, which provide guidance on required resources for initial efforts to reduce infections from resistant organisms. The "business case" for reducing MRSA seems obvious, and is being verified in an increasing number of publications. Unlike most health care interventions, MRSA control may not only be cost-*beneficial*, but actually cost-*saving*, with initial investment more than counterbalanced by savings in antibiotics and other treatments and diagnostic tests required for patients with suspected or established infection, precautions supplies, and length of stay (especially in the ICU)—not to mention the costs of bad publicity and potential litigation.

Studies conducted during MRSA outbreaks, as well as in settings where MRSA has been endemic, have found that the costs of screening cultures and precautions measures are far less than the costs of caring for patients with MRSA infections. For example, one study conducted in a setting where MRSA was endemic estimated that screening high-risk patients on admission and placing them on precautions would prevent from between 8 and 41 nosocomial MRSA infections and save the hospital from $20,000 to $462,000. A recent study found that a program that included screening ICU patients and placing those positive for MRSA on precautions, when combined with other control interventions, cost on average $3,475 per month, but averted $19,700 per month in excess hospital costs by reducing the number of MRSA infections.

> Karchmer TB, Durbin LJ, Simonton BM, Farr BM. Cost-effectiveness of active surveillance cultures and contact/droplet precautions for control of methicillin-resistant *Staphylococcus aureus*. *J Hosp Infect*. 2002;51(2):126-132.
>
> Jernigan JA, Clemence MA, Stott GA, Titus MG, Alexander CH, Palumbo CM, Farr BM. Control of methicillin-resistant *Staphylococcus aureus* at a university hospital: One decade later. *Infect Control Hosp Epidemiol*. 1995;16:686-696.

It is imperative to involve a multidisciplinary team in any improvement process focused on infection reduction. Successful teams set clear aims for their work, establish baseline measurements of performance, regularly measure and study the results of their work, and test various process and systems changes over a variety of conditions in order to find the ones that lead to improvement in their particular setting. In the case of MRSA control efforts, active stakeholders (in addition to physicians and nurses) include personnel from infection control and infectious diseases, the microbiology laboratory, environmental services, physical therapy, respiratory therapy, patients, and others depending on the nature of care being provided. The improvement effort will be enriched by including a patient on the team.

Reducing MRSA Infection: Five Components of Care

A rational strategy for reducing colonization and infection due to MRSA begins with an understanding of how patients acquire this pathogen in the hospital. Of course, some patients come into the hospital already colonized with MRSA. They may have acquired the infection in the community (through contact with individuals colonized with either CA-MRSA or health care-associated MRSA), or from previous contact with the health care system. If undetected, or if infection control practices are suboptimal, such colonized patients provide a "reservoir" of MRSA that can be transmitted to other patients. They join patients who have been colonized during their hospital stay, adding to the "colonization burden" of the ward and hospital. The size of this "reservoir" of colonized patients is a major determinant of the risk of spread to other patients who have not yet been colonized.

By far the principal mode of spread is via the contaminated hands of caregivers. Patients may be heavily colonized with MRSA, and colonized patients often contaminate their immediate environment. Even casual contact with the patient or the patient's immediate environment can contaminate the caregiver's hands. Gloves provide some protection, but hands frequently are contaminated in the process of removing gloves. Therefore, hand hygiene is of pivotal importance in preventing the transmission of MRSA from patient to patient, even if the patient is on contact precautions and gloves are worn.

MRSA, like other so-called "Gram-positive" bacteria that have cell walls, survive rather well in the environment, so personal equipment such as stethoscopes and personal digital assistants (PDAs), if inadequately disinfected, can become an inadvertent source for transmission of MRSA to other patients. The environment of the room itself, if heavily contaminated by a colonized patient and not thoroughly cleaned, can be a source of spread to new patients, although this mode of spread is less important than transmission via contaminated hands.

Airborne transmission of staphylococci can occur, but most experts believe that this is a relatively rare event, and that masks and special air handling are not required routinely.

Finally, caregivers may carry staphylococci, including MRSA, in their nose and on their skin. Rarely, colonized staff members (especially those with chronic skin conditions such as eczema) become staphylococcal “shedders” and can cause outbreaks of staphylococcal disease in the patients under their care. Although it is important to be vigilant for such “common source” outbreaks, authorities in the US do not recommend routinely culturing personnel to determine if they are carriers since outbreaks due to such carriers are uncommon. Epidemiological and microbiological assistance should be sought before embarking on culturing of personnel.

Patients colonized with MRSA are at substantially greater risk of developing a clinical infection due to this pathogen. Patients with invasive devices, such as central venous catheters, and patients on mechanical ventilation are at special risk, and fastidious application of the Central Line Bundle and Ventilator Bundle is necessary to mitigate this risk. Patients who undergo surgery while colonized with MRSA also are at risk, and should be considered for decolonization and adjustment of their antibiotic prophylaxis regimen.

The magnitude of the risk of infection following colonization with MRSA appears to be much higher than first recognized. Huang et al. found that nearly one-third of patients newly colonized with MRSA in an ICU at a tertiary care teaching hospital developed invasive disease within 18 months; approximately 50% of the infections developed after the patient had been discharged from the hospital, often requiring readmission.

Although MRSA is now widespread in many hospitals in the US, the prevalence of colonization and the risk of serious infection tend to be highest in ICUs.

Moreover, outbreaks of MRSA infection occur most frequently in this setting. Although some authorities recommend launching control efforts hospital-wide from the outset, the Campaign recommends that most hospitals begin their work in one or more ICUs, or in another hospital ward or patient population documented to have a substantial incidence of MRSA colonization and infection.

Initial control efforts can be greatly facilitated by choosing an ICU or ward where there is a vigorous clinical champion and opinion leader. This strategy allows a multidisciplinary team to focus its efforts in a well-defined geographical area and patient population, perform rapid-cycle tests of change, and act on real-time data. Reliable performance of all aspects of the MRSA infection control package (described below) almost certainly is easier to achieve initially in a relatively contained setting with receptive clinical leaders, and early success will demonstrate to institutional leadership that dramatic success is possible and the investment in needed resources can pay off. Some experts contend that if the rest of the hospital is left untended, patients colonized in other wards will be admitted to the ICU and serve as a source for further spread. However, this threat highlights the need for reliable practice, starting with the transfer of the patient. It is encouraging that Huang and her co-workers demonstrated hospital-wide improvement in MRSA infection by focusing initially only on the ICUs.

Prevention of transmission almost surely requires a more multifaceted strategy. There are very strong advocates for specific control strategies, especially active surveillance cultures for prompt detection of patients colonized with MRSA. However, most hospitals that have reduced MRSA colonization and infection, or responded successfully to outbreaks, have attacked MRSA on a broad front, often using active surveillance in combination with other preventative measures. Mathematical models provide useful complementary insights when clinical and epidemiological data remain sparse. For example, Bootsma et al. used a mathematical model to analyze the projected impact of various interventions and concluded that an approach that included screening with other prevention measures (especially hand hygiene) should work best. On the other hand, screening personnel for MRSA and decolonizing carriers had little impact. A National Institutes of Health-sponsored, cluster randomized control trial of active surveillance for preventing transmission of MRSA and VRE has just been completed and should provide important additional data in the near future.

For the Campaign, we recommend that organizations start with five components of care:

1. Hand hygiene
2. Decontamination of the environment and equipment
3. Active surveillance cultures
4. Contact precautions for infected and colonized patients
5. Device bundles (Central Line Bundle and Ventilator Bundle)

Abramson MA, Sexton DJ. Nosocomial methicillin-resistant and methicillin-susceptible *Staphylococcus aureus* primary bacteremia: At what costs? *Infect Control Hosp Epidemiol* 1999;20:408-411.

Bootsma MC, Diekmann O, Bonten MJ. Controlling methicillin-resistant *Staphylococcus aureus*: Quantifying the effects of interventions and rapid diagnostic testing. *Proc Natl Acad Sci USA*. 2006;103(14):5620-5625.

Grundmann H, Aires-de-Sousa M, Boyce J, Tiemersma E. Emergence and resurgence of methicillin-resistant *Staphyloccocus aureus* as a public-health threat. *Lancet*. 2006; 368:874-885.

Muto CA, Jernigan JA, Ostrowsky BE, et al. SHEA Guideline for Preventing Nosocomial Transmission of Multidrug-Resistant Strains of *Staphylococcus aureus* and *Enterococcus*. *Infection Control and Hospital Epidemiology*. 2003;24(5);362-386.

Huang SS, Yokoe DS, Rego VH, et al. Impact of MRSA surveillance on bacteremia. *Clin Infect Dis*. 2006:43(8);971-978.

Reducing MRSA Infection: Five Components of Care (continued)

1. Hand Hygiene

MRSA can be recovered from the hands of health care workers (HCWs) in settings where MRSA is endemic or epidemic. Transient contamination of HCWs' hands occurs while caring for colonized or infected patients, and is generally believed to be the most frequent mode by which MRSA is transmitted from one patient to another. Although the nose is the principal site of MRSA colonization, hospitalized patients often have high concentrations of MRSA on their skin and other body sites such as the throat, rectum, and ostomies, even if they are not overtly infected. Patients also tend to contaminate their immediate environment, and MRSA can survive for hours or even days on inanimate objects such as table tops, bed rails, and computer keyboards. HCWs can contaminate their hands even while performing "low-risk" patient care activities such as taking a pulse or blood pressure, lifting a patient up in bed, or handling items in the patient's vicinity.

Although wearing gloves when having direct contact with patients can reduce the risk of hand contamination, hands often are contaminated during glove removal. Therefore, cleaning hands before and after having contact with MRSA patients or their immediate environment is of paramount importance in reducing transmission of MRSA in health care facilities. Unfortunately, compliance with hand hygiene remains abysmal in many hospitals—often well under 50%. It is doubtful whether such low rates of compliance are compatible with efforts to dramatically reduce the rate of MRSA in health care.

Pittet D, Mourouga P, Perneger TV. Compliance with handwashing in a teaching hospital. Infection Control Program. *Ann Intern Med*. 1999;130(2):126-130.

Lankford MG, Zembower TR, Trick WE, Hacek DM, Noskin GA, Peterson LR. Influence of role models and hospital design on hand hygiene of healthcare workers. *Emerg Infect Dis*. 2003;9(2):217-223.

When hands are heavily contaminated or visibly soiled, handwashing with soap and water is critical. Sinks must be conveniently located near the point of care. Sinks with automatic controls or elbow faucet handles are preferred. If the water controls are hand-operated, personnel should turn them off with a clean paper towel. Alcohol hand rubs are the preferred method for general hand hygiene when hands are not heavily contaminated or visibly soiled. Alcohol hand rubs rapidly kill bacteria, including MRSA (but not *Clostridium difficile* spores), take far less time than handwashing, and are relatively gentle on the hands. Alcohol rub dispensers should be conveniently located directly at the point of care, as well as at numerous locations in the staff's traffic pattern, to maximize adherence (Pittet et al., 2000).

The impact of a vigorous hand hygiene campaign was assessed in a widely-cited study from a teaching hospital in Geneva, Switzerland. Overall compliance with hand hygiene during routine patient care was measured before and during implementation of the campaign (Dec 1994 - Dec 1997), which included posters on handwashing and installation of alcohol-based hand rub dispensers by the patient's bedside. Handwashing compliance increased from 48% in 1994 to 66% in 1997; consumption of alcohol-based rub solution increased concurrently. Nosocomial infection rates and MRSA transmission rates decreased significantly during this period (active surveillance was also in use during this time). The recent focus on hand hygiene compliance by the Joint Commission for Accreditation of Healthcare Organizations (National Patient Safety Goal 7A), and the acknowledged importance of hand hygiene in controlling the transmission of antibiotic-resistant pathogens, should catalyze even higher rates of performance.

Note: Providing "tip sheets" to patients and families may encourage them to remind staff to practice hand hygiene; a useful Patient Fact Sheet is available from the Agency for Healthcare Quality and Research.

A study of handwashing frequency in ICUs in the 1980s (before alcohol-based hand rubs were widely used in the US) established “proof of concept” that personnel are more likely to wash their hands when appropriate equipment and supplies are readily available; in this case, compliance was greater when more sinks were placed in patient care areas. Similarly, appropriate use of alcohol-based rubs is far more likely if dispensers are widely available near the point of care. Of course, dispensers must not be empty, should be operational, and should dispense the correct amount of rub.

> Pittet D, Hugonnet S, Harbarth S, et al. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. *Lancet.* 2000;356(9238):1307-1312.
>
> Bischoff WE, Reynolds TM, Sessler CN, Edmond MB, Wenzel RP. Handwashing compliance by health care workers. The impact of introducing an accessible, alcohol-based hand antiseptic. *Arch Intern Med*. 2000;160:1017-1021.
>
> Kaplan LM, McGuckin M. Increasing handwashing compliance with more accessible sinks. *Infection Control.* 1986;7(8):408-410.

» What changes can we make that will result in improvement?

In 2006, IHI prepared a How-to Guide on Hand Hygiene in collaboration with the Centers for Disease Control and Prevention (CDC), the Association for Professionals in Infection Control and Epidemiology (APIC), and the Society of Healthcare Epidemiology of America (SHEA). The Guide was endorsed by APIC and SHEA, and valuable input was provided by the World Health Organization's World Alliance for Patient Safety through the Global Patient Safety Challenge. The following four components of the hand hygiene intervention package are critical:

1. Clinical staff, including new hires and trainees, understand key elements of hand hygiene practice (demonstrate knowledge)
2. Clinical staff, including new hires and trainees, use appropriate technique when cleansing their hands (demonstrate competence)
3. Alcohol-based hand rub and gloves are available at the point of care (enable staff)

4. Hand hygiene is performed at the right time and in the right way and gloves are used appropriately as recommended by CDC's Standard Precautions (verify competency, monitor compliance, and provide feedback)

Refer to the Hand Hygiene Guide for a full description of this intervention.

Reducing MRSA Infection: Five Components of Care (continued)

2. Decontamination of the Environment and Equipment

MRSA survives well in the hospital environment. Personnel who come in contact with contaminated objects or surfaces may contaminate their hands. Patients who are placed in rooms previously occupied by a patient colonized with MRSA occasionally acquire this organism, either via the hands of personnel or through their own direct contact with persisting microorganisms in their immediate environment. Thorough, regularly scheduled cleaning and disinfection of the environment are essential. Accordingly, HICPAC recommendations include fastidious environmental cleaning and disinfection as a priority for all hospitals. It is important to include items that are “high touch” by patients, families, and staff.

Since the environmental services department is under-resourced in many hospitals, leadership must provide the resources and training required to ensure thorough environmental cleaning. It may be extremely useful to include members of the environmental services staff on the improvement team so that they have a clear stake in the results of the MRSA control effort. Education should be tailored to the language and cultural needs of the staff, and competency should be ensured by direct observation. An environmental cleaning and disinfection checklist may be useful. Environmental “tracers” can highlight surfaces that were skipped in the cleaning process. Some programs use selective environmental culturing for MRSA and other antibiotic-resistant organisms to demonstrate the viability and persistence of pathogens. More frequent cleaning may be needed in high-risk areas. Although standard, approved environmental disinfectants are adequate for MRSA and other antibiotic-resistant microorganisms, it is important to note that *C. difficile* spores are especially resistant to standard agents; there is increasing consensus that dilute bleach is superior for disinfecting the rooms of patients with *C. difficile* infection, whether or not they are co-colonized with MRSA.

Equipment that is transported from room to room can harbor MRSA and other organisms. This includes thermometers, blood pressure cuffs, pulse oximeters, IV pumps, and stethoscopes. Such items should be decontaminated routinely for all patients, just as practicing hand hygiene should be routine. Patients who are known to have MRSA should have dedicated equipment that is used solely for them during their stay and decontaminated after they are discharged; dedicated equipment for all patients in high-risk areas such as an ICU would be ideal. At the very least, stethoscopes should be disinfected with a disinfectant wipe (e.g., alcohol) when going from patient to patient.

Education for all staff, both environmental services and clinical, regarding the importance of thorough cleaning and decontamination and the use of appropriate cleaning procedures is essential. Evanston Northwestern Hospital in Illinois uses checklists to help personnel perform all aspects of cleaning and disinfection reliably, rather than relying on memory (see Appendix A for examples). SHEA Guidelines advocate education, checklists, and frequent, scheduled cleaning times, especially during outbreaks.

» What changes can we make that will result in improvement?

Hospital teams across the US have developed and tested process and systems changes that allowed them to improve performance on decontamination and cleaning. Some of these changes are:

- Complete a checklist for each cleaning, documenting that all areas were cleaned, including those that are "high touch."
- Educate staff on the importance of cleaning and proper methods.
- Verify competence in cleaning and disinfection procedures.
- Provide dedicated equipment for patients on isolation or contact precautions.
- Schedule cleaning times for rooms of patients in isolation or on contact precautions.

- Use immediate feedback mechanisms to assess cleaning and reinforce proper technique.

Boyce JM, Potter-Bynoe G, Chenevert C, King T. Environmental contamination due to methicillin-resistant *Staphylococcus aureus*: Possible infection control implications. *Infect Control Hosp Epidemiol*. 1997;18(9):622-627.

Huang SS, Datta R, Platt R. Risk of acquiring antibiotic-resistant bacteria from prior room occupants. *Arch Intern Med*. 2006;166(18):1945-1951.

Reducing MRSA Infection: Five Components of Care (continued)

3. Active Surveillance

Colonized patients represent the major reservoir from which transmission occurs. Accordingly, identifying colonized patients facilitates prompt implementation of control measures designed to reduce transmission. While cultures of clinical specimens (e.g., sputum, wound, urine, blood) will identify infected patients, they fail to detect up to 85% of colonized patients. In contrast, active surveillance cultures (ASCs) of the anterior nares will identify 80% of colonized adult patients. Using a combination of cultures from the anterior nares and wounds will increase sensitivity of detecting colonized adult patients to over 92%. Additional cases can be detected by adding cultures of other sites such as the perineum, axilla, and rectum, but such aggressive culturing probably is not cost-effective, except perhaps for intractable problems or in epidemics. Some patients still will be missed due to insensitivity of the culture method (e.g., broth enrichment of nasal swabs enhances detection) or because they are colonized only in a site that was not cultured, such as the rectum. A combination of cultures of the anterior nares plus the umbilicus will identify most colonized newborns, although some newborns are colonized in the rectum exclusively.

Available MRSA culture methods include routine cultures, preferably plated on a selective antibiotic-containing media or a selective/differential media such as a complex media containing chromopeptone, sodium chloride, cefoxitin, and other antibacterial agents. Use of the complex selective/differential media shortens time to positivity from 48-72 hours to 18-48 hours. Recently, testing using polymerase chain reaction (PCR) has become available, permitting results within hours, or the next day depending on laboratory workflow and staffing. Based on available reports from hospitals that have had success in controlling MRSA, any of these methods can be used provided they are performed reliably and control measures are instituted appropriately. Some experts contend that the additional cost of PCR testing can be offset by more rapid isolation of colonized patients, or, for those institutions that use pre-emptive isolation pending test results, earlier discontinuation of precautions. Data are insufficient at this time to recommend a specific testing method.

Some hospitals, including hospitals in small inter-hospital collaboratives, have elected to perform ASCs on all patients admitted to their facility. A few have reported dramatic success and claim that the required additional microbiology resources and staff time are cost-beneficial in the long run when their rate of MRSA begins to decline (along with associated treatment costs and length of stay) and precautions are required less frequently. Other centers have reported success by confining ASCs to ICUs, with the impact on MRSA extending beyond the ICUs to the entire hospital (as noted in the report by Huang et al., cited previously).

Currently, most hospitals that perform ASCs focus on patients who are considered to be at high risk of being colonized with MRSA. Patient characteristics that are associated with an increased risk of MRSA colonization include a prior history of MRSA colonization or infection, hospitalization within the preceding year, transfer from an extended care facility, being in an ICU, and the presence of skin wounds. However, in one study from France, about 12% of patients admitted to ICUs were missed if cultures were performed only on patients with one identified risk factor; 44% to 56% were missed if only those with two or more risk factors were screened. In another study, about 24% to 50% of non-ICU patients colonized with MRSA were missed if cultures were done on only patients with one of several risk factors. Based on these studies, the most sensitive approach to identifying colonized patents is to perform ASCs on all admitted patients, whether the target is the ICU or the entire hospital. Based on these studies, the most sensitive approach to identifying colonized patents is to perform ASCs without using risk-based criteria. In addition, some experts contend that it is easier to ask staff to culture all patients rather than going through the additional step of assessing risk before culturing.

> Lucet JC, Chevret S, Durand-Zaleski I, Chastang C, Regnier B; Multicenter Study Group. Prevalence and risk factors for carriage of methicillin-resistant *Staphylococcus aureus* at admission to the intensive care unit: Results of a multicenter study. *Arch Intern Med*. 2003;163(2):181-188.
>
> Furuno JP, McGregor JC, Harris AD, et al. Identifying groups at high risk for carriage of antibiotic-resistant bacteria. *Arch Intern Med*. 2006;166(5):580-585.

Regardless of the screening strategy used, knowledge is power. Even if ASC, in and of itself, did not have an impact on entrenched MRSA problems in US hospitals, it would permit institutions to assess the extent of their problem and their success in combating it. Hospitals that rely only on clinical culture data to assess the extent of their MRSA problem will always underestimate the magnitude of their MRSA burden. Moreover, MRSA infections, though serious, occur sufficiently infrequently that a prolonged period of observation may be required to document the impact of control measures. Culturing patients to detect colonization on admission, and again weekly (e.g., all MRSA negative patients on a set day) and/or at discharge, allows the control team to document transmission in real time, determine the root cause of failure, and assess the success of the control effort in weeks or months rather than quarters or years. Including active surveillance cultures as part of a MRSA control program requires that hospital administrators make available sufficient microbiology laboratory resources for performing such cultures on an ongoing basis.

> Chaix C, Durand-Zaleski I, Alberti C, Brun-Buisson C. Control of endemic methicillin-resistant *Staphylococcus aureus*: A cost-benefit analysis in an intensive care unit. *JAMA*. 1999;282(18):1745-1751.
>
> Grundmann H, Aires-de-Sousa M, Boyce J, Tiemersma E. Emergence and resurgence of methicillin-resistant *Staphyloccocus aureus* as a public-health threat. *Lancet*. 2006; 368:874-885.
>
> Karchmer TB, Durbin LJ, Simonton BM, Farr BM. Cost-effectiveness of active surveillance cultures and contact/droplet precautions for control of methicillin-resistant *Staphylococcus aureus*. *J Hosp Infect*. 2002;51(2):126-132.
>
> Lucet JC, Chevret S, Durand-Zaleski I, Chastang C, Regnier B; Multicenter Study Group. Prevalence and risk factors for carriage of methicillin-resistant *Staphylococcus aureus* at admission to the intensive care unit: Results of a multicenter study. *Arch Intern Med*. 2003;163(2):181-188.

Sanford MD, Widmer AF, Bale MJ, Jones RN, Wenzel RP. Efficient detection and long-term persistence of the carriage of methicillin-resistant *Staphylococcus aureus*. *Clin Infect Dis*. 1994;19(6):1123-1128.

Active surveillance is likely to be most beneficial when the other components of the package of interventions (hand hygiene, decontamination of the environment and equipment, and contact precautions) are performed with a high degree of reliability. Engrafting active surveillance on unreliable infection control systems is not a sound strategy, especially given the cost and resources required. Hospitals contemplating the use of ASC also should recognize that institutions reporting success with ASCs often have strengthened their infection control resources at the outset—for example, by hiring an MRSA coordinator or adding microbiology staff.

When considering ASCs as part of a package of interventions to control MRSA, hospitals need to be aware of other multiple drug-resistant organisms (MDROs) that may be circulating or emerging in their ICUs or institution at large. MRSA screening will, of course, detect only MRSA. If resources are diverted to MRSA-colonized patients exclusively, without improving reliability of infection control practices overall, transmission of other dangerous pathogens paradoxically could increase. MRSA is part of a complex mosaic of pathogen transmission, and must not be considered apart from this dynamic system. Hospitals should consider monitoring the incidence of other MDROs, including multi-resistant Gram-negative pathogens, on a regular basis.

» What changes can we make that will result in improvement?

Hospital teams across the US have developed and tested process and systems changes that allowed them to improve performance on ASC. Some of these changes are:

- Begin with collection of cultures on admission only and measure compliance; add the second culture after compliance is high (≥ 90%).

- Provide real-time notification to staff when an admission culture is positive for MRSA, so that precautions can be implemented immediately.
- Schedule a consistent day of the week for second culture, and/or include a culture in routine discharge order sets.
- Measure transmission, i.e., the number or rate of patients who convert from negative to positive.

Reducing MRSA Infection: Five Components of Care (continued)

4. Contact Precautions for Infected and Colonized Patients

Patients can harbor MRSA in a number of body sites. Although the anterior nares is the most common reservoir for MRSA, patients also carry the organism on intact skin of the axillae (15-25% of patients), the perineum (30-40%) and the hands or arms (40%). Some colonized patients, particularly those who have received antimicrobial therapy, develop heavy MRSA colonization of their gastrointestinal tract. Ostomy sites, wounds and pressure ulcers, and sputum are other common colonization sites. MRSA present on the skin, gastrointestinal tract, or other sites is often shed into the patient's immediate environment, resulting in contamination of surfaces and inanimate objects near the patient.

A number of studies have shown that the hands of HCWs can become contaminated by touching not only colonized wounds, secretions, and excretions, but also by touching intact areas of skin and objects in the patient's immediate environment. Contamination of hands through contact with colonized or infected patients is by far the major pathway for MRSA transmission to other patients. When HCWs have substantial contact with infected or colonized patients, they may also contaminate their clothing with MRSA, and then contaminate their hands by touching their clothing. MRSA conceivably could be transmitted to other patients directly through inadvertent contact with HCWs' clothing, although this is quite rare.

Contact precautions are designed to interrupt these important modes of MRSA transmission. Wearing gloves when having contact with patients or the immediate environment of patients colonized or infected with MRSA can reduce the likelihood that HCWs will contaminate their hands. Wearing a gown can protect HCWs from contaminating their clothing when caring for patients colonized or infected with MRSA. Hand hygiene should be performed after removing gloves (since hands are frequently contaminated in the process of glove removal), and gowns should not be worn outside of the isolated patient's room. Wearing gloves and gown to enter the room of a patient who is colonized or infected with MRSA is an essential component of Contact Precautions for MRSA control, as recommended by HICPAC. Complete specifications for Contact Precautions are available on the CDC website.

Placing patients in a single-occupancy room may make it less likely that HCWs will move from an infected or colonized patient to an adjacent, uncolonized patient without removing their gloves and gown and cleaning their hands. When sufficient rooms are not available for placing all infected patients in private rooms, cohorting one or more patients with MRSA together in a room is acceptable, but hand hygiene when moving from patient to patient remains extremely important as patients may be colonized by other MDROs in addition to MRSA. In high-occupancy facilities, either approach can be challenging; hospitals should adapt basic barrier procedures to their individual circumstances. Even where staffing and physical circumstances are the most dire, the integrity of the isolated patient's bed space must be kept intact, for example, by placing a visual cue on the floor (red tape may be one option) as a reminder to staff.

Bhalla A, Pultz NJ, Gries DM, et al. Acquisition of nosocomial pathogens on hands after contact with environmental surfaces near hospitalized patients. *Infect Control Hosp Epidemiol*. 2004;25(2):164-167.

Boyce JM, Potter-Bynoe G, Chenevert C, King T. Environmental contamination due to methicillin-resistant *Staphylococcus aureus*: Possible infection control implications. *Infect Control Hosp Epidemiol.* 1997;18(9):622-627.

Jernigan JA, Titus MG, Groschel DH, Getchell-White S, Farr BM. Effectiveness of contact isolation during a hospital outbreak of methicillin-resistant *Staphylococcus aureus*. *Am J Epidemiol*. 1996;143(5):496-504.

McManus AT, Mason AD, McManus WF, Pruitt BA. A decade of reduced gram-negative infections and mortality associated with improved isolation of burned patients. *Archives of Surgery*. 1994;129(12):1306-1309.

Patients infected with MRSA should always be placed on contact precautions and there is general agreement that patients known to be colonized with MRSA, or detected by ASC on admission or thereafter, should be placed on precautions as well. Contact precautions should be applied and required procedures performed with high reliability. Failure to follow barrier technique specified by contact precautions and to practice appropriate hand hygiene is likely to negate the potential benefit of active surveillance. Prompt communication of results from the laboratory to clinical staff is crucial for timely implementation of contact precautions.

In some hospitals that perform ASCs, all newly admitted patients are placed on contact precautions until the results of screening tests are available—so-called "pre-emptive precautions." There is disagreement as to the value of placing patients on contact precautions pending results of ASCs, as is done in the Dutch "search and destroy" approach (Verhoef J, Beaujean D, Blok H, et al. A Dutch approach to methicillin-resistant *Staphylococcus aureus*. *Eur J Clin Microbiol Infect Dis*. 1999). Pre-emptive precautions increase the use of isolation supplies and the time it takes to care for patients, and may pose additional challenges to room assignments. Some experts advocate a compromise: use of gloves for all contact with patients until the results of screening are back. It is important to note that not all of the few US hospitals that have reported dramatic success in controlling MRSA have used pre-emptive precautions.

Discontinuation of contact precautions may be considered for patients with long lengths of stay if they become MRSA-free, but current HICPAC Guidelines include no official recommendation as there is lack of consensus among experts. Once colonized, patients tend to remain colonized for months to years. Eradication of colonization in patients without a focus of infection and who are colonized only in the nose and on the skin may be attempted using nasal mupirocin and chlorhexidine gluconate body washes. However, broad use of mupirocin is discouraged, as this may lead to development of resistance. At least three negative cultures on separate days are generally recommended before discontinuing precautions.

Patients on precautions require the same level of care and attention as any other patients in the hospital. Some studies have found that clinical personnel, including physicians, entered rooms of patients on precautions less often. Another study suggested that there was an increase in adverse events in such patients. All patients require the same standard of care, whether or not they are on precautions, and this principle should be reinforced with caregivers to avoid unintended adverse consequences and diminished patient/family-provider communication.

> *Management of Multidrug-Resistant Organisms in Healthcare Settings*. Healthcare Infection Control Practices Advisory Committee (HICPAC). 2006:25.

» What changes can we make that will result in improvement?

Hospital teams in the US have developed and tested process and systems changes that allowed them to improve performance with contact precautions. Some of these changes are:

- Train staff on the importance of adhering to all precautions and proper barrier technique.
- Ensure that adequate supplies are stored at the point of care for easy access.
- Check and replenish supplies (gloves, gowns, masks) regularly; consider scheduled times for checking supplies.
- Educate families about contact precautions.
- Instruct patients about precautions and hand hygiene, and encourage them to question personnel who do not comply.
- Use visual cues when a patient cannot be placed in a private room, such as red tape on the floor around the patient area—gowns and gloves for anything that requires crossing the line.
- Ensure that patients on precautions have the same standard of care as other patients (frequency of entering the room, monitoring vital signs, etc.) to prevent adverse events and ensure patient/family-provider communication.

Reducing MRSA Infection: Five Components of Care (continued)

5. Device Bundles

Patients with invasive devices, such as central venous catheters and ventilators, are at greater risk for developing hospital-acquired infections. These devices bypass the natural barriers of skin and upper airway, and catheterized, ventilated patients tend to be more vulnerable to infection due to the severity of their underlying illnesses. Patients with invasive devices who are colonized with MRSA are at greatly increased risk of MRSA bloodstream infection and pneumonia, and fastidious care of invasive devices can greatly diminish the occurrence of MRSA infection in colonized patients. Many hospitals have reduced or eliminated device-related infections through the implementation of "bundles"—groupings of best practices that individually improve care, but when applied together result in substantially greater improvement. The science supporting each bundle component is sufficiently established to be considered the standard of care.

Hospitals working to aggressively reduce MRSA infections should implement and reliably perform the Central Line Bundle and Ventilator Bundle, which are described in detail in the How-to Guides created for the 100,000 Lives Campaign (refer to these Guides on IHI's website for specific recommendations, strategies, and measures). It is important to note that hospitals may decrease hospital-acquired MRSA infections by focusing only on device bundles, but if they ignore transmission, they will fail to address the whole problem.

Additional Considerations: Leadership and Organizational Culture

Changing practice requires a change in organizational culture and attitudes about what is acceptable. Organizations that have nearly eliminated certain types of infections, such as ventilator-associated pneumonia (VAP) and central line infections (BSLI), have moved towards a culture where these infections are viewed as completely preventable. This same philosophy has been adopted in some organizations working on MRSA, for example, VAPHS where "zero tolerance" is part of its reduction effort.

The organizational culture within an individual organization, or even at the local level of a department or patient care unit, develops based on overt and subtle messages employees receive. Leadership actions strongly influence employee beliefs as to what leaders consider important, even more so than what is actually said. This includes not only what leaders do, but also what they do not do.

Teamwork is essential in health care today, and communication within the team is indicative of the organizational culture. Everyone must be considered as an equally important member of the team, regardless of their role, and not only encouraged to speak up, but required to do so. If non-clinical or non-professional (i.e., non-licensed or certified) staff are not treated as equal members of the team, they will be less likely to point out an unsafe condition or take action. For example, environmental services personnel are critical members of the team for infection prevention, not just the clinical personnel who provide direct patient care.

» What changes can we make that will result in improvement?

Understanding how organizational culture develops is important to changing it, and practical tools are available to effect change:

- Implement Leadership Walkrounds™, a structured approach for senior leaders to talk directly with front-line staff about patient safety.

- Train staff in the use of SBAR, a structured format for communication which stands for Situation-Background-Assessment-Recommendation and establishes a clear layout of information in a manner that is non-threatening and allows for appropriate assertion.
- Conduct briefings on units to increase staff awareness by bringing them together for 5 to 10 minutes as part of the daily routine.
- Involve patients and families in processes, such as rounds.

Bibliography

Extensive evidence supports the care recommendations in this Guide. Selected references are found in the Annotated Bibliography, available on www.IHI.org.

Using the Model for Improvement

In order to move this work forward, IHI recommends using the Model for Improvement. Developed by Associates in Process Improvement, the Model for Improvement is a simple yet powerful tool for accelerating improvement that has been used successfully by hundreds of health care organizations to improve many different health care processes and outcomes.

The model has two parts:

- Three fundamental questions that guide improvement teams to 1) set clear aims, 2) establish measures that will tell if changes are leading to improvement, and 3) identify changes that are likely to lead to improvement.

- The Plan-Do-Study-Act (PDSA) cycle to conduct small-scale tests of change in real work settings — by planning a test, trying it, observing the results, and acting on what is learned. This is the scientific method, used for action-oriented learning.

Implementation: After testing a change on a small scale, learning from each test, and refining the change through several PDSA cycles, the team can implement the change on a broader scale — for example, for an entire pilot population or on an entire unit.

Spread: After successful implementation of a change or package of changes for a pilot population or an entire unit, the team can spread the changes to other parts of the organization or to other organizations.

You can learn more about the Model for Improvement on www.IHI.org.

Forming a Team

No single person can create system-level improvements alone. First, it is crucial to have the active support of leadership in this work. The leadership must make patient safety and quality of care strategic priorities in order for any infection reduction improvement team to be successful.

Once leadership has publicly given recognition and support (dollars, person-time) to the program, the improvement team can be quite small. Successful teams working in an ICU (the recommended location for starting this work) include a physician (an intensivist), an ICU nurse, an infection control nurse or hospital epidemiologist, and someone from the quality department. Each hospital will have its own methods for selecting a core team. The team should use the Model for Improvement to conduct small-scale, rapid tests of the ideas for improvement over various conditions in a pilot surgical population. The team should also track performance on a set of measures designed to help them see if the changes they are making are leading to improvement, and regularly report these measures back to leadership.

Measurement Strategies for Reducing MRSA

There is only one way to know if a change represents an improvement: measurement. Ultimately, the goal is to improve an outcome; teams accomplish this by first improving the processes that are key drivers. Therefore, it is important to track both process and outcome measures.

Four of the key processes for MRSA reduction (hand hygiene, decontamination and cleaning, active surveillance, and contact precautions) must be performed reliably in order to prevent transmission of MRSA, as well as other organisms. Measuring compliance with these processes can be helpful in monitoring improvement. Implementation of device bundles, specifically the Ventilator and Central Line Bundles, is the fifth area of focus. There is a How-to Guide for each bundle that contains recommended process measures. Teams should collect data for these process measures at the unit level (e.g., an ICU or other designated high-risk area) where improvement work is focused.

Reduction in hospital-acquired MRSA infection is the ultimate goal and the Campaign begins with a focus on bloodstream infections. These may occur infrequently and should be measured hospital-wide. A detailed description of these outcome measures can be found in the measures linked to in Appendix C. Due to the low frequency, it may be beneficial to measure transmission, which is an indicator of how well all of the process measures are being followed. Reduction in infection is dependent on prevention of transmission; however, active surveillance must be in place in order to track this.

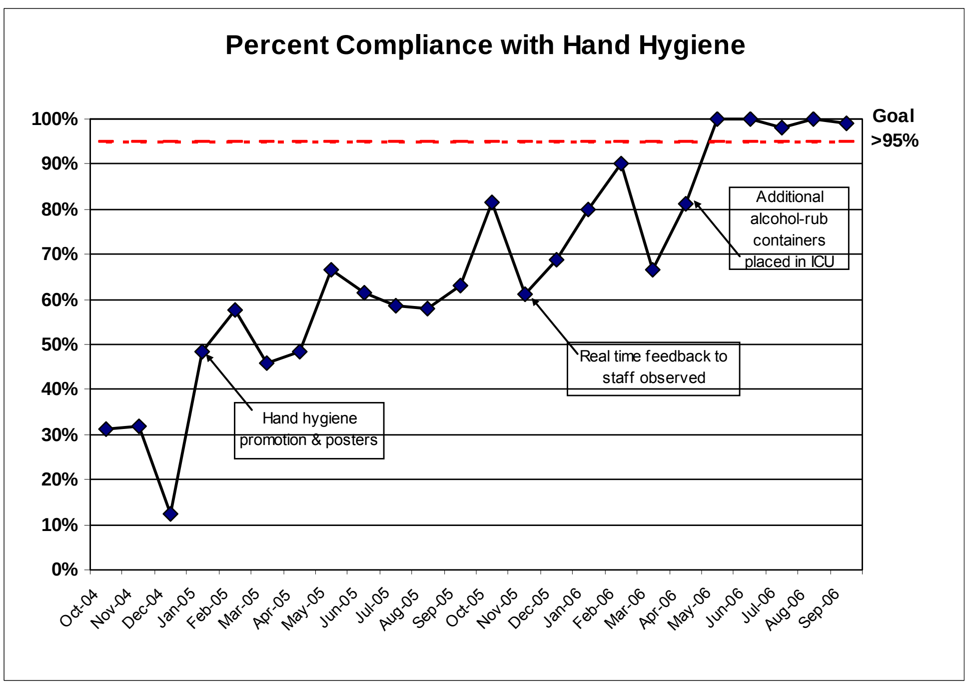
See Appendix C for detailed information regarding the recommended process and outcome measures for reducing MRSA bloodstream infections.

Run Charts

Improvement takes place over time. Determining if improvement has really happened and if it is lasting requires observation of patterns over time. Run charts are graphs of data over time and are one of the single most important tools in performance improvement. Using run charts has a variety of benefits:

- They help improvement teams formulate aims by depicting how well (or poorly) a process is performing.
- They help in determining when changes are truly improvements by displaying a pattern of data that you can observe as you make changes.
- As you work on improvement, they provide information about the value of particular changes.

This sample run chart graphs compliance with hand hygiene over time; note that it includes annotations showing which changes were introduced:



First Test of Change

Teams may elect to work on any or all of the care components: hand hygiene, decontamination of the environment and equipment, active surveillance and contact precautions, isolation for infected patients, and device bundles. A first test of change should involve a very small sample size (typically, one patient) and should be described ahead of time in a Plan-Do-Study-Act (PDSA) format so that the team can easily predict what they think will happen, observe the results, learn from them, and continue to the next test. (The sample PDSA Worksheet on the next page describes a first test of change.) Ideally, teams will conduct multiple small tests of change simultaneously across all components of care. This simultaneous testing usually begins after the first few tests are completed and the team feels comfortable and confident in the process.

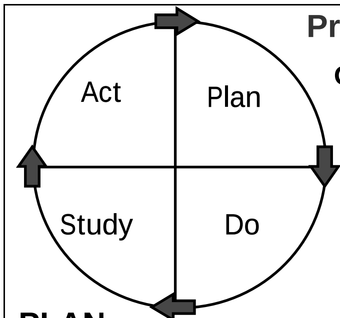
Implementation and Spread

For reducing MRSA, teams will usually choose to begin their improvement process by working with a "pilot" population, specifically one intensive care unit or other area where MRSA is a major problem. We recommend starting in one intensive care unit, rather than hospital-wide, in order to increase the ability to measure and detect improvement. This is also one of the populations at highest risk. Small, rural hospitals (less than 50 beds) may choose to work on MRSA reduction efforts hospital-wide.

In order to maximize the reduction in MRSA bloodstream infections and transmission of MRSA, however, hospitals must spread improvements begun in a pilot population to other intensive care units and eventually the entire hospital. Organizations that successfully spread improvements use an organized, structured method in planning and implementing spread across populations, units, or facilities. Information about planning, tracking, and optimizing spread can be found at www.IHI.org. (See IHI's Innovation Series white paper, "A Framework for Spread: From Local Improvements to System-Wide Change," downloadable for free at www.ihi.org.)

PDSA WORKSHEET

CYCLE: 1 **DATE:** **12/8/06**



Project: Reduce MRSA Infection

Objective for this PDSA Cycle: Test obtaining a nasal swab culture for MRSA on admission to the ICU.

PLAN:

Questions: Will obtaining nasal cultures on admission to the ICU be easy? Will staff be willing to do this as part of the admission process?

Predictions: Cultures will be easy to obtain on admission if the materials are available.
Staff will be willing to collect the cultures if they understand why we are doing this.

Plan for change or test – who, what, when, where:
Who – Mary (ICU nurse) with Joann (ICU nurse)
What – Test obtaining a nasal culture on the next admission to ICU
When – Tuesday
Where – ICU

Plan for collection of data – who, what, when, where:
Who and What – Joann will meet with Mary at the start of the shift and explain the purpose of and procedure for obtaining the culture. Joann will ensure that culture swabs are available.
When – When next admission arrives in ICU

DO:

Carry out the change or test. Collect data and begin analysis.
Mary received an admission around 11am. Culture swabs were available in the utility room and she obtained a culture from the patient and sent it to the lab. The lab called Mary to ask about the culture as there was no order in the computer system for it.

STUDY:

Complete analysis of data: Mary told Joann that it was easy to do the culture, but that it would be easier if she did not have to go to the utility room for the swabs. She also suggested that it should be on the ICU admission checklist. The lab did not know what to do with the culture because no order had been entered into the computer system.

How did or didn't the results of this cycle agree with the predictions that we made earlier?
The culture was easy to obtain, but the materials were not in a convenient location. It had not been predicted about the lab portion of the test.

Summarize the new knowledge we gained by this cycle: The swabs need to be in the patient rooms. The lab needs to have an order in the system in order to process the culture.

ACT: List actions we will take as a result of this cycle:

Repeat the test with another admission, but store swabs in the ICU patient rooms. Joann will ask the intensivist, Dr. Jones, for permission to place an order in the computer for the culture.

Plan for the next cycle (adapt change, another test, implementation cycle?):
Test again tomorrow in the ICU with Mary. Also plan for possible revision to admission checklist if tests are successful.

Barriers

Teams working on reducing MRSA infections and transmission have learned a great deal about barriers to improvement and how to address them. Some common challenges and solutions:

1. **Lack of support by leadership**
   Solution: Use opinion leaders (physicians) and data, if possible; a business case for the project may help to win leadership support.

2. **Uneven physician acceptance of new practices**
   Solution: Use physician opinion leaders, review the medical literature, and feed back data on a physician-specific level. Remember that physicians may fall anywhere on the "Adoption of Innovations" curve; work first with your early adopters and use their stories to convince the majority.

3. **Lack of clear ownership for care practices**
   Solution: Work with physician leaders to develop standard approaches to postoperative care, including clear designation of the physician owner.

Looking for advice from other organizations like yours? Ask a Campaign Mentor Hospital! The organizations on the <u>Campaign Mentor Hospitals list</u> have volunteered to provide support, advice, clinical expertise, and tips to hospitals seeking help with their implementation efforts.

Appendix A

EVANSTON NORTHWESTERN HEALTHCARE

ENVIRONMENTAL SERVICES CHECK LIST AUDIT
DAILY CLEANING OF PATIENT ROOM

STEPS

1. High Dusting Performed	**Yes___**	**No___**
a. Use high duster/mop head: wipe ledges (shoulder high and above)	**Yes___**	**No___**
b. Vents	**Yes___**	**No___**
c. Lights *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:	**Yes___**	**No___**
a. Ledges (shoulder high)	**Yes___**	**No___**
b. Door handles	**Yes___**	**No___**
3. Bedside Table – Disinfect Surface	**Yes___**	**No___**
4. Glass Surfaces	**Yes___**	**No___**
a. Wall spots **N/A___**	**Yes___**	**No___**
5. Bathroom (Toilet Bowl Mop) All Surfaces	**Yes___**	**No___**
a. Weekly toilet chemical allow to stay	**Yes___**	**No___**
b. Ledges in bathroom	**Yes___**	**No___**
c. Door handles	**Yes___**	**No___**
d. Sink	**Yes___**	**No___**

e. Shower stall	**Yes___**	**No___**
f. Finish toilet	**Yes___**	**No___**
g. Damp wipe toilet seat	**Yes___**	**No___**
h. Clean mirrors/chrome	**Yes___**	**No___**
6. Empty Waste Basket	**Yes___**	**No___**
a. Disinfect if wet	**Yes___**	**No___**
b. Bags – close	**Yes___**	**No___**
7. Isolation (Red Bag Waste) Empty	**Yes___**	**No___**
a. Carry to soiled utility room	**Yes___**	**No___**
b. Carry to Large Red Hazard trash	**Yes___**	**No___**
8. Needle Boxes		
a. Check level of Sharps	**Yes___**	**No___**
b. Replace if ½ to ¾ full **N/A___**	**Yes___**	**No___**
c. To soiled Utility Room after securely closing **N/A___**	**Yes___**	**No___**
9. Floor Disinfection – Sign on Door		
a. Wet mop head in disinfectant	**Yes___**	**No___**
b. Mop (farthest from door) ½ way room	**Yes___**	**No___**
c. Bathroom shower floor	**Yes___**	**No___**
d. Bathroom floor	**Yes___**	**No___**
e. Flip mop head – do remainder of room	**Yes___**	**No___**

Appendix B

EVANSTON NORTHWESTERN HEALTHCARE

ENVIRONMENTAL SERVICES CHECK LIST AUDIT
CHECK OUT CLEANING (PATIENT DISCHARGE)

STEPS

***Check for isolation sign**

1. High Dust

a.	Ledges: shoulder and higher	**Yes___**	**No___**
b.	Vents	**Yes___**	**No___**
c.	Lights	**Yes___**	**No___**
d.	Lights (bathroom)	**Yes___**	**No___**
e.	TV – rotate all ledges	**Yes___**	**No___**
f.	TV cabinet	**Yes___**	**No___**
g.	Screen and wires	**Yes___**	**No___**
h.	Go to ES cart and gently remove dust	**Yes___**	**No___**

2. Damp Dust

	Cloth (rag) and spray bottle of disinfectant – damp wide all surfaces in room	**Yes___**	**No___**
a.	Ledges (shoulder high)	**Yes___**	**No___**
b.	Door handles	**Yes___**	**No___**
c.	Door hinges	**Yes___**	**No___**

3. Bed (top to bottom, head to foot, and left to right)
Bring bed up to highest position

a.	Raise mattress and disinfect top, sides, and bottom	**Yes___**	**No___**

b.	Disinfect exposed frame, springs, or bed panels	**Yes___**	**No___**
c.	Headboard: disinfect top, front, and back	**Yes___**	**No___**
d.	Disinfect side rails, undercarriage and lower ledges	**Yes___**	**No___**
e.	Disinfect all bed controls	**Yes___**	**No___**
f.	Disinfect the foot-board (top, front, and back)	**Yes___**	**No___**
g.	Allow moisture to dry before placing linen on bed	**Yes___**	**No___**

4. Over Bed Table

a.	Disinfect surfaces and legs	**Yes___**	**No___**
b.	Two-layer table top	**Yes___**	**No___**
c.	Wipe out drawer	**Yes___**	**No___**
d.	Wipe off mirror	**Yes___**	**No___**

5. Bedside Table

a.	Disinfect surface and legs	**Yes___**	**No___**
b.	Wipe out drawer	**Yes___**	**No___**

6. Glass Surfaces	**Yes___**	**No___**
a. Wall spots **N/A___**	**Yes___**	**No___**
7. Bathroom (Toilet Bowl Mop) All Surfaces	**Yes___**	**No___**
a. Use toilet chemical, allow to stay	**Yes___**	**No___**
b. Run all hot water faucets for 5 minutes	**Yes___**	**No___**
c. Ledges in bathroom	**Yes___**	**No___**
d. Door handles	**Yes___**	**No___**

e. Sink and faucets	**Yes___**	**No___**
f. Wipe down toilet surface/apply paper barrier	**Yes___**	**No___**

8. Shower Stall and Faucets

a. Run hot water faucet for 5 minutes	**Yes___**	**No___**
b. After running hot water for 5 minutes, leave shower head dangling down (do not loop)	**Yes___**	**No___**
c. Wipe down walls, curtain, check for signs of mildew	**Yes___**	**No___**

9. Floor Disinfection – Sign on Door

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

Appendix C: Recommended Intervention-Level Measures

The following measures are relevant for this intervention. The Campaign recommends that you use some or all of them, as appropriate, to track the progress of your work in this area. In selecting your measures, we offer the following advice:

1. Whenever possible, use measures you are already collecting for other programs.
2. Evaluate your choice of measures in terms of the usefulness of the results they provide and the resources required to obtain those results; try to maximize the former while minimizing the latter.
3. Try to include both process and outcome measures in your measurement scheme.
4. You may use measures not listed here, and, similarly, you may modify the measures described below to make them more appropriate and/or useful to your particular setting; however, be aware that modifying measures may limit the comparability of your results to others'. (Note that hospitals using different or modified measures should not submit those measure data to IHI.)
5. Remember that posting your measure results within your hospital is a great way to keep your teams motivated and aware of progress. Try to include measures that your team will find meaningful, and that they would be excited to see.

Process Measure(s):

Compliance with Hand Hygiene
Owner: **IHI** Owner Measure ID: **N/A** Measure Information: **[Campaign MIF]** Comments:

Compliance with MRSA Contact Precautions
Owner: **IHI** Owner Measure ID: **N/A** Measure Information: **[Campaign MIF]** Comments:

Compliance with Room Cleaning
Owner: **IHI**
Owner Measure ID: **N/A**
Measure Information: **[Campaign MIF]**
Comments:

Compliance with Active Surveillance Cultures on Admission
Owner: **IHI**
Owner Measure ID: **N/A**
Measure Information: **[Campaign MIF]**
Comments:

Outcome Measure(s):

MRSA Bloodstream Infections per 100 Admissions
Owner: **IHI**
Owner Measure ID: **N/A**
Measure Information: **[Campaign MIF]**
Comments:

MRSA Bloodstream Infections per 1,000 Patient Days
Owner: **IHI**
Owner Measure ID: **N/A**
Measure Information: **[Campaign MIF]**
Comments:

Transmission of MRSA
Owner: **IHI**
Owner Measure ID: **N/A**
Measure Information: **[Campaign MIF]**
Comments:

Alignment with Other Measure Sets:

Measure Name	**CDC**
Compliance with MRSA Contact Precautions	√[1]
MRSA Bloodstream Infections per 100 Admissions	√[2]
MRSA Bloodstream Infections per 1,000 Patient Days	√[2]

[1] This measure uses the CDC guidelines for "Contact Precautions" as the basis for compliance.
[2] This measure uses the CDC National Healthcare Safety Network definition for laboratory-confirmed bloodstream infection (LCBI) with MRSA as the organism identified in blood culture.