An APIC Guide

2009

Guide to the Elimination of Methicillin-Resistant *Staphylococcus aureus* (MRSA) in the Long-Term Care Facility

About APIC

APIC's mission is to improve health and patient safety by reducing risks of infection and other adverse outcomes. The Association's more than 12,000 members have primary responsibility for infection prevention, control and hospital epidemiology in healthcare settings around the globe. APIC's members are nurses, epidemiologists, physicians, microbiologists, clinical pathologists, laboratory technologists and public health professionals. APIC advances its mission through education, research, consultation, collaboration, public policy, practice guidance and credentialing.

Financial support for the Distribution of This Guide Provided by Covidien in the Form of an Unrestricted Educational Grant

For additional resources, please visit http://www.apic.org/EliminationGuides.

Look for other topics in APIC's Elimination Guide Series, including:

- Catheter-Related Bloodstream Infections
- Catheter-Related Urinary Tract Infections
- *Clostridium difficile*
- Mediastinitis

All inquires about this document or other APIC products and services may be addressed to:

APIC Headquarters

1275 K Street, NW

Suite 1000

Washington, DC 20005

Phone: 202.789.1890

Email: APICinfo@apic.org

Web: **www.apic.org**

Cover image courtesy of CDC/Rodney M. Donlan, Ph.D.; Janice Carr
Highly magnified electron micrograph depicting numbers of Staphylococcus aureus bacteria, found on the luminal surface of an indwelling catheter. (2005)
ISBN: 1-933013-41-9

Table of Contents

Acknowledgments

APIC acknowledges the valuable contributions of the following individuals:

Authors

Kathy Aureden, MS, MT(ASCP)SI, CIC
Epidemiology Coordinator
Sherman Hospital
Elgin, IL

Deb Burdsall, RN, MSN, CIC
Infection Preventionist
Infection Control New Program Development
Lutheran Life Communities
Arlington Heights, IL

Martha Harris, BS, MT(ASCP), CIC
Infection Preventionist
Inova Continuum of Care
Clifton, VA

Patricia Rosenbaum, RN, CIC
CEO
PAR Consulting, LLC
Silver Spring, MD

Reviewers

Irena Kenneley, PhD, APRN-BC, CIC
Public/Community Health Clinical Nurse Specialist
Assistant Professor
Case Western Reserve University Frances Payne Bolton School of Nursing
Cleveland, OH

James Marx, RN, MS, CIC
Infection Preventionist
Broad Street Solutions
San Diego, CA

Guide Overview

Multidrug-resistant organism transmission and infection are among the most important current issues in healthcare settings, including long-term care (LTC) facilities. Although there are many multidrug-resistant organisms that may cause resident infections, methicillin-resistant *Staphylococcus aureus*, commonly referred to as MRSA, is one of the most prevalent and persistent of these significant pathogens.

The Burden of MRSA

According to a recent article by R. M. Klevins, MRSA prevalence in the United States has received widespread media attention. "The estimated number of people developing a serious MRSA infection in 2005 was about 94,360; this is higher than estimates using other methods."[1] Other statistics from this article include:

- Many invasive MRSA infections (85%) were associated with healthcare, of which two-thirds occurred outside of the hospital, and one-third occurred during hospitalization.
- About 14% of MRSA infections occurred in persons without obvious exposures to healthcare.
- Rates of disease varied geographically, but overall rates of disease were consistently highest among older persons (age >65), African Americans, and males.

The MRSA Infection Prevention and Control Program in LTC Facilities

The effective facility infection prevention and control program is comprised of many components and interventions that can reduce MRSA risk to residents, healthcare providers, staff, and visitors. This guide will provide strategies and tools that can be used for MRSA management in any LTC facility. The successful management of MRSA in LTC is necessary to ensure the best possible outcomes for individual residents. Also, effective facility-wide MRSA management can prevent the negative impact that MRSA infections can have on quality of life for all residents of the facility.

An organization's leaders must give active support, resources, and commitment to the infection prevention and control program. Leadership ensures that the program is managed by a professional with knowledge of general principles of infection prevention and control, LTC-specific infection, infection surveillance, process monitors, and data analysis. If necessary, leadership must provide for appropriate support and consultation from external infection prevention experts.

The professional assigned responsibility for the facility's infection prevention and control program may be an infection preventionist (see Box 1). Successful management of the program will protect residents, staff, and visitors (e.g., family, friends, etc.) from the risk of transmission of MRSA and any other infectious microorganisms. Bacteria, especially MRSA, have developed mechanisms to promote their survival and to resist attempts by humans to eliminate them. Armed with the knowledge of how infections are transferred, what barriers are used to deter their transmission, and how infections can be effectively resolved, it is possible to be properly prepared to take on such a persistent adversary as MRSA.

Other Benefits of the Successful MRSA Program

Successful MRSA management results in the prevention of MRSA-related resident mortality and morbidity as well as decreased healthcare costs for the resident and the facility (e.g., costs related to transfers to hospitals, additional medications, etc.). Additionally, standardization of best practice for MRSA management can improve staff productivity and heighten compliance on processes that are crucial for all patient safety and infection prevention.

Box 1: According to APIC, an infection preventionist* is typically a registered nurse, physician, epidemiologist, or medical technologist who:

- Helps to prevent healthcare-associated infections (HAIs) by isolating sources of infections and limiting their spread
- Implements infection prevention interventions
- Systematically collects, analyzes, and interprets health data in order to plan, implement, evaluate, and disseminate appropriate public health practices
- Trains healthcare staff through instruction and dissemination of information on infection control practices

**APIC stresses the importance of infection prevention interventions. Formerly known as infection control professionals (ICPs), the new designation by APIC for those competent in this arena is infection preventionist.*

Not All LTC Facilities Are the Same: Specialized Settings in LTC May Require More Advanced Management

Many different types of facilities are grouped under the heading of LTC facilities. Some provide care in a resident-centric environment and strive to replace the "hospital-like environment" with a comfortable place that residents can call home. Other facilities care for residents who come to them directly from the hospital for short-term, acute care where a more "hospital-like" environment is critical for positive resident outcomes. Many are combinations of both.

This guide provides resources that may be used across the entire spectrum of LTC facilities. Basic recommendations are appropriate in all facilities; however, some resources provided may be appropriate in certain, specific situations. In addition to recommendations and guidance in the following sections, there may be advanced needs and/or modifications that are important for special or unique resident populations. For instance, long-term acute care (LTAC) facilities, ventilator units, and Alzheimer's programs, among others, may need to be aligned more closely to general hospital MRSA management processes than to the basic processes discussed here.

It is beyond the scope of this guide to provide specific direction for advanced MRSA management needs. For instance, in LTAC facilities or similar facilities, MRSA management may need to be aligned more closely with general hospital MRSA management processes. The reader is encouraged to use the **Centers for Disease Control and Prevention/Healthcare Infection Control Practices Advisory Committee (CDC/HICPAC)** guidelines and resources and the **APIC Guide to the Elimination of MRSA Transmission in Hospital Settings** (March 2006) when developing practices that may be required in specialized LTC settings. Guidance related to modifications, investigations, or strategies that may be important for unique resident populations (dialysis, HIV-positive, etc.), alternate settings (ventilator units), or situations (outbreaks) should be obtained from sources such as the CDC or other resources provided by professional organizations.

Evidence-Based Studies

Every attempt was made to find the most current and relevant evidence-based, LTC information on which to base our guidelines. Due to the fact that most of the studies that have been undertaken have been conducted in hospital settings, we have identified these studies and extrapolated their conclusions for use in LTC facilities.

References

[1] Klevens RM, Morrison MA, Nadle J, et al. Invasive Methicillin-resistant *Staphylococcus aureus* Infections in the United States. *JAMA*. 2007;298(15):1763-1771. Available online at http://jama.ama-assn.org/cgi/content/full/298/15/1763.

Other Resources

APIC Web site: www.apic.org
Centers for Disease Control and Prevention Web site: www.cdc.gov
APIC Text of Infection Control and Epidemiology, 2nd ed. Washington, DC: Association for Professionals in Infection Control and Epidemiology, Inc.; 2005.

Definitions and Terms

Carrier: An individual who is found to be persistently colonized (culture-positive for a particular microorganism) at one or more body sites but has no signs or symptoms of active infection.

Cohort: A resident colonized or infected with a specific infectious agent sharing a room (cohorted) with another resident infected with the same agent.

Cohort staffing: Assigning personnel to care only for residents known to be colonized or infected with a specific infectious agent.

Colonized person: A person who is culture-positive for an infectious agent, but has no signs or symptoms of active infection.

Contact precautions: A method of transmission-based precautions recommended by the CDC that requires barrier precautions for direct contact with residents or equipment contaminated with an infectious agent.

Contamination: The presence of an infectious agent on a body surface or on clothes, gowns, gloves, bedding, furniture, computer keyboards, or other inanimate objects.

Decolonization therapy: Topical and/or systemic antibiotic treatment used with the intention of eliminating carriage of a microorganism.

Direct resident care: Providing hands-on care, such as bathing, washing, turning resident, changing clothes and briefs, care of wounds or lesions, or toileting.

Endemic: A baseline rate or the usual frequency of an infectious agent or disease in a facility as established by ongoing surveillance.

Hand hygiene: A process of the removal of visible soil or transient microorganisms from the hands. This involves use of soap and water if hands are visibly soiled and alcohol sanitizers if hands are not visibly soiled.

Healthcare-associated infection (HAI): An infection in a patient/resident who develops within a selected timeframe related to the admission to the healthcare setting. For MRSA, the typical timeframe is after the first 48 hours of admission to a facility or a unit.

Incidence: The number of new cases of infection or disease or colonization identified in a specific population in a given time period.

Infection: A breach of the body's defenses with resulting multiplication of infectious agents in body tissues, and causing tissue injury and inflammatory response.

Long-term care (LTC) facility: A facility that provides rehabilitative, restorative, and/or ongoing skilled nursing care to patients or residents in need of assistance with activities of daily living. LTC facilities include nursing homes, rehabilitation facilities, inpatient behavioral health facilities, and long-term chronic care hospitals.

Methicillin-resistant *Staphylococcus aureus* (MRSA): A multidrug-resistant strain of *Staphylococcus aureus*. The characteristic feature of this strain of staph is resistance to methicillin or oxacillin.

CA-MRSA: Community-associated MRSA (CA-MRSA) colonization or infection develops in people who have not recently been involved in the healthcare system (i.e., develop "in the community").

HA-MRSA: Healthcare-associated MRSA (HA-MRSA) colonization or infection develops in people who have had recent contact with a healthcare facility, or have been in a healthcare facility for greater than 48 hours.

Multidrug-resistant organism (MDRO): An organism that is resistant to more than one class of antibiotics.

Outbreak: An increase in the incidence of disease in a facility above the endemic level or a cluster of new cases that are epidemiologically linked.

Prevalence: The total number of residents with active infection or colonization (both old and new) in a given population at a specified point in time.

Staphylococcus aureus: Common gram-positive bacteria that are often found on the skin and in the anterior nares of persons.

Standard precautions: Precautions taken to protect against all body fluids, except sweat, when caring for residents. These precautions are always taken without regard for the diagnosis or perceived diagnosis of the resident.

Susceptibility testing (sensitivity testing): A laboratory test to determine if an organism can be effectively treated with a particular antibiotic. Most often reported as Sensitive, Intermediate, or Resistant for each antibiotic tested.

Surveillance: The monitoring of patient data to determine incidence and prevalence of infections and distribution in a facility.

Terminal cleaning: The thorough cleaning of a resident room following discharge or transfer in order to prevent transmission of potentially infectious organisms to the next room occupant.

MRSA Risk Assessment

Purpose

The purpose of the MRSA risk assessment is to evaluate the level of MRSA risk within an LTC facility and to develop facility- and unit-specific strategies to reduce MRSA transmission risk to residents, staff, and visitors.

Key Concepts

- MRSA risk assessment is a part of the LTC infection prevention and control program assessment for the potential of the spread of infection in the facility.
- MRSA risk assessment is based on:
  - information regarding MRSA history of residents (past infections or colonizations)
  - MRSA risk (residents who are in a high-risk group)
  - prevalence of MRSA in units and/or the facility
  - community, state, and national rates of MRSA
- The MRSA risk assessment is reviewed and updated annually.
- The MRSA risk assessment identifies the appropriate data collection for the facility.
- Data collection is ongoing so that trends in MRSA transmission and/or infections are monitored and investigated promptly.
- Evaluation of MRSA risk assessment data is linked to clearly defined outcome or process measures for the management of MRSA in the LTC facility.

Background

Performing a MRSA LTC facility risk assessment is an important first step in determining MRSA prevalence, MRSA transmission level, and unique risk factors within your facility.

The Centers for Medicare & Medicaid Services (CMS) requires a facility's infection control program to monitor and investigate causes of healthcare-associated infection, causes of community-associated infection, and transmission of infections within the facility. The CMS protocols also require timely analysis of infection clusters and increases, identification of changes in prevalent organisms, and performance of an annual risk assessment based on facility data. Surveillance data collected to monitor and investigate infections in the LTC facility provide the basis of the MRSA risk assessment.[1]

The CDC guideline "Management of Multidrug-resistant Organisms (MDRO) in Healthcare Settings, 2006" recommends *routine* monitoring for trends in MRSA (and other MDRO) incidence. Surveillance consistently performed over time and data analysis by appropriate statistical methods will demonstrate trends in resident MRSA acquisition and in rates of MRSA infection.[2]

The CDC MDRO guideline also recommends *intensified* interventions to prevent transmission and infection when incidence or prevalence is not decreasing, despite implementation of and correct adherence to the routine control measures. Surveillance during a period of intensified infection prevention interventions will demonstrate whether the interventions implemented are effective or not.

The elimination of MRSA transmission and the prevention of MRSA infections in an LTC facility require consistent surveillance, ongoing monitoring, and, when appropriate, implementation of enhanced interventions. The LTC facility MRSA risk assessment identifies facility-specific risks and aids in developing effective policies, protocols, and interventions.

MRSA Risk: Location-Specific Factors

Occasionally, MRSA surveillance data is available from local public health departments, or in published data from facilities of similar demographic and geographic characteristics. When available, this data may help to identify possible high-risk groups, populations, or services of relevance to a given LTC facility (see **MRSA Risk Factors** later). However, data on the rates of infections in LTC facilities have not been systematically collected on a national or international level and facility-to-facility comparison of rates is rarely possible because of differences in resident population and nonstandardization of surveillance methods.

MRSA Risk: Resident-Specific Factors

An individual's risk of acquiring MRSA is well-documented in the literature.[3,4] Known patient/resident risk factors include, but are not limited to:

- Severity of illness
- Previous exposure to antimicrobial agents
- Underlying disease conditions, particularly:
  - Chronic renal disease
  - Insulin-dependent diabetes mellitus
  - Peripheral vascular disease
  - Dermatitis or skin lesions
- Invasive procedures, such as:
  - Dialysis
  - Presence of invasive devices
  - Urinary catheterization
  - Ventilators
  - Repeated contact with the healthcare system
  - Previous colonization by an MDRO
  - Advanced age

Specific risk factors that may be related to a facility's geographic or demographic location should also be included in your facility's risk assessment.

Performing the MRSA Risk Assessment

Preparation for the MRSA risk assessment requires identifying and obtaining:

- Administrative support
- Facility technical support
- Resources, such as laboratory and pharmacy capabilities
- Infection prevention and control department staffing and/or hours assigned to infection prevention and control

- Public health support
- Current infection prevention and control interventions (i.e., hand hygiene, Contact Precautions, etc.)
- Measurement parameters for the current interventions
- Comprehensive line list of identified MRSA residents (colonization and infection)
- Facility antibiogram for MRSA (see section on **Antimicrobial Management and Stewardship**)

The baseline determination of the LTC facility's MRSA risk may begin with known MRSA high-risk populations, but the ongoing facility MRSA surveillance may detect other risk groups. Also, the baseline data may identify patient care units (dementia units, ventilator units, rehabilitation units, etc.) and/or other resident groups likely to be at high-risk for colonization or infection. This information is used to validate and, if necessary, *to enhance* facility MRSA surveillance and the overall infection prevention and control program. After the baseline is determined, MRSA surveillance and data evaluation is ongoing and provides the comparative basis for annual assessment, trends, and identification of outbreaks.

MRSA Risk Assessment Outcomes and Measures

When the facility risk assessment shows that transmission and/or infection rates for MRSA are not decreasing, additional infection prevention interventions should be implemented. Consequently, an important aspect of the infection prevention plan is the choice of appropriate and quantifiable outcomes or goals. Clear expectations of the infection control plan implementation must be expressed in measurable terms.

Example of *outcome* measure:

- Decrease in healthcare-associated MRSA infections in the ventilator unit by X% in the next six months

Examples of *process* measures:

- Annual increase in compliance with hand hygiene requirements to the 90% level
- Increase in compliance with Contact Precautions to the 95% level as measured by the monthly isolation compliance monitor

Data Collection Standardization

Data collection necessary for the outcome or process measurements must be clear and appropriate for the measure. If a team of staff members is responsible for data collection, standardize the process so that data collection is consistent and accurate.

Actions Based on Findings

Once the data is collected and evaluated, communicate the results of the outcomes and/or process measurement with the facility quality improvement/assurance committee (or whichever committee is appropriate in a given facility). If the desired outcomes have not been achieved, this committee can convene planning and improvement teams. Key personnel can be added to maximize support and participation (i.e., laboratory, nursing leadership, facility administrator, medical director, pharmacy, rehabilitation director, etc.). It may be advisable to invite infection prevention consultants, infectious disease consultants, and/or physician experts for select situations or interventions (i.e., antimicrobial stewardship, advanced data collection, and evaluation, etc.) in order to evaluate the data or plan an intervention.

After an intervention has been implemented, the MRSA surveillance results are analyzed over time to determine the success of the intervention and improve the process again as necessary. Although a review of process improvement systems is beyond the scope of this section, the reader is encouraged to investigate some of the useful systems that are available (Deming's Plan-Do-Check-Act (PDCA), Six Sigma, Toyota Production System, etc.)

Recommendations

Using the LTC facility-specific MRSA assessment, those responsible for infection prevention and control will perform *any or all* of the following as appropriate to the facility/unit:

- Establish baseline incidence and/or prevalence MRSA rates for the whole facility or for a specific unit using available data (clinical culture, history, screening culture).
- Identify high-risk populations and/or units based on incidence rates, local demographic risk data, or known risk factors from scientifically based evidence.
- Evaluate MRSA data over time for the facility and/or specific units to characterize MRSA prevalence or transmission rates.
- Identify clusters in MRSA transmission in the resident population and/or units to determine if enhanced interventions may be appropriate.
- Based on MRSA surveillance and risk assessment, finalize a MRSA management plan in terms of time and interventions (if needed), allowing enough time to communicate the plan to staff for maximum participation.

Example of the Use of the MRSA Risk Assessment Surveillance to Evaluate Incidence on Resident Unit(s)

Step 1: Utilizing MRSA surveillance data to determine MRSA incidence

Surveillance data is evaluated for new cases of MRSA in each resident unit. This results in a determination of MRSA incidence rate which is used in the facility's Risk Assessment. Transmission of MRSA within the facility setting is assumed if the new case of MRSA meets the LTC facility's case definition* of healthcare-associated MRSA.

**Definition of new onset MRSA case: MRSA isolated from clinical culture obtained more than 48 hours after admission to the unit in a resident who had no signs or symptoms of infection on admission and who has no prior MRSA by culture or by history.*[2]

Incidence calculation:

$$\frac{\text{\# of newly identified MRSA residents on the unit/month}}{\text{\# of resident days on the unit/month}} \times 1{,}000$$

= unit-associated MRSA incidence per 1,000 unit resident days

The baseline incidence for the unit is determined and reported in the risk assessment report. An incidence of MRSA that is higher than expected or desired on the unit, or is not decreasing over time, leads to investigation and intervention as appropriate. Compliance with infection prevention processes is monitored and may need to be enhanced. If compliance with facility infection prevention processes is demonstrated to be very good, additional interventions may be required. Surveillance is continued during the intervention and post intervention periods.

An excellent process for follow-up is available in the IHI "5 Million Lives" campaign, which includes a "Getting Started Kit: Reduce Methicillin-Resistant *Staphylococcus aureus* (MRSA) Infection, How-to Guide."[5]

Step 2: MRSA incidence: assessment and intervention based on results

In the following theoretical example, ongoing surveillance for the MRSA risk assessment reveals that the incidence of MRSA skin and soft tissue infections has increased on the dementia unit.

$$\frac{\text{\# of new MRSA-positive wound infections on the dementia unit}}{\text{\# of resident days on the dementia unit}} \times 1{,}000$$

$$= \text{MRSA rate per 1,000 resident days (dementia unit)}$$

An analysis of data by the infection prevention and control staff confirms that most of the MRSA cases are related to new admissions (culture-positive within 48 hours of admission). Therefore, the increasing rate is not related to transmission on the unit. The number of MRSA-positive residents admitted to this unit may lead to a future MRSA problem if compliance with hand hygiene, Contact Precautions, environmental, and equipment decontamination is inadequate.

Known risk factors in this population include central lines, age, antimicrobial therapy, and wounds. Based on their analysis, members of the infection prevention and control department take the following steps:

- The infection prevention and control risk assessment team communicates its original surveillance findings to the appropriate facility staff. In collaboration with the medical director, the director of nursing and the microbiology laboratory in the infection control department institute an active surveillance culture (ASC) process on this unit in order to determine the magnitude of the MRSA burden for this unit.
- Infection control institutes audits for hand hygiene and Contact Precautions compliance and audits of wound dressing changes.
- MRSA surveillance data and the results from the audits of hand hygiene and Contact Precautions compliance and audits of wound dressing changes are communicated to the unit in a timely manner. Based on the analysis of the enhanced MRSA interventions, checklists for dressing change procedures are created and put in place.

Results: A reduction in MRSA rates for three consecutive quarters is achieved on the dementia unit. The MRSA active surveillance program is discontinued until such time as the rates of MRSA trend above the new baseline.

References

[1] The Long-term Care Survey F-tag# 441 Regulation § 483.65 (a) Infection Control Program Guidance to Surveyors. American Health Care Association, September 2007 edition, pp 619, Appendix PP - Guidance to Surveyors for Long-term Care Facilities Revisions of November 19, 2004 of the CMS Manual System State Operations Provider Certification. Pub. 100-07 Department of Health & Human Services (DHHS), Centers for Medicare & Medicaid Services (CMS). Available online at www.cms.hhs.gov/Transmittals/Downloads/R5SOM.pdf.

[2] Siegel JD, Rhinehart E, Jackson M, Linda C; Healthcare Infection Control Practices Advisory Committee. Management of multidrug-resistant organisms in healthcare settings, 2006. Available online at www.cdc.gov/ncidod/dhqp/pdf/ar/mdroguideline2006.pdf.

[3] Trick WE, Weinstein RA, DeMarais PL, et al. Hospital Infectious Program, Centers for Disease Control and Prevention, Atlanta, Georgia, USA. Colonization of skilled-care facility residents with antimicrobial-resistant pathogens. *J Am Geriatr Soc.* 2001;49(3):270–276.

[4] Hughes CM, Smith MBH, Tunney MM. Infection control strategies for preventing the transmission of Methicillin-resistant *Staphylococcus aureus* (MRSA) in nursing homes for older people. *Cochrane Database Syst Rev.* 2008;1:CD006354. DOI: 10.1002/14651858.CD006354.pub2. This version first published online January 23, 2008 in Issue 1, 2008. Date of most recent substantive amendment: October 17, 2007. Available online at www3.interscience.wiley.com/homepages/106568753/CD006354.pdf.

[5] Institute for Healthcare Improvement (IHI) "5 Million Lives" campaign. Getting Started Kit: Reduce Methicillin-resistant *Staphylococcus aureus* (MRSA) Infection How-to Guide, 2006. Available online at www.ihi.org/ihi.

Other References and Resources

Guide to the Elimination of Methicillin-resistant *Staphylococcus aureus* (MRSA) Transmission in Hospital Settings. An APIC Guide. Association of Professionals in Infection Control and Epidemiology, Inc. (APIC) March 2007. *MRSA Risk Assessment*:13.

Huang SS, Platt R. Risk of Methicillin-resistant *Staphylococcus aureus* infection after previous infection or colonization. *Clin Infect Dis.* 2003;36:281–285.

Infection Control for Long-term Care Facilities. APIC Infection Control Toolkit Series. Developed by the Long-Term Care Task Force.

Perl TM, Pottinger JM, Hewaldt LA. Basics of surveillance: An overview. The Society for Healthcare Epidemiology of America. In: Lautenbach E, *Practical Handbook for Healthcare Epidemiologists*, 2nd ed. Thorofare, NJ: Slack Incorporated; 2004:49.

Sorrentino. Sheila A., Preventing Infection. In: *Mosby's Textbook for Nursing Assistants*, 5th ed. Philadelphia: Mosby Publications; 1999:Chapter 10, pp 219.

Soule, Barbara RN, MPA, CIC. Analyzing Risk and Setting Goals and Objectives for the Infection Control Program: The APIC/JCAHO Infection Control Workbook. Edited by Arias, Kathleen MS, CIC, Soule, Barbara RN, MPA, CIC, Association of Professionals in Infection Control and Epidemiology, Inc. (APIC) Joint Commission Resources; 2006:45.

MRSA Surveillance Cultures

Purpose

The purpose of implementing a MRSA surveillance culture process is to identify colonized MRSA residents in a facility or in a specific unit.

Key Concepts

- Clinical cultures are focused on identifying the pathogen responsible for a specific active infection, not for determining colonization status.
- MRSA surveillance cultures are obtained for the purpose of identifying MDRO colonization.
- The results of active surveillance cultures do not indicate the presence of active infection.
- MRSA surveillance cultures are *not to be used* as a means of denying admission to a facility.
- When MRSA surveillance cultures are available, they can provide data for the annual facility risk assessment.
- When enhanced control efforts are needed in order to manage high rates of MRSA or during outbreaks, MRSA surveillance cultures can be used to track success of the implemented interventions.
- The specimen typically obtained for MRSA surveillance is the nares (primary site), but additional sites such as axilla, groin, and areas of skin disruption (wounds, lines, tubes) may also be cultured if deemed appropriate.

Background

CMS survey protocols for an LTC facility state that a facility's infection control program must have a system to monitor and investigate causes of healthcare-associated infection, of community-associated infection, and the manner of spread or transmission of infections within the facility. In some circumstances, a facility MRSA surveillance culture process may be an appropriate intervention for infection monitoring and/or investigations of MRSA transmission.

The CDC/HICPAC guideline "Management of Multidrug-resistant Organisms in Healthcare Settings, 2006" recommends a two-tiered approach to the management of MDRO in healthcare settings.[1]

- Tier One: Routine surveillance activities that can identify evolving MRSA problems (e.g., increased MRSA transmission) and safeguards for managing unidentified MRSA carriers.
- Tier Two: Enhanced control efforts used when incidence or prevalence is not decreasing despite implementation of, and good adherence to, the routine infection control measures. An LTC facility may want to consider MRSA screening as a tool when increasing numbers of MRSA-colonized residents are identified, or there is an increase in the number of MRSA-related infections.

Although there are few LTC facilities that have implemented active surveillance programs as a general (Tier One) requirement of the facility infection prevention and control program, it is one possible appropriate intervention when action is needed to manage a MRSA outbreak or if MRSA rates are found to be increasing.

Regulations and Guidelines on MRSA Surveillance Cultures

Although there are currently no regulations that mandate obtaining active surveillance cultures for MRSA, it is relevant to review regulations and guidelines that may impact decisions to use MRSA screening cultures.[2]

Certain states have enacted laws requiring active surveillance cultures in hospitals. As increasing numbers of MRSA-colonized LTC residents are identified outside of the LTC facility (i.e., during hospitalization), the MRSA-positive culture results must be communicated to the LTC facility. An LTC facility that admits a resident from a hospital in a state that requires hospitals to screen for MRSA must be aware of the possibility of MRSA screens done in the hospital and take steps to obtain any MRSA screen results.

Resident MRSA Surveillance Cultures

A recent Cochrane review noted that there is little data on the effectiveness of MRSA interventions in LTC facilities.[3] In light of this finding, the authors make the following comment:

> The current lack of research evidence, to inform practice in nursing homes, forces a reliance on evidence and guidelines derived in other settings. Screening those at risk of MRSA (i.e., recent admissions from hospital) may be part of any pragmatic approach adopted in the nursing home environment.

To date, there is some promising data from hospitals that have been able to justify an ongoing program of universal MRSA screening based on risk assessment.[4–6] These programs have required increased availability of resources (supplies and personnel), medical and clinical staff support, and development of a strong business case for the program.[7–9]

Universal MRSA Screening Cultures

One option for a MRSA screening program is universal screens on all admissions. The advantage to universal screening is that it eliminates the need for the complex process of identifying and promptly obtaining cultures from subsets of residents who are eligible for MRSA screening.[10] A major disadvantage is the cost to the facility, which includes expenses related to cultures, staff, resources, and the additional requirements for data accrual and evaluation. If such an undertaking is contemplated, careful planning is required. All facets of such planning, including management and cost allocation for needed resources in hospitals, are examined by Diekema and Edmond.[11] This has not been thoroughly examined in LTC.

Targeted MRSA Screening Cultures

Another option for the LTC facility that has decided to implement a MRSA screening process is targeted MRSA screens. This type of MRSA screening process will be useful in the determination of incidence and/or prevalence of MRSA in the facility. Additionally, this could be used to evaluate the success of an intervention that was implemented in response to increased MRSA infections or a MRSA outbreak.

Examples of short-term MRSA screening programs include:

- Determining incidence or prevalence for the facility or for a particular unit or services
- Getting a baseline MRSA determination for a facility risk assessment
- During implementation of a process change (i.e., opening a new service or facility)
- During implementation of an intervention developed to reduce MRSA rates (see Tier Two interventions in previous **Background** section)

Examples of long-term MRSA screening processes include:

- Interventions for a recognized increased incidence of MRSA infection or MRSA transmission
- Facility- or unit-specific outbreak
- Known continuous influx of residents from high-risk groups

Whether the screening process will be short- or long-term, implementation must be carefully thought out and must be relevant to the reasons that the MRSA screening process was implemented.

Importance of Communication about MRSA Screening

Physicians and healthcare providers view microbiologic cultures as tools in the management of a patient's clinical condition. Surveillance cultures, however, are tools used in infection prevention and control efforts. Therefore, effective communication and collaboration with medical and clinical staff is crucial to the success of the program. Provide a notification letter to physicians if a MRSA screening process is implemented in the facility.

Residents and families have the right to know and understand the reasons for active surveillance culture. Resident and/or family letters that explain surveillance cultures, as well as readily available MRSA fact sheets, are helpful components of the MRSA screening program. Resident and family satisfaction regarding care can be enhanced when the communication is clear and questions are honestly and correctly answered. A dialogue with a point person from a resident's family can be vital for information and clarification. Consider developing informational scripts for resident caregivers to guide their discussions with the resident and family.

Results and Reports

In order for the MRSA surveillance process to be useful in the LTC facility, results and reports must be shared and discussed with key stakeholders, often as a report from the multidisciplinary quality team. For example, increasing incidence of MRSA on a unit would be shared and discussed with unit staff so that process improvements could be initiated. MRSA specimen collection compliance monitor reports should be shared with the team responsible for developing the collection process so that successes are recognized, and poor compliance improved. See page 21 for example of screening culture compliance monitor.

Recommendations

1. Facility MRSA surveillance cultures can be used by the facility to establish baseline data when developing the facility's annual risk assessment.
2. If the facility's annual risk assessment determined that there is a high rate of MRSA transmission, or during MRSA outbreaks, targeted facility-wide surveillance cultures can be used to enhance infection control interventions.
3. MRSA active surveillance cultures should not be used as a way to deny admission of a prospective resident.
4. If the facility chooses to perform active MRSA surveillance, communication with facility administration, healthcare providers, residents and their family members is essential.

References

[1] Siegel JD, Rhinehart E, Jackson M, Linda C; Healthcare Infection Control Practices Advisory Committee. Management of multidrug-resistant organisms in healthcare settings, 2006. Available online at http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf.

[2] Weber SG, Huang SS, Oriola S, et al. Legislative mandates for use of active surveillance cultures to screen for methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococci: Position statement from the joint SHEA and APIC task force. *Infect Control Hosp Epidemiol.* 2007;28:249–260.

[3] Hughes CM, Smith MBH, Tunney MM. Infection control strategies for preventing the transmission of meticillin-resistant Staphylococcus aureus (MRSA) in nursing homes for older people. *Cochrane Database Syst Rev* 2008;1. This version first published online January 23, 2008 in Issue 1, 2008. Date of most recent substantive amendment October 17, 2007. Available online at http://www3.interscience.wiley.com/homepages/106568753/CD006354.pdf

[4] Robicsek A, Beaumont JL, Paule SM, et al. Universal surveillance for methicillin-resistant Staphylococcus aureus in 3 affiliated hospitals. *Ann Intern Med.* 2008;148(6):409–418.

[5] Jernigan JA, Clemence MA, Stott GA, et al. Control of methicillin-resistant *Staphylococcus aureus* at a university hospital: one decade later. *Infect Control Hosp Epidemiol.* 1995;16:686–696.

[6] Cunningham R, Jenks P, Northwood J, et al. Effect on MRSA transmission of rapid PCR testing of patients admitted to critical care. *J Hosp Infect.* 2007;65:24–28.

[7] Warren DK, Guth RM, Coopersmith CM, et al. Impact of a methicillin-resistant *Staphylococcus aureus* active surveillance program on contact precaution utilization in a surgical intensive care unit. *Crit Care Med.* 2007;35:430–434.

[8] Robicsek A. Designing a program to eliminate MRSA transmission part II: making the business case. APIC webinar; January 10, 2007. Available online at *http://www.apic.org/Content/NavigationMenu/Education/Webinars/070110_robicsek.pdf.* Accessed February 27, 2007.

[9] Muto C. Designing a program to eliminate MRSA transmission part I: making the clinical case. APIC webinar; December 6, 2006. Available online at http://www.apic.org/Content/NavigationMenu/Education/Webinars/061206_muto.pdf. Accessed February 27, 2007.

[10] Ogle AM. The Role of Surveillance in a Successful Program to Eliminate MRSA Transmission. APIC webinar; February 7, 2007.

[11] Diekema DJ, Edmond MB. Look before you leap: Active surveillance for multidrug-resistant organisms. *CID.* 2007:44 (15 April)

Other References and Resources

Toth M, Norstrand P. Workplace cultural transformation—using Positive Deviance to eliminate MRSA transmission. APIC webinar; January 24, 2007.

Collection and Laboratory Considerations: Resident MRSA Surveillance Culture

Purpose

To outline the specimen collection and laboratory considerations of a MRSA screening culture process.

Key Concepts

- A nasal specimen is the primary means for detecting MRSA colonization, but other specimen sites may be appropriate based on resident characteristics, i.e., infection history.
- Accurate culture results require appropriate and standardized specimen collection.
- Specifics of different laboratory culture or test types for MRSA must be considered in the MRSA management program.
- MRSA data collection is an essential component of MRSA management.
- If MRSA surveillance is being done, specimen collection compliance should be monitored.

MRSA Screening Culture Specimens: Basic Consideration

Residents who have a MRSA infection will be positive for MRSA at the site of the infection, and may also be colonized at other body sites. Residents who are colonized carry MRSA in one or more sites that may include the nose, throat, groin, axilla, nonintact skin surfaces, and skin/tube interfaces (including tracheotomy sites and percutaneous feeding tubes).

The colonization site most often cultured to detect MRSA colonization is the anterior nares. Culturing additional sites such as the groin, axilla, or throat will increase the sensitivity of ASC screens. However, additional screens may be impractical in terms of cost, time, resources and results.[1]

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

Specimen Collection from the Nose (Anterior Nares)

The following is one example* of a nasal specimen collection procedure.

1. Use a sterile standard culture swab to obtain the specimen.
2. Culture both anterior nares (inner nose surfaces) utilizing one culture swab.
3. Rotate moistened swab in each nares two to five times clockwise and counterclockwise.
4. The process should gently rub across the nasal mucous membranes about three-fourths of an inch into the nasal passage (adult) so that squamous epithelial cells from the inside of the nose are obtained.
5. When obtaining specimens from residents with dementia or memory loss, choose a time that is least distressing for the resident.

**Regardless of the steps in this example, it is important to follow any manufacturer's instructions specific to the MRSA test methodology for nasal specimen collection if available.*

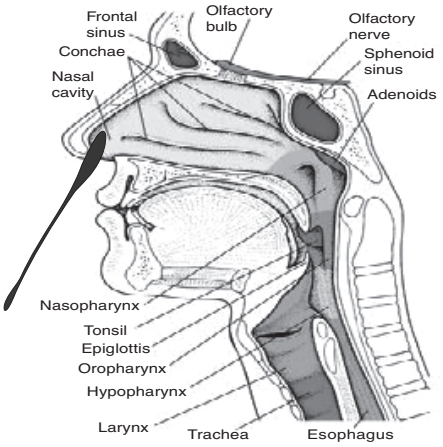

Figure 5.1. Correct nasal specimen collection procedure. Adapted from the Merek Manual online—Second Home Edition.

MRSA Screening Culture Specimens: Laboratory Testing

If the LTC facility has a choice of testing from its contracted microbiology laboratory, its staff must know about testing regimens currently available for MRSA nasal screens in order to make the decision which option to use.

1. Routine culture: Results are available in 48 hours if negative, but may take as long as three to four days if MRSA is present.
2. Screening culture: Selective media for MRSA can identify MRSA from a nasal specimen in 24 to 48 hours without requiring any additional tests. This may be more expensive than a routine culture.[2]
3. Rapid MRSA assays (PCR technology): Rapid assays have the potential for results in two hours if testing is done immediately on receipt, but longer (6–24 hours) if done as batched tests. These tests cost more than conventional and selective culture methods.[3]

An important MRSA surveillance consideration when comparing these methodologies is the *length of time* it takes to get results. The other important consideration is the difference in cost between the methodologies.

Specimen Collection Process

Prior to implementing an ASC program, it is necessary to develop a process that will have a high rate of compliance with collection. To determine the best process, use a team approach and include representative members from all departments that play a role. For instance, if MRSA screens will be collected on residents as part of a program to identify MRSA prevalence on admission to a specific unit, a team may decide to have pre-made Admission MRSA Collection kits that include instructions and supplies.

Option: Admission MRSA Collection Kits

The use of a pre-made MRSA collection kit may help to standardize the collection process. For example, if a facility has implemented MRSA screens on admission to the facility or to a particular unit, the kit can be part of the admission process.

A MRSA collection kit may include any or all of the following (possibly packaged in a large zipper storage bag):

- MRSA collection instruction sheet
- MRSA order information
- Culture swab
- Specimen bag
- Patient Information Letter *MRSA Screening*
- Collection information form (name, date, time) to be filled out when specimen is obtained and then sent to infection control (or a designated data compliance monitor)

Data Collection Process

Standardized tools should be used for data collection. Collect information on compliance with collecting the screens and share the results with the team to track compliance and demonstrate improvement when compliance is not at the level expected.

Example of a MRSA Screening Culture Line Listing and Compliance Monitor

Step 1

This is an example of a simple form that can be used to collect data on all patients admitted to a specific unit that is performing ASC on admit and on discharge from unit.

Active Surveillance Culture Collection Log: Compliance Monitor					
Resident Identifier	Admit Date to Unit	Date of ASC Collection	ASC Results/Date	Discharge or Transfer Date from Unit	Discharge ASC Date/Results

Step 2

Using the Compliance Monitor results, a monthly graph of collection compliance was created. The team's expectation for compliance with collecting ASC is >90% for both admission and discharge from unit screens. They tracked compliance for 6 months and used results to drive an improvement effort.

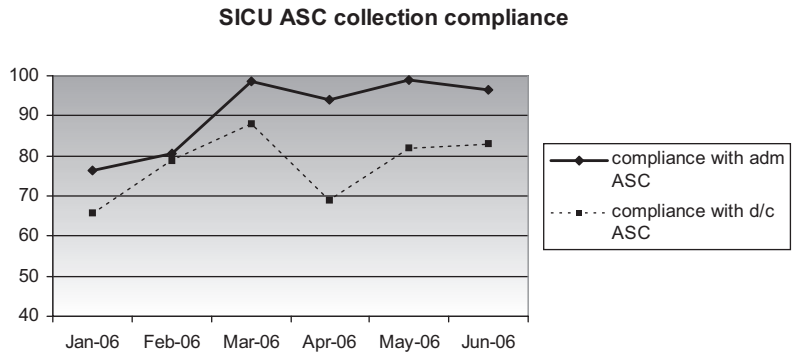

Figure 5.2. Sample SICU ASC collection compliance.

Discussion: team should work to improve the process of obtaining discharge surveillance cultures.

Timing of Specimen Collection for MRSA Surveillance (Screening) Based on Type of Investigation

A basic MRSA screening culture program may include a nasal swab of candidate residents at the time of admission to the facility or unit, and at the time of discharge or transfer from the facility or unit.

Example 1: Prevalence Study

Collect MRSA screening specimens
- at the time of admission to the facility or unit
- at the time of discharge or transfer from the facility or unit

$$\frac{\text{number of positive MRSA screens}}{\text{\# of resident days on the unit/month}}$$

Example 2: Unit-specific incidence study

This captures important data when lengths of stays are extended and during outbreak situations. It shows the number of new cases within a specified time period divided by the size of the population initially at risk.

Collect MRSA screens in the unit
- at the time of admission to the unit
- at the time of discharge or transfer from the unit
- collect ASC on every resident once a week (pick a weekday that works best for the unit)

$$\frac{\text{number of new MRSA-positive screens in a given timeframe}}{\text{number of at-risk residents (not MRSA-positive) during the given timeframe}}$$

There may be other options that better suit the needs of a given ASC program. Timing of specimen collections should be customized to meet surveillance and/or intervention needs.

References

[1] Diekema DJ, Edmond MB. Look before you leap: active surveillance for multidrug-resistant organisms. *Clin Infect Dis.* 2007;44(8):1101–1107.

[2] Loulergue J, de Giallully C, Morange V, et al. Evaluation of a new chromogenic medium for isolation and presumptive identification of Methicillin-resistant *Staphylococcus aureus* from human clinical specimens. *Eur J Clin Microbiol Infect Dis.* 2006;25:407–409.

[3] Cunningham R, Jenks P, Northwood J, et al. Effect on MRSA transmission of rapid PCR testing of patients admitted to critical care. *J Hosp Infect.* 2007;65:24–28.

Other References and Resources

APIC MRSA Elimination Webinar Series. Available at www.apic.org/store.

Ogle AM. The Role of Surveillance in a Successful Program to Eliminate MRSA Transmission. APIC webinar; February 7, 2007.

Siegel JD, Rhinehart E, Jackson M, Chiarello L; Healthcare Infection Control Practices Advisory Committee. Management of Multidrug-resistant Organisms in Healthcare Settings, 2006. Available online at www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf.

Management of MRSA-Positive Residents: Resident Placement

Purpose

Appropriate room placement of LTC residents is a critical first step in preventing the transmission of MRSA and reducing the risk of infections due to MRSA within your facility. Selecting the correct roommate, based on key variables, will protect the facility's population and improve resident safety.

Background

Residents of LTC facilities often have underlying factors that put them at risk for MRSA colonization and infection. These factors include, but are not limited to, age, immune status, close living quarters, underlying conditions, medications, invasive devices, frequent transfers to different levels of medical care, and personal hygiene. (See **Risk Assessment**.) It has been well-documented that the residents of an LTC facility can comprise a significant reservoir of MRSA colonization. Therefore, effective resident placement should be employed at the time of admission to reduce the risk of transmission of MRSA that may occur with colonized and actively infected residents. The CDC/HICPAC guideline documents are appropriate resources for developing policies related to infection prevention and control in long-term care.

CDC/HICPAC recommendations for patient placement (2006 MDRO guideline):
V.A.5.g. Patient placement in hospitals and LTCFs

V.A.5.g.i. When single-patient rooms are available, assign priority for these rooms to patients with known or suspected MDRO colonization or infection. Give highest priority to those patients who have conditions that may facilitate transmission, i.e., uncontained secretions or excretions.

V.A.5.g.ii. When single-patient rooms are not available, cohort patients with the same MDRO in the same room or patient-care area.

V.A.5.g.iii. When cohorting patients with the same MDRO is not possible, place MDRO patients in rooms with patients who are at low risk for acquisition of MDROs and associated adverse outcomes from infection, and are likely to have short lengths of stay.

See recommendations on Standard and Transmission-based Precautions for those aspects of resident room placement.

Key Concepts

- The MRSA status of newly admitted/readmitted residents should be assessed and documented upon admission to the LTC facility.
- A process to track MRSA-positive residents throughout their stay must be maintained.
- Appropriate room placement will protect existing residents from transmission of MRSA while providing for their physiological needs.
- A resident's ability to comply with good personal hygiene is considered when selecting appropriate room placement.
- MRSA colonization or infection should never be used as a reason for denial of admission to an LTC facility.

MRSA Admission Status

Because admissions come from a variety of settings (hospitals, other long-term care facilities, and the community), it is important to gather as much history as possible pertaining to a resident's MRSA history, current colonization, or active MRSA infection during the admission process to ensure proper resident placement decisions. This information may be historical or may be in the form of a positive MRSA screening result or a MRSA active infection (clinical) culture.

MRSA Resident Tracking (Flagging) and Communication

Presence of MRSA colonization is not a static situation (meaning that the presence of colonization can vary or change over time) so a flagging or tracking system for residents who have a history of MRSA should be implemented. This list must be readily available to the infection preventionist and the admissions office.

The most commonly used flagging system is the line listing. The list should be updated when new clinical or screening culture results are available. When available, electronic flagging in the resident's medical record information system is a very helpful alternative to the manual line listing.

A resident's MRSA history is essential information at the time of admission to a healthcare facility and at the time of discharge of the patient to another service or healthcare facility. The line listing may include other MDRO and significant pathogens. **When discharging a resident to another level of care, the MRSA status information that you received upon admission and any changes while the resident was under your care should be communicated to the next caregiver.**

Example of a Resident Line Listing

Admissions/Infection Control Line Listing
Admission Instructions: Update at time of admission/readmission of residents who are known to have infectious condition or multidrug-resistant organism history. **Notify Infection Control, ext. 0000.**

Infection Control: Update when resident culture is positive for infectious disease or multidrug-resistant organism.

Name/ Room	Unit	Admit/ Readmit date	Symptoms/ Site	Culture Result/ Date/Site	Treatment	Actions	Resolved?	Condition/ Diagnosis
Missy Muffet room 202	2A	1/1/07	none	long history	none	contact precautions (VRE, ESBL)	history only - VRE colonized	HX of MRSA, VRE, C. diff, and ESBL
Willy Winky room 108	1B	10/1/08	diarrhea and UTI	12/25/2007	on antibiotics start 12/24-1/6/08	contact precautions	C. diff resolved 1/3/08	C. diff stool MRSA urine
Tom Thumb room 210	2B	1/11/08	infected wounds	1/9/2008 (obtained at hospital)	on antibiotics	contact precautions		cellulitis MRSA
Jane Doe room 301	3J	12/3/08	infected wounds	1/15/2008	treatment complete 1/23/08	contact precautions - d/c 1/23/08	yes	cellulitis MRSA

Room Placement: Balancing Resident Needs with Potential Risks to Other Residents

Recommendations for placement of patients with MRSA colonization and infection within a hospital are very straightforward—a private room is preferred. Recommendations for placement within an LTC facility are not as clear cut. Some guidance on the use of Contact Precautions in an LTC facility is given in the CDC/HICPAC Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings, 2007:

> Make decisions regarding patient placement on a case-by-case basis, balancing infection risks to other patients in the room, the presence of risk factors that increase the likelihood of transmission, and the potential adverse psychological impact on the infected or colonized patient.

The safety of *all* residents is one of the infection preventionist's fundamental responsibilities. These guidelines for resident placement should only be modified when the risk of MRSA transmission within the facility is very low, as validated by the facility risk assessment.

Personal Hygiene: A Resident's Cognitive Ability to Comply with Infection Prevention Measures

Room placement for a resident (colonized or active infection) who cannot maintain personal and environmental hygiene is a challenge, especially if the resident suffers from a type of dementia or other condition that limits his or her ability to comply with good personal hygiene. If the resident either cannot or will not follow daily personal cleaning or hand hygiene, he or she poses an increased risk of transmission to residents and the environment. Due to this increase in potential MRSA transmission, creative room placement or other interventions may be necessary to diminish the increased risk. In resident-centered eldercare, resident and family members are encouraged to play active roles in resident decisions and care while in the facility. The resident's family and visitors can be educated to assist the resident with the care plan implemented to prevent the risk of transmission of MRSA.

Regulatory Standards

MRSA colonization and/or infection history should not be used as a reason to deny admission to an LTC facility. Every attempt should be made to locate an appropriate room and/or roommate. Denial of any admission can occur if an appropriate precaution room or roommate cannot be located. The LTC facility must be in compliance with federal and state regulatory agencies. **All LTC facilities should have a copy of standards and regulations applicable in their state to assure compliance with specific infection control requirements.**

In Subpart B, section 483.65 (infection control) of the CMS requirements for an LTC facility, it states that the facility must establish and maintain an infection control program which will prevent the spread of infection. A component of this requirement is that "when the infection control program determines that a resident needs isolation to prevent the spread of infection, the facility must isolate the resident."

OBRA mandated that CMS develop a survey process for LTC facilities. The section in the CMS requirements for infection control is as follows:

Code of Federal Regulations
[Title 42, Volume 3]
[Revised as of October 1, 2002]
From the U.S. Government Printing Office via GPO Access
[CITE: 42CFR483.65]
[Page 514-515]
TITLE 42--PUBLIC HEALTH
CHAPTER IV--CENTERS FOR MEDICARE & MEDICAID SERVICES, DEPARTMENT OF HEALTH AND HUMAN SERVICES

PART 483--REQUIREMENTS FOR STATES AND LONG-TERM CARE FACILITIES--Table of Contents

Subpart B—Requirements for Long-term Care Facilities

Sec. 483.65 Infection Control.

The facility must establish and maintain an infection control program designed to provide a safe, sanitary, and comfortable environment and to help prevent the development and transmission of disease and infection.

(a) Infection control program. The facility must establish an infection control program under which it:

(1) Investigates, controls, and prevents infections in the facility;

(2) Decides what procedures, such as isolation, should be applied to an individual resident; and

(3) Maintains a record of incidents and corrective actions related to infections.

(b) Preventing spread of infection.

(1) When the infection control program determines that a resident needs isolation to prevent the spread of infection, the facility must isolate the resident.

(2) The facility must prohibit employees with a communicable disease or infected skin lesions from direct contact with residents or their food, if direct contact will transmit the disease.

(3) The facility must require staff to wash their hands after each direct resident contact for which hand washing is indicated by accepted professional practice.

(c) Linens. Personnel must handle, store, process, and transport linens so as to prevent the spread of infection.

[56 FR 48876, Sept. 26, 1991, as amended at 57 FR 43925, Sept. 23, 1992]

Room Placement Recommendations

Single Rooms for Known MRSA-Positive Residents

Single resident rooms are always preferred for residents who are infected or colonized with MRSA.* However, most LTC facilities do not have adequate single rooms to accommodate their MRSA population, so it is necessary to assess each patient for the appropriate placement of the MRSA-positive resident with a roommate.

See **Transmission-Based Precautions section for information regarding appropriate contact precautions placement.*

Facility Units with Low Risk of MRSA Transmission

If the risk assessment shows that units within a facility can demonstrate a low risk of MRSA acquisition, colonized residents or residents with a previous history of a resolved active MRSA infection may be roomed with residents who have no MRSA history if they have no portals of exit (e.g., open wounds, G-tubes, IV, Foley catheters, etc.) and have good personal hygiene. *This provision excludes units that care for more acute residents, such as ventilator or joint replacement units.*

Other Room Placement Considerations: High or Unknown Risk of MRSA Transmission, LTAC, Skilled Nursing Units

1. Cohorting with a known MRSA-positive patient.
If a single room is unavailable, cohort residents with the same organism in the same room. Admissions and infection control can determine *most* appropriate roommates by referring to the line listing of previously positive MRSA residents.

2. Cohorting with a patient whose MRSA status is unknown or who is negative for MRSA.
If the first cohorting option is not possible, a resident can be placed with another resident who is at low risk for acquiring a MRSA infection. This type of placement is based on several factors, including whether the MRSA-positive resident's roommate has:

- Respiratory illness
- Open skin areas
- Gastrostomy tube
- Intravenous fluids
- Indwelling catheters
- Any uncontained excretions or secretions
- Any comorbidity that renders them more vulnerable to infection (This option should not be used when there is a significant risk that the MRSA-positive resident may be a risk for transmission.)

3. Cohorting a MRSA-colonized or infected resident with a known VRE-colonized or infected resident.
MRSA-colonized or infected residents are **never** placed with VRE colonized or infected residents, since this is a known risk for the development of Vancomycin Resistant *Staphylococcus aureus* (VRSA).

4. Cohorting a MRSA-colonized or infected resident with a known MDRO-colonized or infected resident.
MRSA-colonized or infected residents who have an infection with an additional MDRO (VRE, ESBL *E. coli*, multidrug-resistant pseudomonas, etc.) must not be cohorted with a known MRSA patient due to the risk of transmission of the other MDRO. If a private room is not available, he or she can only be cohorted with another resident who has an infection or colonization with like organisms.

Based on HICPAC guidelines, a simple to follow, general flow chart may look like this:

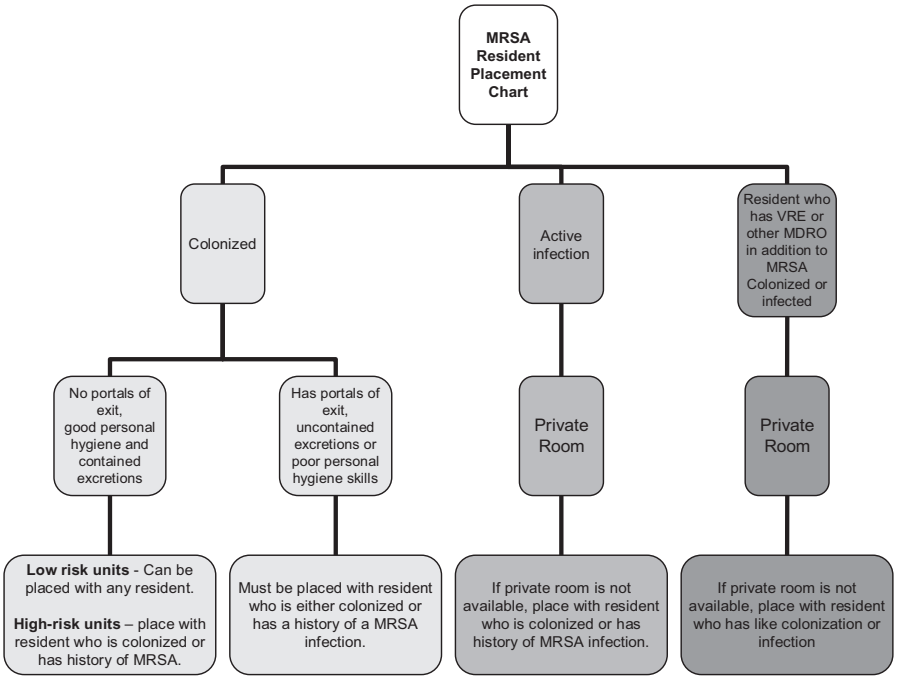

Figure 6.1. Example of an LTC facility MRSA resident placement chart.

Other References and Resources

Report of the Iowa Antibiotic Resistance Task Force - Public Health Guide, 2nd ed. Fall 2004. Available online at www.idph.state.ia.us/adper/common/pdf/cade/antibioticreport.pdf.

Siegel JD, Rhinehart E, Jackson M, Chiarello L; the Healthcare Infection Control Practices Advisory Committee. Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings, June 2007. Available online at www.cdc.gov/ncidod/dhqp/pdf/isolation2007.pdf.

Siegel JD, Rhinehart E, Jackson M, Chiarello L; Healthcare Infection Control Practices Advisory Committee. Management of Multidrug-resistant Organisms in Healthcare Settings, 2006. Available online at www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf.

Smith P, Bennett G, Bradley S, et al. APIC/SHEA Guideline: Infection prevention and control in the long-term facility. *Am J Infect Control.* 2008;36(7):504–535.

Standard Precautions

Purpose

Standard Precautions are comprised of the basic and necessary steps that all employees, residents, and visitors of an LTC facility must follow to prevent transmission or acquisition of infectious agents in the healthcare setting.

Key Concepts

- Standard Precautions is an infection prevention strategy used with all residents, all of the time, regardless of suspected or confirmed infection status.
- Standard Precautions ensures that handling of blood and body fluids is done in a manner that protects residents, visitors, and staff.
- Standard Precautions protects residents by ensuring that contaminated hands and equipment are cleaned and/or disinfected prior to use.
- Standard Precautions protects facility staff by ensuring that personal protective equipment (PPE)is always available when contact with blood or body fluids is anticipated.

Background

Standard Precautions combines the major features of Universal Precautions (UP) and Body Substance Isolation (BSI). It is based on the principle that all blood, body fluids, secretions, and excretions (except sweat); nonintact skin; and mucous membranes may contain or be contaminated with transmissible infectious agents. Standard Precautions includes a group of infection prevention practices that apply to all residents, *regardless of suspected or confirmed infection status*, in any setting in which healthcare is delivered.[1,2]

Components of Standard Precautions

The prevention practices include adherence to hand hygiene standards; use of gloves, gown, mask, eye protection, or face shield *as appropriate to the anticipated exposure*; and safe injection practices. PPE, including gloves, masks, gowns, and eyewear, must be readily available throughout the facility to ensure that staff have the "tools" needed to comply with Standard Precautions.

Standard Precautions also addresses contaminated equipment or items in the resident environment. Handle contaminated equipment in a manner to prevent transmission of infectious agents. Proper handling includes the use of gloves and other appropriate PPE for direct contact with contaminated equipment. Heavily soiled reusable equipment must be immediately contained, bagged if appropriate, and removed to soiled utility rooms for thorough cleaning and disinfecting or sterilizing before use on another resident. (See the **Environment and Equipment Cleaning and Disinfection** section.)

Standard Precautions was updated in the HICPAC "2007 Guideline for Isolation Precautions" to include respiratory etiquette, a strategy for reducing the risk of respiratory infection spread. It includes:

- Educating healthcare facility staff, residents, and visitors about the risk of spread of respiratory infections in the healthcare setting
- Posting signs with instructions to residents and accompanying family members or friends

- Methods to control respiratory secretions (covering the mouth/nose with a tissue when coughing and prompt disposal of used tissues, using surgical masks on the coughing person when tolerated and appropriate)
- Hand hygiene after contact with respiratory secretions
- Maintaining a minimum of three-foot separation from persons with respiratory infections in common areas

When respiratory etiquette is universally used throughout a facility, it can mitigate the risk of MRSA spread, especially from unknown MRSA reservoirs. Refer to the current CDC/HICPAC *Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings 2007* for a complete discussion and list of recommendations related to Standard Precautions.[1] Signage, posters, and informational pamphlets for healthcare workers and visitors (hand hygiene, respiratory etiquette) also can be downloaded from the CDC at www.cdc.gov.

Staff Education and Training on Standard Precautions in the LTC facility

The use of Standard Precautions during resident care is determined by the nature of the healthcare worker (HCW)-resident interaction and the extent of anticipated blood, body fluid, or pathogen exposure. Education must focus on the crucial elements of Standard Precautions that are the principles and rationale for recommended practices. Training related to facility protocols and to the correct use of appropriate PPE will facilitate appropriate decision-making and promote adherence when HCWs are faced with new circumstances. Standard Precautions is an essential element of orientation and annual education and competencies.

Expected Outcomes Related to Standard Precautions

The use of Standard Precautions is intended to protect residents by ensuring that healthcare personnel do not transmit infectious agents to residents via their hands or equipment used during resident care.

The use of Standard Precautions is intended to protect staff and visitors by ensuring that potentially infectious agents are not acquired when visiting, working with, caring for, and interacting with residents.

Impact of Standard Precautions on MRSA Management in LTC

Unless an LTC facility has a program of culturing residents for MRSA colonization, the status of a resident is often unknown. Residents of LTC can be expected to have some level of risk of acquiring MRSA related to individual specific risk factors, including the likelihood of multiple experiences in different healthcare settings. There are a growing number of hospitals that are employing surveillance cultures to determine the MRSA status of newly admitted residents. This practice is usually not employed in the LTC facility due to the high cost and lack of resources to maintain such a program. Therefore, LTC facilities do not always know the MRSA status of all their residents.

In order to minimize the risk associated with unknown reservoir of MRSA residents, staff must strictly comply with Standard Precautions when caring for every resident.

In addition to Standard Precautions, Contact Precautions should be used when risk of MRSA transmission is recognized. See **Contact Precautions** and **Resident Placement** sections for further information.

Standard Precautions Recommendations: Hand Hygiene

Hand hygiene is the cornerstone of any infection control program and plays an integral role in reducing the transmission and occurrence of infection. All healthcare facilities must have comprehensive hand hygiene programs. The importance of

hand hygiene in the elimination of MRSA transmission cannot be overstated. Guidelines for implementing a hand hygiene program have been published by the CDC and by the World Health Organization (WHO).

Hand Hygiene is Important for Staff

Follow CDC or WHO recommendations for hand hygiene.

The "CDC Guideline for Hand Hygiene in Healthcare Settings, 2002" includes the following major components.[3]

1. Implement a hand hygiene program, including all levels of healthcare providers and other patient contact workers.
2. Ask visitors to wash their hands or use an alcohol-based hand rub on entering and leaving the room.
3. Wear gloves for all contact with blood, body fluids, and moist body surfaces. Remove gloves after caring for a patient, when moving from a dirty to clean site on same patient, and before care of the next patient.
4. Wash hands or use an alcohol-based hand product after removing gloves.
5. Perform hand hygiene before and after contact with a patient.
6. Perform hand hygiene before and after contact with the patient's environment.
7. Monitor compliance with hand hygiene for all levels of staff. Provide feedback of rates based on observations or volume of hand hygiene products used.
8. Make improved hand-hygiene adherence an institutional priority and provide appropriate administrative support and financial resources.

Hand Hygiene Options

Option 1: soap and water

1. Before and after contact with resident or resident's environment
2. When hands are visibly soiled
3. After using the restroom

Option 2: alcohol hand hygiene products

1. Before and after contact with resident or resident's environment
2. Do not use if hands are visibly soiled

There are many good references and educational materials on appropriate techniques for hand hygiene which can be used for staff and resident education. The following illustration highlights the importance of GOOD hand hygiene and the ineffectiveness of it if not done properly.

Hand Hygiene is Important for Residents

Good resident compliance with personal hand hygiene has been proven to significantly reduce the transmission of MRSA. This should be encouraged whenever a resident's hands are contaminated through contact with their person or their environment. Residents who have trouble following good personal hygiene should be encouraged to clean their hands throughout the day to reduce risk of transmission.

Hand Hygiene is Important for Visitors

Visitors or family members may not be aware of the importance of hand hygiene when they come to your facility. Often, they have direct contact with residents or the environment, providing a vehicle for potential infection transmission. Education on how and when to perform hand hygiene should be easily available throughout the

facility. An informational sheet and/or signage with hand hygiene illustrations provide good encouragement in addition to verbal reminders from residents and staff.

Additional hand hygeine resources are available online at www.apic.org/eliminationguides.

Hand Hygiene Monitors and Hand Hygiene Compliance

Compliance with elements of Standard Precautions of hand hygiene and in any healthcare setting begins with effective education. Staff and visitors must be provided well-designed (using appropriate language and visual aids) educational resources on components of Standard Precautions/hand hygiene. Annual staff mandatory education must include review of elements of Standard Precautions and a staff competency on hand hygiene (i.e., return demonstration).

Hand hygiene monitors are important elements of a compliance program also. Immediate feedback during monitoring, as well as unit-specific and facility reports of (hopefully wonderful) hand hygiene compliance must be shared with staff. There are many options for engaging staff in improving hand hygiene compliance—some of which are fun as well as effective. Consider sharing hand hygiene results at staff meetings and then challenging staff to devise interventions for improvement. Interventions may be educational and fun (contests for the best hand hygiene posters, developing hand hygiene screen savers, organizing a "glow germ" demonstration for a safety fair).

After any intervention is implemented, results of hand hygiene compliance should again be compiled and shared with staff. It is usually necessary to rotate interventions and monitor results in order to sustain improvements in hand hygiene.

*See **Appendix E** for an example of a hand hygiene monitoring tool.*

Standard Precautions Recommendations: Personal Protective Equipment

A colonized or infected MRSA resident, especially one who has impaired cognition or certain other conditions, has a much greater chance of contaminating the facility's environment when compared to a resident who has good personal hygiene. Proper use of PPE serves to provide a barrier between staff and potentially infectious substances associated with the resident or resident environment. Take into account the personal hygiene and mental status of residents when making the decisions to use PPE and to follow specific Standard Precautions procedures.

General Considerations

1. PPE (gloves, gown, and/or mask) is worn when contact with blood and body fluids is anticipated.
2. Train staff to safely remove PPE to prevent contamination of person or environment.
3. Remove PPE before leaving the resident's room and discard in an appropriate waste container.
4. Perform hand hygiene after PPE removal.

Glove-Specific Considerations

1. Wear gloves as appropriate during direct care of the resident.
2. Limit surfaces and items touched when wearing gloves that may have become contaminated.
3. Keep gloved hands away from the face.

4. Remove torn or ripped gloves.
5. Perform hand hygiene before putting on a clean pair.

Change gloves and perform hand hygiene between tasks to reduce cross-contamination. Do not wash or put alcohol sanitizer on gloves. If hands are visibly dirty, wash hands with soap and water before putting on a clean pair of gloves.

Gown-Specific Considerations

1. Wear a gown to protect skin and clothes during procedures that are likely to generate splashes or sprays of blood or body fluids.
2. Remove the gown and discard it before exiting resident's room.

Mask, Nose, or Eye Protection Considerations

1. Wear face protection if splashes of blood or body fluid may occur during resident care.
2. Safely remove and discard face protection before exiting resident's room.

Please see the CDC guide to donning personal protective equipment for more information.

Standard Precautions Recommendations: Environmental Cleaning and Disinfection, Equipment and Devices, Linens and Laundry

Linens and Laundry Considerations

1. Take care when handling linen so as not to aerosolize potentially infective material.
2. Bag linen at the bedside and carry it directly to the dirty linen hamper.

See the Environment and **Equipment Cleaning and Disinfection** section for information on resident care equipment, instruments and devices, daily care of the environment, and linens and laundry.

References

[1] Siegel JD, Rhinehart E, Jackson M, et al. Healthcare Infection Control Practices Advisory Committee. Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings, June 2007. Available online at www.cdc.gov/ncidod/dhqp/pdf/isolation2007.pdf.

[2] Siegel JD, Rhinehart E, Jackson M, Chiarello L; Healthcare Infection Control Practices Advisory Committee. Management of Multidrug-resistant Organisms in Healthcare Settings, 2006. Available online at www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf.

[3] Centers for Disease Control and Prevention. Guideline for Hand Hygiene in Healthcare Settings: Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *MMWR.* 2002;51(No. RR-16). Available online at www.cdc.gov/mmwr/PDF/rr/rr5116.pdf.

Other References and Resources

CDC. Example of Safe Donning and Removal of Personal Protective Equipment. Available online at www.cdc.gov/ncidod/dhqp/pdf/ppe/ppeposter1322.pdf.

Fendler EJ, Ali Y, Hammond BS, et al. The impact of alcohol hand sanitizer use on infection rates in an extended care facility. *Am J Infect Control.* 2002;30(4):226–233.

Gordin FM, Schultz ME, Huber RA, Gill JA. Reduction in nosocomial transmission of drug-resistant bacteria after introduction of an alcohol-based handrub. *Infect Control Hosp Epidemiol.* 2005;26(7):650–653.

Mody L, McNeil SA, Sun R, Bradley SE, Kauffman CA. *Introduction of a waterless alcohol-based hand rub in a long-term care facility. Infect Control Hosp Epidemiol.* 2003;24(3):165–171.

Trick WE, Weinstein RA, DeMarais PL, et al. Comparison of routine glove use and contact-isolation precautions to prevent transmission of multidrug-resistant bacteria in a long-term care facility. *J Am Geriatr Soc.* 2004;52:2003–2009.

Transmission-Based Precautions: Contact Precautions

Purpose

The main goal of a MRSA management program is the prevention of the transmission of MRSA. The addition of Transmission-based Precautions to Standard Precautions, when appropriate, will reduce the risk of MRSA transmission within the facility.

Background

In 1996, the CDC developed a new approach to reducing transmission of microorganisms, which was named "Standard Precautions and Transmission-based Precautions." This approach was based on elements of the previously established UP and BSI guidelines, but added an emphasis on the mode of transmission of an infection to enhance the isolation process. The HICPAC 2006 MDRO guideline[1] and the HICPAC 2007 guideline[2] for isolation precautions both continue to promote the use of Transmission-based Precautions as an appropriate approach to MDRO control (including MRSA).

Key Concepts

- There are reservoirs of the pathogenic organisms, including MRSA, within an LTC facility.
- There are different modes of MRSA transmission.
- Techniques that impact transmission of MRSA must be implemented in the LTC facility.
- Standard and Transmission-based Precautions break the chain of infection by interrupting transmission of pathogenic organisms, including MRSA.

Modes of MRSA Transmission

Contact Transmission

The most common mechanism of transmission attributed to MRSA is contact transmission. Contact transmission is divided into two subgroups, direct and indirect:

- Direct transmission after contact with the MRSA-contaminated skin or body fluids of a patient who is colonized or infected with MRSA
- Indirect transmission after contact with a MRSA-contaminated object or environment

Although anything that contacts a contaminated patient or object can be the source of transmission, the most common vehicles of MRSA spread in healthcare settings are the hands of healthcare staff.

Respiratory Tract MRSA: Transmission Issues

Components that are typically used in droplet precautions are sometimes needed to prevent the transmission of MRSA. During droplet transmission, respiratory droplets can expose individuals and environmental surfaces within three feet of the coughing person to an infectious agent in the droplets. When a MRSA-infected or colonized resident has a respiratory infection, droplets expelled during coughing, sneezing, or talking may contain MRSA. Therefore, in this situation, it is prudent to use Contact Precautions plus the additional components of

droplet precautions. This includes wearing a mask when working within three feet of a resident, and ensuring that the resident follows respiratory etiquette as described in the section on **Standard Precautions**.

Components of Precautions for MRSA-positive Residents

Decision to Implement Contact Precautions

Contact Precautions are implemented when transmission of MRSA may be reasonably anticipated to occur. Each LTC facility must develop policies for MRSA management that address the appropriate use of Contact Precautions. MRSA management policies are based on all of the following:

- The facility's MRSA risk assessment and MRSA surveillance
- Evidence-based practice guidance
- Any state regulations that apply

*See the **Patient Placement** section for a more complete discussion of the basic considerations regarding appropriate placement of MRSA-positive residents.*

Appropriate patient placement for MRSA-positive residents will require use of Contact Precautions in certain situations. Contact Precautions are intended to prevent direct and indirect transmission of MRSA from a colonized/infected resident and from a contaminated environment. Contact Precautions are always used in addition to Standard Precautions.

Examples of possible situations that **will** require implementation of the facility's process for Contact Precautions include:

- Active MRSA infection (for duration of signs and symptoms of infection)
- MRSA-colonized resident who has risk factors for transmission (poor hygiene, open or draining wounds, recurrent infections, unable to contain bodily secretions, etc.)
- MRSA-colonized resident in specialized units (ventilator unit, long-term acute care unit, etc.)
- Resident implicated in known MRSA transmission to other residents

Patient placement of residents who are MRSA-positive will not always require Contact Precautions. Examples of possible situations that **may not** require implementing Contact Precautions include:

- Known MRSA-colonized resident who is able to maintain good hand hygiene and personal hygiene
- Resident who has history of MRSA infection (successfully resolved) who is able to maintain good hand hygiene and personal hygiene
- Resident who has completed appropriate treatment for MRSA infection and symptoms have resolved
- Resident who has been screened for MRSA colonization by laboratory culture and meets facility definition for standard room placement

Room Considerations Related to Implementation of Contact Precautions

Private rooms are preferred for residents placed in Contact Precautions. When private rooms are not available, decisions on patient placement take into consideration certain aspects of the MRSA-positive resident and of the resident's potential roommate as discussed in the **Resident Placement** section.

When MRSA-positive patients are placed with roommates, the best option is placement with another MRSA-positive resident (cohorting). In situations where a MRSA-positive resident on Contact Precautions must be

placed with a resident who is not colonized/infected with the same infectious agent, do not place with a resident who may be at higher risk of adverse outcome from infection (e.g., those who are immunocompromised, have open wounds, invasive tubes or devices, etc.) due to underlying conditions.

Use of Personal Protective Equipment (PPE) When Caring for Residents in Contact Precautions

1. Gloves and hand hygiene:
   a. Don gloves before or immediately upon entry to room.
   b. Change gloves after contact with infectious material.
   c. Change gloves when moving from a contaminated body site to a clean body site.
   d. Remove gloves and decontaminate hands before leaving resident's room.
   e. Remove gloves and decontaminate hands before performing care for another resident.
   f. After glove removal and hand hygeine, ensure that hands do not touch potentially contaminated surfaces or items in the resident's room.
2. Gowns:
   a. Don gowns before or immediately upon entry to the room/cubicle.
   b. Remove and discard gloves before removing gown.
   c. Remove gown and discard prior to leaving the resident room. After gown removal, ensure that clothing does not contact potentially contaminated environmental surfaces.
3. Mouth, nose, eye protection:
   a. Wear masks, eye shields, and/or goggles when performing procedures involving the respiratory tract and in any situation where the potential for splashes or spray is present.
   b. Removing masks and face protection after removing gloves can be safely done IF the clean parts (ties, straps) are the only things touched during removal.
   c. Wear masks when working within three feet of MRSA-positive resident who has a respiratory infection.

Always perform hand hygiene after PPE removal.

Considerations When Residents in Contact Precautions Leave Their Rooms (Hygiene Issues, Transport Issues)

1. When a MRSA-infected resident has uncontained drainage or body secretions, limit movement or transport of the resident from the room for essential purposes only.
2. Notify receiving department, unit, or common area of resident's isolation status.
3. If a resident must leave his or her room, ensure that precautions are maintained:
   a. Help resident to perform hand hygiene.
   b. Have resident wear clean clothing or patient gown.
   c. For MRSA-colonized or infected residents who have respiratory infections, place mask on resident during their time away from their rooms. Provide tissues and assist in performing hand hygiene if resident is unable to comply with mask use.
   d. Adequately contain wounds or nonintact skin.
   e. For incontinent residents, ensure containment of urine or stool.
   f. After performing patient care activities, dispose of contaminated PPE and perform hand hygiene prior to transporting resident from the room.

g. Ensure that clothing and skin do not contact potentially contaminated environmental surfaces, including resident wheelchairs, that could result in possible transfer of microorganism to other patients or environmental surfaces.
h. Don clean, appropriate PPE when directly assisting the resident at the transport destination.

Special Considerations: MRSA and Respiratory Infection

Respiratory droplets expelled during coughing, sneezing, or even talking may lead to transmission of infectious pathogens that are present in the respiratory tract. Some components of *droplet precautions* are used in addition to Contact Precautions for MRSA-positive residents who have respiratory infections. This includes resident compliance with cough and respiratory etiquette guidelines (see Standard Precautions) and use of mask for those who are within three feet of the resident.

Room Considerations Related to MRSA and Respiratory Infections

The preferred placement is a single-patient room. When a single patient room is not available, apply the following principles for making decisions on resident placement:

1. Prioritize residents who have excessive cough and sputum production for single-resident room placement.
2. Cohort residents in the same room who are infected with the same pathogen and are suitable roommates after consulting with the infection preventionist in the operating unit.
3. Maintain at least a three-foot separation between cohorted residents (arrange chairs, bed, and tables to maintain the separation).
4. If possible, draw curtains between roommates.
5. Door to room may remain open.

Resident Care Equipment: General Considerations

1. Dedicate the use of resident care equipment to a single resident.
2. If use of common equipment is unavoidable, these items must be disinfected between residents with a facility approved product.

Environmental Measures: General Considerations

1. Prioritize Contact Precautions rooms for frequent cleaning and disinfection, at least daily, with a focus on frequently touched surfaces and equipment in the immediate vicinity of the patient.
2. Terminally clean room upon resident discharge per Environmental Services policy.

Discontinuation of Contact Precautions

1. The HICPAC guidelines referenced in this section do not recommend specific actions for making decisions to discontinue Contact Precautions for MRSA-positive residents. The LTC facility must determine the process that will be used.
2. State regulations: States may have regulations regarding infection prevention measures in LTC facilities. Make sure that state regulations are met in the facility's policy on discontinuation of precautions.

Note: An exploration of scenarios that may require implementation of Contact Precautions does provide some guidance related to possible policy decisions on discontinuation of precautions. The reader is referred to "Examples

of a possible situation that **may not** require implementing Contact Precautions" under the heading **"Decision to implement Contact Precautions"** for relevant considerations germane to this issue.

Participation in Resident Activities

Residents who are colonized or are recovering from MRSA infection may be allowed to participate in resident activities (meals, etc.) in common areas if the resident can maintain good hand hygiene, personal hygiene, and respiratory etiquette practices. The resident should be evaluated individually; assessing their personal hygiene habits, the ability to completely cover their MRSA infection site, and the level of physical participation that the activity entails. Staff involved in the resident's care and activities must be aware of the need to observe and monitor that the resident can maintain good hygiene practices while outside the resident's room.

Management of multidrug-resistant organisms in healthcare settings, 2006[1]

V.B.6.a.iii. In LTC facilities, modify Contact Precautions to allow MDRO-colonized/infected patients whose site of colonization or infection can be appropriately contained and who can observe good hand hygiene practices to enter common areas and participate in group activities. *Category IB*

Visiting Considerations When Resident Is Taking Precautions for MRSA

Family members and other visitors of residents of LTC facilities often have more extensive contact with the resident and the resident's environment than visitors of patients in hospital settings. It is not uncommon for visitors to assist residents in care activities and accompany residents to common areas and to visit other residents' rooms. Therefore, it can be expected that visitors may have frequent opportunities to acquire infectious agents from either residents or their environments.

It is important to reduce the risk of MRSA transmission to visitors, some of whom may be at increased risk of infection due to underlying conditions. It can also be expected that visitors may be a source of spread of acquired "contamination" via their own hands or from their clothes or accessories. Education of families and other visitors is the first step in ensuring that visitors of MRSA-positive residents do not contribute to MRSA transmission in the LTC facility. If English is the second language of a resident and his or her family, it is considerate and effective to provide education translated into the native language, and to use visual as well as verbal reminders on signage.

Additional MRSA educational resources are available online at www.apic.org/eliminationguides.

One way to provide information to residents and family members is by meeting with them during infection control rounds to explain Transmission-based Precautions. This is the opportunity to provide and discuss educational material and answer any questions that they might have when a resident has been placed in Transmission-based Precautions. Care staff should always clearly document infection prevention—related education and comments from discussions with the resident and family members.

Example of an Infection Control Rounding Log

Date	Resident Name	Room	Rounding Reason	Patient/Family Education Given	Actions Taken
			☐ MRSA ☐ VRE ☐ C. diff Other _____	☐ Verbal to patient ☐ Verbal to family ☐ Written to patient ☐ Written to family ☐ Left written education in room/nurse Other _____	☐ None needed _____ _____
			☐ MRSA ☐ VRE ☐ C. diff Other _____	☐ Verbal to patient ☐ Verbal to family ☐ Written to patient ☐ Written to family ☐ Left written education in room/nurse Other _____	☐ None needed _____ _____
			☐ MRSA ☐ VRE ☐ C. diff Other _____	☐ Verbal to patient ☐ Verbal to family ☐ Written to patient ☐ Written to family ☐ Left written education in room/nurse Other _____	☐ None needed _____ _____

The HICPAC 2007 Isolation Guideline makes the following points regarding education in the section titled Education of HCWs, patients, and families:

> Patients, family members, and visitors can be partners in preventing transmission of infections in healthcare settings. Additional information about Transmission-based Precautions is best provided at the time they are initiated. Fact sheets, pamphlets, and other printed material may include information on the rationale for the additional precautions, risks to household members, room assignment for Transmission-based Precautions purposes, explanation about the use of personal protective equipment by HCWs, and directions for use of such equipment by family members and visitors.

The CDC/HICPAC 2007 Isolation Guideline does not provide specific recommendations on visitor use of PPE for residents on Contact Precautions.

II.N.3.b. Use of barrier precautions by visitors. The use of gowns, gloves, or masks by visitors in healthcare settings has not been addressed specifically in the scientific literature. Some studies included the use of gowns and gloves by visitors in the control of MDROs, but did not perform a separate analysis to determine whether their use by visitors had a measurable impact. Family members or visitors who are providing care or having very close patient contact (i.e., feeding, holding) may have contact with other patients and could contribute to transmission if barrier precautions are not used correctly. Specific recommendations may vary by facility or by unit and should be determined by the level of interaction.

Each LTC facility must develop a facility policy regarding the use of PPE by visitors while in transmission-based isolation rooms. The policy should take into account visitor or family member MRSA transmission risk based on the facility risk assessment, applicable guidelines, and best practice standards. The policy must make provisions for situations that will require enhanced PPE compliance by families and visitors, including situations during which there is increased transmission, confirmed outbreak, or when a specific resident poses a transmission risk.

References

[1] Siegel JD, Rhinehart E, Jackson M, Linda C; Healthcare Infection Control Practices Advisory Committee. Management of multidrug-resistant organisms in healthcare settings, 2006. Available online at www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf.

[2] Siegel JD, Rhinehart E, Jackson M, Chiarello L. Healthcare Infection Control Practices Advisory Committee. Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings, June 2007. Available online at www.cdc.gov/ncidod/dhqp/pdf/isolation2007.pdf.

Other References and Resources

Example of Safe Donning and Removal of Personal Protective Equipment. Available online at www.cdc.gov/ncidod/dhqp/pdf/ppe/ppeposter1322.pdf.

Environmental and Equipment Cleaning and Disinfection

Purpose

Effective environmental cleaning and equipment cleaning/disinfection will reduce the risk of transmission of MRSA in LTC settings.

Key Concepts

- Properly trained environmental services staff, and effective protocols and/or checklists are key elements in the management of MRSA in LTC facilities.
- Proper use of cleaning and disinfection products requires that manufacturer's instructions and contact times are carefully observed.
- All staff must take responsibility for ensuring that the LTC environment is appropriately cleaned and that equipment is cleaned and disinfected between resident uses.

Background

MRSA in the Environment

The prevalence of MRSA in the LTC setting and the risk to nursing home residents is still not well quantified. Few studies have been done in the LTC setting. However, it is known from hospital studies that staphylococci, including MRSA, can survive readily in the environment. In studies by Neely[1] and Huang,[2] staphylococci were recovered for at least 1 day and up to 56 days after contamination on common hospital materials, and two strains of MRSA survived for 9 to 11 days on a plastic patient chart, a laminated tabletop, and a cloth curtain in a hospital setting.

The LTC setting is unique in healthcare for the following reasons: lengths of stay are measured in months or years rather than days or weeks; private rooms are scarce; residents move freely within the facility for care or social activities; and mitigation of contamination within the environment and on equipment is difficult due to the variety of opportunities for unanticipated contamination to occur. The role that the environment may play in the transmission of infectious agents, including MRSA, therefore becomes an important consideration that remains burdened with unanswered questions and concerns.[3]

Transmission of MRSA to Residents from the LTC Environment

It is possible to draw some conclusions about the probable role of the environment in acquisition of MRSA by residents of LTC facilities from investigations of environment-to-person transmission in hospital settings. Not only has it been proven that MRSA can survive on common hospital surfaces, but studies have shown that persons can acquire MRSA from contact with those contaminated surfaces.[4,5]

In a study on environmental contamination conducted by Hardy et al.,[6] there was strong evidence to suggest that 3 of 26 patients who acquired MRSA while in the intensive care unit acquired the organism from the environment. In addition, the study revealed that MRSA was isolated from every environmental sample collected. In a study of environmental contamination in the rooms of patients who had MRSA, Boyce et al.[7] recovered MRSA from the rooms of 73% of infected patients and 69% of colonized patients. The authors of both studies concluded that

inanimate surfaces in close proximity to infected or colonized patients commonly become contaminated and may become a source of transmission of MRSA.

These studies demonstrate that people who share the environment with a MRSA-positive patient have a risk of transmission through contact with surfaces contaminated with MRSA. This has implications for efforts in all healthcare settings in which the elimination of MRSA transmission is a priority. For more discussion of the link between environmental contamination and transmission from the environment via hands of healthcare workers, see, "Special Pathogen Concerns" (Environmental Services, Section E) in the CDC's Guidelines for environmental infection control in healthcare facilities, 2004.[8]

Environmental Services' Responsibility for Cleaning

Cleaning and disinfection protocols are effective tools for the management of environmental contamination with antimicrobial-resistant pathogens such as MRSA. Environmental services and housekeeping staff are extremely important to this process. Initial training on cleaning and disinfection, reinforcement, and competency of environmental staff procedures are important for the elimination of transmission of MRSA. In facilities where English is a second language for some staff, ensure that written and verbal communication is provided in a way to maximize understanding (interpreters, visual reminders, translated materials, etc.).

Environmental Cleaning and Disinfection Plan

An environmental cleaning and disinfection plan includes policies or protocols that specify a defined schedule of environmental cleaning.

Daily cleaning of patient rooms by trained environmental staff is an essential policy component. Many healthcare organizations, including LTC facilities, assign dedicated environmental staff to targeted resident care areas to provide consistency of appropriate cleaning and disinfection procedures.

Rooms of residents who are in Contact Precautions should be prioritized to frequent cleaning and disinfection. Also, when a facility or specific units in a facility are experiencing high or increasing MRSA rates, it is warranted to consider increasing the frequency of cleaning and disinfection.[9] Areas requiring more frequent, effective cleaning and disinfection include, but are not limited to, bed rails, light switches, over-bed tables, bedside commodes, bathroom fixtures in the resident's room, doorknobs, any equipment in the immediate area of the resident, and any equipment that is multi-use between residents.

Equipment cleaning that is not performed by environmental services staff must be clearly delegated to the appropriate healthcare staff per facility protocols. For instance, a facility cleaning and disinfection policy or protocol will address the specific patient care staff responsibility for disinfection of equipment that may be taken from one resident to another.

An environmental cleaning and disinfection plan includes policies or protocols that specify appropriate use of cleaning and disinfecting products.

Policies and protocols must specify that environmental surfaces are cleaned with the proper dilution and amount of the standard facility-approved disinfecting agents. For more information, see the Environmental Protection Agency document "EPA List H: Registered Products Effective Against Methicillin-resistant *Staphylococcus aureus* (MRSA) and Vancomycin-resistant *Enterococcus faecalis* or *faecium* (VRE)," issued June 30, 2008, and available online at http://www.epa.gov/oppad001/list_h_mrsa_vre.pdf.

It is very important to identify and correctly clean and/or disinfect electronic equipment. Personal care electronic equipment and multi-use electronic items, including any equipment used during delivery of resident care and mobile devices that are moved in and out of residents' rooms, may have special **manufacturer instructions** for cleaning and disinfection requirements. Training staff to carefully follow manufacturer instructions is an important resident and staff safety component of an effective cleaning and disinfection process. For more information, see the Public Health Notification from the FDA, CDC, EPA, and OSHA, "Avoiding Hazards with Using Cleaners and Disinfectants on Electronic Medical Equipment," issued October 31, 2007, and available online at http://www.fda.gov/cdrh/safety/103107-cleaners.html.

Labels on disinfection agents and cleaning products must be read carefully to ensure that the product is being appropriately used. Using the appropriate product and ensuring the appropriate contact time for disinfectants are very important aspects of effective disinfection. It is very important that staff understand that different formulations of any given type of disinfectant (liquid, spray, saturated cloths) may require different contact times and carefully adhere to requirements for each.

Environmental Cleaning Is Everyone's Responsibility

Although the routine facility cleaning duties in an LTC facility are performed by trained facility environmental services staff, unanticipated contamination of the environment may happen frequently. It is also reasonable to expect that some environmental contamination will occur during times when cleaning is not scheduled. The LTC facility infection control program must make sure that all staff members have a high-level awareness of the importance of a clean environment for resident, visitor, and staff safety. With this awareness, there must also be a willingness and an expectation that staff will assist in ensuring that the environment is cleaned when contamination is observed or suspected. Staff may either perform the cleaning themselves or make sure that the contamination is immediately reported to and cleaned by those who have knowledge of and access to appropriate cleaning supplies.

Monitoring Environmental Cleaning

A monitor to assess the cleaning performance of environmental staff will ensure consistency in cleaning and disinfection procedures. Monitoring should include an assessment of the cleaning of surfaces in close proximity to the patient, including bedrails, carts, doorknobs, bedside commodes, bedside tables, and faucet handles.

The use of a standardized environmental cleaning checklist may increase the efficacy of cleaning. A checklist can also serve as a training tool for new staff, and as the basis for a cleaning monitor. When cleaning monitors indicate inadequate cleaning on a unit or throughout a facility, an enhanced or updated checklist that addresses known or suspected inadequate cleaning processes can be implemented as an intervention to improve cleaning outcomes. Units that have persistently high rates or increasing rates of MRSA should develop a customized environmental cleaning plan that includes monitoring for compliance to the plan and proper use of cleaning solutions.

There is generally no need for environmental cultures unless there is epidemiologic evidence that an environmental source is associated with ongoing transmission of MRSA. In situations where environmental culturing is being considered, it would be prudent to get expert help from an infection preventionist who has knowledge of and experience in this area.

Terminal Cleaning

There is no information in the HICPAC Isolation (2007) or MDRO (2006) guidelines regarding terminal cleaning of rooms after Contact Precautions have been discontinued. However, the CDC 1996 "Guidelines for

Isolation Precautions in Hospitals," which preceded the 2007 Isolation Guide, specifically addressed the concept of a terminal cleaning as follows:

> The room, or cubicle, and bedside equipment of patients on Transmission-based Precautions are cleaned using the same procedures used for patients on Standard Precautions, unless the infecting microorganism(s) and the amount of environmental contamination indicates special cleaning. In addition to thorough cleaning, adequate disinfection of bedside equipment and environmental surfaces (i.e., bedrails, bedside tables, carts, commodes, doorknobs, faucet handles) is indicated for certain pathogens, especially *Enterococci*, which can survive in the inanimate environment for prolonged periods of time.[10]

Although not specifically recommended in the current CDC/HICPAC guidelines, facilities may incorporate the concept of a "terminal clean on discharge" for MRSA residents in their cleaning protocols. Room curtains, especially privacy curtains around a bed, may be a source of contamination in the room of a resident who had been infected or colonized with MRSA. A facility may find it prudent to change these when a MRSA-infected or colonized resident is discharged from a room, and this would be an important room "discharge cleaning" step during outbreak situations.

Example of a Cleaning Checklist

Appendix F provides an example of room cleaning checklists (daily and discharge) adapted from the Evanston Northwestern Healthcare (Illinois) checklists published in The Institute for Healthcare Improvement's (IHI) 5 Million Lives Campaign "How-to-Guide: Reduce MRSA Infection."[11] This is provided as a sample only and, if used, should be reviewed and individualized to each facility.

Environmental Cleaning Processes

It is outside the scope of this section to outline appropriate cleaning processes and discuss selection of appropriate disinfectants. For more information, refer to the APIC Text of Infection Control and Epidemiology Chapter 102 and the "Guidelines for environmental infection control in healthcare facilities," Section E "Environmental Services."[12]

References

[1] Neely AN, Maley MP. Survival of *enterococci* and *staphylococci* on hospital fabrics and plastic. *J Clin Microbiol.* 2000;38:724–726.

[2] Huang R, Mehta S, Weed D, et al. Methicillin-resistant *Staphylococcus aureus* survival on hospital fomites. *Infect Control Hosp Epidemiol* 2006;27:1267–1269.

[3] Strausbaugh LJ, Crossley KB, Nurse BA, et al. Antimicrobial resistance in long-term care facilities. *Infect Control Hosp Epidemiol.* 1996;17:129–140. Available online at www.shea-online.org/assets/files/position_papers/AbxR-LTCF96.pdf

[4] 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;25:164–167.

[5] Carling PC, Briggs J, et al. An evaluation of patient area cleaning in 3 hospitals using a novel targeting methodology. *Am J Infect Control.* 2006;34:513–519.

[6] Hardy KJ, Oppenheim BA, Gossain S, et al. A study of the relationship between environmental contamination with Methicillin-resistant *Staphylococcus aureus* (MRSA) and patients' acquisition of MRSA. *Infect Control Hosp Epidemiol.* 2006;27:127–132.

[7] Boyce JM, Potter-Bynoe G, Chenevert C, et al. Environmental contamination due to Methicillin-resistant *Staphylococcus aureus*: possible infection control implications. *Infect Control Hosp Epidemiol.* 1997;18:622–627.

[8] Sehulster LM, Chinn RYW, Arduino MJ, et al. Guidelines for environmental infection control in healthcare facilities. Recommendations from CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). Chicago, IL: American Society for Healthcare Engineering/American Hospital Association; 2004.

[9] Siegel JD, Rhinehart E, Jackson M, Linda C; Healthcare Infection Control Practices Advisory Committee. Management of multidrug-resistant organisms in healthcare settings, 2006. Available online at www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf.

[10] *The following is a historical CDC guideline that has been updated, but was accessed for information on terminal cleaning:* Garner JS; the Hospital Infection Control Practices Advisory Committee Guidelines for Isolation Precautions in Hospitals. Hospital Infection Control Advisory Committee CDC. January 1, 1996.

[11] Institute for Healthcare Improvement (IHI) 5 Million Lives campaign. Getting Started Kit: Reduce Methicillin-resistant *Staphylococcus aureus* (MRSA) Infection How-to Guide, 2006. Available online at www.ihi.org/ihi.

[12] Chapter 102 and the Guidelines for environmental infection control in healthcare facilities, Section E Environmental Services. *APIC Text of Infection Control and Epidemiology,* 2nd ed. Washington, DC: Association for Professionals in Infection Control and Epidemiology, Inc.; 2005.

Other References and Resources

Ayliffe GAJ. Control of *Staphylococcus aureus* and Enterococcal Infections. In: Block SS, ed. *Disinfection, Sterilization, and Preservation,* 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2001:491–501.

Muto CA, Jernigan JA, Ostrowsky BE, et al. SHEA guideline for preventing nosocomial transmission of multidrug-resistant strains of *Staphylococcus aureus* and *Enterococcus. Infect Control Hosp Epidemiol.* 2003;24:362–386.

Scott E, Gaber D, Cusack, T. Chemical disinfection of microbial contaminants on surfaces. Pathogens of concern to both hospitals and long-term care facilities. In: Block SS. *Disinfection, Sterilization, and Preservation,* 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2001:1214–1215.

Antimicrobial Management and Stewardship in LTC

Purpose

Stewardship is defined as "the careful and responsible management of something entrusted to one's care or oversight." Antimicrobial stewardship is a process of ensuring that appropriate, successful antibiotic treatments are used for resident infections. In order to increase the chance of positive outcomes, the appropriate antibiotic should be prescribed based on the resident's diagnosis and/or culture and sensitivity data, and the limitation of unnecessary antibiotics. This prudent management of antimicrobial agents will impact resident risk of developing MDRO transmissions or infections, including those caused by MRSA.

Background

The occurrence of antimicrobial-resistant pathogens has become an increasing problem over the past decade. It is estimated that more than half of the greater than two million healthcare-associated infections (HAIs) occurring annually in the United States are due to antibiotic-resistant organisms, affecting more than 70,000 people with a cost of $5 billion to $10 billion dollars annually. Based on the magnitude of this problem, the CDC committed to investing $10 million on research to reduce infections in healthcare. (Press release of May 3, 2006; available online at http://www.cdc.gov/media/pressrel/r060504.htm.)

Ever since the first antibiotic, penicillin, was introduced for public use in 1945, bacteria have been coming up with ways to defend themselves by developing resistance. MDROs have long been associated with the healthcare system. Usually found at hospitals, the greatest prevalence of MDROs is seen in the intensive care units, especially those at tertiary facilities.

Within the LTC facility environment, it is believed that there is a low occurrence rate of clinical infection caused by MDROs, but they can still cause serious disease and mortality. The LTC resident who is either colonized or infected will serve as a reservoir and may introduce MDROs into acute care facilities when transferred for a higher level of medical care.

The accumulation of individuals with MRSA colonization remains a challenge for LTC facilities. Antimicrobial use, especially broad spectrum antimicrobial use, is a known risk factor for MRSA colonization.[2] Antimicrobial stewardship and prudent, thoughtful antimicrobial use are essential strategies that affect long-term, sustainable MRSA management.

Key Concepts

- Risk factors in the LTC population place residents at risk for acquiring MDROs.
- Overuse of antimicrobials is a key factor in promoting multidrug resistance.
- Consequences of inappropriate use of antibiotics in LTC include risk of MDRO infection.
- A team approach to stewardship of antimicrobials is a key infection prevention and control strategy in LTC.

LTC MDRO Risk Factors

Antibiotic resistance is a problem in all healthcare settings. According to the CDC, each year, approximately 250,000 residents of LTC facilities develop infections. Of these, 27,000 residents have an infection due to bacteria resistant to at least one class of antibiotics commonly used to treat them. (See the CDC Campaign to Prevent

Antimicrobial Resistance in Healthcare Settings online at http://www.cdc.gov/DRUGRESISTANCE/healthcare/images/ltcBurdenPyramid_r2_c2.gif)

Residents of LTC facilities are prone to antibiotic-resistant infections for a number of reasons, including:

Facility Factors

- Close contact with other individuals
- Transfer to and from acute care facilities
- Staffing issues
- Inadequate hand hygiene (healthcare workers, residents, visitors)
- Inappropriate use of antibiotics

Patient Factors

- Older age
- Decreased immune function
- Functional impairment
- Use of invasive devices
- Chronic and degenerative disease

Overuse of Antimicrobial Agents

Many studies to date have evaluated and characterized the increase in MDROs from the acute care setting, but it is believed that there has been a comparable increase in LTC facilities. It has shown that the common use of fluoroquinolones can result in increased rates of multidrug resistance in LTC facilities. After transfer to a higher level of care, LTC residents show significantly increased risk of fluoroquinolone-resistance when hospitalized with *E. coli* or *Klebsiella* infections in a study by Viray et al.[1]

Another study demonstrated that the number of LTC facility residents diagnosed with a MDRO infection increased significantly from 2000 to 2004. An increase in residents diagnosed with *Clostridium difficile* infection was also noted.[2]

Consequences of Inappropriate Use of Antibiotics in LTC

The prevalence of MDROs in our healthcare facilities has resulted in a negative impact on patients, LTC residents, and healthcare systems in general. Infection caused by an MDRO is more difficult and more expensive to treat, and has the potential to result in a worse clinical outcome for the resident. For example, a study of *Staphylococcus aureus* bacteremia showed a near doubling of mortality odds if the bacteremia was due to MRSA versus a sensitive *S. aureus* strain.[3]

Due to the possibility that a resident's infection may be caused by an MDRO, physicians are inclined to prescribe broad spectrum empiric therapy when an infection is suspected. While this may be clinically necessary, especially in the initial timeframe and when the resident is very ill, the negative aspects of this practice are increased cost and increased MDROs.

Recommendations

Develop a culture of prudent antibiotic stewardship within the LTC facility team. Use the CDC 12 Step Campaign to guide development of strategies for the appropriate use of antibiotics (link available at www.apic.org/EliminationGuides).

The CDC's 12 Step Campaign to Prevent Antimicrobial Resistance in Long-term Care gives clear guidance on the elements of a successful antibiotic stewardship program.

Steps 5 through 8 are particularly applicable to this section and are provided below.

Step 5. Use local resources
- Consult infectious disease experts for complicated infections and potential outbreaks.
- Know your local and/or regional data.
- Get previous microbiology data for transfer residents.

Step 6. Know when to say "no"
- Minimize use of broad-spectrum antimicrobials.
- Avoid chronic or long-term antimicrobial prophylaxis.
- Develop a system to monitor antimicrobial use and provide feedback to appropriate personnel.

Step 7. Treat infection, not colonization or contamination
- Perform proper antisepsis with culture collection.
- Reevaluate the need for continued therapy after 48–72 hours.
- Do not treat asymptomatic bacteriuria.

Step 8. Stop antimicrobial treatment
- When cultures are negative and infection is unlikely.
- When infection has resolved.

Additional references that speak to the importance of antimicrobial stewardship are included in the following papers.

1996 SHEA position paper "Antimicrobial Resistance in Long-term Care Facilities" makes recommendations for developing infection control programs which monitor antimicrobial use and promote judicious use of antimicrobials.[4]

The CDC/HICPAC "Management of Multidrug-resistant Organisms in Healthcare Settings, 2006" (MDRO guide) recommends that "systems are in place to promote optimal treatment of infections and appropriate antimicrobial use."

Although the relative importance of antimicrobial stewardship as a specific control measure for MRSA remains unclear, the 2006 MDRO guide notes that careful antimicrobial use is important to the management of MDROs, including MRSA.

LTC Facility Team Approach to Antimicrobial Stewardship

A multidisciplinary approach to prudent antimicrobial use should be in place in LTC. Core members of a comprehensive LTC antimicrobial management program include physicians, advance practice nurses (APN), medical directors, nurses, clinical pharmacists with infectious disease training, infection control professionals, and administration.

Prudent antimicrobial use includes (1) review and feedback on **antibiotic usage** for resident infections, and (2) ongoing collection of local bacterial isolate susceptibility patterns for each significant organism which is then published in a facility **antibiogram**. As many long-term care facilities utilize off-site reference laboratories and

pharmacies, it is important to partner with each and request that appropriate lab and antimicrobial prescribing information is gathered for review and analysis. The details of the prescribing analysis need to be shared with the physicians and nurses if they are to have any meaningful effect. These details can be found in the 2006 CDC/HICPAC MDRO guide on pages 35–36.

Action steps:

1. Contract with your reference laboratory to provide facility-specific reports of significant pathogens.
2. Contract with your pharmacy for review of prescribing practices over time for all or for specific antimicrobials. This is sometimes referred to as a DUE (drug utilization evaluation).
3. Does your pharmacist review cultures results to evaluate the effectiveness of the antimicrobials prescribed? If not, ask your medical director to intervene (who, and how will this be done?).

An antimicrobial stewardship team may implement additional strategies that will impact prudent antimicrobial use. This may include:

- Education for caregivers related to clinical treatment strategies
- Streamlining or deescalating empiric antimicrobial therapy based on culture results. Specific emphasis should be on staff nurse education when following up with physicians and APNs, so that there is a clear understanding that not every positive culture needs antimicrobial treatment
- Evidence-based practice guidelines derived from local organism-specific resistance patterns
- Antimicrobial order forms with automatic stops requiring physician justification for continuation

For additional background and guidance on antimicrobial stewardship, see the IDSA/SHEA position paper on developing an institutional program to enhance antimicrobial stewardship.[5]

Another SHEA position paper, "Antimicrobial Use in Long-term Care Facilities," also recommends basic antimicrobial review in all LTC facilities. These recommendations focus mainly on review to decrease inappropriate prescribing practices on a case-by-case basis. However, they also recommend antimicrobial utilization review to minimize use of broad spectrum antimicrobials on a facility-wide basis.[6]

Role of Susceptibility Testing and Sensitivity Pattern Data of Bacterial Culture Isolates: Susceptibility (Sensitivity/Resistance) Patterns

A reported susceptibility pattern for each clinical pathogen is essential. It should be readily and quickly accessible by physicians and caregivers. In LTC, the pharmacists may or may not have access to susceptibility reports. Therefore, it is important that staff nurses understand how to read a susceptibility report to assure that the "right bug" is getting the "right drug" throughout the treatment regimen.

The microbiology laboratory plays a critical role by providing patient-specific culture and susceptibility data. Not only are the data essential for resident treatment regimens, but they are also valuable in infection control surveillance of resistant organisms and in the epidemiologic investigation of outbreaks.

Antibiogram: Analysis and Presentation of Cumulative Antimicrobial Susceptibility Test Data

Unlike the bacterial susceptibility that is resident-centric, antibiograms are used to track the changing sensitivity pattern of the bacteria that exist in a facility's environment. Susceptibility testing results are compiled into

antibiograms for MRSA and for other significant pathogens (i.e., *S. aureus*, MRSA, VRE, etc.) during a specified timeframe (usually one year) and updated at least annually. Compiling an antibiogram is usually done by the laboratory that performs your microbiology. The data are accrued from cultures obtained from the residents of the facility or of a specific unit for which the antibiogram is being prepared. The resulting antibiogram will reflect the antibiotic sensitivity patterns for significant organisms within that area.

Antibiograms can be used by physicians to guide decisions regarding appropriate empiric antimicrobial treatment choices at times when a susceptibility report is not yet available. They can be used by the infection prevention and control team to assess changes in multidrug resistance of significant pathogens specific to their resident populations, and provide data for antimicrobial stewardship initiatives.

The Clinical and Laboratory Standards Institute (CLSI) is a recognized authority in quality assurance of laboratory testing. Standards have been published that specify the criteria for antibiogram development in CLSI M39-A2.[7]

Clinical and Laboratory Standards Institute (CLSI) **M39-A2**
Analysis and Presentation of Cumulative Antimicrobial Susceptibility Test Data
Approved Guideline, Second Edition

- Analyze/present data at least annually.
- Use only final results.
- Do not include organisms having less than 30 isolates.
- Include isolates from clinical specimens.
- Include the first isolate/patient, irrespective of
  - body site
  - susceptibility pattern
- Include only antibiotics routinely tested.
- Calculate % sensitive (do not include intermediate).
- Patient/resident isolate counted once (even if positive in multiple cultures).
- Isolates from clinical cultures over a specified time frame.
- Isolates from a defined location (healthcare facility-specific, or unit-specific, or service-specific, etc.).
- Numerator is the number of first susceptible clinical isolates, regardless of specimen source, per patient for each unit or for entire facility.
- Denominator is number of total isolates (both susceptible and resistant) per patient for each unit or for entire facility.

Example: Antibiogram for gram-positive organisms (including MRSA) from nonurinary sources (systemic panel) at "ABC LTC Facility." *Numbers in the antimicrobial columns reflect the percentage of susceptible isolates per total isolates.*

ABC LTC Facility 2006 Antibiogram Gram Positive Organisms	Total # Isolates	Cefazolin	Ceftriaxone	Ampicillin	Penicillin	Oxacillin	Ampicillin/ Sulbactam	Imipenem	Erythromycin	Clindamycin	Tetracycline	Vancomycin	Trimeth/ Sulfa	Levofloxacin
Staphylococcus epidermidis	***97***	21	20	-	-	21	21	21	32	53	88	99	60	25
MSSA	***431***	99	99	20	19	100	98	99	65	77	95	100	99	91
MRSA	***452***	-	-	-	-	-	-	-	85	***62***	93	100	99	***54***
Enterococcus faecalis	***38***	-	-	100	100	-	-	-	21	-	17	100	-	60

MSSA; methicillin-susceptible *Staphylococcus aureus*.
Number of *S. aureus* isolates (no duplicates) = 883
Percent of *S. aureus* isolates that are MRSA = 51%.
Numbers in bold italics reflect a change of 10% or greater when compared with last year's antibiogram.

An Antimicrobial Stewardship Success Story

In a 2007 issue of the *Journal of the American Geriatrics Society*, the results of an antimicrobial utilization educational intervention were published (abstract included here).[8]

Monette J, Miller MA, Laurier C, et al. Effect of an educational intervention on optimizing antimicrobial prescribing in long-term care facilities. *J Am Geriatr Soc.* 2007;55:1301–1302.

OBJECTIVE: To assess the effect of an educational intervention aimed at optimizing antimicrobial prescribing in long-term care (LTC) facilities.

DESIGN: Cluster randomized, controlled trial.

SETTING: Eight public LTC facilities in the Montreal area.

PARTICIPANTS: Thirty-six physicians.

INTERVENTION: The educational intervention consisted of mailing an antimicrobial guide to physicians along with their antimicrobial prescribing profile covering the previous three months. Targeted infections were urinary tract, lower respiratory tract, skin and soft tissues, and septicemia of unknown origin. In the prescribing profile, each antimicrobial was classified as adherent or non-adherent to the guide. Physicians in the experimental group received the intervention twice, four months apart, whereas physicians in the control group provided usual care.

MEASUREMENTS: Data on antimicrobial prescriptions were collected over four three-month periods: pre-intervention, post-intervention I, post-intervention II, and follow-up. A generalized estimating equation (GEE) model was used to compare the proportion of non-adherent antimicrobial prescriptions of the experimental and control groups.

RESULTS: By the end of the study, non-adherent antimicrobial prescriptions decreased by 20.5% in the experimental group, compared with 5.1% in the control group. Based on the GEE model, during post-intervention II, physicians in the experimental group were 64% less likely to prescribe non-adherent antimicrobials than those in the control group (odds ratio = 0.36, 95% confidence interval = 0.18–0.73).

CONCLUSION: An educational intervention combining an antimicrobial guide and a prescribing profile was effective in decreasing non-adherent antimicrobial prescriptions. Repetition of the intervention at regular intervals may be necessary to maintain its effectiveness.

References

[1] Viray M, Linkin D, Maslow JN, et al. Longitudinal trends in antimicrobial susceptibilities across long-term care facilities: emergence of fluoroquinolone resistance. *Infect Cont Hosp Epidemiol.* 2005;26:56–62.

[2] Crnich CJ, Safdar N, Robinson J, et al. Longitudinal trends in antibiotic resistance in US nursing homes: 2000-2004. *Infect Cont Hosp Epidemiol.* 2007;28(8):1006–1008.

[3] Cosgrove SE, Sakoulas G, Perencevich EN, et al. Comparison of mortality associated with Methicillin-resistant and Methicillin-susceptible *Staphylococcus aureus* bacteremia: A meta-analysis. *Clin Inf Dis.* 2003;36:53–59.

[4] Strausbaugh LJ, Crossley KB, Nurse BA, et al, SHEA Long-term Care Committee. Antimicrobial resistance in long-term care facilities. *Infection Control & Hospital Epidemiology.* 2006;17:129–140.

[5] Dellit TH, Owens Rc, McGowan JE Jr, et al; Infectious Diseases Society of America; Society for Healthcare Epidemiology of America. IDSA and SHEA guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clin Infect Dis.* 2007;44:159–177.

[6] Nicolle LE, Bentley DW, Garibaldi R, et al. Antimicrobial use in long-term care facilities. *Infect Control Hosp Epidemiol.* 1996;17:119–128. Available online at www.shea-online.org/assets/files/position_papers/Abx-LTCF96.pdf.

[7] Clinical and Laboratory Standards Institute. *Analysis and Presentation of Cumulative Antimicrobial Susceptibility Test Data: Approved Guideline,* 2nd ed. CLSI document M39-A2. Reston, VA: Clinical and Laboratory Standards Institute; 2005.

[8] Monette J, Miller MA, Monette M, et al. Effect of an educational intervention on optimizing antimicrobial prescribing in long-term care facilities. *J Am Geriatr Soc.* 2007; 55(8):1231–1235.

Other References and Resources

Capitano B, Leshem A, Nightingale CH, et al. Cost Effect of Managing Methicillin-resistant *Staphylococcus aureus* in a Long-term Care Facility. *J Am Geriatr Soc.* 2003;51(1):10–16.

CDC's Campaign to Prevent Antimicrobial Resistance Among Long-term Care Residents. Available online at www.cdc.gov/DRUGRESISTANCE/healthcare/ltc/12steps_ltc.htm.

Fishman N. Antimicrobial stewardship. *Am J Infect Control.* 2006;34(5 Suppl 1):S55–63; S64–73.

Loeb M, Bentley DW, Bradley S, et al. Development of minimum criteria for the initiation of antibiotics in residents of long-term care facilities: results of a consensus conference. *Infect Control Hosp Epidemiol.* 2001;22(2):120–124.

Siegel JD, Rhinehart E, Jackson M, et al; Healthcare Infection Control Practices Advisory Committee. Management of multidrug-resistant organisms in healthcare settings, 2006. Available online at www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf.

Smith P, Bennett G, Bradley S, et al. APIC/SHEA Guideline: Infection prevention and control in the long-term facility. *Am J Infect Control.* 2008;36(7):504–535.

Colonization and Decolonization

Purpose

Prevention of MRSA colonization is one goal of MRSA management in LTC. The purpose of MRSA decolonization is to eliminate MRSA from nose and skin areas when a resident is known to be MRSA-colonized.

Key Concepts

- Prevention of MRSA colonization is a goal of MRSA management in LTC.
- When MRSA colonization is present, it is not routinely recommended to attempt decolonization. There are circumstances, though, in which decolonization can be considered.
- Decolonization has been suggested as a MRSA control and prevention measure when there is ongoing MRSA transmission in a well-defined cohort group having close contact.
- Decolonization has been suggested as a resident management strategy when a clinician determines that a resident may benefit clinically from decolonization, such as recurrent infections or prior to certain surgeries or procedures.
- MRSA colonization recurs in a significant number of decolonization attempts, and despite short-term benefits, long-term MRSA decolonization success is questionable.
- Decolonization may lead to the selection of high- or low-level, Mupirocin-resistant MRSA strains in a treated resident and in resident populations.

Background

Prevention of Colonization

A retrospective study[1] that ran from 1994 to 2000 in a hospital setting found that 12.6% of patients in the study acquired MRSA within a 7- to 10-day period after exposure to a MRSA-positive roommate. This was verified using pulse-field gel electrophoresis testing that showed in each case that the strain acquired was the same as the colonized roommate's strain. It follows that a high priority for MRSA management is proactive MRSA colonization prevention.

When colonization prevention is successful, the need for decolonization is eliminated altogether! As part of a prevention strategy, it is important to recognize that when a resident is known to be colonized in the nose or skin, other sites may also be sources of infection or transmission risk. Common sites with the potential for colonization and infection include wounds and sites of lines or tubes. Preventing colonization at these sites is a desirable goal.

Wound Care, Bioburden, Antimicrobial Dressing Options

In LTC, many different types of wounds, as well as sites of lines or tubes (urinary catheters, PICCs, ostomy, etc.), require clinical management due to a potential for infectious complications. Pressure ulcers, diabetic wounds, stasis ulcers, surgical sites, skin tears, etc., are some of the more common wounds that occur in the resident population. Residents are usually physically compromised and may be colonized with bacteria, some of which could be multidrug resistant, which provides the environment and the potential pathogen for an infection.

It has been demonstrated that wound dressings become contaminated with bacterial bioburden over time. The bioburden (often associated with biofilm formation within the dressing) then becomes a risk for wound infection. The use of antimicrobial dressings for wound care is one of the avenues being explored by researchers and clinicians as a way to address this risk.

A variety of dressings, including antimicrobial dressings, are now available for wounds. New and ongoing research and investigations regarding use of these products in healthcare settings is being published. The antimicrobial dressings have the benefits of both reducing bacterial growth and providing a moist environment for healing. These dressings come in a variety of forms such as gauze, foams, and transparent dressings. Dressings containing one of a variety of different antimicrobial additives, including silver, chlorhexidine, polyhexamethylene biguanide (PHMB), and iodine-containing compounds, are examples of products marketed to decrease bacterial colonization and promote healing.

Treatment nurses or wound care nurses should work with the infection preventionist to evaluate the appropriateness of the use of antimicrobial dressings. Considerations would include: types of wound, expected duration of use of dressing, irritation or sensitivity issues, demonstrated lack of development of multidrug resistance to the antimicrobial component of the dressing, and review of evidence-based practice and results. The infection preventionist should be aware of the wounds in the facility and any infections resulting from them. Monitoring dressing changes to ensure proper hand hygiene and procedure technique will help to reduce the opportunity for infection. Many wound care product companies offer education and training to promote healing and prevent infection.

Criteria for Decolonization

The CDC guideline, "Management of Multidrug-resistant Organisms in Healthcare Settings, 2006," states that MRSA decolonization is not sufficiently effective to warrant routine use.[2] *(See section V.B.9. Decolonization.)* In addition, public health guidance documents on community-associated strains of MRSA,[3] military and correctional settings guidelines, and the IDSA guideline[4] on treatment of skin and soft tissue infections recommend against routine decolonization. However, these guidelines do support the use of decolonization when there is ongoing MRSA transmission in a well-defined cohort group having close contact, or when a clinician determines that a patient may benefit clinically from decolonization and is at high risk for MRSA infection.

Decolonization strategies have been used with varying success in select patient or clinical situations, including: eradication of known MRSA colonization prior to select elective surgeries; MRSA decolonization of patients, residents, and/or healthcare staff implicated in transmission during outbreak situations; and elimination of MRSA carriage in patients with recurrent MRSA infections.

In LTC, there are little national data that examine MRSA colonization rates using active surveillance. In one set of data derived from hospital admissions of residents from LTC, the MRSA prevalence for admissions ranged from 5% to 54%.[5] In another study of 283 residents in 14 LTC facilities, there was a 12% to 54% colonization rate.[6] As more hospitals do active surveillance cultures (ASC) on LTC residents, MRSA-positive residents not previously known to be colonized will be discovered.

Infection Prevention and Control Strategy Related to Resident Decolonization

In the Tier 1 strategy of the CDC/HICPAC guideline "Management of Multidrug-resistant Organisms in Healthcare Settings, 2006," decolonization is not considered a routine MRSA prevention and control intervention in LTC settings.

In Tier 2, when intensified MRSA control efforts are necessary, decolonization may be considered as part of a control program for a limited time and for select colonized residents or healthcare workers on a case-by-case basis.

If endemic MRSA colonization rates are high, there is an identified MRSA transmission problem, or when surveillance detects a MRSA outbreak in a specific unit or facility-wide, a decolonization strategy must be considered. A decision to use decolonization as an intervention requires review and evaluation by the appropriate multidisciplinary team or committee, and is implemented under the direction of the LTC facility's medical director. Also, in some instances, the multidisciplinary team may want to consult with infectious disease experts regarding decolonization regimens.

If a decolonization strategy using nasal Mupirocin is implemented in an LTC facility, monitors must be put in place to detect emerging resistance. Laboratory protocols for detecting Mupirocin resistance in MRSA isolates and/or surveillance for decolonization failure should be implemented.

Infection Prevention and Control Strategy Related to Healthcare Worker Decolonization

Healthcare worker decolonization is indicated only as a prevention and control intervention when a healthcare worker is chronically colonized with MRSA and/or has been epidemiologically implicated in ongoing transmission of MRSA to patients. See section V.B.9. "Decolonization" in CDC/HICPAC "Management of Multidrug-resistant Organisms in Healthcare Settings, 2006."

MRSA Decolonization Regimens

In an LTC setting, a standardized regimen for decolonization should be established for those situations in which a resident will benefit clinically (as determined by expert medical opinion), or there is an identified MRSA transmission problem in a resident unit or resident population. Therefore, a standardized regimen for decolonization should be established. Although optimal regimens have not yet been definitively established, expert opinion is that a MRSA decolonization regimen should include:[7]

- Nasal decolonization with intranasal topical Mupirocin (BID for 5 days)
- Skin antisepsis (i.e., chlorhexidine baths*) concurrently with the decolonization regimen
- Oral antimicrobials (usually rifampin and trimethoprim-sulfamethoxazole or rifampin and doxycycline or rifampin and minocycline) under the direction of a physician

**Monitor for adverse skin reactions to chlorhexidine bathing.*

Other considerations during a resident decolonization protocol would be strict adherence to personal hygiene and environmental cleaning and disinfection. Reintroduction of MRSA after decolonization could occur if actions are not taken to ensure that clothes, linens, equipment, and the resident's environment are carefully cleaned and/or disinfected throughout the decolonization period.

Surveillance During the Intervention Period

The effectiveness of the decolonization intervention will depend on the ability to eliminate MRSA transmission while avoiding Mupirocin resistance. During an intervention that includes decolonization, closely monitor MRSA transmission rates. If possible to obtain Mupirocin resistance testing on MRSA isolates, survey for an increase in resistance.

Discontinue the routine use of Mupirocin nasal decolonization when MRSA transmission rates decrease significantly and consistently over time, or when Mupirocin resistance and/or decolonization failures increase.

Practice Tools

The following is an example from the U.S. Navy and Marine Corps of a decolonization regimen that may be used if clinically indicated. It can be accessed in "Guidelines for the Management of Community-associated Methicillin-resistant *Staphylococcus aureus* (CA-MRSA) Infections in the U.S. Navy and Marine Corps," May 2005. Available online at http://chppm-www.apgea.army.mil/documents/MRSA/CA-MRSAguidelines-NEHC-Aug05.pdf

Example of Regimen for Decolonization

Mupirocin	• Apply approximately one-half of 2% calcium Mupirocin ointment from the 1-gm single-use tube (Bactroban®) into one nostril and the other half of the ointment to the other nostril • The individual should press the sides of the nose together and gently massage to spread the ointment throughout the inside of the nostrils. • Continue twice daily for 10 days, avoiding contact of the medication with the eyes.
Chlorhexidine*	• Rinse area thoroughly with water, avoiding excessively hot or cold water. • Wash gently from the neck down with the minimum amount of Hibiclens® as necessary. • Rinse thoroughly with warm water. • Continue once daily for 5 days.
*Hibiclens®, containing 4% chlorhexidine gluconate, is known to be toxic. The manufacturer provides the following precautions when using Hibiclens®: Hypersensitivity reactions may occur, particularly in the genital area. Keep away from face and head, since middle ear contact has led to deafness and permanent eye injury may occur following prolonged contact.	

References

[1] Christine Moore, Dhaliwali J, Tong A, et al. Risk factors for Methicillin-resistant *Staphylococcus aureus* (MRSA) acquisition in roommate contacts of patients colonized or infected with MRSA in an acute-care hospital. *Infect Control Hosp Epidemiol.* 2008;29:600–606.

[2] Siegel JD, Rhinehart E, Jackson M, et al. Healthcare Infection Control Practices Advisory Committee. Management of multidrug-resistant organisms in healthcare settings, 2006. Available online at www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf.

[3] Borlaug G, Davis JP, Fox BC. Community-associated Methicillin-resistant *Staphylococcus aureus*: guidelines for clinical management and control of transmission. Wisconsin Division of Public Health; October 2005.

[4] Infectious Disease Society of America (IDSA). Practice guidelines for the diagnosis and management of skin and soft-tissue infections. *Clin Infect Dis.* 2005;41:1373–1406. Available online at www.journals.uchicago.edu/CID/journal/issues/v41n10/37519/37519.html.

[5] Peterson L, Robicsek A. Managing MRSA: A Call to Action. Second Annual APIC/JCR/Joint Commission Conference. Cambridge, MA: August 15, 2006.

[6] Wendt C, Svoboda D, Schmidt C, et al. Characteristics that promote transmission of *Staphylococcus aureus* in German nursing homes. *Infect Control Hosp Epidemiol.* 2005;26:816–821.

[7] Simor AE, Phillips E, McGeer A, et al. Randomized controlled trial of chlorhexidine gluconate for washing, intranasal Mupirocin, and rifampin and doxycycline versus no treatment for the eradication of Methicillin-resistant *Staphylococcus aureus* colonization. *Clin Infect Dis.* 2007;44:178–185.

Other References and Resources

Coutts P, Sibbald RG. The effect of a silver- containing Hydrofiber dressing on superficial wound bed and bacterial balance of chronic wounds. *Int Wound J.* 2005;2(4):348–356.

Deshpande LM, Fix AM, Pfaller MA, et al. SENTRY Antimicrobial Surveillance Program Participants Group. Emerging elevated Mupirocin resistance rates among staphylococcal isolates in the SENTRY Antimicrobial Surveillance Program (2000): correlations of results from disk diffusion, Etest and reference dilution methods. *Diagn Microbiol Infect Dis.* 2002;42:283–290.

Henderson DK. Managing Methicillin-resistant staphylococci: a paradigm for preventing nosocomial transmission of resistant organisms. *Am J Med.* 2006;119(6 Suppl 1):S45–S52.

Konvalinka A, Errett L, Fong IW. Impact of treating *Staphylococcus aureus* nasal carriers on wound infections in cardiac surgery. *J Hosp Infect.* 2006;64:162–168.

Loeb M, Main C, Walker-Dilks C, et al. Antimicrobial drugs for treating Methicillin-resistant *Staphylococcus aureus* colonization. Cochrane Library review of six decolonization studies: no evidence to support nasal or extra-nasal decolonization. Available online at www.mrw.interscience.wiley.com/cochrane/clsysrev/articles/CD003340/frame.html. (Date of last substantial Update: August 25, 2003.)

Mann TJ, Orlikowski CE, Gurrin LC, et al. The effect of the biopatch, a chlorhexidine impregnated dressing, on bacterial colonization of epidural catheter exit sites. *Anaesth Intensive Care.* 2001;29(6):600–603.

Mody L, Kauffman CA, McNeil SA, et al. Mupirocin-based decolonization of *Staphylococcus aureus* carriers in residents of 2 long-term care facilities: a randomized, double-blind, placebo-controlled trial. *Clin Infect Dis.* 2003;37(11):1467–1474.

Mueller SW, Krebsbach LE. Impact of an Antimicrobial Impregnated Gauze Dressing on Surgical Site Infections Including Methicillin Resistant *Staphylococcus Aureus* Infections. *AJIC.* 2007;35(5):E212–E213.

Mulder GD, Cavorsi JP, Lee DK. Polyhexamethylene Biguanide (PHMB): An addendum to current topical antimicrobials. *Wounds.* 2007;19(7).

Nicholson MR, Huesman LA. Controlling the usage of intranasal Mupirocin does impact the rate of *Staphylococcus aureus* deep sternal wound infections in cardiac surgery patients. *Am J Infect Control.* 2006;34:44–48.

Perl T. Prevention of *Staphylococcus aureus* infections among surgical patients: Beyond traditional perioperative prophylaxis. *Surgery.* 2003;134:S10–S17.

Trick WE, Weinstein RA, DeMarais PL, et al. Colonization of skilled-care facility residents with antimicrobial-resistant pathogen. *J Am Geriatr Soc.* 2001;49:270–276.

Case Studies

CASE STUDY 1: Admission of MRSA-Colonized Resident

Mrs. A

Admissions receives a call from the hospital requesting bed availability for Mrs. A, an 86-year-old woman recovering from a MRSA urosepsis. Mrs. A has a history of hip fracture and repair, with an 8-month stay at your facility one year ago. Mrs. A requires physical and occupational therapy to regain her strength, with the goal to return to her apartment. Mrs. A is on treatment for MRSA urosepsis and is now asymptomatic. Mrs. A has mixed incontinence and wears briefs. Mrs. A has been identified in the hospital as MRSA-colonized (positive nasal culture). Mrs. A needs assistance with her activities of daily living, but she is alert and oriented and can follow directions. She is a good candidate for teaching.

Can Mrs. A safely be admitted to Medicare?

Yes

Does Mrs. A need Contact Precautions?

No. As long as she has clean hands, clothes, and equipment and her drainage is contained, Standard Precautions are sufficient in the LTC setting.

Teaching of Mrs. A and her family is very important. Reinforce basic hygiene, and emphasize excellent hand hygiene.

Does Mrs. A need to be identified by the infection preventionist?

Yes. She should be included in the MRSA line listing. The infection preventionist needs to keep a line listing of all individuals with a history of MRSA infection or colonization.

CASE STUDY 2: Dementia Unit Resident with MRSA Wound Infection

Mr. M

The nurse manager of the Late Stage Memory Support Unit (dementia unit) calls the infection preventionist regarding Mr. M, a resident of the unit. Mr. M bumped his leg on his wheelchair and the open area is now infected. MRSA is isolated from the wound culture. Mr. M is being treated with appropriate wound care and antibiotics. Mr. M shares a room with Mr. P, who requires an indwelling urinary catheter for urinary retention. Mr. M wanders in his wheelchair, he becomes agitated when restrained, and he will occasionally urinate in wastebaskets or plants if he cannot find the toilet.

Unassisted, Mr. M cannot comply with good personal or environmental hygiene. Mr. M is cooperating with wound and antibiotic treatment.

Can Mr. M continue to safely be cared for on the Memory Support (dementia) Unit?

- **Yes.** If Mr. M is placed under increased supervision with special attention to hygiene and keeping clothes and his wheelchair clean, and his wounds covered, then he can be safely cared for on the unit. Per facility policy, use Precautions appropriate for Contact Transmission for Mr. M.

Should Mr. M continue to share a room with Mr. P?

- The best room placement option for Mr. M is a private room.
- If a private room is not available, Mr. M may be placed with a resident who does not have catheters, lines, or open areas if at all possible.

Mr. M's room needs to be cleaned routinely and correctly. Ensure a cleaning schedule for the dementia unit that frequently attends to common areas like hallway rails and other high-touch areas (Mr. M likes to wander.)

What are priorities in Mr. M's care?

- Cleanliness, hygiene, and completion of therapy
- More frequent bathing/showers. Consider using antibacterial soap.
- Disinfect shower area after Mr. M has a shower.
- Perform hand hygiene frequently.
- Maintain clean clothes, room, and wheelchair.
- Implement daily cleaning of room and equipment with appropriate facility-approved disinfectant. (More frequent cleaning may be required based on observed contamination of the environment and equipment.)
- Increase supervision: Consider one-on-one caregiver if Mr. M removes his wound dressings.
- Increase scheduled toileting to discourage public urination.
- Discuss with care team the possibility of decolonization after completion of antibiotic therapy as a possible intervention if medically indicated.
- If Mr. M's physician orders decolonization regimen and the original culture report is available, check the laboratory for availability of mupirocin (Bactroban)* susceptibility result. (*Mupirocin is the nasal decolonization treatment.)
- Communicate with family members or visitors about Mr. M's situation and educate them about general and facility-specific MRSA infection control.

CASE STUDY 3: Surveillance Shows a Unit-Specific Increase in MRSA Urinary Tract Infections

As an infection preventionist, you notice that the culture results are showing an increased number of MRSA urinary tract infections on a skilled nursing unit. The antibiotic susceptibility patterns show that the MRSA infections have similar resistance and susceptibility to antibiotics. There is no PCR testing available, and a MRSA screening program is not currently implemented.

Evaluate the following infection prevention strategies as possible interventions:

Increase communication.

Contact nursing management and ensure that all members of the resident Interdisciplinary Care Team, including staff nurses, nurse's aides, and housekeeping, are aware of the pattern of increased infections.

As appropriate, convene a special care team, including nursing management and unit staff, medical director, and others as you deem appropriate.

Ensure that the physicians and APNs are aware of the pattern of MRSA infections.

Contact the lab; consider requesting notification of positive MRSA cultures by phone, pager, or e-mail to facilitate surveillance and interventions.

Increase surveillance

- Monitor hand hygiene of both staff and residents.
  - Observe for and address improper personal hygiene.
  - Monitor cleaning products and techniques used; housekeeping and nursing technique should be monitored.
- Observe for and address improper environmental cleaning.
- Observe for and address improper use of Standard and Contact Precautions.
- Observe for and address improper PPE usage.
- Monitor for increased urinary catheter usage.
  - Observe catheter care; discontinue catheters promptly when medically indicated.
- Consider admission patterns from admitting hospitals or other healthcare facilities.
  - Is there a pattern or commonality?
- Monitor resident behavior and activity patterns.
  - Has there been a change in residents' behavior?
  - Have new residents been admitted?
- Consider active surveillance cultures, if the number of infections identified continues to increase.
- Monitor antibiotic usage (appropriateness, duration, etc.).

Implement those strategies that you and/or the appropriate multidisciplinary team have decided will be effective.

Monitor for expected outcome. Adjust strategies if the MRSA UTI rate does not decrease.

Consider attempting a unit-specific decolonization strategy if the numbers of infections identified continue to increase, and other infection prevention strategies have been unsuccessful. Do this after consultation with the entire care team, including physicians and APNs, the resident, the family, and nursing staff.

CASE STUDY 4: Appropriate Use of PPE

An alert, oriented resident who is totally dependent on assistance with activities of daily living is on Contact Precautions for a MRSA urinary tract infection. An observation is made while two certified nursing assistants are assisting this resident with brief changes and perineal care.

The nursing assistants are observed to:

- Wash and sanitize their hands and put on clean gowns and gloves upon entering the resident's room.
- Greet the resident and ask if they can assist her to change her brief.
- Position the resident and open the brief.
- Ask if the resident has had a bowel movement.
- **The nursing assistant who opened the brief goes to the closet, opens the closet, and gathers additional supplies. She does not remove gloves before these activities.**

Outcome: Bacteria and other organisms from inside the brief now contaminate everything that the nursing assistant touched with the unchanged gloves.

Action: Give immediate feedback and just-in-time education to the nursing assistants. Emphasize appropriate glove use, hand hygiene, environmental cleaning, and disinfection. Based on observation, recommend process changes:

1. Assemble supplies before assisting with the brief change.
2. Remove soiled gloves, sanitize hands, and apply fresh gloves before touching additional supplies or room surfaces.
3. After cleaning up observed contamination, use facility approved disinfectant per label instructions.

CASE STUDY 5: Resident Known to Have MRSA Nasal Colonization with New Onset Respiratory Symptoms

Mrs. R

Mrs. R, who has documented MRSA respiratory colonization, develops a fever and respiratory symptoms, including sneezing and a productive cough. Mrs. R is alert and oriented, and she follows directions. She has right-sided hemiplegia and requires extensive assistance with activities of daily living. Her daughter is very involved in her care.

What is the appropriate room placement?

- Mrs. R should be placed in a private room
- If no private room is available, cohort with another MRSA-positive resident.
- If no MRSA cohort is available, place in room with a resident who does not have catheters, lines, or open areas.
- Close the curtain around Mrs. R's living area to maintain a three-foot distance between roommates to eliminate possible exposure to droplets.

What are priorities in Mrs. R's care?

- Contact Precautions with the addition of components that are used to prevent droplet transmission
  - Caregivers working within three feet of Mrs. R protect eyes, nose, or mouth from droplet transmission by using a mask and eye protection
- Teach Mrs. R's daughter, who provides care within three feet of Mrs. R, to use respiratory hygiene techniques, including use of a mask and the correct way to apply and remove PPE
- Teach Mrs. R to perform respiratory hygiene techniques (adapted to her abilities)
- Mrs. R should remain in her room for the duration of her respiratory symptoms
- If it is medically necessary for Mrs. R to leave her room, assist Mrs. R with hand hygiene and the proper placement of a mask to wear while outside of her room
- Mrs. R must be assisted in keeping her clothes, room, and wheelchair very clean with daily (at least) cleaning with appropriate cleaning agents and disinfecting solutions
- The staff needs to socialize with Mrs. R to prevent the adverse effects of being in Contact Precautions

Appendix A: Surveillance and Data Collection

An assessment of MRSA relies on the availability of culture results or a flagging system to identify patients with a laboratory confirmed history of MRSA. Clinical cultures from residents identified with MRSA will be a core component of surveillance. To perform a MRSA risk assessment, a tracking log can be used for MRSA-positive residents. Processes used to capture the data must be consistent so that statistical evaluation is relevant and comparative over time. Line listings are a basic tool and can be kept as a manual or electronic (i.e., Excel worksheet) record.

Example of a MRSA Tracking Log

MRSA-Positive Resident Tracking Log

Name	Unit/ Room History	Admit Date	Name of Facility Admitted From	Culture Date	Site of Culture/ Specimen Type	Date and Culture Result	Infection or Colonized	HAI Y/N?	Present Prior to Admit Y/N?	Contact Prec. Needed Y/N?	Contact Prec. Start Date	Contact Prec. Discontinue Date

Appendix B: Definitions and Outcome Measurements

Definitions and Criteria

The MRSA risk assessment must include clear definitions for all measurements. A new MRSA acquisition is typically considered to be associated with the healthcare facility if it is detected more than 48 hours after admission.

When incidence or prevalence rates are used in the risk assessment, numerator and denominator data—as well as the types of statistical tools used in the data evaluation—must be clearly defined.

Risk Assessment Tool

Many facilities effectively used tools for compiling data related to infection risks, including MRSA, as part of the *annual* infection prevention and control program process. Risk assessment forms are tools that can be customized for units and facilities, and will provide information for the initial baseline assessment and the ongoing surveillance data evaluations.

Example of a Risk Assessment Template for Identifying Risk Populations and Services

INFECTION CONTROL RISK ASSESSMENT: Risk Groups and Services

This risk assessment has been prepared with input and collaboration from the following departments or quality committees:

_____ _____ _____ _____ _____

Patient Population	Services Provided	Risks	*Risk Level	Prevention Strategies

HR – High-Risk HV – High Volume PP – Problem Prone LR – Low-Risk LV – Low Volume

Performance Improvement Plan for Surveillance and Goals is based on the above identified risks.

Appendix C: Example of a Risk Assessment Scoring Tool

Nature of Risk	Data Collection Tool	Measurement	Score	Comments
Incidence of MRSA				
Percentage of residents with MRSA (colonization or infection) upon admission to your facility	Based on the facility MRSA line list	1. 0%–25% 2. 26%–50% 3. 51% or higher		
Total facility rate of residents with community-associated MRSA (colonization or infection)	Based on the facility MRSA line list	1. less than last year 2. same as last year 3. increase over last year (use zero if you cannot compare)		
Total facility rate of residents with healthcare-associated MRSA (colonization or infection)	Based on the facility MRSA line list	1. less than last year 2. same as last year 3. increase over last year (use zero if you cannot compare)		
What is the incidence of MRSA in your community? How does it compare with the state and national average? This information can be obtained from the CDC/state health departments.	Facility rate _____ (This includes community associated and healthcare-associated MRSA) Community rate _____ State rate (if available) _____ National rate (if available) _____	1. less than community rate 2. same as the community rate 3. higher than the community rate (State and national rates for information only)		
Rates of Healthcare-associated MRSA on Specialized Units Within the LTC Facility				
Ventilator Unit	Base on previous surveillance data analysis	1. low rate 2. moderate, steady rate 3. increasing rate		
Dialysis Unit	Base on previous surveillance data analysis	1. low rate 2. moderate, steady rate 3. increasing rate		
Alzheimer/Dementia Unit	Base on previous surveillance data analysis	1. low rate 2. moderate, steady rate 3. increasing rate		
Medical/Surgical Unit	Base on previous surveillance data analysis	1. low rate 2. moderate, steady rate 3. increasing rate		
Brain Injury Unit	Base on previous surveillance data analysis	1. low rate 2. moderate, steady rate 3. increasing rate		
LTC Resident Unit	Base on previous surveillance data analysis	1. low rate 2. moderate, steady rate 3. increasing rate		
Rehabilitation Unit	Base on previous surveillance data analysis	1. low rate 2. moderate, steady rate 3. increasing rate		

Nature of Risk	Data Collection Tool	Measurement	Score	Comments
Rate of Infection				
Bloodstream infection rates associated with MRSA	Facility-defined target rate _____ (Evaluate current rate as low, moderate, or high)	1. low rates 2. moderate rates 3. high rates (as compared to current year target rate)		
Urinary tract infections associated with MRSA	Facility-defined target rate _____ (Evaluate current rate as low, moderate, or high)	1. low rates 2. moderate rates 3. high rates (as compared to current year target rate)		
TOTAL SCORE: Current Year				
TOTAL SCORE: Past Year(s)				

MRSA Facility Risk Assessment Scoring Tool

Risk Score	Degree of Risk	Possible Interventions
0–20	Low Transmission Risk	1. Hand hygiene program 2. Standard precautions 3. Transmission-based precautions 4. Appropriate environmental cleaning 5. Monitor hand hygiene 6. Monitor precaution practices 7. Monitor procedure practices
21–30	Medium Transmission Risk	1. Hand hygiene program 2. Standard precautions 3. Transmission-based precautions 4. Increase environmental cleaning 5. Monitor hand hygiene, increase 6. Monitor precaution practices, increase 7. Monitor procedure practices, increase
31–39	High Transmission Risk	1. Hand hygiene program 2. Standard precautions 3. Transmission-based precautions 4. Increase environmental cleaning 5. Monitor hand hygiene, increase 6. Monitor precaution practices, increase 7. Monitor procedure practices, increase 8. Facility interdisciplinary planning meeting to address the issue 9. Develop a plan of action 10. Review residents' transmission-based isolation status 11. Employ an infection preventionist consultant

Appendix D: Reports, Plans, Communication

Risk Assessment Evaluation and Reporting

Results of the risk assessment must be reported to key personnel in the facility. Reports are communicated quarterly and whenever the risk assessment changes related to modifications in facility services (i.e., opening of a ventilator-dependent unit) or alterations in rates detected via ongoing surveillance (i.e., outbreak on a particular unit or related to a particular patient population).

Example of an Annual Risk Assessment Report

ABC LTC Facility 2007 Review of MDRO Surveillance
And Infection Control Risk Assessment for MRSA

1. Purpose
The Infection Control Risk Assessment identifies and quantifies specific high-risk and/or high-volume facility multidrug-resistant organism (MDRO) colonizations and infections at ABC LTC facility annually.

2. Initial and Periodic Risk Assessment
For the year 2006, MRSA and MDRO surveillance at ABC LTC facility included review of culture reports and identification of resident infection or colonization history from chart review. MRSA continues to be the highest volume MDRO.

ABC LTC facility has admitted residents who have been infected or colonized with the following organisms. These have been listed in decreasing order of frequency:

Methicillin-resistant *Staphylococcus aureus* (MRSA)

Clostridium difficile (C. diff)

Extended Spectrum Beta-lactamase *E. coli* or *Klebsiella*

Vancomycin-resistant *Enterococcus* (VRE)

- There have been no identified cases of other MDROs during 2006–2007.
- There have been no identified MDRO outbreaks at ABC LTC facility.
- MRSA transmission within ABC LTC facility has decreased over the past year on A and B resident wings.
- An increase in MRSA-positive clinical cultures was identified on C wing (ventilator unit) during the fourth quarter of 2006. A multidisciplinary team evaluated the problem and made recommendations for improvement. Interventions were implemented to ensure compliance with infection and control processes, including:
    - Daily hand hygiene monitors with weekly result postings
    - Contact Precautions competency for all staff
    - Increased availability of isolation supplies at point of use
    - In the third quarter of 2007, MRSA transmission was verified by surveillance for 3 consecutive months. Refer to infection control MRSA surveillance reports (2006–2007) posted on the infection control bulletin board.

3. Key Infection Prevention and Control Strategies
There are no revisions to the applicable infection prevention and control policies for 2007–2008.

Compliance with the following **ABC LTC** facility policies are key components of the infection control program:

- Hand hygiene policy
- Standard Precautions policy
- Transmission-based Precautions policy
- Resident assessment and room placement policy
- Environment cleaning and disinfection policy
- Hand-off communication (internal and external) policy
- Patient assessment

Hand hygiene is monitored monthly on all units (see the section on **Standard Precautions**). Compliance with Transmission-based Precautions is monitored monthly on the ventilator unit. Monitors of other infection prevention and control processes are performed at the direction of infection control when results of ongoing surveillance indicate that interventions are needed.

Appendix E: Example of a Hand Hygiene Monitoring Tool

Modify as appropriate according to facility requirements, policies, or improvement needs.

Name or position of person being observed	Position 1. Nurse 2. Physician 3. Other	Unit	Before contact with resident Appropriate hand hygiene used	After contact with resident Appropriate hand hygiene used	After contact with contaminated environment / equipment	Hand hygiene compliant
	1 2 3		YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	1 2 3		YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
	1 2 3		YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐	YES ☐ NO ☐
Comments:						

Hand Hygiene Criteria

Hand hygiene compliance is determined as the appropriate use of the following:

Before each patient contact/encounter:

- Handwashing with alcohol hand gel, or with soap and water if hands are visibly soiled
- Use of gloves as appropriate

After each patient contact/encounter:

- Handwashing with alcohol hand gel, or with soap and water if hands are visibly soiled
- If gloves were used, hand hygiene after removal of gloves

After contact with contaminated equipment or environment:

- Handwashing with alcohol hand gel, or soap and water if hands are visibly soiled
- If gloves were used, hand hygiene after removal of gloves

Appendix F: Environmental Services Checklist Audit: Daily Cleaning of Resident Room

	STEPS	
Cleaning Task	**Compliance**	**Comment / Recommendation**
High Dusting Performed		
Use high duster/mop head: wipe ledges (shoulder high and above)	☐ Yes ☐ No	
Vents	☐ Yes ☐ No	
Lights *Do not high dust OVER the resident*	☐ Yes ☐ No	
Dust TV: rotate and dust screen and wires		
Damp Dust: Clothes (rags) and spray bottle of disinfectant for damp wipe		
Ledges (shoulder high)	☐ Yes ☐ No	
Door handles	☐ Yes ☐ No	
Room furniture (bureaus, chairs, etc.)	☐ Yes ☐ No	
Bedside Table: Disinfect Surface	☐ Yes ☐ No	
Equipment (per policy)	☐ Yes ☐ No	
Glass Surfaces	☐ Yes ☐ No	
Bathroom: All Surfaces		
Toilet	☐ Yes ☐ No	
Ledges in bathroom	☐ Yes ☐ No	
Door handles	☐ Yes ☐ No	
Sink (especially faucet handles)	☐ Yes ☐ No	
Shower stall	☐ Yes ☐ No	
Clean mirrors/chrome	☐ Yes ☐ No	
Waste Basket		
Liner bags: close before removing	☐ Yes ☐ No	
Clean and disinfect if can is visibly soiled	☐ Yes ☐ No	
Isolation (Red Bag Waste)		
Close and carry to soiled utility room	☐ Yes ☐ No	
Place in covered Red Hazard trash	☐ Yes ☐ No	
Needle Boxes		
Check level of sharps	☐ Yes ☐ No	
Replace if half to three-fourth full	☐ Yes ☐ No	
Take to soiled utility room after securely closing	☐ Yes ☐ No	

Cleaning Task	Compliance	Comment / Recommendation
Floor Disinfection		
Sweep floor before wet mopping	☐ Yes ☐ No	
With wet mop, start farthest from door; half of room first, then other half	☐ Yes ☐ No	
Bathroom shower floor	☐ Yes ☐ No	
Bathroom floor	☐ Yes ☐ No	

Adapted from the *Evanston Northwestern Healthcare (Illinois) Checklist*, as published in the Institute for Healthcare Improvement (IHI). Getting Started Kit: Reduce Methicillin-resistant *Staphylococcus aureus* (MRSA) Infection How-to Guide, 2006. Available online at www.ihi.org/IHI/Programs/Campaign.

Appendix G: Environmental Services Checklist Audit: Terminal Cleaning (Resident Discharge)

RESIDENT REMOVED FROM ISOLATION*

***Do not remove isolation sign until checkout cleaning is completed.**

Cleaning Task	Compliance	Comment / Recommendation
High Dust		
Use high duster/mop head: wipe ledges (shoulder high and above)		
Vents		
Lights *Do not high dust OVER the resident*		
Dust TV: rotate and dust screen and wires		
Damp Dust: Clothes (rags) and spray bottle of disinfectant for damp wipe		
Ledges: shoulder and higher		
Vents		
Lights		
Lights (bathroom)		
TV: rotate all ledges		
TV cabinet		
Screen and wires		
Damp Dust: Cloth (rag) and spray bottle of disinfectant; damp wipe all surfaces in room		
Ledges (shoulder high)		
Door handles		
Door hinges		
Room furniture (bureaus, chairs, etc.)		
Bed (top to bottom, head to foot, and left to right); bring bed up to highest position		
Raise mattress and disinfect top, sides, and bottom		
Disinfect exposed frame, springs, or bed panels		
Headboard: disinfect top, front, and back		
Disinfect side rails, undercarriage, and lower ledges		
Disinfect all bed controls (where applicable)		
Disinfect the footboard top, front, and back		
Allow to completely dry before replacing linen on bed		
Glass Surfaces		

Cleaning Task	Compliance	Comment / Recommendation
Over Bed Table and Bedside Table		
Disinfect surfaces and legs		
Wipe out drawer		
Equipment (per policy)		
Replace Privacy Curtains		
Bathroom: All Surfaces		
Toilet (bowl, seat, handle, etc.)		
Ledges in bathroom		
Door handles		
Sink (especially faucet handles)		
Shower stall		
Clean mirrors/chrome		
Waste Basket		
Liner bags; close before removing		
Clean and disinfect if can is visibly soiled		
Isolation (Red Bag Waste)		
Close and carry to soiled utility room		
Place in covered Red Hazard trash		
Needle Boxes		
Check level of sharps		
Replace if half to three-fourths full		
Take to soiled utility room after securely closing		
Floor Disinfection		
Sweep floor before wet mopping		
With wet mop, start farthest from door; half of room first, then other half		
Bathroom shower floor (especially mildew)		
Bathroom floor		

Adapted from the *Evanston Northwestern Healthcare (Illinois) Checklist* published in the Institute for Healthcare Improvement (IHI) 5 Million Lives campaign. Getting Starter Kit: Reduce Methicillin-resistant *Staphylococcus aureus* (MRSA) Infection How-to Guide, 2006. Available online at www.ihi.org/ihi.