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# Management of Multidrug-Resistant Organisms in Long Term Care Facilities*

## 1-Introduction

Although transmission of MDROs is most frequently documented in acute care facilities (hospitals), all healthcare settings are affected by the emergence and transmission of antimicrobial-resistant microbes. Long-term care facilities (LTCF) are receiving patients with MDROs from acute care facilities, but are also responsible for the transmission of MDROs.

Approaches to prevention and control of these pathogens must be tailored to the specific needs of each population and individual institution. The following recommendations are provided to guide the implementation of strategies and practices to prevent the transmission of MDROs in LTCFs. They are largely based on recommendations made by the diverse organizations listed in the references at the end of this document.

These recommendations are primarily based on:

- CDC HICPAC 2006 Recommendations: *Management of Multidrug-Resistant Organisms In Health Care Settings*. Jane D. Siegel, MD; Emily Rhinehart, RN MPH CIC; Marguerite Jackson, PhD; Linda Chiarello, RN MS; the Healthcare Infection Control Practices Advisory Committee, 2006.
- CDC.Gov Website: *Management of Multidrug-Resistant Organisms In Healthcare Settings*, accessible at: http://www.cdc.gov/hicpac/mdro/mdro_4.html

## 2-Background

### 2.1-MDRO

For epidemiologic purposes, MDROs are defined as microorganisms, predominantly bacteria, that are resistant to one or more classes of antimicrobial agents. Although the names of certain MDROs describe resistance to only one agent (e.g., MRSA, VRE, CRE), these pathogens are frequently resistant to most available antimicrobial agents.

* *See Glossary Page 16*

Multidrug-resistant organisms (MDROs), include:

- Methicillin-resistant *Staphylococcus aureus* (MRSA),
- Vancomycin-resistant *enterococci* (VRE),
- Vancomycin intermediate (VISA) and Vancomycin Resistant *Staphylococcus aureus* (VRSA),
- *Enterobacteriaceae* multi-resistant: *Enterobacteriaceae* represent a large family of Gram-negative bacteria (GNB) that includes genera such as *Klebsiella, Escherichia, Enterobacter, Morganella, Proteus, Providencia, Salmonella* and *Shigella*.

-Some produce extended spectrum β-lactamases (ESBLs), and others that are resistant to multiple classes of antimicrobial agents, are of particular concern. Some of these *enterobacteriaceae* have become carbapenem resistant. Carbepenem resistance (CR) was uncommon before 2001. Resistance is due to production of carbapenemase (special β-lactamase); a porin mutation limits the penetration ability of carbapenems. This mutation is located on transferable plasmids. First CR spread among *Klebsiella pneumoniae* with a Klebsiella pneumonia carbapenemase (KPC). Soon after, *E.coli* and *Enterobacter* have followed suit.

-More recently, alarm has been raised over the spread of drug resistance to carbapenem antibiotics among these coliforms, due to production of the New Delhi metallo-β-lactamase, NDM-1. These Metallo-β-lactamases (MBLs), have become the more prevalent mechanisms for CRE. MBLs include New-Dehli (NDM), Verona Integron Encoded (VIM), and imipenemase (IMP).

-Some *Enterobacteriaceae* have intrinsic resistance to imipenem: *Morganella, Proteus and Providencia*

-Other *Enterobacteriaceae* include *Salmonella* and *Shigella*

-CR is often associated with resistance to other antibiotics to create pan-resistant strains. There are currently no new antibiotics in development to combat bacteria resistant to carbapenems, and worldwide spread of the resistance gene is considered a potential nightmare scenario.

- Third generation cephalosporin resistance (ceftazidime), resistance to fluoroquinolones, carbapenems, and aminoglycosides
- Some strains of *Acinetobacter baumannii* are resistant to all antimicrobial agents, or all except imipenem.
- Micro-organisms such as *Stenotrophomonas maltophilia, Burkholderia cepacia*, and *Ralstonia pickettii* are intrinsically resistant to the broadest-spectrum antimicrobial agents.
- In LTCFs it is important to control multidrug-resistant *S. pneumoniae* (MDRSP) that are resistant to penicillin and other broad-spectrum agents such as macrolides and fluoroquinolones.

Colonization with multiple MDROs appears to be common. One study found that nearly 50% of residents in a skilled-care unit in a LTCF were colonized with a target MDRO and that 26% were co-colonized with more than one MDRO; a detailed analysis showed that risk factors for colonization may vary by pathogen. However, patient risk factors associated with colonization with MRSA, VRE, MDR-GNB, *C. difficile* and *Candida* sp were the same. This review concluded that control programs that focus on only one organism, or one antimicrobial drug are unlikely to succeed because vulnerable patients will continue to serve as a magnet for other MDROs.

## 2.2-Clinical Importance of MDROs

In most instances, MDRO infections have clinical manifestations that are similar to infections caused by susceptible pathogens. However, options for treating patients with these infections are often extremely limited.

## 3- Epidemiology of MDROs

### 3.1-Trends:

Prevalence of MDROs varies temporally, geographically, and by healthcare setting. For example, VRE emerged in the eastern United States in the early 1990s, but did not appear in the western United States until several years later; MDRSP varies in prevalence by state.

The type and level of care also influence the prevalence of MDROs. ICUs, especially those at tertiary care facilities, may have a higher prevalence of MDRO infections than do non-ICU settings. Antimicrobial resistance rates are also strongly correlated with hospital size, tertiary-level care, and facility type (LTCF).

The frequency of clinical infection caused by these pathogens is low in LTCFs, but MDRO infections in LTCFs can cause serious disease and mortality; colonized or infected LTCF residents may serve as reservoirs and vehicles for MDRO introduction into acute care facilities.

There is a trend towards increase in prevalence of numerous MDROs (See Antibiotic Resistance Trends in Louisiana on website *http://new.dhh.louisiana.gov/index.cfm/page/534*.)

### 3.2-Important Concepts in Transmission.

Once MDROs are introduced into a healthcare facility, transmission and persistence of the resistant strain is determined by the availability of vulnerable patients, selective pressure exerted by antimicrobial use, increased potential for transmission from larger numbers of colonized or infected patients ("colonization pressure"), and the impact of implementation and adherence to prevention efforts.

LTCF residents are commonly vulnerable to colonization and infection; this includes those with severe disease, especially those with compromised host defenses from underlying medical conditions, or indwelling medical devices (e.g., urinary catheters or endotracheal tubes.

There is ample epidemiologic evidence to suggest that MDROs are carried from one person to another via the hands of healthcare personnel (HCP). Hands are easily contaminated during the process of care-giving or from contact with environmental surfaces in close proximity to the patient. The latter is especially important when patients have diarrhea and the reservoir of the MDRO is the gastrointestinal tract. Strategies to increase and monitor adherence are important components of MDRO control programs.

Opportunities for transmission of MDROs beyond the acute care hospital result from patients receiving care at multiple healthcare facilities, and moving between acute-care, ambulatory and/or chronic care and LTC environments.

### 3.3-Role of colonized HCP in MDRO transmission.

Rarely, HCP may introduce an MDRO into a patient care unit. Occasionally, HCP can become persistently colonized with an MDRO, but these HCP have a limited role in transmission, unless other factors are present. Additional factors that can facilitate transmission, include chronic sinusitis, upper respiratory infection, and dermatitis.

## 4- MDRO Prevention and Control

**TRANSFERS TO AND FROM ACUTE CARE FACILITIES (LA Rules)**

**• The presence of any MDRO infection or colonization alone should not preclude the transfer of a patient from a facility to another (for example from an acute care to a LTCF).**
**• If a facility can provide the level of medical care needed for a patient, the simple fact that the patient has a MDRO should not be a pretext for denying admission.**
**• The source facility should ensure that the transporter and the receiving facility staff were notified.**
**• Contact Precautions should be taken during the transfer**
**• The authority of the State Health Officer (or the Office of Public Health, his delegate) for communicable disease control is specified in Title 51: Public Health Sanitary Code; Part II. The Control of Diseases; §117. Disease Control Measures.**
**Measures specific to prevention and control of infections/diseases of public health importance are posted on the DHH/OPH website under the Section of Infectious Disease Epidemiology" available at www.infectiousdisease.dhh.louisiana.gov**

**Rationale:** A large proportion of MDRO occur in patients who present no symptoms; they are colonized (also named carriers of the micro-organisms). There are colonized patients in the community, but the proportion of colonization is much higher among those that were hospitalized, or residents in a LTCF (for example MRSA is present in 2% of the healthy Louisiana population, 8% to 12% among those who were hospitalized or residents of nursing homes). The same observations are made for most MDROs.

No facility is free from harboring patients with MDROs. The role of infection control is to prevent the transmission of a MDRO between patients, health care providers and visitors.

### 4.1-Prevention of Infections

Preventing infections will reduce the burden of MDROs in LTCFs. Prevention of antimicrobial resistance depends on appropriate clinical practices that should be incorporated into all routine patient care. These include optimal management of

- Vascular catheters
- Urinary catheters
- Lower respiratory tract infection in intubated patients
  -Judicious antimicrobial selection and utilization.

### 4.2-Judicious Use of Antimicrobial Agents

- Recommendations for control of MDROs must include attention to judicious antimicrobial use focusing on MDR-GNBs and *C. difficile* infection.
- Limiting antimicrobial use for controlling MRSA and VRE remains unclear.

### 4.3-MDRO surveillance.

Surveillance is a critically important component of any infection control program, allowing detection of new infections, monitoring epidemiologic trends, and measuring the effectiveness of interventions.

### 4.3.1-Surveillance for MDROs isolated from routine clinical cultures.

Surveillance of clinical microbiology laboratory results obtained as part of routine clinical care is the main type of surveillance used in LTCFs.

**Antibiograms:** The simplest form of MDRO surveillance is monitoring of clinical microbiology isolates resulting from tests ordered as part of routine clinical care. This method is particularly useful to detect new MDROs not previously detected, either within an individual HCF or community-wide. In addition, this information can be used to prepare facility- or unit-specific summary antimicrobial susceptibility reports that describe pathogen-specific prevalence of resistance among clinical isolates. Such reports may be useful to monitor for changes in known resistance patterns that might signal emergence or transmission of MDROs, and also to provide clinicians with information to guide antimicrobial prescribing practices.

**MDRO Incidence Based on Clinical Culture Results:** Some investigators have used clinical microbiology results to calculate measures of incidence of MDRO isolates in specific populations or patient care locations (e.g. new MDRO isolates per 1,000 patient days, new MDRO isolates per month). Because this is based solely on positive culture results without accompanying clinical information, they do not distinguish colonization from infection.

**MDRO Infection Rates.** Clinical cultures can also be used to identify targeted MDRO infections in certain patient populations or units. This strategy requires investigation of clinical circumstances surrounding a positive culture to distinguish colonization from infection, but it can be particularly helpful in defining the clinical impact of MDROs within a facility.

### 4.3.2-Surveillance for MDROs by Active Surveillance Cultures (Detecting Asymptomatic Colonization):

In LTCFs such an approach is mostly indicated in case of an outbreak. Active surveillance cultures (ASC) may be done to identify patients who are colonized with a targeted MDRO. This approach is based upon the observation that, for some MDROs, detection of colonization may be delayed or missed completely if culture results obtained in the course of routine clinical care are the primary means of identifying colonized patients.

Active surveillance cultures have been used as part of efforts to successful control of outbreaks. The experience with ASC as part of successful control efforts in endemic settings is mixed.

## 5. Infection Control Precautions.

Since 1996, the Centers for Disease Control and Prevention (CDC) has recommended the use of Standard and Contact Precautions for MDROs “judged by an infection control program…to be of special clinical and epidemiologic significance.” This recommendation was based on general consensus and was not necessarily evidence-based. No studies have directly compared the efficacy of Standard Precautions alone versus Standard Precautions and Contact Precautions, with or without ASC, for control of MDROs. Some reports mention the use of one or both sets of precautions as part of successful MDRO control efforts; however, the precautions were not the primary focus of the study intervention.

**Identifying patients previously known** to be colonized/infected with MDROs is important to determine the infection control precautions to be implemented, particularly when the patient is re-admitted.

### 5.1-Standard Precautions

Standard precautions have an essential role in preventing MDRO transmission, even in facilities that use Contact Precautions for patients with an identified MDRO. Colonization with MDROs is frequently undetected; even surveillance cultures may fail to identify colonized persons due to lack of sensitivity, laboratory deficiencies, or intermittent colonization due to antimicrobial therapy. Therefore, Standard Precautions must be used in order to prevent transmission from potentially colonized patients.

Hand hygiene is an important component of Standard Precautions. Several studies demonstrated a temporal relationship between improved adherence to recommended hand hygiene practices and control of MDROs.

### 5.2-Contact Precautions

Contact precautions are intended to prevent transmission of infectious agents, including epidemiologically important microorganisms, which are transmitted by direct or indirect contact with the patient or the patient's environment.

- Patient placement: A single-patient room is preferred for patients who require Contact Precautions. When a single-patient room is not available, consultation with infection control is necessary to assess the various risks associated with other patient placement options (e.g., cohorting, keeping the patient with an existing roommate).
- Barriers: HCP caring for patients on Contact Precautions should wear a gown and gloves for all interactions that may involve contact with the patient or potentially contaminated areas in the patient's environment. Donning gown and gloves upon room entry and discarding before exiting the patient room is done to contain pathogens, especially those that have been implicated in transmission through environmental contamination (e.g., VRE, *C.difficile*, noroviruses and other intestinal tract agents; RSV).
- Duration of Contact Precautions**.** The necessary duration of Contact Precautions for patients treated for infection with an MDRO, but who may continue to be colonized with the organism at one or more body sites, remains an unresolved issue. Patients may remain colonized with drug resistant organisms for prolonged periods; shedding of these organisms may be intermittent, and surveillance cultures may fail to detect their presence.

The 1995 HICPAC guideline for preventing the transmission of VRE suggested three negative stool/perianal cultures obtained at weekly intervals as a criterion for discontinuation of Contact Precautions. However, studies have noted a recurrence of VRE positive cultures in persons who subsequently receive antimicrobial therapy, and persistent or intermittent carriage of VRE for more than one year has been reported. Similarly, colonization with MRSA can be prolonged.

Studies demonstrating initial clearance of MRSA following decolonization therapy have reported a high frequency of subsequent carriage. There is a paucity of information in the literature on when to discontinue Contact Precautions for patients colonized with a MDR-GNB, possibly because infection and colonization with these MDROs are often associated with outbreaks.
In general, it seems reasonable to discontinue Contact Precautions when three or more surveillance cultures for the target MDRO are repeatedly negative over the course of a week or two in a patient who has not received antimicrobial therapy for several weeks, especially in the absence

of a draining wound, profuse respiratory secretions, or evidence implicating the specific patient in ongoing transmission of the MDRO within the facility.

Impact of Contact Precautions on Patient Care and Well-being. Some studies reported that patients in private rooms and on barrier precautions for an MDRO had increased anxiety and depression scores, had more preventable adverse events, expressed greater dissatisfaction with their treatment, and had less documented care than control patients who were not in isolation. (Therefore, when patients are placed on Contact Precautions, efforts must be made by the healthcare team to counteract these potential adverse effects.)

### 5.3-Cohorting and Other MDRO Control Strategies.

Cohorting of patients, cohorting of staff and use of designated beds or units may be necessary to control transmission in case of outbreak.

### 5.4-Strengthening Infection Control Precautions

Infection control precautions need to be well understood by the staff, facilitated by availability of hand sanitation and barriers, and reinforcement strategies.

- Provide the necessary number and appropriate placement of hand washing sinks and alcohol-containing hand rub dispensers in the facility.
- Enforce adherence to recommended infection control practices (e.g., hand hygiene, Standard and Contact Precautions).
- Direct observation with feedback to HCP on adherence to recommended precautions.
- Targeted and informal educational interventions to encourage a behavior change through improved understanding of the problem MDRO that the facility tries to control. Whether the desired change involved hand hygiene, antimicrobial prescribing patterns, or other outcomes, enhancing understanding and creating a culture that supported and promoted the desired behavior, were viewed as essential to the success of the intervention.

## 6. Environmental measures.

The role of environmental reservoirs, such as surfaces and medical equipment, in the transmission of VRE and other MDROs is very important. While environmental cultures are not routinely recommended, environmental cultures were used in numerous studies to document contamination, and led to interventions that included:

- Dedicated noncritical medical equipment
- Assignment of dedicated cleaning personnel to the affected patient care unit; increased cleaning and disinfection of frequently-touched surfaces (e.g., bedrails, charts, bedside commodes, doorknobs).
- Monitoring for adherence to recommended environmental cleaning practices is an important determinant for success in controlling transmission of MDROs and other pathogens in the environment.

## 7-Decolonization

Decolonization entails treatment of persons colonized with a specific MDRO. Decolonization regimens are not sufficiently effective to warrant routine use. Decolonization has been successful and is recommended only in some very specific circumstances.

7.1-MRSA: Decolonization of persons carrying MRSA in their nares has proved possible with several regimens that include topical mupirocin alone or in combination with orally administered

antibiotics (e.g., rifampin in combination with trimethoprim- sulfamethoxazole or ciprofloxacin) plus the use of an antimicrobial soap for bathing.

Therefore, most healthcare facilities have limited the use of decolonization to MRSA outbreaks, or other high prevalence situations. Several factors limit the utility of this control measure on a widespread basis:

- Identification of candidates for decolonization requires surveillance cultures.
- Candidates receiving decolonization treatment must receive follow-up cultures to ensure eradication.
- Recolonization with the same strain, initial colonization with a mupirocin-resistant strain, and emergence of resistance to mupirocin during treatment can occur.
- HCP implicated in transmission of MRSA are candidates for decolonization and should be treated and culture-negative before returning to direct patient care. In contrast, HCP who are colonized with MRSA, but are asymptomatic and have not been linked epidemiologically to transmission, do not require decolonization.

7.2-VRE: Some investigators have attempted to decolonize patients harboring VRE, few have achieved success.

## 8-Feasibility

The subject of feasibility, as it applies to the extrapolation of results in one health care setting to another and to other healthcare settings, has not been addressed. For example, LTCFs lack the on-site laboratory services needed to obtain active surveillance cultures in a timely manner. This factor limits the applicability of an aggressive program based on obtaining cultures and preemptive placement of patients on Contact Precautions. However, with the growing problem of antimicrobial resistance, and the recognized role of all healthcare settings for control of this problem, it is imperative that appropriate human and fiscal resources be invested to increase the feasibility of recommended control strategies in every setting.

Although some common principles apply, the literature review indicates that no single approach to the control of MDROs is appropriate for all healthcare facilities. Many factors influence the choice of interventions to be applied within an institution, including:

### 8.1-Type and Significance of Problem MDROs Within the Institution - Importance of Surveillance

Many facilities have an MRSA problem while others have ESBL-producing *K.pneumoniae*. Some facilities have no VRE colonization or disease; others have high rates of VRE colonization without disease; and still others have ongoing VRE outbreaks. The magnitude of the problem also varies**.** Healthcare facilities may have very low numbers of cases, e.g., with a newly introduced strain, or may have prolonged, extensive outbreaks or colonization in the population. Between these extremes, facilities may have low or high levels of endemic colonization and variable levels of infection.

Prevention strategies must be adapted to the problems encountered in the facility. Hence the importance of surveillance that will identify the infection controls to be addressed.

### 8.2-Population and healthcare-settings.

The presence of high-risk patients (e.g., transplant, hematopoietic stem-cell transplant), and special-care units (patients on ventilators, chemotherapy, cystic fibrosis, hemodialysis) will influ-

ence surveillance needs and could limit the areas of a facility targeted for MDRO control interventions.

**8.3-Differences of opinion on the optimal strategy to control MDROs**.

Published guidance on the control of MDROs reflects areas of ongoing debate on optimal control strategies. A key issue is the use of ASC in control efforts and preemptive use of Contact Precautions pending negative surveillance culture results. The various guidelines currently available exhibit a spectrum of approaches, which their authors deem to be evidence-based.

One guideline for control of MRSA and VRE, the Society for Healthcare Epidemiology of America (SHEA) guideline from 2003, emphasizes routine use of ASC and Contact Precautions. That position paper does not address control of MDR-GNBs. The salient features of SHEA recommendations for MRSA and VRE control and the recommendations in this guideline for control of MDROs, including MRSA and VRE, have been compared; recommended interventions are similar.

Other guidelines for VRE and MRSA, e.g., those proffered by the Michigan Society for Infection Control (www.msiconline.org/resource_sections/aro_guidelines), emphasize consistent practice of Standard Precautions and tailoring the use of ASC and Contact Precautions to local conditions, the specific MDROs that are prevalent and being transmitted, and the presence of risk factors for transmission.

Therefore, selection of interventions for controlling MDRO transmission should be based on assessments of the local problem, the prevalence of various MDRO and feasibility. Individual facilities should seek appropriate guidance and adopt effective measures that fit their circumstances and needs. **Most studies have been in acute care settings; for non-acute care settings (e.g., LCTF, small rural hospitals), the optimal approach is not well defined.**

**Two-Tiered Approach for Control of MDROs.**

Reports describing successful control of MDRO transmission in healthcare facilities have included seven categories of interventions (Table). As a rule, these reports indicate that facilities confronted with an MDRO problem selected a combination of control measures, implemented them, and reassessed their impact. In some cases, new measures were added serially to further enhance control efforts. This evidence indicates that the control of MDROs is a dynamic process that requires a systematic approach tailored to the problem and healthcare setting. The nature of this evidence gave rise to the two-tiered approach to MDRO control recommended in this guideline. This approach provides the flexibility needed to prevent and control MDRO transmission in every kind of facility addressed by this guideline.

Detailed recommendations for MDRO control in all healthcare settings follow and are summarized in the following table.

-In the first tier are the baseline level of MDRO control activities designed to ensure recognition of MDROs as a problem, involvement of healthcare administrators, and provision of safeguards for managing unidentified carriers of MDROs.

-With the emergence of an MDRO problem that cannot be controlled with the basic set of infection control measures, additional control measures should be selected from the second tier of interventions presented in the table.

Decisions to intensify MDRO control activity arise from surveillance observations and assessments of the risk to patients in various settings. Circumstances that may trigger these decisions include:

- Identification of an MDRO from even one patient in a facility or special unit, with a highly vulnerable patient population that had previously not encountered that MDRO.
- Failure to decrease the prevalence or incidence of a specific MDRO (e.g., incidence of resistant clinical isolates) despite infection control efforts to stop its transmission. Statistical process control charts or other validated methods that account for normal variation can be used to track rates of targeted MDROs.
- The combination of new or increased frequency of MDRO isolates and patients at risk necessitates escalation of efforts to achieve or re-establish control, i.e., to reduce rates of transmission to the lowest possible level. Intensification of MDRO control activities should begin with an assessment of the problem and evaluation of the effectiveness of measures in current use. Once the problem is defined, appropriate additional control measures should be selected from the second tier of the table. A knowledgeable infection prevention and control professional or healthcare epidemiologist should make this determination. This approach requires support from the governing body and medical staff of the facility. Once interventions are implemented, ongoing surveillance should be used to determine whether selected control measures are effective and if additional measures or consultation are indicated.

The CDC/HICPAC system for categorizing recommendations is as follows:
**Category IA** Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies.
**Category IB** Strongly recommended for implementation and supported by some experimental, clinical, or epidemiologic studies and a strong theoretical rationale.
**Category IC** Required for implementation, as mandated by federal and/or state regulation or standard.
**Category II** Suggested for implementation and supported by suggestive clinical or epidemiologic studies or a theoretical rationale.

**Table: Prevention of transmission of Multidrug Resistant Organisms**

| 1 | **General recommendations for all healthcare settings independent of the prevalence of multidrug resistant organism (MDRO) infections or the population served.** | |
|---|---|---|
| **1.1** | **Administrative measures** | |
| **1.1.1** | Make MDRO prevention and control an organizational patient safety priority. | IB |
| **1.1.2** | Provide administrative support, and both fiscal and human resources, to prevent and control MDRO transmission within the facility | IB |
| **1.1.3** | In HCF without expertise for analyzing epidemiologic data, recognizing MDRO problems, or devising effective control strategies (long-term care facilities), identify experts who can provide consultation as needed. | II |
| **1.1.4** | Implement systems to communicate information about reportable MDROs [e.g., VRSA, VISA, MRSA, Penicillin resistant *S. pneumoniae* (PRSP)] to administrative personnel and as required by state and local health authorities | II |
| **1.1.5** | Implement a multidisciplinary process to monitor and improve healthcare personnel (HCP) adherence to recommended practices for Standard and Contact Precautions | IB |
| **1.1.6** | Implement systems to designate patients known to be colonized or infected with a targeted MDRO and to notify receiving healthcare facilities and personnel prior to transfer of such patients within or between facilities. | IB |
| **1.1.7** | Support participation of the facility or healthcare system in local, regional, and national coalitions to combat emerging or growing MDRO problems. | IB |
| **1.1.8** | Provide updated feedback at least annually to healthcare providers and administrators on facility and patient-care-unit trends in MDRO infections. Include information on changes in prevalence or incidence of infection, results of assessments for system failures, and action plans to improve adherence to and effectiveness of recommended infection control practices to prevent MDRO transmission. | IB |
| **1.2** | **Education and training of healthcare personnel** | |
| **1.2.1** | Provide education and training on risks and prevention of MDRO transmission during orientation and periodic educational updates for healthcare personnel; include information on organizational experience with MDROs and prevention strategies. | IB |
| **1.2.2** | Judicious use of antimicrobial agents. The goal of the following recommendations is to ensure that systems are in place to promote optimal treatment of infections and appropriate antimicrobial use | |
| **1.2.3.1** | In hospitals and LTCFs, ensure that a multidisciplinary process is in place to review antimicrobial utilization, local susceptibility patterns (antibiograms), and antimicrobial agents included in the formulary to foster appropriate antimicrobial use | IB |
| **1.2.3.2** | Implement systems to prompt clinicians to use the appropriate antimicrobial agent and regimen for the given clinical situation | IB |
| **1.2.3.3** | Provide clinicians with antimicrobial susceptibility reports and analysis of current trends, updated at least annually, to guide antimicrobial prescribing practices | IB |
| **1.2.3.4** | In LTCFs implement a process for appropriate review of prescribed antimicrobials. Prepare and distribute reports to prescribers that summarize findings and provide suggestions for improving antimicrobial use. | II |
| **1.4** | **Surveillance** | |
| **1.4.1** | Establish systems to ensure that clinical microbiology laboratories (in-house and outsourced) promptly notify infection control staff or a medical director/ designee when a novel resistance pattern for that facility is detected | IB |
| **1.4.2** | Implement a process for appropriate review of prescribed antimicrobials. Prepare and distribute reports to prescribers that summarize findings and provide suggestions for improving antimicrobial use. | IB |
| **1.4.3** | In LTCFs with special-care units (e.g., ventilator-dependent, oncology units), develop and monitor unit-specific antimicrobial susceptibility reports. | IB |
| **1.4.4** | Establish a frequency for preparing summary reports based on volume of clinical isolates, | II |

| | | |
|---|---|---|
| | with updates at least annually | |
| **1.4.5** | In healthcare organizations that outsource microbiology laboratory services (LTCFs), specify by contract that the laboratory provide either facility-specific susceptibility data or local or regional aggregate susceptibility data in order to identify prevalent MDROs and trends in the geographic area served | II |
| **1.4.6** | Monitor trends in the incidence of target MDROs in the facility over time using appropriate statistical methods to determine whether MDRO rates are decreasing and whether additional interventions are needed | IA |
| **1.5** | **Infection control precautions to prevent transmission of MDROs** | IB |
| **1.5.1** | **Follow Standard Precautions** during all patient encounters in all settings in which healthcare is delivered | IB |
| **1.5.1.1** | Use masks according to Standard Precautions when performing splash generating procedures (e.g., wound irrigation, oral suctioning, intubation); when caring for patients with open tracheostomies and the potential for projectile secretions; and in circumstances where there is evidence of transmission from heavily colonized sources (e.g., burn wounds). Masks are not otherwise recommended for prevention of MDRO transmission from patients to healthcare personnel during routine care (e.g., upon room entry). | IB |
| **1.5.1.2** | For relatively healthy residents (e.g., mainly independent) follow Standard Precautions, making sure that gloves and gowns are used for contact with uncontrolled secretions, pressure ulcers, draining wounds, stool incontinence, and ostomy tubes/bags | II |
| **1.5.1.3** | For MDRO colonized or infected patients without draining wounds, diarrhea, or uncontrolled secretions, establish ranges of permitted ambulation, socialization, and use of common areas based on their risk to other patients and on the ability of the colonized or infected patients to observe proper hand hygiene and other recommended precautions to contain secretions and excretions | II |
| **1.5.2** | **Use of Contact Precautions** in LTCFs, consider the individual patient's clinical situation and prevalence or incidence of MDRO in the facility when deciding whether to implement or modify Contact Precautions in addition to Standard Precautions for a patient infected or colonized with a target MDRO | II |
| **1.5.2.1** | For ill residents (e.g., those totally dependent upon HCP for healthcare and activities of daily living, ventilator-dependent) and for those residents whose infected secretions or drainage cannot be contained, use Contact Precautions in addition to Standard Precautions. | II |
| **1.5.2.2** | Discontinuation of Contact Precautions. No recommendation can be made regarding when to discontinue Contact Precautions | -- |
| **1.5.3** | **Patient placement in LTCFs** | |
| **1.5.3.1** | 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, e.g., uncontained secretions or excretions. | IB |
| **1.5.3.2** | When single-patient rooms are not available, cohort patients with the same MDRO in the same room or patient-care area | IB |
| **1.5.3.3** | 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 | II |
| **1.6** | **Environmental measures** | |
| **1.6.1** | **Clean and disinfect surfaces and equipment** that may be contaminated with pathogens, including those that are in close proximity to the patient (e.g.,bed rails, over bed tables) and frequently-touched surfaces in the patient care environment (e.g., door knobs, surfaces in and surrounding toilets in patients' rooms) on a more frequent schedule compared to that for minimal touch surfaces (e.g., horizontal surfaces in waiting rooms). | IB |
| **1.6.2** | Dedicate noncritical medical items to use on individual patients known to be infected or colonized with MDROs | IB |

| | | |
|---|---|---|
| **1.6.3** | Prioritize room cleaning of patients on Contact Precautions. Focus on cleaning and disinfecting frequently touched surfaces (e.g., bedrails, bedside commodes, bathroom fixtures in the patient's room, doorknobs), and equipment in the immediate vicinity of the patient. | IB |
| **2** | **Intensified interventions to prevent MDRO transmission**<br>**NOT ROUTINE;**<br>**TO BE USED ONLY IF A MDRO PROBLEM HAS BEEN IDENTIFIED** | |
| | The interventions presented below have been utilized in various combinations to reduce transmission of MDROs in healthcare facilities. Neither the effectiveness of individual components nor that of specific combinations of control measures has been assessed in controlled trials. Nevertheless, various combinations of control elements selected under the guidance of knowledgeable content experts have repeatedly reduced MDRO transmission rates in a variety of healthcare settings. | |
| **2.1** | **Indications and approach** | |
| | Indications for intensified MDRO control efforts should result in selection and implementation of one or more of the interventions described below. Individualize the selection of control measures according to local considerations | IB |
| **2.1.1** | When incidence or prevalence of MDROs are not decreasing despite implementation of and correct adherence to the routine control measures described above, intensify MDRO control efforts by adopting one or more of the interventions described below | IB |
| **2.1.2** | When the first case or outbreak of an epidemiologically important MDRO (e.g., VRE, MRSA, VISA, VRSA, MDR-GNB) is identified within a healthcare facility, intensify MDRO control efforts by adopting one or more of the interventions described below | IB |
| **2.1.3** | Continue to monitor the incidence of target MDRO infection and colonization after additional interventions are implemented. If rates do not decrease, implement more interventions as needed to reduce MDRO transmission. | IB |
| **2.2** | **Administrative measures** | |
| **2.2.1** | Identify persons with experience in infection control and the epidemiology of MDRO, either in house or through outside consultation, for assessment of the local MDRO problem and for the design, implementation, and evaluation of appropriate control measures | IB |
| **2.2.2** | Provide necessary leadership, funding, and day-to-day oversight to implement interventions selected. Involve the governing body and leadership of the healthcare facility or system that have organizational responsibility for this and other infection control efforts | IB |
| **2.2.3** | Evaluate healthcare system factors for their role in creating or perpetuating transmission of MDROs, including: staffing levels, education and training, availability of consumable and durable resources, communication processes, policies and procedures, and adherence to recommended infection control measures (e.g., hand hygiene and Standard or Contact Precautions). Develop, implement, and monitor action plans to correct system failures | IB |
| **2.2.4** | During the process, update healthcare providers and administrators on the progress and effectiveness of the intensified interventions. Include information on changes in prevalence, rates of infection and colonization; results of assessments and corrective actions for system failures; degrees of adherence to recommended practices; and action plans to improve adherence to recommended infection control practices to prevent MDRO transmission. | IB |
| **2.3** | **Educational interventions** | |
| **2.3.1** | Intensify the frequency of MDRO educational programs for healthcare personnel, especially those who work in areas in which MDRO rates are not decreasing. Provide individual or unit-specific feedback when available | IB |
| **2.4** | **Judicious use of antimicrobial agents** | |
| **2.4.1** | Review the role of antimicrobial use in perpetuating the MDRO problem targeted for intensified intervention. Control and improve antimicrobial use as indicated. Antimicrobial agents that may be targeted include vancomycin, third-generation cephalosporins, and anti-anaerobic agents for VRE; third-generation cephalosporins for ESBLs; and quinolones and carbapenems | IB |

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| **2.5** | **Surveillance** | |
| **2.5.1** | Calculate and analyze prevalence and incidence rates of targeted MDRO infection and colonization in populations at risk; when possible, distinguish colonization from infection: Include only one isolate per patient, not multiple isolates from the same patient, when calculating rates | IB |
| **2.5.2** | Increase the frequency of compiling and monitoring antimicrobial susceptibility summary reports for a targeted MDRO as indicated by an increase in incidence of infection or colonization with that MDRO | II |
| **2.5.3** | Develop and implement protocols to obtain active surveillance cultures (ASC) for targeted MDROs from patients transferred from facilities known to have high MDRO prevalence rates; and patients known to have been previously infected or colonized with an MDRO (Not applicable for *C.diff*) | IB |
| **2.5.4** | Obtain ASC from areas of skin breakdown and draining wounds. In addition, include the following sites according to target MDROs | IB |
| **2.5.4.1** | For MRSA: Sampling the anterior nares is usually sufficient; throat, endotracheal tube aspirate, percutaneous gastrostomy sites, and perirectal or perianal cultures may be added to increase the yield. Swabs from several sites may be placed in the same selective broth tube prior to transport | IB |
| **2.5.4.2** | For VRE: Stool, rectal, or perirectal samples should be collected | IB |
| **2.5.4.2** | For MDR-GNB: Endotracheal tube aspirates or sputum should be cultured if a respiratory tract reservoir is suspected | IB |
| **2.5.4.3** | For *C.diff*, do NOT collect ASC | II |
| **2.5.5** | **Outbreak Control** | |
| **2.5.5.1** | Conduct culture surveys to assess the efficacy of the enhanced MDRO control interventions | IB |
| **2.5.5.2** | Conduct serial (e.g., weekly, until transmission has ceased and then decreasing frequency) unit-specific point prevalence culture surveys of the target MDRO to determine if transmission has decreased or ceased. | IB |
| **2.5.5.3** | Collect cultures to assess the colonization status of roommates and other patients with substantial exposure to patients with known MDRO infection or colonization | IB |
| **2.5.5.4** | Obtain cultures of healthcare personnel for target MDRO when there is epidemiologic evidence implicating the healthcare staff member as asource of ongoing transmission | IB |
| **2.6** | **Enhanced infection control precautions** | |
| **2.6.1** | **Use of Contact Precautions** | |
| **2.6.1.1** | In LTCFs, 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. | IB |
| **2.6.1.2** | Because environmental surfaces and medical equipment, especially those in close proximity to the patient, may be contaminated, don gowns and gloves before or upon entry to the patient's room or cubicle | IB |
| **2.6.1.3** | When ASC are obtained as part of an intensified MDRO control program, implement Contact Precautions until the surveillance culture is reported negative for the target MDRO | IB |
| **2.6.2** | Implement policies for patient admission and placement as needed to prevent transmission of a problem MDRO | IB |
| **2.6.2.1** | Place MDRO patients in single-patient rooms | IB |
| **2.6.3** | Cohort patients with the same MDRO in designated areas (e.g. rooms, bays, patient care areas) | IB |
| **2.7.1** | When transmission continues despite adherence to Standard and Contact Precautions and cohorting patients, assign dedicated nursing and ancillary service staff to the care of MDRO patients only. Some facilities may consider this option when intensified measures are first implemented. | IB |
| **2.7.2** | Stop new admissions to the unit of facility if transmission continues despite the imple- | IB |

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| | mentation of the enhanced control measures described above | |
| **2.8** | **Enhanced environmental measures** | |
| **2.8.1** | Implement patient-dedicated or single-use disposable noncritical equipment (e.g., blood pressure cuff, stethoscope) and instruments and devices. | IB |
| **2.8.2** | Intensify and reinforce training of environmental staff who work in areas targeted for intensified MDRO control and monitor adherence to environmental cleaning policies. Some facilities may choose to assign dedicated staff to targeted patient care areas to enhance consistency of proper environmental cleaning and disinfection services | IB |
| **2.8.3** | Monitor (i.e., supervise and inspect) cleaning performance to ensure consistent cleaning and disinfection of surfaces in close proximity to the patient and those likely to be touched by the patient and HCP (e.g., bedrails, carts, bedside commodes, doorknobs, faucet handles) | IB |
| **2.8.4** | Obtain environmental cultures (e.g., surfaces, shared medical equipment) when there is epidemiologic evidence that an environmental source is associated with ongoing transmission of the targeted MDRO | IB |
| **2.8.5** | Vacate units for environmental assessment and intensive cleaning when previous efforts to eliminate environmental reservoirs have failed | II |
| **2.9** | **Decolonization** | |
| **2.9.1** | Consult with physicians with expertise in infectious diseases and/or healthcare epidemiology on a case-by-case basis regarding the appropriate use of decolonization therapy for patients or staff during limited periods of time, as a component of an intensified MRSA control program | II |
| **2.9.2** | When decolonization for MRSA is used, perform susceptibility testing for the decolonizing agent against the target organism in the individual being treated or the MDRO strain that is epidemiologically implicated in transmission. Monitor susceptibility to detect emergence of resistance to the decolonizing agent. Consult with a microbiologist for appropriate testing for mupirocin resistance, since standards have not been established. | IB |
| **2.9.3** | Because mupirocin-resistant strains may emerge and because it is unusual to eradicate MRSA when multiple body sites are colonized, do not use topical mupirocin routinely for MRSA decolonization of patients as a component of MRSA control programs in any healthcare setting | IB |
| **2.9.4** | Limit decolonization of HCP found to be colonized with MRSA to persons who have been epidemiologically linked as a likely source of ongoing transmission to patients. Consider reassignment of HCP if decolonization is not successful and ongoing transmission to patients persists | IB |
| **2.9.5** | No recommendation can be made for decolonizing patients with VRE or MDR-GNB. Regimens and efficacy of decolonization protocols for VRE and MDR-GNB have not been established | -- |
| **2.9.6** | Do NOT decolonize patients with *C.diff.* | |

## Glossary - Multidrug-Resistant Organisms

**Ambulatory care settings.** Facilities that provide health care to patients who do not remain overnight (e.g., hospital-based outpatient clinics, nonhospital-based clinics and physician offices, urgent care centers, surgicenters, free-standing dialysis centers, public health clinics, imaging centers, ambulatory behavioral health and substance abuse clinics, physical therapy and rehabilitation centers, and dental practices.

**Cohorting.** In the context of this guideline, this term applies to the practice of grouping patients infected or colonized with the same infectious agent together to confine their care to one area and prevent contact with susceptible patients (cohorting patients). During outbreaks, healthcare personnel may be assigned to a cohort of patients to further limit opportunities for transmission (cohorting staff).

**Contact Precautions.** Contact Precautions are a set of practices used to prevent transmission of infectious agents that are spread by direct or indirect contact with the patient or the patient's environment. Contact Precautions also apply where the presence of excessive wound drainage, fecal incontinence, or other discharges from the body suggest an increased transmission risk. A single patient room is preferred for patients who require Contact Precautions. When a single patient room is not available, consultation with infection control is helpful to assess the various risks associated with other patient placement options (e.g., cohorting, keeping the patient with an existing roommate). In multi-patient rooms, more than three feet spatial separation between beds is advised to reduce the opportunities for inadvertent sharing of items between the infected/colonized patient and other patients.

Healthcare personnel caring for patients on Contact Precautions wear a gown and gloves for all interactions that may involve contact with the patient or potentially contaminated areas in the patient's environment. Donning of gown and gloves upon room entry, removal before exiting the patient room and performance of hand hygiene immediately upon exiting are done to contain pathogens**.**

**Epidemiologically important pathogens.** Infectious agents that have one or more of the following characteristics:

1) A propensity for transmission within healthcare facilities based on published reports and the occurrence of temporal or geographic clusters of more than two patients, (e.g., VRE, MRSA and MSSA, *Clostridium difficile*, norovirus, RSV, influenza, rotavirus, *Enterobacter* spp; *Serratia* spp., Group A Streptococcus). However, for Group A Streptococcus, most experts consider a single case of healthcare-associated disease a trigger for investigation and enhanced control measures because of the devastating outcomes associated with Hospital Acquired Infection (HAI) Group A Streptococcus infections. For susceptible bacteria that are known to be associated with asymptomatic colonization, isolation from normally sterile body fluids in patients with significant clinical disease would be the trigger to consider the organism as epidemiologically important.

2) Antimicrobial resistance implications:
- Resistance to first-line therapies (e.g., MRSA, VRE, VISA, VRSA, ESB- producing organisms).

- Unusual or usual agents with unusual patterns of resistance within a facility, (e.g., the first isolate of *Burkholderia cepacia* complex or *Ralstonia* spp. In non-CF patients, or a quinolone-resistant strain of *Pseudomonas* in a facility.
- Difficult to treat because of innate or acquired resistance to multiple classes of antimicrobial agents (e.g., *Stenotrophomonas maltophilia, Acinetobacter* spp.).

3) Associated with serious clinical disease, increased morbidity and mortality (e.g., MRSA and MSSA, Group A Streptococcus); or

4) A newly discovered or reemerging pathogen. The strategies described for MDROs may be applied for control of epidemiologically important organisms other than MDROs.

**Hand hygiene.** A general term that applies to any one of the following:
1) handwashing with plain (nonantimicrobial) soap and water;
2) antiseptic hand wash (soap containing antiseptic agents and water);
3) antiseptic hand rub (waterless antiseptic product, most often alcohol-based, rubbed on all surfaces of hands); or
4) surgical hand antisepsis (antiseptic hand wash or antiseptic hand rub performed preoperatively by surgical personnel to eliminate transient hand flora and reduce resident hand flora).

**Healthcare-associated infection (HAI).** An infection that develops in a patient who is cared for in any setting where healthcare is delivered (e.g., acute care hospital, chronic care facility, ambulatory clinic, dialysis center, surgicenter, home) and is related to receiving health care (i.e., was not incubating or present at the time healthcare was provided). In ambulatory and home settings, HAI would apply to any infection that is associated with a medical or surgical intervention performed in those settings.

**Healthcare epidemiologist** A person whose primary training is medical and/or masters or doctorate-level epidemiology who has received advanced training in healthcare epidemiology. Typically these professionals direct or provide consultation to an infection prevention and control program in a hospital, long term care facility (LTCF), or healthcare delivery system (also see infection prevention and control professional).

**Healthcare personnel (HCP).** All paid and unpaid persons who work in a healthcare setting, also known as healthcare workers (e.g. any person who has professional or technical training in a healthcare-related field and provides patient care in a healthcare setting or any person who provides services that support the delivery of healthcare such as dietary, housekeeping, engineering, maintenance personnel).

**Infection preventionist or infection control professional (ICP).** A person whose primary training is in either nursing, medical technology, microbiology, or epidemiology and who has acquired specialized training in infection control. Responsibilities may include collection, analysis, and feedback of infection data and trends to healthcare providers; consultation on infection risk assessment, prevention and control strategies; performance of education and training activities; implementation of evidence-based infection control practices or those mandated by regulatory and licensing agencies; application of epidemiologic principles to improve patient outcomes; participation in planning renovation and construction projects (e.g., to ensure appropriate containment of construction dust); evaluation of new products or procedures on patient outcomes; oversight of employee health services related to infection prevention; implementation of preparedness plans; communication within the healthcare setting, with local and state health depart-

ments, and with the community at large concerning infection control issues; and participation in research.

**Infection prevention and control program.** A multidisciplinary program that includes a group of activities to ensure that recommended practices for the prevention of healthcare-associated infections are implemented and followed by healthcare personnel, making the healthcare setting safe from infection for patients and healthcare personnel. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requires the following five components of an infection prevention and control program for accreditation:

1) Surveillance: monitoring patients and healthcare personnel for acquisition of infection and/or colonization;
2) Investigation: identification and analysis of infection problems or undesirable trends;
3) Prevention: implementation of measures to prevent transmission of infectious agents and to reduce risks for device- and procedure-related infections;
4) Control: evaluation and management of outbreaks; and
5) reporting: provision of information to external agencies as required by state and federal law and regulation (www.jcaho.org).

The infection prevention and control program staff has the ultimate authority to determine infection control policies for a healthcare organization with the approval of the organization's governing body.

**Long-term care facilities (LTCFs).** An array of residential and outpatient facilities designed to meet the bio-psychosocial needs of persons with sustained self-care deficits. These include skilled nursing facilities, chronic disease hospitals, nursing homes, foster and group homes, institutions for the developmentally disabled, residential care facilities, assisted living facilities, retirement homes, adult day health care facilities, rehabilitation centers, and long-term psychiatric hospitals.

**Mask.** A term that applies collectively to items used to cover the nose and mouth and includes both procedure masks and surgical masks (www.fda.gov/cdrh/ode/guidance/094.html#4).

**Multidrug-resistant organisms (MDROs).** In general, bacteria (excluding *M. tuberculosis*) that are resistant to one or more classes of antimicrobial agents and usually are resistant to all but one or two commercially available antimicrobial agents (e.g., MRSA, VRE, extended spectrum beta-lactamase [ESBL]-producing or intrinsically resistant gram-negative bacilli).

**Nosocomial infection.** Derived from two Greek words "nosos" (disease) and "komeion" (to take care of). Refers to any infection that develops during or as a result of an admission to an acute care facility (hospital) and was not incubating at the time of admission.

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

equipment, properly clean and disinfect or sterilize reusable equipment before use on another patient).