Report of the Iowa Antibiotic Resistance Task Force

A Public Health Guide

3rd Edition

Fall 2011

DISCLAIMER

The guidelines in this report represent a consensus of opinions of the members of the Iowa Antibiotic Resistance Task Force (IARTF). They do not constitute official policy. This report was created to provide a concise practical guide for all public health workers and health care providers regarding the evolving problem of antibiotic resistance as it relates to patients, residents and clients in Iowa.

The report is organized by type of setting to enable the user to read specific sections of interest without having to read the entire report. All readers are urged to become familiar with the introduction, bibliography and additional sections that pertain to their particular setting. The IARTF hopes you will find this publication useful.

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OVERVIEW

On January 29, 1998, a task force was convened by the Iowa Department of Public Health (IDPH) to address the development of bacterial resistance to antibiotics in Iowa. The purpose of this task force was to evaluate and monitor the prevalence of resistance in Iowa, to monitor the status of the problem, and to develop strategies to diminish the risk to the population of Iowa. The goals of the Iowa Antibiotic Resistance Task Force (IARTF) are to facilitate appropriate use of antibiotics, discourage prescribing practices that promote the development of antibiotic resistance, and decrease the spread of antibiotic-resistant organisms with appropriate prevention and control measures. This group has been meeting since 1998 to accomplish these goals. Current members of the IARTF represent a number of concerned organizations:

Iowa Academy of Family Physicians
Iowa Chapter, American Academy of Pediatrics
Iowa Dental Association
Iowa Department of Public Health
Iowa Health Care Association
Iowa Hospital Association
Iowa Medical Society
Iowa Nurses Association
Iowa Pharmacy Association
Iowa Veterinary Medical Association
Iowa's Statewide Epidemiology Education and Consultation Program
State Hygienic Laboratory
University of Iowa Hospitals and Clinics

Nationwide, the medical and public health community has become aware of the increase in the numbers of microbial species which have developed resistance to antibiotics as well as their growing endemicity or prevalence. Eleven isolates of vancomycin-resistant *Staphylococcus aureus* (VRSA) have been reported to date in the United States. However, population-based data to assess antibiotic resistance have been limited. With emerging antibiotic resistance possibly related to geographical and demographic variables, state and local data becomes invaluable. Upon the recommendation of the IARTF, a comprehensive statewide, laboratory-based surveillance program began on January 1, 1999. This program, through IDPH and the State Hygienic Laboratory (SHL), was designed to detect and monitor antibiotic resistance throughout the state of Iowa.

The surveillance included <u>invasive</u> disease caused by these organisms:

Enterococcus species,

Group A *Streptococcus* (GAS),

Methicillin-resistant *Staphylococcus aureus* (MRSA),

Streptococcus pneumoniae.

Additionally, *Staphylococcus aureus* resistant to vancomycin (VRSA) from <u>any site</u> was included in the program.

This statewide surveillance program ended January 1, 2011 due to lack of funding.

However VRSA remains reportable under IAC 641.1. Information should be called immediately to IDPH at 800 362-2736 and the isolate sent to SHL

The IARTF encourages all readers to review the updated information and guidelines provided. In addition, there are many professional organizations that offer excellent resources for patient educational material, information on the impact of antibiotic resistance and recommendations in specific settings regarding this issue. IARTF representatives have reviewed the literature and have provided an extensive bibliography that may be very helpful to public health workers and health care providers during this educational process.

The IARTF's multidisciplinary approach signifies its joint interest in the evolution of antibiotic resistance. The IARTF urges all readers and especially public health workers and health care providers to educate themselves on this complicated and changing subject.

> "Good antimicrobial stewardship entails more than consideration of the immediate benefit to the individual patient being treated. It also considers the long-term effects of use on the future preservation of susceptibility in the practice population of the prescriber."
>
> McGowan, J.E. Jr. and Gerding, D.N.
> New Horizons 1996: 4:370-376.

ANTIBIOTIC USE

Methods to prevent the development of antibiotic resistance must include appropriate and judicious use of antibiotics. Numerous studies establish a relationship between the use of antibiotics and development of resistance by microorganisms. In general, the greater the exposure to antibiotics, the more resistance develops. The likely and undesirable outcome is an increased population of resistant organisms causing increasingly untreatable infections. New measures focused on changing the patterns of use of antibiotics are necessary to slow the rise of resistance.

Ensuring appropriate use of antibiotics will take a concerted and coordinated effort of patients, public health, medical institutions and health care providers. This multidisciplinary approach, where all parties have ownership in the issue and strive for the same outcomes, will be most successful. Achieving appropriate use of antibiotics will thus require behavioral changes not only in the medical community but the public as well.

Strategies to accomplish judicious use of antibiotics include development of guidelines or pathways of prescribing for optimal use. Health care providers should be encouraged to follow guidelines and obtain expert guidance from infectious disease specialists when appropriate. Antibiotics can also be removed from the clinical formularies or controlled based on surveillance data for a geographic area or institution. Rotational use of antibiotics and use of combination therapy are other methods that can be effective at reducing resistance. Contemporary medical practice is refocusing on the judicial use of antibiotics through formalized “stewardship” programs as well as reinforcing traditional infection prevention and control strategies.

In the outpatient clinic setting, the strategies for appropriate use may be more directed. Antibiotics are commonly prescribed for upper respiratory infections most of which are caused by viruses. Reserving antibiotics for clinically diagnosed bacterial complications of the URI (e.g. otitis media, sinusitis) would be a more appropriate approach to antibiotic use. For most URIs, antibiotics should not be the accepted or expected treatment and patient education about symptomatic care and the expected course of illness should be the norm.

When antibiotics are indicated, practitioners should strive to have all patients treated with the most effective, least toxic, and least costly regimen for the duration necessary to cure or prevent infection. Whether the patient is prescribed an antibiotic or not, there are several messages that all members of the medical team must emphasize to help achieve appropriate use. Taking the time to deliver these messages is the key to educating the consumer.

The following guidelines address some measures to achieve the appropriate use of antibiotics:

Guidelines for Antibiotic Use

- Obtain appropriate cultures and interpret results with care. Restrict antibiotics to patients with bacterial infections. Patients must be educated that antibiotics are not appropriate for viral infections.
- Choose the narrowest-spectrum, most targeted antibiotic possible.
- Follow established institutional guidelines or prescribing pathways to ensure appropriate selection.
- Reserve long-term and perioperative antibiotic prophylaxis for specific clinical conditions where the benefit - risk ratio has been well established.
- Refrain from using antibiotics as an antipyretic. Empiric use of broad-spectrum antibiotics for fever will only increase the chance for resistance to develop, and put patients at risk for an adverse reaction.
- Take time to educate patients when they request antibiotics for viral illnesses. Tell patients that antibiotics will not help the condition and have potential harmful effects. Explain the natural course expected in this condition and what symptomatic care is appropriate. Educate patients about the symptoms of bacterial complications and to when to seek re-evaluation.
- Take measures to ensure that patients use antibiotics properly when their use is appropriate. Antibiotics must be taken exactly as prescribed - at correct intervals and for the indicated length of time. Patients should also be instructed not to save antibiotics for future illnesses, not to take “leftover” antibiotics, and not to share antibiotic prescriptions with others.

These general guidelines should apply to all health care providers. More specific guidelines regarding antibiotic prescribing may be found in the section referred to as Primary Care.
All providers who work in the primary care setting are urged to read this additional section.

LABORATORY

Testing Considerations for Laboratories

- Laboratories must adhere to the current Clinical and Laboratory Standards Institute (CLSI) guidelines to determine when susceptibility testing should be done on an organism, the method preferred, and appropriate drugs of choice for testing.
- When a facility's cost or personnel considerations render appropriate susceptibility testing impossible, these organisms should be referred to a facility certified by the Clinical Laboratory Improvement Act (CLIA), which adheres to CLSI guidelines and provides data within a turn-around time consistent with optimum patient care.

Over the past few years new information and changes in the guidelines for susceptibility testing have been developed. These testing modifications are described in detail in the latest CLSI guidelines.

- VISA and VRSA

To date there have been eleven isolates of vancomycin-resistant *Staphylococcus aureus* (VRSA) identified in the United States, none in Iowa. A few existing factors seem to predispose case patients to VRSA infection, including:

Prior MRSA and enterococcal infections or colonization,
Underlying conditions such as chronic skin ulcers and diabetes, and
Previous treatment with vancomycin

Detection of a *Staphylococcus aureus* isolate with reduced susceptibility to vancomycin is a critical part of monitoring susceptibility patterns in your laboratory.

Current CLSI standard breakpoints for vancomycin when tested against *Staphylococcus aureus* are as follows: [1]

Susceptible	≤ 2 µg/mL
Intermediate	4-8 µg/mL
Resistant	≥ 16 µg/mL

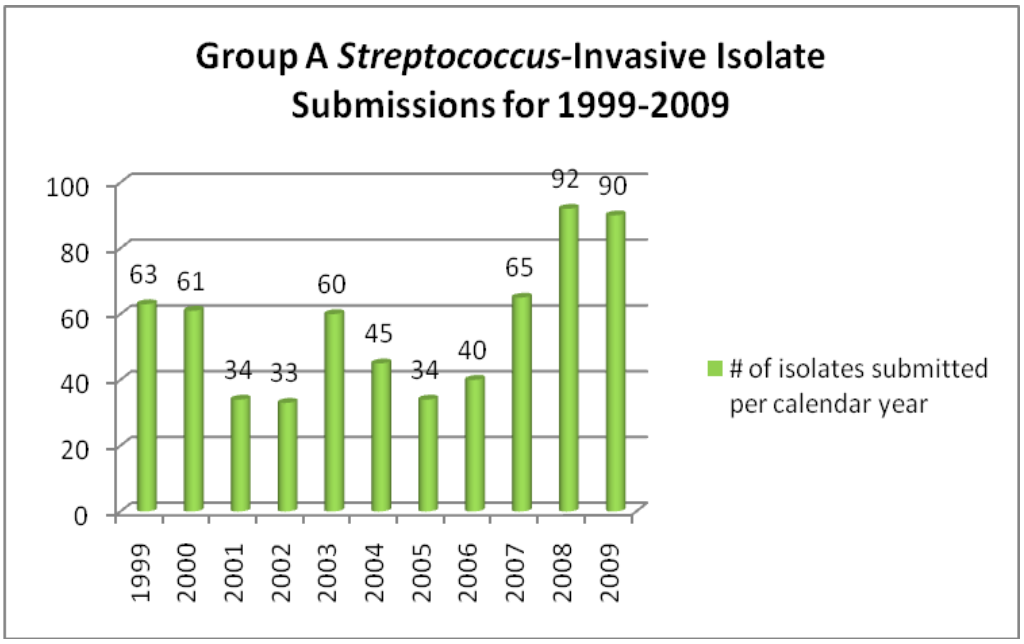
Staphyloccocus aureus isolates should be tested by a reference MIC method. The disk diffusion procedure will not differentiate strains with reduced susceptibility to vancomycin (MICs 4 to 8 µg/mL) from susceptible strains (MIC range 0.5 to 2 µg/mL) even when incubated for 24 hours. Additionally, vancomycin resistant *S. aureus* (VRSA) strains (MICs =16 µg/mL) may produce only subtle growth around a vancomycin disk (CLSI M100).

A brain heart infusion (BHI) vancomycin agar screen plate containing 6 µg/mL of vancomycin, such as that used for detection of vancomycin-resistant enterococci (see M7, Table 2D), may be inoculated to enhance the sensitivity of detecting vancomycin-intermediate and vancomycin-resistant strains of *S. aureus*. (CLSI M100)

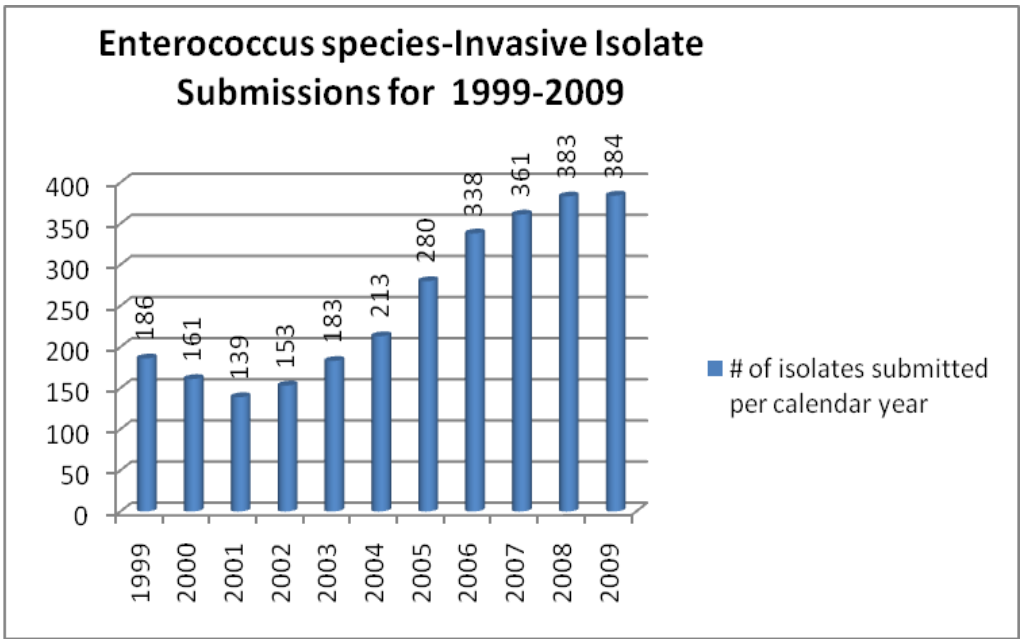
Any laboratory that finds a *Staphylococcus aureus* isolate (regardless of source) with a vancomycin breakpoint of ≥2 µg/mL should contact SHL or refer to the Sentinel Lab Page on their website (www.shl.uiowa.edu) for instructions on sending the isolate to the SHL.

SHL will evaluate the MIC by reference methods to determine if the isolate has reduced susceptibility.

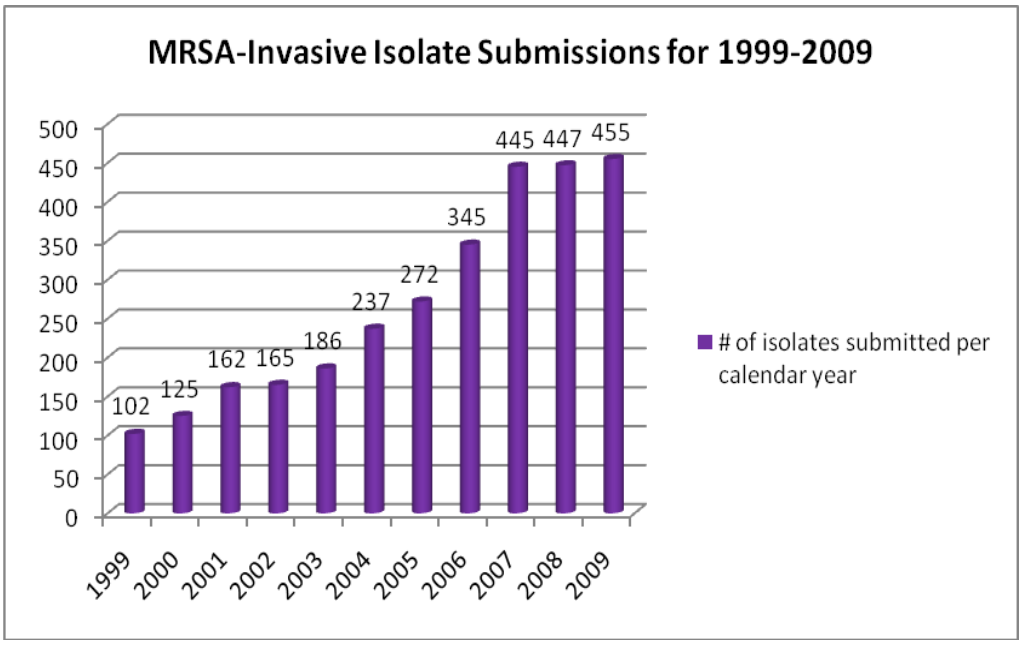
Numbers of Invasive Isolates Submitted to SHL during the Iowa Antibiotic Resistance Surveillance Program



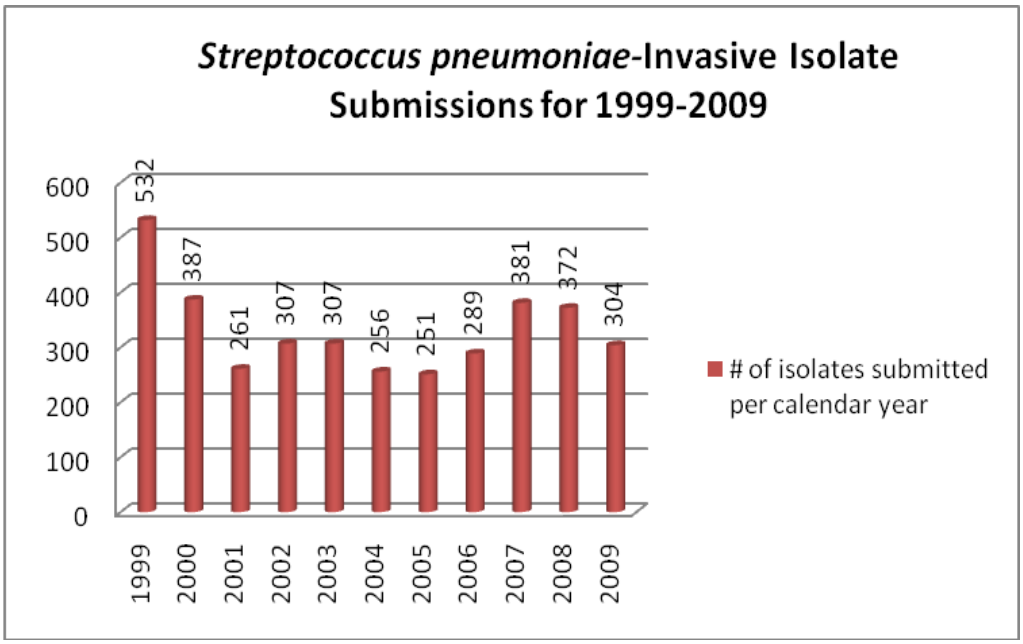
Submissions of invasive Group A *Streptococcus* isolates flucutated every 2-3 years until 2008 and 2009 when we saw a large increase to 90+ submissions for each year. Since overall submission of all organisms o the surveillance project increased during these years, we cannot determine the significance of this increase.



Data for submission of invasive isolates of Enterococcus species includes isolates of *Enterococcus faecium* and *Enterococcus faecalis*. While there was a slight decline in these submissions for about 3 years after the first year of the program, we have seen an increase in these isolate submissions each year since 2003.

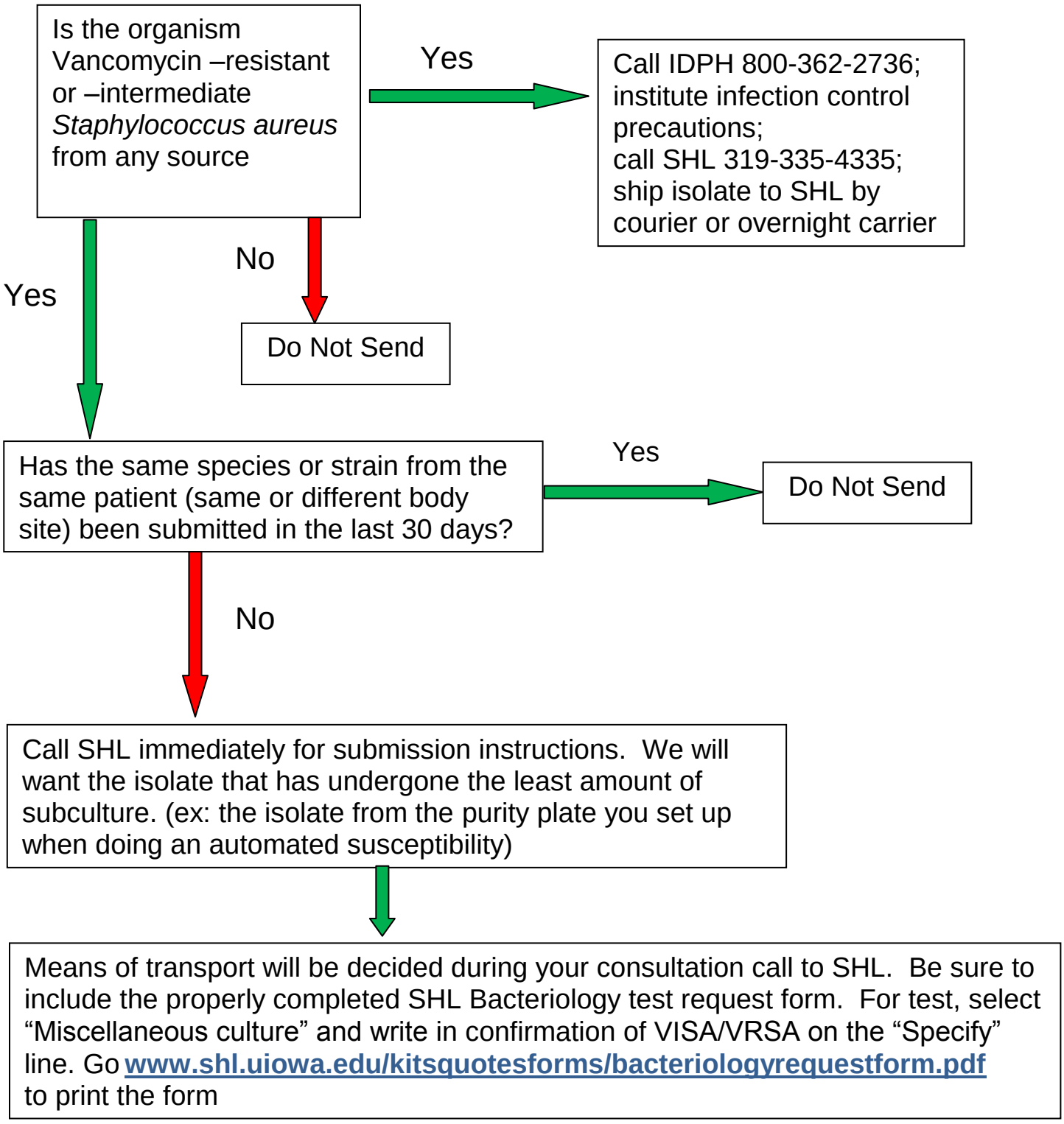


Submission of invasive isolates of MRSA has steadily increased since the start of the surveillance program in 1999. Submissions have remained stabile for the last few years with close to 450 isolate submissions for each of years 2007, 2008 and 2009. Since evaluation of the surveillance program several years ago indicates that only about 45% of isolates qualifying for submission were actually being submitted by clinical labs, there is reason to believe that the incidence of invasive MRSA is actually higher than shown here.



Invasive *Streptococcus pneumoniae* isolate submissions has been fairly steady since the year 2000. Iowa did see a drop in the number of invasive isolates from children less than five years of age with the advent of the pneumococcal vaccines.

Instructions for submitting Vancomycin resisitant – or Vancomycin intermediate – *Staphylococcus auereus* to State Hygienic Laboratory (SHL)



PREVENTION AND CONTROL MEASURES for Persons with Multidrug Resistant Organisms or *Clostridium difficile* IN SPECIFIC SETTINGS

A variety of health care facilities, including hospitals and long-term care, have experienced an increase in multidrug- resistant organisms (MDRO) including methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant *Enterococcus* (VRE) or *Clostridium difficile*. Antibiotic resistant organisms can develop in patients who receive broad-spectrum antibiotics and in those who receive care in various health care settings.

A multidisciplinary approach including physicians, veterinarians, public health workers, pharmacists, nurses and personnel from infection prevention and performance improvement programs, pharmacy and therapeutics committees, microbiology laboratories, and health care facilities is needed to control these organisms. All involved should develop strategies to detect, prevent, and control colonization and infection of patients with multidrug resistant organisms.

The following sections contain guidelines and strategies for reducing the risk of antibiotic resistance in various settings including: primary care, acute care, long-term care, psychiatric inpatient care, partial hospitalization and day treatment programs, dental offices, home care and hospice, hemodialysis units, schools and child care, veterinary practices, the community, and correctional facilities. The summaries of specific measures were developed by the Iowa Antibiotic Resistance Task Force (IARTF) members and are based on articles cited in the bibliography. Providers are encouraged to educate themselves regarding strategies to combat antibiotic resistance in their specific area of practice.

Hand Hygiene

Definitions:

- Alcohol-based hand rub: an alcohol-containing preparation designed to reduce the number of viable microorganisms on the hands. Such preparations contain 60 – 90 percent ethanol or isopropanol.
- Antimicrobial soap: soap (i.e., detergent) containing an antiseptic agent.
- Antiseptic agent: antimicrobial substances (e.g., alcohols) that are applied to the skin to reduce the number of microorganisms.
- Hand hygiene: general term that applies to either hand washing with plain liquid soap, or hand antisepsis by washing with an antiseptic soap or by using an alcohol-based hand rub.
- Hand washing: washing hands with **plain,** (i.e., non-antimicrobial) soap and water.
- Hand antisepsis: refers to either washing hands with an antimicrobial soap or to rubbing an alcohol-based waterless product on the hands until they are dry.

General Information:

- Hand hygiene is the single most important procedure for preventing the spread of microorganisms that cause infections.
- Microorganisms that are carried on the skin for short periods of time (i.e., transient flora) can be transmitted to susceptible patients who could subsequently acquire health care-associated infections.

Health Care Workers:

- Health care workers should wash their hands to remove:
  Visible contamination or soil,
  Transient microorganisms acquired by recent contact with infected or colonized patients or contaminated environmental sources.
- Health care workers should perform hand antisepsis to:
  Eliminate transient microorganisms,
  Reduce resident or colonizing microorganisms.

- Perform *hand washing*:
  When hands are visibly dirty or contaminated with blood or body fluids,

  After contact with body fluids or excretions, mucous membranes, non-intact skin, or wound dressings,

  When caring for patients with diarrhea,

  Before eating, preparing or serving food,

  After using the bathroom.

  Caring for patients with *Bacillus anthracis,Clostridium difficile (spore formers)* or norovirus,
    - Washing hands with non-antimicrobial or antimicrobial soap and water may help to physically remove spores from the surface of contaminated hands.
    - If your institution experiences an outbreak, consider using only soap and water for hand hygiene when caring for patients with *Clostridium difficile* or norovirus infection.

- Perform *hand antisepsis*:
  Before donning sterile gloves when performing tasks such as inserting a central venous catheter, a urinary catheter, a peripheral vascular catheter, or other invasive devices that do not require a surgical procedure for insertion,

  When patients are colonized with MRSA, VRE or any MDRO,

  When hands are not visibly soiled.

- Perform *hand antisepsis* or *hand washing:*
  Before having direct contact patients,

  After contact with patient's intact skin (e.g., taking a pulse or blood pressure or lifting a patient),

  If moving from a contaminated body site to a clean body site during patient care (e.g., after suctioning the endotracheal tube and before cleaning the exit-site of the central venous catheter),

After contact with inanimate objects (including equipment) in the immediate vicinity of the patient,

After removing gloves, because hands may be contaminated during or after glove removal.

Patients:

- Patients should wash their hands:
  When hands are visibly contaminated or soiled,

  Before leaving room,

  Before eating, preparing or serving food,

  After toileting.

- Patients should use alcohol-based hand rub:
  If colonized with MRSA, VRE, or any MDRO.

If patients are unable to wash their hands, health care workers should assist them with hand hygiene.

Equipment Needed:
Hand Hygiene

- *Hand washing*
  Non-antimicrobial soap,
  Warm running water,
  Paper towels.

Or

- *Hand Antisepsis* (preferred method)
  Alcohol-based waterless hand rub.

Or

Hand Antisepsis
Antimicrobial soap,
Warm running water,
Paper towels.

Procedure:
Hand washing or *hand antisepsis* with antimicrobial soap

- Adjust running water to a comfortable temperature,
- Adjust the force of the water to prevent contamination of surrounding area by splashing water,
- Wet hands,
- Use soap dispenser with foot, knee, or hand controls and dispense enough soap to achieve a rich lather (or as per manufacturer's recommendation.)
- Using friction, lather soap on hands for at least 15 seconds,
- Rub all surfaces of fingers, palms, back and sides of hands,
- Pay particular attention to the medial areas of the fingers, fingertips and nail beds,
- Rinse hands well,
- Dry hands thoroughly with paper towels,
- Turn off hand controlled faucets using paper towel to protect hands from recontamination,
- Discard paper towels.

Hand Antisepsis with alcohol

Be sure hands are not visibly soiled. If visibly soiled, wash hands first.

- Apply 3-5 ml of gel to hands.
- Spread over all surfaces of fingers and hands,
- Pay particular attention to the medial areas of the palms, backside of hands, fingers, fingertips, between fingers, and nail beds,
- Rub the solution vigorously into hands until dry (approximately 15-30 seconds).
- When hands begin to feel sticky (usually after several uses of an alcohol-based hand rub), wash them with plain soap and water.

Skin Care:

Hospital approved hand lotions or creams that are latex and chlorhexidine (CHG) compatible should be available for health care workers to use.

PRIMARY CARE

The proliferation of bacteria resistant to multiple antibiotics has become an increasingly important health issue for individual patients and for communities. There is little question that this has resulted in part from the widespread use of antibiotics and the selective pressure these agents apply to bacterial populations. Antibiotic resistance can increase the cost of health care by prolonging hospitalizations and increasing the use of expensive antibiotic agents. Infections with multidrug-resistant bacteria can also increase morbidity and mortality.

The primary care provider must play a pivotal role in preventing and controlling the spread of resistant organisms. Primary care providers have the responsibility to provide quality health care to their patients and at the same time must share responsibility for the health of the community. With respect to antibiotic resistance, this dual task can best be accomplished when antibiotics are prescribed on a selective and thoughtful basis.

Guidelines for Primary Care

General principles

- Patients should
  - Be educated not to expect antibiotics for viral illnesses,
  - Be informed about the potential dangers associated with unnecessary antibiotic use,
  - Be aware of the appropriate length of therapy and the importance of completing a full course of antibiotics, and
  - Be instructed not to save antibiotics for future illnesses, not to take “leftover” antibiotics, and not to share their prescriptions with others.
- Most common respiratory tract infections are viral: influenza, common cold, croup, laryngitis, most bronchitis and most pharyngitis. Patients with these common infections should be educated on
  - The relief that symptomatic care can provide,
  - The natural course of the illness and
  - When to call back to the office.
- Antibiotics should be reserved for patients that develop bacterial complications of these common viral ailments – including otitis media, sinusitis and pneumonia.
- Diagnosis and management guidelines for several bacterial infections of the upper airway are presented below. These recommendations are a compilation of several evidence-based, nationally accepted clinical practice guidelines.

Acute Otitis Media

- Diagnosis requires a history of acute onset, evidence of middle ear effusion, and signs and symptoms of inflammation of the middle ear. Evidence of middle ear effusion includes: otoscopic changes such as bulging from neutral position, limited or absent mobility to pneumatic otoscopy, air fluid levels or otorrhea. Signs or symptoms of inflammation would be indicated by opacity (pus) behind the tympanic membrane (TM), distinct erythema of the TM, and pain clearly referable to the ear(s).
- Acute otitis media (AOM) should not be confused the otitis media with effusion (OME). OME is the presence of middle ear effusion without signs or symptoms of an acute ear infection (no inflammation). The primary treatment of OME does not include use of antibiotics, therefore this condition is not addressed here.
- Selected children with uncomplicated AOM can be observed. This approach involves deferring antibacterial treatment for 48-72 hours and limiting management to symptomatic relief. This approach should be limited to otherwise healthy children two years of age and older without severe symptoms who are likely to return for follow up if necessary.
- If the clinician decides to treat the patient with an antibiotic, amoxicillin (at 80-90 mg/kg/day in two divided doses) should be used for most children.
- Children whose AOM did not respond to amoxicillin therapy may be infected with beta-lactamase-producing *H influenzae* or *Moraxella catarrhalis*. Amoxicillin clavulanate 14:1 (80-90 mg/kg per day amoxicillin component in two divided doses) or a cephalosporin (oral cefdinir, cefuroxime, cefpodoxime, or parenteral ceftriaxone, 50 mg/kg once daily for three days, intramuscularly) could be considered as therapy for these patients.
- Middle ear effusion without inflammation (OME) is often present at the end of therapy. This can last two to three months and does not require any treatment.

Sinusitis

- Clinical diagnosis of acute bacterial sinusitis requires the presence of nasal discharge (of any quality) without improvement for 10-14 days or fever ≥102º F and purulent nasal discharge of at least 3 consecutive days in a person who appears ill. Facial pain or tenderness and periorbital swelling and redness are more specific indicators of acute sinusitis in older children and adults.
- Antibiotic therapy is only indicated after these strict criteria for diagnosis are met. Antibiotic therapy is identical to that recommenced for otitis media (above).
- The common cold is a rhino-sinusitis that often includes radiologic or computed tomography evidence of sinus involvement. Therefore, imaging studies should be used only in selected circumstances (i.e., suspicion of complications, recurrent disease) and should be interpreted with caution.

Pharyngitis

- Infectious causes of pharyngitis can be bacterial or viral (viral being much more common). Antibiotic therapy is indicated for group A *Streptococcus* (GABS) and for the very rare infections caused by certain bacterial pathogens such as *Corynebacterium diphtheriae, Neisseria gonorrhoeae* and group C and G Streptococci. In general, antibiotic therapy has not been proven to benefit patients with acute pharyngitis caused by other bacterial species.
- The signs and symptoms of GABS pharyngitis and viral pharyngitis overlap broadly. Therefore, a laboratory test should be done to determine whether GABS are present in the pharynx prior to determining appropriate therapy. A rapid antigen detection test (RADT) should only be done if clinical and epidemiological features are suggestive of GABS

pharyngitis. These features include sudden onset, sore throat, fever, pharyngeal inflammation, lymphadenopathy, patient age 5-15y, winter and spring season, and lack of cold symptoms (cough and runny nose). A positive RADT is adequate to establish the diagnosis of GABS pharyngitis. A negative RADT in children and adolescents should be confirmed by a throat culture. Because of the low incidence of GABS in adults and the extremely low risk of rheumatic fever, a negative RADT does not need to be confirmed by culture in that population.

- Antibiotic therapy is indicated for persons with symptomatic pharyngitis only after GABS has been confirmed by laboratory testing. Several antibiotics have demonstrated efficacy against GABS including penicillins, cephalosporins and macrolides. Tetracyclines and sulfonamides should not be used for treating GABS pharyngitis.

The Common Cold (viral rhinosinusitis)

- Antibiotics should not be given for the common cold.
- Mucopurulent rhinitis (thick, opaque, or discolored nasal discharge) commonly accompanies the common cold and is not an indication for antibiotic treatment unless it persists without signs of improvement for 10 to 14 days, suggesting possible acute bacterial sinusitis.
- Antibiotics do not effectively treat viral rhinosinusitis or prevent subsequent bacterial infections. Do not over diagnose sinusitis. Although most colds involve the paranasal sinuses, only a small minority are complicated by bacterial sinusitis. Avoid unnecessary treatment by using strict criteria as outlined for sinusitis.

Acute Bronchitis (nonspecific cough illness)

- Nonspecific cough illness (bronchitis), regardless of duration, in children or adults without underlying chronic pulmonary or heart disease, does not warrant antibiotic treatment.
- Prolonged cough (>10-14 days) may be caused by *Bordetella pertussis*, *Bordetella parapertussis*, *Mycoplasma pneumoniae*, and *Chlamydophila pneumoniae*. When infection caused by these organisms is suspected clinically or confirmed, appropriate antibiotic therapy is indicated.
- The evaluation of patients with an acute cough illness or presumptive diagnosis of uncomplicated acute bronchitis should focus on ruling out serious illness, particularly pneumonia.

HOSPITALS (ACUTE CARE FACILITY)

The presence of multidrug- resistant organisms (MDROs) is becoming an increasingly difficult problem in hospitals. As more resistant organisms emerge, therapeutic options available to the practitioner become more limited.

Factors that contribute to the acquisition, and transmission, of multidrug-resistant organisms in acute care facilities include:

- Previous use of antibiotic agents - especially those effective against a broad range of bacteria,
- Use of invasive devices (e.g., urinary or intravascular catheters),
- Sub-optimal recognition and reporting of antibiotic-resistant organisms by the clinical laboratory,
- Unrecognized "silent" carriage,
- Environmental contamination and survival of the organism(s) on inanimate surfaces,
- Intrahospital and interhospital transfer of colonized or infected patients,
- Admission of patients who are unrecognized carriers from other health care facilities and from the community,
- Inadequate compliance with hand hygiene and standard barrier precautions.

A multidisciplinary approach is necessary to interrupt the transmission of multidrug- resistant organisms in the acute care setting. Hospitals should develop an Infection Prevention and Control Plan that addresses prevention and control measures for this very complex problem. The Iowa Antibiotic Resistance Task Force offers the following guidelines as strategies to decrease the risk of colonization with and transmission of multidrug-resistant organisms in the acute care setting.

ACUTE CARE FACILITY

Guidelines in Hospitals for patients with Multidrug-resistant organisms or *Clostridium difficile*

- **Room Assignment**

  A <u>private room</u> is recommended. The room should have a bathroom that is not shared, hand washing facilities in addition to those in the bathroom, and a dispenser of an alcohol-based hand hygiene product.

  When a private room is not available or when cohorting patients is not possible, place an infected or colonized patient who can cooperate with strategies to contain their bodily secretions with another patient who <u>does not have</u> underlying immunocompromising illness, open wounds, indwelling devices, or diarrhea.

- **Hand Hygiene**

  Hand hygiene is the **<u>single most effective</u>** infection prevention and control measure for reducing transmission of all organisms, including those that are resistant to antibiotic agents.

All staff that provide direct patient care to patients with multidrug-resistant organisms should:

Perform hand hygiene before and after every episode of care; use an alcohol-based product if hands are not visibly soiled or wash hands for at least 15 seconds if they are visibly soiled. Consider hand washing when caring for patients with *Clostridium difficile* or norovirus.

Change gloves and perform hand hygiene when moving from a dirty site to a clean site on the same patient,

Perform hand hygiene after removing gloves.

Patients should:

Wash their hands after toileting,

Wash their hands or use an alcohol-based hand hygiene product before leaving the room for common areas or interacting with other persons,

If patients are unable to wash their hands, health care workers should assist them with hand hygiene.

- **Isolation Precautions**

  For Isolation Precautions refer to Centers for Disease Control and Prevention (CDC) *Guideline for Isolation Precautions*: *Preventing Transmission of Infectious Agents in Healthcare Settings, 2007* and *Management of Multidrug- Resistant Organisms in Healthcare Settings, 2006*. In addition to Standard Precautions, health care workers should observe Contact Precautions.

  Health care workers should:

  Wear a gown and gloves upon room entry when contact with the patient or patient's environment is anticipated or when contact is found to be necessary,

  Change gloves and perform hand hygiene between procedures on the same patient if the gloves become contaminated or when the health care worker moves from caring for a dirty to a clean site,

  Remove gloves and gowns and perform hand hygiene before leaving the patient's room,

  Use appropriate barriers on the patient when transporting patients outside their rooms for diagnostic testing, therapy, etc.

- **Criteria for Discontinuing Isolation Precautions for Patients in Acute Care Facilities**

  The current Hospital Infection Control Practices Advisory Committee (HICPAC) guidelines for isolation precautions and for MDROs both indicate that

  - patients may remain colonized with these organisms at one or more body sites,
  - patients may shed these organisms intermittently,
  - surveillance cultures may fail to detect their presence, and
  - patients who appear to be decolonized can subsequently have positive cultures.

  CDC recommends that if a health care facility uses active surveillance cultures (ASC) to detect and isolate patients colonized with MRSA or VRE and the facility does not decolonize these

patients (note there are no good protocols for decolonizing patients with VRE), it is logical to use Contact Precautions for the duration of stay in the setting where they were first implemented. CDC also notes that it is 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 antibiotic 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.

Acute care facilities should adopt criteria for determining when a patient with a multidrug-resistant organism may be released from Contact Precautions. The following suggestions are based on current expert opinion and limited available scientific data.

MRSA - A patient with MRSA may have Contact Precautions discontinued after two cultures taken 24 - 48 hours apart are found to be negative for MRSA. These cultures should be taken from each previously infected or colonized site and from the anterior nares. (Some institutions also include the axilla, perineum and any open wounds in their basic protocol.) Cultures of most sites should be taken at least 48 - 72 hours after antibiotics have been discontinued. Cultures of the nares should be obtained at least 48 hours after stopping nasal mupirocin. However, nares cultures can be obtained while the patient is on systemic antibiotic agents because most of the these agents do not penetrate into the nasal secretions.

VRE - A patient with VRE may have Contact Precautions discontinued after three consecutive cultures obtained at least one week apart are negative for VRE. These cultures should be taken from multiple body sites (including stool, rectum, or perirectal area, any initial sites(s) of infection or colonization with VRE, and if present, open wounds, colostomy sites and catheter [urine]). If the patient is on antibiotics, the antibiotics do not need to be discontinued before obtaining these cultures.

Multidrug-Resistant Gram-negative Organisms (MDR-GNB) - CDC notes that there are few data in the literature indicating when it is safe to discontinue Contact Precautions for patients colonized with a MDR-GNB, possibly because infection and colonization with these MDROs are often associated with outbreaks. CDC recommends that Contact Precautions be used indefinitely in the context of an outbreak for all patients that were previously infected or known to be colonized with MDR-GNB**.** CDC has not addressed non-outbreak settings.

Clostridium difficile – Patients who no longer have diarrhea may have Contact Precautions discontinued. Do not test asymptomatic patients to determine whether their tests for *C. difficile* are negative.

- **Mechanism to Flag the Records of Patients with MDRO When Introduced or Reintroduced Into the Health Care System**

  Use a computer or other system to inform staff members about the patient's history of colonization or infection with resistant organisms at the time of admission, readmission and reintroduction into the health care system. This is not necessary for patients with a history of *Clostridium difficile*.

- **Criteria to Remove the MDRO Flag from Records of Patients**

  Currently there is no set standard of removing the flag from a medical record. Each facility should determine a process that works within their system and their patient population. Below are two methods currently used in Iowa hospitals to determine removal of the flag from a patient's record:

MRSA and VRE:

Hospital A: If a patient returns to a health care facility who has met criteria for discontinuing Contact Precautions, the flag should have already been removed during that prior stay. The protocol may be followed and criteria met as an outpatient The patient will not be isolated unless they have MRSA or VRE isolated from a new culture. Patients who have **not** met criteria for discontinuing Contact Precautions or had Contact Precautions continued throughout their prior stay and their colonization status is unknown (no intervening cultures), then the patient is placed on Contact Precautions upon readmission and screening cultures are obtained (nares and open wound if present for MRSA, perirectal for VRE).

Method B: The flag is left on the record for one year after the patient has met the criteria for discontinuing Contact Precautions during a particular visit. During that year, if a patient has a negative culture documented within the past 30 days, the patient may be readmitted or seen without using Contact Precautions. If there is not a documented negative culture in the past 30 days, the patient must be readmitted or seen using Contact Precautions and surveillance cultures obtained. If the cultures are negative, Contact Precautions may be discontinued. The flag is removed from the record after one year of negative cultures

Multidrug-Resistant Gram-negative Organisms (MDR-GNB):

Method A: The record is not flagged for subsequent admissions.

Method B: Flag is never removed from the record, but the patient may come out of Contact Precautions if not actively infected.

Clostridium difficile:

Patients may be removed from Contact Precautions when they are no longer having diarrhea. A negative test is not necessary. The patient's record is not flagged for subsequent admissions.

- **Equipment and Environment**

  A disinfectant registered by the Environmental Protection Agency (EPA) should be used on surfaces such as furniture, door handles, and floors, in areas where patients have multidrug-resistant organisms.

  If possible, dedicate reusable items to a specific patient in isolation for their use only. Always clean and disinfect items after they are no longer needed to care for that patient. If equipment must be shared, clean and disinfect the items between uses for different patients (e.g., stethoscope, sphygmomanometer, and electronic thermometer). Do not use rectal thermometers for patients with VRE or *Clostridium difficile*.

  Limit use of commodes to patients who cannot get to the bathroom. Commodes should not be shared. Commodes should be cleaned and disinfected when visibly soiled and periodically as with a toile. If sharing does occur, clean and disinfect between patients.

  Clean and disinfect rooms daily and between patients.

  Educate staff about which disinfectant to use and how to dilute the product.

Instruct staff to remove all organic material before applying disinfectant and leave the disinfectant on the surfaces for the appropriate amount of time (contact time), following the manufacturer's directions.

Limit items entering the patient's room.

No special precautions are needed for handling food or soiled dishes.

Follow routine practices for handling trash: place non-hazardous trash in ordinary waste receptacles; place all regulated trash in red containers or containers with a biohazard label.

- **Transferring Patients**
  The facility transferring a patient should notify the receiving facility and transport personnel of the patient's colonization or infection status before transfer.

- **Visitors**
  Visitors should perform hand hygiene before they have contact with a patient.

  Visitors who <u>are not</u> providing direct patient care should perform hand hygiene at the end of their visit. No special barriers are required.

  Visitors who <u>provide</u> direct patient care must follow the guidelines for barriers and hand hygiene used by health care workers. Health care facilities should provide educational materials to visitors.

- **Appropriate Antibiotic Utilization**
  Staff members who prescribe antibiotics should be educated about proper antibiotic use. Systematic controls (such as limiting formularies) have been useful in numerous hospitals.

- **Education**
  Staff: Health care workers who give direct care must be educated continuously.

  Patients: Develop educational materials or use reputable commercial educational tools that address the following issues:

  The reasons for isolation, the use of barriers, and the duration of practices and barriers,

  How to perform hand hygiene,

  The importance of not sharing food or beverages,

  The importance of maintaining a clean home environment and disinfecting common shared items with an approved disinfectant.

  Patients who are colonized with MRSA and VRE are at risk for acquiring vancomycin-resistant *Staphylococcus aureus*. There are no national guidelines for caring for co-colonized and co-infected patients. However, the Iowa Antibiotic Resistant Task Force believes that clinicians would be wise to consult with an infectious disease specialist before treating these patients with vancomycin because such treatment may encourage the vancomycin-resistance gene to be transferred from *Enterococcus* species to *S. aureus*.

- **Active Surveillance Cultures (ASCs)**

  CDC's MDRO guideline acknowledges that various experts and groups interpret the literature on ASCs differently. Some hospitals have used ASCs successfully as part of their strategy to control or prevent spread of MDROs, particularly MRSA and VRE. In contrast, other hospitals have controlled or prevented spread of these organisms without implementing ASCs but by consistently applying hand hygiene and Standard Precautions.

  In addition, CDC notes that most studies have not included small rural hospitals or long-term-care facilities, which are common in Iowa. Therefore, the IARTF agrees with CDC's recommendation that health care facilities should assess their local problem by

  - defining the prevalence of specific MDROs,
  - evaluating the adherence to hand hygiene, Standard Precautions, and Contact Precautions, and
  - evaluating the adequacy of environmental cleaning.

  ASCs (on admission and periodically thereafter) may be of benefit in populations that are at high risk for complications from colonization or infection with MDROs and if transmission occurs despite optimal adherence to hand hygiene, Standard Precautions, Contact Precautions, and environmental cleaning. Health care facilities that elect to do ASCs should ensure that clinical staff, the infection prevention team, and the laboratory collaborate so that specimens are obtained properly and the laboratory is not overwhelmed with specimens.

  Readers are referred to the CDC MDRO guideline and the Institute for Healthcare Improvement's MRSA getting started kit for further discussions on this topic.

LONG-TERM CARE FACILITY

The number of residents in long-term care facilities who are colonized or infected with multidrug-resistant organisms has increased. The Task Force offers the following guidelines, which are modifications of acute care guidelines or guidelines developed by other states and facilities to assist in preventing and controlling resistant organisms in the long-term care setting. This guideline addresses MRSA, VRE and *Clostridium difficile* and other multi-drug resistant organisms such as extended spectrum beta-lactamase (ESBL) producers or multi-drug resistant *Pseudomonas* in the long-term care facility.

Long-Term Care Facility Guidelines for Residents with Multidrug- Resistant Organisms or *Clostridium difficile*

- **Resident Placement**

  Admission to licensed facilities should not be denied because the resident is colonized or infected with an antibiotic resistant organism.

  Private rooms are always ideal, but in most long-term care facilities the number of private rooms is limited. Routinely placing a colonized or infected resident into a private room is not required. However, if possible, place residents with the same organism together in the same room (cohorting).

  When a private room is not available and cohorting residents is not possible, place the infected or colonized resident with another resident who is at low risk of acquisition, or of an adverse outcome, from infection: i.e., no immunosuppression, open wounds, or indwelling catheters, and not totally dependent on health care workers for activities of daily living.

- **Infection Prevention and Control Measures**

  For Isolation Precautions refer to Centers for Disease Control and Prevention (CDC): *Guideline for Isolation Precautions in Hospitals,* HICPAC– 2007. The individual resident's clinical situation is key in determining whether to implement Contact Precautions (in addition to Standard Precautions) for a resident infected or colonized with a multi-drug resistant organism (MDRO).

  Standard Precautions should be practiced consistently for every contact with every resident.

  In addition, on the basis of the site of infection or colonization and the risk of transmission to others, **Contact Precautions** may also be needed but may be modified for the long-term care setting.

  (Refer to Chart for Long-Term Care Page 37)

Factors that affect the likelihood that a resident will shed resistant organisms should be considered when deciding whether to use Standard or Contact Precautions include:

Resident's mental status and reliability,

Presence or absence of diarrhea,

Resident's personal hygiene,

Ability to contain wound drainage with dressings,

Resident's ability to control their urine and stool (continent or incontinent).

Appropriate use of gloves and gowns should be determined on the basis of whether Standard or Contact Precautions are indicated.

Follow **Standard Precautions** for all residents. Standard Precautions include the use of gloves and possibly gowns for contact with uncontrolled secretions, pressure ulcers, draining wounds, stool incontinence, and ostomy tubes or bags. Masks should be worn when caring for a resident with a cough illness. Standard Precautions are adequate for relatively healthy residents (e.g., mainly independent) and for those in the following situations:

Residents who are colonized with MRSA in their nares or in a superficial lesion and who do not have indications of infection (e.g., purulent sputum, signs of active or progressive wound infection).

Residents who are colonized with VRE in the GI tract, but are continent of stool and capable of maintaining hygiene practice, e.g., hand washing.

Residents with prior *Clostridium difficile* infection who do not have diarrhea. The risk of shedding is linked to clinical signs (i.e., diarrhea). In addition, *C.difficile* toxin may still be detectable after adequate treatment. Therefore there is no need to obtain a negative test as proof of a cure.

Follow Contact Precautions for other residents (e.g., those totally dependent upon health care personnel for health care and activities of daily living, ventilator dependent) and for those residents whose infected secretions or drainage cannot be contained. **Contact Precautions** include the following:

Wear a gown and gloves upon room entry when contact with the resident or resident's environment is anticipated,

Gloves should be changed between procedures on the same resident if they become contaminated or when the health care worker moves from caring for a dirty to a clean site.

Remove gloves gown before leaving the resident's room.

Gloves are not required for casual contact outside the resident's room.

Contact Precautions are needed in the following situations:

Residents who have wounds that are colonized or infected with resistant organisms (MRSA or VRE) and the wounds cannot be covered fully by dressings or produce drainage that cannot be contained by dressings.

Incontinent residents who carry resistant organisms (MRSA or VRE) in their genitourinary or gastrointestinal tracts and whose urine or stool cannot be contained in incontinence products, urine or ostomy bags.

Incontinent residents with *C. difficile* with diarrhea or stool that is not contained in incontinence products.

Residents with tracheostomies who have MRSA or VRE in their respiratory secretions and they produce significant amounts of secretions that are not contained.

When a cluster of nosocomial (institutionally acquired) infections is recognized.

- **Hand Hygiene**

Please review pages 21-23 of this report for complete hand hygiene information.
Hand hygiene (i.e., hand washing or hand antisepsis) before and after resident contact and after removing gloves is the **single most effective** infection prevention and control measure for reducing the transmission of all organisms, including those that are antibiotic resistant.

All staff that provide direct care to residents with multidrug-resistant organisms should:

Perform hand hygiene with an alcohol-based product if hands are not visibly soiled or wash hands for at least 15 seconds if they are visibly soiled.

Perform hand hygiene after every episode of resident care,

Change gloves between different body sites on the same resident,

Perform hand hygiene after removing gloves.

Caring for patients with *Bacillus anthracis, Clostridium difficile (spore formers)* or norovirus,

- Washing hands with non-antimicrobial or antimicrobial soap and water may help to physically remove spores from the surface of contaminated hands.
- If your institution experiences an outbreak, consider using only soap and water for hand hygiene when caring for patients with *Clostridium difficile* or norovirus infection. “

Residents should:

Wash hands after toileting,

Wash hands or use an alcohol-based hand hygiene product before leaving their room for common areas or before interacting with other persons.

If residents are unable to wash their hands, health care workers should assist them with hand hygiene.

- **Environment:**
  The rooms of residents with resistant organisms can be cleaned with the facility's standard (EPA-approved) disinfectant using the facility's standard procedures for cleaning. The resident's room (particularly in those on Contact Precautions) should be cleaned daily to reduce the number of bacteria contaminating the environment.

  Specific attention should be given to bed rails, commodes, bedside tables and other surfaces that are frequently touched.

  If possible, dedicate resident care equipment to the resident. Clean and disinfect the items after they are no longer needed to care for the resident. If equipment must be shared, clean and disinfect the items between use on different residents, e.g., stethoscopes, sphygmomanometer, or electric thermometer. Do not use rectal thermometers for patients with VRE.

  Shared bathrooms, showers, tubs

  Bathrooms: In situations where a resident with a resistant organism shares a bathroom with a non-infected or colonized roommate, the bathroom should be cleaned and disinfected using the facility's standard procedure (daily and when visibly soiled). Commodes may be useful for certain residents with resistant organisms and should not be shared with roommates.

  Showers and tubs: Shared tubs and showers should be cleaned and disinfected per the facility's standard procedure after use by residents with resistant organisms.

  Teach staff which disinfectants to use and how to use them safely, removing all organic material before disinfecting and allowing the appropriate contact time for the disinfectant, following the manufacturer's directions.

- **Dishes and eating utensils:**
  No special requirements are needed for dishes, glasses, cups, or eating utensils. The combination of hot water and detergents used in institutional dishwashers, if used properly, is sufficient to decontaminate these items.

- **Laundry:**
  Laundry staff should wear gloves and long sleeved gowns when sorting laundry.

  Standard Precautions are adequate for handling laundry from all residents. However, visibly soiled laundry should be handled in a way that minimizes contamination of staff and the environment. Special handling (i.e., double bagging, etc) is not necessary. Laundry should not be rinsed at point of use.

- **Activities:**
  Long-term care facilities are considered to be a resident's home. Residents who have multidrug-resistant organisms should be allowed to ambulate, socialize as usual and participate in therapeutic and group activities as long as body substances are contained. Barrier protection to contain wound drainage, feces, urine, etc. is preferred over restricting the resident.

- **Decolonization:**
  Routine decolonization for MRSA is not recommended for residents of long-term care facilities at this time. Decolonization therapy for MRSA may result in the emergence of resistance to the agents used and since re-colonization is common, decolonization has had little impact on the incidence of infections experienced by residents of long-term care facilities.

There is no proven decolonization regimen for VRE. Among residents of long-term care facilities, VRE colonization is likely to persist for extended periods of time.

Treatment of residents colonized with *C. difficile* is not recommended.

- **Criteria for Discontinuing Isolation Precautions in Residents of Long- Term Care Facilities.** Long-term care facilities may use the criteria outlined in the acute care section on pages 27-28 to discontinue Contact Precautions.

  The likelihood of the resident transmitting resistant organisms (i.e. presence or absence of incontinence, diarrhea, uncontained body fluids) should be reassessed periodically.

- **Mechanism to Flag Residents Introduced or Reintroduced Into the Health care System**
  Use a computer or other system to inform staff members about the resident's history of colonization or infection with resistant organisms at the time of admission, readmission and reintroduction into the health care system. This is not necessary for patients with a history of *Clostridium difficile*.

- **Criteria to Remove the MDRO Flag from Records of Residents**
  Currently there is no set standard of removing the flag from a medical record. Each facility should determine a process that works within their system and their patient population.

  Long-term care facilities may use the criteria outlined in the acute care section on pages to remove the MDRO flag from a resident's record

- **Transferring Residents**
  It is the responsibility of the facility transferring the resident to notify a receiving facility and transport personnel of the resident's colonization or infection status before transfer.

- **Visitors**
  Visitors should perform hand hygiene before they have contact with a resident.

  Visitors who <u>are not</u> providing direct resident care should perform hand hygiene at the beginning and end of their visits. No special barriers are required.

  Visitors who <u>provide</u> direct resident care must follow the guidelines for barriers and hand washing or hand hygiene used by health care workers.

  Provide educational materials to visitors.

- **Appropriate Antibiotic Utilization**
  Prescribing staff should be educated about proper antibiotic use. Systematic controls (such as limiting formulary) have been useful in numerous hospitals.

- **Education**
  Staff: Health care workers who give direct care must be educated continuously.

  Residents and their visitors: Develop educational materials or use reputable commercial educational tools that address the following:

The reasons for isolation, the use of barriers, and the duration of practices and barriers,

Using good hand hygiene technique,

Refraining from sharing food or beverages,

Maintaining a clean home environment and disinfecting common shared items with a household disinfectant.

Residents who are colonized with MRSA and VRE are at risk of acquiring vancomycin-resistant *Staphylococcus aureus*. There are no national guidelines for co-colonized or co-infected residents. However, the Iowa Antibiotic Resistance Task Force believes that clinicians would be wise to consult with an infectious disease specialist before treating such residents with vancomycin. Such treatment may encourage the vancomycin-resistance gene to be transferred from the *Enterococcus* to *Staphylococcus aureus*.

Long-term Care Facility: Recommended Practices for Residents with Multidrug Resistant Organisms *or Clostridium difficile*

Resident Transmission Risk	Room Placement	Care of Resident in Resident Room	Care of Resident in Common Area	Rehab Activity (RT, OT, RT)
*Incontinent of stool or urine (VRE, *C. difficile*) *Diarrhea (VRE, *C. difficile*) *Uncontained body fluids or drainage (VRE or MRSA) *Cognitively impaired	*Private room with hand hygiene and toilet facilities OR *Cohort with a resident with the same resistant organism OR *Share room with resident who does not have venous or arterial access devices♦, urinary catheter, trach, open wounds, is not on antibiotics, and is not immunocompromised ++ AND *Both residents are able to cooperate in strategies to contain their body secretions.	*Wear gloves to enter room and for direct resident care and any contact with frequently touched surfaces in resident room. *Change gloves after contact with material that could contain high concentrations of drug resistant organisms, e.g., stool, and body fluids. *Remove gloves before leaving room. *Perform proper hand hygiene after gloves are removed. *Wear gown if substantial contact with resident or with environmental surfaces in the resident's room is anticipated. *Limit or dedicate supplies to resident's room. *Clean all equipment with disinfectant before removing from room. ♦♦ *Resident's clothing can be washed using regular detergent and dried in machines provided in the facility.	(This includes dining room, hallway, activity room, etc.) *Case-by-case assessment when resident's body fluids, stool cannot be contained. *Instruct or assist resident to wash hands consistently and properly after using the toilet and before leaving room for common areas. *Do not allow multiple residents to handle items, e.g., cards, puzzle pieces, and TV remote. *Gloves are not required for casual contact with resident outside of the resident's room. Staff wears gowns and gloves when cleaning spills. *If resident needs to use bathroom, take them back to own room; instruct resident about washing their hands or help resident wash hands t after using the toilet. *Surfaces contaminated by resident secretions or excretions should be cleaned and disinfected. ♦♦ Have residents use chairs, etc that can be easily cleaned; avoid fabric furniture. +++	*Case-by-case assessment of resident leaving room when body fluids, stool cannot be contained. Consider doing rehab activities and other services in the resident's room. Minimize sending residents to other sites. *Instruct resident about washing their hands or help the resident with wash their hands after using the toilet. *Gloves are not required for casual contact with resident outside of the resident's room. Staff should wear gowns and gloves when cleaning spills. *Wipe equipment with disinfectant after contact with a resident and before use with the next resident. ♦♦ *Surface contaminated by residents' secretions or excretions should be cleaned and disinfected. +++,♦♦
*Continent of stool or urine (or on a regulated program)+ *No diarrhea *Wound drainage or body fluids is contained *Able to cooperate in strategies to contain their body secretions.	Same as above	*Gloves are not required for casual contact. Gloves are worn for direct resident care and contact with frequently touched surfaces in resident's room. *Perform proper hand hygiene before entering and after leaving resident room. *Gowns are required only if risk of soiling with fecal material or infectious drainage is anticipated.	*Instruct residents to wash their hands after using toilet and before leaving their room for common areas. *Instruct residents to use the toilet in their own rooms. Reinforce hand washing. *Gloves are not required for casual contact with resident outside of the resident's room. Staff should wear gowns and gloves when cleaning spills.	*Instruct or assist resident to wash hands on arrival to rehab department and before leaving room. *Gloves are not required for casual contact with resident outside of the resident's room. Staff should wear gown and gloves when cleaning spills. *Wipe equipment with disinfectant after resident contact and before next resident use. ♦♦ *Surfaces contaminated by resident secretions or excretions should be cleaned and disinfected. +++,♦♦

+ Regulated program: As defined by the Rehab Standards

++ The health status of residents with drug resistant organisms and uninfected roommates should be periodically reassessed to determine whether they should continue to share a room.

+++Daily environmental cleaning of surfaces commonly touched by residents known to be positive for drug resistant organisms and their care givers is recommended.

♦ Exception: A resident with an implanted port not being used can share a room with a resident who has drug resistant organism

♦♦ The disinfectant must be in contact with the item to be cleaned for 10 minutes.

Mental Health Facility
Inpatient, Partial Hospitalization and Day Treatment Programs
Guidelines for Patients and Clients with Multidrug Resistant Organisms or *Clostridium difficile*

Admission Policy: Admission to a mental health facility should not be denied because the patient is colonized or infected with a multidrug resistant organism or has *Clostridium difficile*.

Patients admitted to a licensed mental health facility typically do not have acute medical conditions, but they are at risk due to co-morbidities. Mental health facilities are somewhat unique in that the patients or clients are encouraged to join in group activities and may eat in a common dining room. These activities are important as an adjunct to their treatment regimen.

It is imperative to identify those patients that are known to be colonized or infected with a multidrug resistant organism or *Clostridium difficile* based on their medical history, institution flagging system, or current testing results. Assessing the patient or client for active infection, containment of body substances and ability to comply with recommended precautions is necessary in developing a plan of care and providing a safe environment of care for other patient or clients.

Isolation Precautions: For Isolation Precautions refer to Centers for Disease Control and Prevention (CDC) *Guideline for Isolation Precautions*: *Preventing Transmission of Infectious Agents in Healthcare Settings, 2007* and *Management of Multidrug- Resistant Organisms in Healthcare Settings, 2006*. In addition to Standard Precautions, health care workers should observe Contact Precautions.

Standard Precautions: should be practiced consistently for every contact with patients or clients including hand hygiene and use of personal protective equipment such as gloves and gowns when contact with body substances is expected.

Contact Precautions: should be utilized for patient or clients in addition to Standard Precautions which includes hand hygiene, use of gloves and gowns. The personal protection equipment is used to prevent person-to-person, person-to-environment and environment-to-person transmission.

Infection Prevention and control Measures for Mental Health Facilities include:

1.) Hand hygiene in mental health is usually limited to soap and water. Alcohol based hand gels are often limited to supervised instances.
2.) Cleaning of the environment is per the facility's procedures based on health care recommended guidelines.
3.) Patient or client's personal laundry may be their responsibility to complete as described in mental health policy and procedures. Laundry items such as linens and towels would be processed per institutional processes.
4.) Activities are developed as appropriate to the patient or client individual and group needs.

5.) Decolonization would not be routinely recommended for mental health patients or clients.
6.) Staff will be knowledgeable on how to implement Standard and Contact Precautions and how to use personal protective equipment and to dispose of it safely. Education on multidrug resistant pathogens and *Clostridium difficile* and how to break the chain of transmission should be provided at a level of understanding for the patient or client and their visitors. If family will be responsible for their care on discharge they should receive information.
7.) Transfer to long term care, acute care or another mental health setting requires that the presence of any multidrug resistant pathogen or *Clostridium difficile* be shared with the receiving institution. If laboratory results are received post transfer that information is required to be forwarded to the receiving institution

Standard Precautions with Resistant Organism colonization or *Clostridium difficile* in mental health situations as determined by:

1. Mental health guideline chart page for recommendations of room placement, care of patient or client in their room, and care of patient or client in common areas,
2. Patients or clients who are colonized with MRSA in their nares or a superficial lesion and who do not have an indication of infection,
3. Patients or clients who are colonized with VRE in the GI tract, but are continent of stool and capable of maintaining good hygiene practice such as hand washing,
4. Patient or client that has prior a history of or a current *Clostridium difficile* infection but does not have diarrhea or is not incontinent of stool. The risk of shedding is linked to clinical signs such as diarrhea. *Clostridium difficile* toxin may still be detected after adequate treatment. It is not recommended to obtain a negative test as proof of a cure.

Implementation of Contact Precautions with Resistant Organism or *Clostridium difficile* active infection and uncontained body substances in mental health situations as evidenced by:

1. Refer to chart (page) for recommendations of room placement, care of patient or client in their room, and care of patient or client in common areas,
2. MRSA or VRE in a wound with drainage that cannot contained by dressings,
3. MRSA or VRE in sputum from a tracheostomy that cannot be contained,
4. MRSA or VRE in stool or urine with incontinence, and not contained by incontinence products,
5. *Clostridium difficile* in stool with active diarrhea that is not contained by incontinence products.

When there is a cluster of health-care associated infections identified, Contact Precautions may need to be added to the care of the patients or clients with MRSA, VRE, other resistant organisms, or *Clostridium difficile*.

Assessment of the patient or client infected with MRSA, VRE, other resistant organisms, or *Clostridium difficile* that have body substances that cannot be contained needs to be conducted on an individual basis. If they are unwilling, or unable, to follow recommended measures, they could be placing other patients or clients at risk.

Partial Hospitalization or Day Treatment for patients or clients with MRSA, VRE, other resistant organisms, and *Clostridium difficile, participation is allowed if*:

1.) Patient or clients who are colonized with MRSA in their nares or have an infection which is contained by dressings,

2.) Patients or clients who are with VRE in the GI tract but are continent of stool or able to use incontinent supplies and capable of maintaining hygiene.
3.) Patient or client with prior *Clostridium difficile* infections who do not have diarrhea or is capable of using incontinent supplies safely and maintains good hand hygiene. The risk of shedding is linked to clinical signs of diarrhea. *Clostridium difficile* toxin may still be detectable after adequate treatment. It is not recommended to obtain a negative test as proof of a cure.

MENTAL HEALTH GUIDELINES FOR PATIENTS or CLIENTS WITH RESISTANT ORGANISMS or *CLOSTRIDIUM DIFFICILE*

DISEASE or RESISTANT ORGANISM	**ROOM PLACEMENT**	**CARE OF PATIENT or CLIENT IN THEIR ROOM**	**PATIENT or CLIENT IN COMMON AREAS** (dining room, group meetings, game room, etc)
Patients or clients who have had MRSA infection or colonization in the past but currently have no signs of active infection (no draining wounds or copious amounts of purulent sputum) Patients who have had VRE infection or colonization in the past but have no current signs of infection (draining wounds) and are continent of stool	Patient or clients may be placed in a double room. If possible avoid roommates with the following: 1) open skin lesions, sores or burns 2) indwelling devices 3) colonized or infected with a different resistant organism 4) immunosupression – AIDS, transplant patients, neutropenic patients or those on chronic steroids	Use personal protective equipment (gloves, gown and mask) as needed per Standard Precautions. Masks are not needed even for patients with MRSA in their respiratory tract. Hand washing with soap and water immediately prior to leaving the room and as needed per hand hygiene policy. Clean equipment (BP cuffs, etc.) with appropriate disinfectant before removing from room. If patient is going to another area of the hospital for tests or procedures, notify the receiving department that patient is in Contact Precautions.	Patient or client: 1) May attend group meetings in any area, use dining room and other common areas, go to game room. 2) Should be instructed to wash hands after using toilet and before leaving their room for common areas. 3) Should be encouraged to use their room for toilet use. Reinforce hand washing. Staff: Use Standard Precautions. Common surfaces such as tables do not need to be disinfected after each patient contact. They should be cleaned on a routine basis.
Patients or clients who have had MRSA infection or colonization in the past and currently have signs of active infection (draining wounds or copious amounts of purulent sputum) Patients or clients who have had VRE infection or colonization in the past and have current signs of infection (draining wounds) or are incontinent of stool	Private room with hand washing and toilet facilities If a private room is not available, cohort with another patient or client known to have infection or colonization with the same organism If private room and cohort not available, avoid roommates with the following: 1) open skin lesions, sores or burns 2) indwelling devices 3) colonized or infected with a different resistant organism 4) immunosupression – AIDS, transplant patients, neutropenic patients or those on chronic steroids If drainage is uncontained, assess whether a private room is the only option for this individual. No other patient or client should be in the patient's or client's room. If this is witnessed, have them leave the room and wash their hands	Gloves are worn for direct care and contact with frequently touched surfaces in the room. Masks are not needed even for patients or clients with MRSA in their respiratory tract. Hand washing with soap and water should be completed immediately after gloves are removed per hand hygiene policy. Gowns are not required except when there is a risk of soiling clothing with fecal material or infectious drainage. Clean equipment (BP cuffs, etc.) with appropriate disinfectant before removing from room. If patient or client is going to another area of the hospital for tests or procedures, notify the receiving department that they are in Contact Precautions	Patient or client: 1) May attend group meetings in any area, use dining room and other common areas, go to game room unless wound drainage cannot be contained. 2) Should be instructed to wash hands after using toilet and before leaving their room for common areas. 3) Should be encouraged to use their room for toilet use. Reinforce hand washing. 4) Patient or client does not need to wear a gown, gloves or mask Staff: Use Standard Precautions Common surfaces such as tables do not need to be disinfected after each patient contact. They should be cleaned on a routine basis.
	Private room with hand washing and toilet facilities **until patient is no longer having diarrhea** No other patient or client should be in the patient or client's room. If this is witnessed, have them leave the room and wash their hands	Gloves are worn for direct care and contact with frequently touched surfaces in the room. Hand washing with soap and water immediately after gloves are removed. Gowns are not required except when there is a risk of soiling clothing with fecal material or infectious drainage. Clean all equipment (BP cuffs, etc.) with appropriate disinfectant If patient or client is going to another area of the hospital for tests or procedures, notify the receiving department that they are in Contact Precautions	Patient or client, if continent: 1) May attend group meetings in any area, use dining room and other common areas. 2) Should be instructed to wash hands after using toilet and before leaving their room for common areas. 3) Should be encouraged to use their room for toilet use. Reinforce hand washing. Staff: Use Standard Precautions If patient or client is not continent and stool cannot be contained (adult diaper), they should not be in common areas.

Guidelines for Correctional Facilities

The Iowa Antibiotic Resistant Task Force endorses the Federal Bureau of Prisons "Management of Methicillin-Resistant *Staphylococcus aureus* - Clinical Practice Guidelines April 2011". The guidelines can be found at:

www.bop.gov/news/PDFs/mrsa.pdf

Dental

2007 American Heart Association
Guidelines for the Prevention of Infective Endocarditis

In April of 2007 the American Heart Association (AHA) published a landmark revision in the guidelines for the prevention of bacterial endocarditis. After extensive review of the worldwide body of scientific literature, the AHA's Endocarditis Committee concluded that there is not conclusive evidence that links invasive dental, genitourinary (GU) or gastrointestinal (GI) tract procedures with the development of infective endocarditis (IE). As a result, the AHA no longer recommends routine antibiotic prophylaxis prior to GU or GI tract procedures and has drastically limited the scope of cardiac conditions that require prophylaxis.

Invasive dental procedures include those which involve perforation of the oral mucosa or manipulation of gingival tissues or the structures surrounding the apices of teeth. These procedures are known to precipitate bacteremias and include extraction of teeth, placement of implants and routine oral prophylaxis (cleanings). Injection of local anesthetics, dental fillings placed above the gum line, and adjustment of orthodontic appliances generally do not require antibiotic prophylaxis.
The revised guidelines reflect a paradigm change whereby the emphasis on the causation of IE has shifted from the infrequent bacteremias that occur during the course of dental treatment to the cumulative bacteremias experienced by patients in the course of daily life. It has long been recognized that routine oral hygiene procedures (toothbrushing, flossing, powered irrigation) and mastication of food cause transient bacteremias and that the vast majority of cases of IE occur "spontaneously" and are not attributed to medical or dental procedures.
In the previous nine reiterations of the AHA guidelines, the "first do no harm" rationale prevailed, and it was deemed that patients with preexisting cardiac conditions known to confer only a moderate-risk of IE over a lifetime would benefit from antibiotic prophylaxis prior to invasive dental procedures. "Moderate-risk" conditions included a variety of non-life threatening congenital cardiac malformations, pathologic heart murmurs and hypertrophic cardiomyopathy.
Currently, the AHA recommends antibiotic prophylaxis prior to invasive dental procedures only for the cardiac conditions which confer the highest risk of morbidity or mortality from endocarditis (Table1). Thus the vast majority of patients with pre-existing cardiac conditions no longer require antibiotic coverage.

(Table 1) Cardiac Conditions for Which Antibiotic Prophylaxis is Necessary

- Prosthetic cardiac valve
- Previous infective endocarditis
- Congenital heart disease (CHD)*
  - Unrepaired cyanotic CHD, including palliative shunts and conduits
  - Completely repaired congenital heart defect with prosthetic material or device, whether placed by surgery or by catheter intervention, during the first six months after the procedure**
  - Repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device (which inhibit endothelialization)
- Cardiac transplantation recipients who develop cardiac valvulopathy

*Except for the conditions listed above, antibiotic prophylaxis is no longer recommended for any other form of CHD

**Prophylaxis is recommended because endothelialization of prosthetic material occurs within six months after the procedure

The extensive revisions in the 2007 AHA guidelines for the prevention of infective endocarditis reflects the current emphasis on evidence based practice and the growing concern over the risks associated with the overuse of antibiotics. These risks include development of bacterial resistance to antibiotics and allergic reactions to antibiotics.

Antibiotic Prophylaxis for Patients with Total Joint Replacements

In 2003 the American Dental Association (ADA) and the American Academy of Orthopaedic Surgeons (AAOS) updated their joint advisory statement regarding secondary antibiotic prophylaxis for patients with weight bearing prosthetic joints. The committee concluded that prophylaxis "should be considered" for select patients who may be at increased risk of total joint infections secondary to invasive dental procedures. (Table 2)

(Table 2) Patients at Potential Increased Risk of Hematogenous Total Joint Infections

- All patients during the first two years following total joint replacement
- Patients who are immunocompromised or immunosuppressed due to:
  - Inflammatory arthropathies (rheumatoid arthritis, systemic lupus erythematosus)
  - Drug treatment (corticosteroids, immunomodulators, etc.)
  - Radiation therapy
- Patients with select comorbidities:
  - History of prosthetic joint infection
  - HIV infection
  - Malignancy
  - Insulin-dependent diabetes
  - Malnourishment

Prior to the first joint advisory statement in 1997, all patients with prosthetic knee or hip joints were routinely prescribed antibiotics prior to dental treatment. Authors have cited the morbidity, mortality and hospitalization costs associated with joint infections as justification for secondary prophylaxis, yet close examination of the literature (temporal procedure-infection associations, causative organisms etc.) does not support the cause and effect relationships that serve as the basis for many of these recommendations.

Issues to Address

- The disproportionate emphasis placed on dental bacteremias as the precipitating factor in the development of bacterial endocarditis and prosthetic joint infections has fostered a fear of litigation that continues to drive the overuse of prophylactic antibiotics in dentistry.
- Many patients with prosthetic joints are advised to remain on secondary prophylaxis indefinitely despite current ADA/AAOS recommendations.
- Outdated prophylaxis regimens that call for the initiation of oral antibiotics up to 24 hours before invasive procedures and maintenance for an additional two to three days continue be prescribed for patients with total joint replacements.

- Education is a key component to enhancing compliance with prophylaxis guidelines as health care providers, uncomfortable with the new AHA recommendations, continue to prescribe antibiotics inappropriately.
- The maintenance of optimal oral hygiene together with the prompt treatment of oral infections to prevent metastases will prevent more cases of endocarditis and prosthetic joint infections than the use of prophylactic antibiotics for dental appointments.

HOME CARE AND HOSPICE

Transmission risks during home care are presumed to be minimal. Since home care involves patient care by a limited number of personnel in settings without multiple patients or shared equipment, the potential reservoir of pathogens is reduced. There are no published data on indirect transmission of multidrug- resistant organisms (MDROs) from one home care patient to another, although this is theoretically possible if contaminated equipment is transported from an infected or colonized patient and used on another patient.

Home Care and Hospice
Guidelines for Patients with Multidrug Resistant Organisms

- **Barriers:**
  Gloves should be used by visiting care providers when providing direct patient contact. Family members and other care providers should also be instructed on appropriate use of gloves in the home, (e.g., when doing direct patient care and handling potentially infected secretions).

  As per **Standard Precautions** gowns should be worn if there is risk of soiling with any body fluid. Consider using a face shield to protect the eyes in the event of a splash or spray.

  Family members and other care givers should be instructed to change and wash clothing if clothing becomes soiled with any body fluid.

- **Hand Hygiene:**
  Please review pages 21-23 of this report for complete hand hygiene information.

  Hand hygiene procedures in the home health care setting are essentially the same as in the acute care setting. Health care workers should use paper towels to dry their hands after washing their hands and should not use the patient's or family member's towels for this purpose. An alcohol-based hand hygiene product may be used if the hands are not soiled (and when sinks and running water are not available.)

  Patients should have plain soap or antimicrobial soap in the home and the patient and family members should be instructed on appropriate hand hygiene techniques.
  Many alcohol hand gels are available over the counter. Those containing at least 60 percent alcohol are useful.

  Care of Equipment: Care of patient equipment in the home health care setting is essentially the same as in the acute care setting. Specific recommendations can be found in the APIC Guideline for Selection and Use of Disinfectants.

The home care provider should:

Disinfect stethoscope, thermometer, and glucometer with alcohol swabs before returning to bag.

Use disposable items whenever possible.

Establish a safe working surface by placing a barrier, e.g., paper towels or newspapers between environmental surfaces and the care provider's supply bag and clean the supply bag exterior with a disinfectant before leaving the home.

Clean reusable equipment either in the patient's home or bag it before leaving the patient's home.

Patients and family caregivers should be taught the importance of:

Changing bed linens regularly and when soiled and performing hand hygiene after completing such duties.

Cleaning and disinfecting bathrooms and other environmental surfaces promptly that may become contaminated with fecal material or other secretions and excretions.

Using a household disinfectant to clean surfaces in the home at least twice a week and when they become visibly contaminated.

Environmental culturing is not necessary in the home environment.

- **Health care workers**

  To aid in surveillance for resistant organisms health care workers should report resistant organisms and infections that may have been acquired during home health care to the appropriate person(s) in their agency.

  The home care or hospice agency should communicate with Infection Preventionists in other health care facilities that care for the same patients to ensure that infection prevention and control precautions are used across the spectrum of care and to aid in surveillance for resistant organisms.

  Patients in high-risk categories should be encouraged to receive influenza vaccine annually, unless medically contraindicated.

  Patients with medical indications should be encouraged to receive pneumococcal vaccine.

  Home health care staff may evaluate the status of other persons within the home setting when determining what precautions may be instituted.

  Necessary supplies may be left in the patient's home in a supply box for ready use by caregivers.

  Home health care staff should educate patients and families about resistant organisms.

  IDPH provides fact sheets online to help provide guidance regarding MRSA, VRE, Influenza, and *Clostridium difficile*.

www.idph.state.ia.us/adper/cade_content/epifacts/mrsa.pdf

www.idph.state.ia.us/adper/cade_content/epifacts/vre.pdf

www.idph.state.ia.us/adper/cade_content/epifacts/influenza.pdf

www.idph.state.ia.us/idph_universalhelp/main.aspx?system=IdphEpiManual&context=Cdifficile_factsheet

- **Visitors**
  Visitors should practice proper hand hygiene before and after visiting the patient. Persons providing direct patient care should follow the guidelines for hand hygiene and use of barriers (gloves, gowns) as outlined above for home care nurses.

  Visitors with the following problems should consider deferring their visit:

  Recent major surgery (such as a transplant, open heart surgery),

  Chemotherapy.

OUTPATIENT HEMODIALYSIS UNITS

Health care workers providing care to patients receiving hemodialysis in an inpatient setting should follow the acute care guidelines. Precautions for patients receiving hemodialysis on an outpatient basis are slightly different than the precautions for acute care patients.

Outpatient Hemodialysis Units
Guidelines for Patients with Multidrug Resistant Organisms or *Clostridium difficile*

Providers should follow the procedures listed on the attached chart for outpatient hemodialysis.

(Refer to Chart – Page 43)

Hemodialysis Unit: Recommended Practices for Patients with VRE or MRSA or *C. difficile*

Patient Transmission Risk	Patient Placement and Precautions	Care of Patient	Dialyzer Use	Environmental	Other
*Incontinent of stool or urine (VRE) *Diarrhea (VRE or *C. difficile*) *Uncontained body fluids or drainage (VRE or MRSA)	*A private room with a hand washing sink, dispenser for alcohol-based hand hygiene products and toilet is ideal. WITH *Contact precautions OR *Cohort patients with the same resistant organisms in one area of the dialysis unit, in so far as practical. *When practical, cohort staff. *Instruct patient to wash hands or help patient wash their hands after using the toilet or touching body fluids or drainage.	***Proper hand hygiene is essential for all staff.** *An adequate number of staff is important so that those who care for patients with VRE or MRSA do not need to respond to emergencies with other patients. *Gowns are not required; gowns are needed if health care worker's clothing could become soiled with fecal material or infectious drainage. *Health care workers should wear gowns when they clean spills of body fluids or drainage.	Dialyzer reuse is acceptable	***Cultures of other patients, unit staff, or environmental surfaces are not routinely indicated. *Standard guidelines for disinfection of dialysis machines, chairs, and environmental surfaces after each patient use should be followed meticulously. *Equipment should not be shared between patients colonized or infected with MRSA or VRE and patients who are NOT colonized or infected with those organisms. Equipment must be cleaned and disinfected before use by another patient.	***Notify Infection Prevention staff when patient with VRE or MRSA is identified.
*Is continent of stool or urine (VRE) *No diarrhea (VRE) *Wound drainage or body fluids is contained (VRE or MRSA)	Contact precautions, except a private room is not required. *Instruct patient or assist patient with washing hands after using the toilet.	Same as above Emphasis on **hand hygiene.**	Same as above	Same as above	

SCHOOLS AND CHILD CARE

There are no national guidelines for addressing the issue of antibiotic-resistant bacteria in the school and child care settings; however, occasionally transmission of antibiotic resistant bacteria has been documented in these situations. For example, MRSA has been transmitted among high school wrestlers, likely due to direct skin-to-skin contact and skin abrasions. In most cases, transmission requires direct contact with contaminated material, including the following:

- MRSA: Skin or respiratory secretions or material from an infected site.
- VRE: Stool, urine, or material from an infected site.

Persons whose hands are contaminated with these organisms can transmit them to another person.

In most schools and child care centers, children do not have specific risk factors for acquiring resistant organisms or of having serious infections, should transmission occur. Furthermore, colonization would probably not persist for long periods of time in these populations. Unrecognized colonization probably occurs, but does not appear to pose a serious threat to the children. However, good hygienic practices are important at all times. The Task Force offers the following guidelines for workers in the school and child care setting.

Guidelines for Schools and Child Care
Guidelines for Persons with Multidrug Resistant Organisms

- **Good hygienic practices are important at all times. Drug resistant organisms are spread:**
  By unwashed hands,
  By environmental contamination with feces or other body fluids.

- **The following preventive measures should be promoted to staff, parents, and children.**
  Practice good hand washing procedures outlined below.

  Do not use antibiotics for viral upper respiratory tract infections (colds).

  Use antibiotics only as prescribed.

  Do not take someone else's medication.

  Do not share your medication with others.

  Do not take old or outdated medication.

  Use caution in formulating policies that specify the criteria children must meet before returning to child care or to school. Policies that require ill children to be treated with antibiotics regardless of necessity before they can return to the facility will encourage unnecessary use of antibiotics and promote development of resistance.

  Clean and cover all open wounds before allowing staff and children to return to regular activities

Do not permit sick employees to have physical contact with children or handle food.

- **Hand washing**

  Hand washing is the simplest, most effective way to prevent infection.
  - Keep fingernails short and do not wear artificial nails.
  - Instruct children and staff to wash their hands for 15 seconds with warm, running, and soapy water.
  - Instruct children to sing the song "*Happy Birthday"* twice or the "*ABC's"* song to themselves while washing hands. When they are done singing the song, they can stop washing their hands.
  - Instruct children to rub hands together including all surfaces of fingers, palms and backs of hands.
  - Thoroughly rinse and dry hands.
  - Use paper towels to turn off faucet.
  - Always use disposable towels in child care or food preparation settings.
  - Do not use a common hand towel.
  - Do not use a single damp cloth to wash a group of children's hands.
  - Do not use a standing basin of water to rinse hands.
  - Use liquid or foam soap. If bar soap is used, use soap racks to ensure drainage and use small bars.
  - Children should wash their hands
    Upon arrival,
    Before handling or eating food,
    After using the bathroom or being diapered,
    After playing outside or on the playground,
    After sneezing and touching one's nose,
    After handling pets and animals, and
    Before going home.
  - Staff should always wash their hands
    Upon arrival,
    Before preparing food and bottles,
    Before giving medications,
    Before eating,
    After using the rest room,
    After assisting children with toileting or diapering,
    Before and after giving first aid, and
    Before going home.

  - Children learn by example. Let them observe good hand washing technique from the adults who care for them.

  - Supervise children while they wash their hands to ensure they use proper technique.

  - If hand washing facilities are not available because of special activities, such as field visits, use alcohol based gels (for children over 24 months of age).

- **Gloves**
  Staff should wear gloves when cleaning spills of bodily fluids (urine and blood), and administering first aid if there is contact with any wound (cut, sore or scrape) that has material that could be transmitted to another surface.

- **Environment**
  Use disposable cleaning cloths. If reusable cloths are used, they must be laundered on a regular basis with chlorine bleach in the wash water. The use of sponges is not recommended. Remember that germs thrive on moist surfaces.

  Surfaces contaminated by a child's bodily fluids should be cleaned and disinfected with a household disinfectant. Use chairs and other furniture that can be easily cleaned; avoid fabric furniture.

- **Laundry**
  Clothing, linens, and towels that are heavily soiled with body fluids should be washed by themselves in detergent and bleach using the hottest cycle possible for that fabric.

  If the child care center does not launder clothes, put soiled clothes in a sealed waterproof bag to be sent home. Tell parents how to launder the items properly.

  Articles that are not soiled with bodily fluids can be washed with other clothing.

- **Waste Management**
  Place all disposable wastes like dressings and bandages into plastic bags. Tie the bags securely and discard them with the regular trash.

- **Eating**
  Staff members who prepare food must wash their hands thoroughly before touching the food or equipment.

  Consider using prepackaged snacks.

  Do not allow children to share dishes and utensils, take bites of another child's food or touch other children’s food.

  Make sure children wash their hands before eating.

  A dishwasher is the preferred method for washing, rinsing, and disinfecting dishes and eating utensils.

  If the facility does not have a dishwasher, wash the dishes with dish soap and hot water and disinfect with chlorinated (bleach) water for at least 1 minute. (1 1/2 T. liquid bleach for each gallon of water) *(This recommendation is for ALL dishes and utensils used by all staff and students.)*

- **Preventing Transmission**

  Students COLONIZED with antibiotic resistant organisms <u>should not</u> be excluded from school or child care.

  Students with <u>an infection</u> due to antibiotic resistant bacteria should be under appropriate medical care before being allowed to return.

  In situations when infected students *(or colonized students who are unable to control secretions)* need to participate in school or child care, the school should follow clinical guidelines for preventing transmission. These precautions may designate specific space for the child's use or exclude the child from activities where direct contact with other children may occur (e.g., wrestling).

  Education about the risks and transmission of antibiotic resistant organisms should be available to staff of schools and child care facilities.

  Any student with a draining skin lesion could transmit potentially infectious agents to others. When a student with a suspected or confirmed skin infection is in the classroom, infection prevention and control measures (based on Centers for Disease Control and Prevention [CDC] guidance) should include, but may not be limited to:

  - Keeping the wound covered. All skin infections, particularly those that produce pus must be covered with a clean, dry bandage to contain the drainage.

  - Providing wound care or dressing changes following Contact Precautions. Contaminated dressings and other materials associated with the infected lesion should be placed in a plastic bag before discarding as appropriate.

  - Practicing good basic hygiene. The infected student, medical staff, sport team, staff and anyone expected to have contact with the infected student must be diligent with hand hygiene**.**

  - Prohibiting students from sharing personal items**.** Instruct students and athletes to avoid sharing personal hygiene supplies and other items such as athletic clothing, towels, uniforms, skin balms, skin lubricants, razors, and certain sports equipment at all times.

  - Laundering soiled clothing appropriately. Parents and caregivers should be instructed to wash clothes and other soiled items (e.g. towels, sheets) with hot water and laundry detergent as appropriate. They should also be advised to dry items in a hot dryer to help eliminate bacteria when possible.

  - Cleaning environmental surfaces. Establish a written procedure and schedule for routine surface cleaning of shared athletic equipment and toys. Clean and disinfect environmental surfaces, athletic equipment and toys that has been in contact with potentially infectious wound drainage, blood, or non-intact skin utilizing an EPA-registered disinfectant cleaner that meets the requirements of the Bloodborne Pathogens Standard developed by the Occupational Safety and Health Administration.

VETERINARY MEDICINE

Antibiotics are important therapeutic agents used in the practice of veterinary medicine for the treatment and control of diseases in animals. The use of these agents is necessary for the animals' welfare and for the maintenance of an abundant, wholesome and safe food supply. Appropriate use of antibiotic agents in the veterinary setting will minimize the emergence of resistant organisms in animals and will ensure the efficacy of antibiotics in humans and animals in the future.

Guidelines for Veterinary Medicine

The Iowa Veterinary Medical Association recommends that when veterinarians use antibiotics in the practice of veterinary medicine, judicious use principles should be implemented as outlined in the American Veterinary Medical Association (AVMA) Judicious Therapeutic Use of Antimicrobial Guidelines.

This position statement is copied below and also can be found at:
www.avma.org/issues/policy/jtua.asp

American Veterinary Medical Association Judicious Therapeutic Use of Antimicrobials
(Oversight:FSAC; Approved by the AVMA Executive Board, November 1998; revised April 2004, November 2008)

- **Position Statement**
  When the decision is reached to use antimicrobials for therapy, veterinarians should strive to optimize therapeutic efficacy and minimize resistance to antimicrobials to protect public and animal health.

- **Objectives**
  Support development of a scientific knowledge base that provides the basis for judicious therapeutic antimicrobial use.

  Support educational efforts that promote judicious therapeutic antimicrobial use.

  Preserve therapeutic efficacy of antimicrobials.

  Ensure current and future availability of veterinary antimicrobials.

- **Strategies**
  Facilitate development and distribution of appropriate antimicrobial use guidelines by practitioner species-interest groups.

  Improve scientifically based therapeutic practices through education.

- **Recognized Needs**
  Improved monitoring and feedback systems for antimicrobial use and resistance patterns.

  Research to improve scientifically based therapeutic practices.

- **Judicious Use Principles**
  Preventive strategies, such as appropriate husbandry and hygiene, routine health monitoring, and immunization, should be emphasized.

  Other therapeutic options should be considered prior to antimicrobial therapy.

  Judicious use of antimicrobials, when under the direction of a veterinarian, should meet all requirements of a veterinarian-client-patient relationship.

  Prescription, Veterinary Feed Directive, and extralabel use of antimicrobials must meet all the requirements of a veterinarian-client-patient relationship.

  Extralabel antimicrobial therapy must be prescribed only in accordance with the Animal Medicinal Drug Use Clarification Act amendments to the Food, Drug, and Cosmetic Act and its regulations.

  Veterinarians should work with those responsible for the care of animals to use antimicrobials judiciously regardless of the distribution system through which the antimicrobial was obtained.

  Regimens for therapeutic antimicrobial use should be optimized using current pharmacological information and principles.

  Antimicrobials considered important in treating refractory infections in human or veterinary medicine should be used in animals only after careful review and reasonable justification. Consider using other antimicrobials for initial therapy.[1]

  Use narrow spectrum antimicrobials whenever appropriate.

  Utilize culture and susceptibility results to aid in the selection of antimicrobials when clinically relevant.

  Therapeutic antimicrobial use should be confined to appropriate clinical indications. Inappropriate uses such as for uncomplicated viral infections should be avoided.

  Therapeutic exposure to antimicrobials should be minimized by treating only for as long as needed for the desired clinical response.

  Limit therapeutic antimicrobial treatment to ill or at risk animals, treating the fewest animals indicated.

  Minimize environmental contamination with antimicrobials whenever possible.

  Accurate records of treatment and outcome should be used to evaluate therapeutic regimens.

  [1] In this context, this principle takes into account development of resistance or cross-resistance to important antimicrobials.

- **Glossary**
  (Incorporated into general glossary of report.)

- **Veterinarian/Client/Patient Relationship (VCPR)** -- A VCPR exists when all of the following conditions have been met:

The veterinarian has assumed the responsibility for making clinical judgments regarding the health of the animal(s) and the need for medical treatment, and the client has agreed to follow the veterinarian's instructions.

The veterinarian has sufficient knowledge of the animal(s) to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s). This means that the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of an examination of the animal(s) or by medically appropriate and timely visits to the premises where the animal(s) are kept.

The veterinarian is readily available for follow-up evaluation, or has arranged for emergency coverage, in the event of adverse reactions or failure of the treatment regimen.

Veterinary Feed Directive (VFD) Drug--The VFD category of medicated feeds was created by the Animal Drug Availability Act of 1996 to provide an alternative to prescription status for certain therapeutic animal pharmaceuticals for use in feed. Any animal feed bearing or containing a VFD drug shall be fed to animals only by or upon a lawful VFD issued by a licensed veterinarian in the course of the veterinarian's professional practice.
(EB 11/98; EB approved SCAR revision 4/04 oversight:SCAR)

Additional position statements and guidelines for use of antimicrobials for various species of animals for specific diseases are also provided on this website.

On June 28, 2010, the U.S. Department of Health and Human Services, Food and Drug Administration, Center for Veterinary Medicine issued draft guidance on the Judicious Use of Medically Important Antimicrobials in Food-Producing Animals. This draft guidance is currently being distributed for comment purposes only. The draft guidance can be accessed at: www.fda.gov/downloads/AnimalVeterinary/GuidanceComplianceEnforcement/GuidanceforIndustry/UCM216936.pdf.

PREVENTION AND CONTROL MEASURES IN THE COMMUNITY

Approximately 75 years ago, people began to rely on antibiotics to treat previously deadly infections. Unfortunately, once antibiotic use began, organisms also began to develop resistance. While most antibiotics are still very effective, some pathogenic bacteria have developed resistance, in part because antibiotics have been misused to treat viral infections and other conditions that do not respond to antibiotics. If these practices are not changed, all presently available antibiotics may become useless. Antibiotics are, without a doubt, incredible tools for fighting bacterial infections; however, because of this, many people have come to believe that antibiotics can cure anything. This mode of thought can result in misuse of antibiotic agents: 1) antibiotics can be mistakenly prescribed to treat viral infections and 2) patients may stop treatment when they feel better and save the rest of the antibiotic pills for future illnesses. When antibiotics are misused, resistant bacteria can develop.

Many people in the community mistakenly believe that all bacteria are bad and should be killed to protect human beings. This belief has led industry to develop, advertise, and sell innumerable household cleaning products with "antimicrobial" compounds to supposedly "protect" us from all the bad bacteria around us. In reality, most of the bacteria around, and in us are not only **not** bad, but are actually necessary to keep us healthy. The indiscriminant use of these cleaning compounds in the community is not necessary, or desirable, and may allow antibiotic resistant bacteria to develop. See section on Methacillin-Resistant *Staphylococcus aureus* (MRSA) for a discussion of MRSA in the community, decolonization, prevention, diagnosis and treatment of these infections.

Communities can prevent and control antibiotic resistant organisms through coordinated efforts. For example, health care organizations in a tri-state region around Sioux City, Iowa significantly reduced the colonization rate of vancomycin-resistant *Enterococcus* (VRE) of inpatients and long-term care residents. A community-wide task force developed in 1997 coordinated a prevention and control effort including all 32 health care facilities in the area. Over a year and a half, the documented colonization rate of VRE was decreased by almost half.

Clearly, the philosophy and practices regarding bacteria and antibiotic use must change. The Iowa Antibiotic Resistant Task Force has developed simple recommendations to educate the public on how to stop the development and spread of antibiotic resistant bacteria in the home and community. These recommendations emphasize preventing infections and the more judicious use of antibiotics and antimicrobial products and may allow the prevention and treatment of illness while ensuring that antibiotics work in the future.

Actions to protect yourself, your family, and your community against antibiotic resistance:

Wash your hands. Proper hand washing is the easiest, most effective way to prevent diseases from spreading and to prevent the need to use antibiotics.

- **When to wash your hands**

  After using the bathroom,

  After changing diapers,

  After handling pets,

  Before handling food,

  After handling blood or other bodily fluids.

- **How to wash your hands**

  Use regular soap and warm, running water.

  Scrub hands and fingernails for at least 15 seconds. Sing the song "*Happy Birthday*" twice or the "*ABCs*" song to help time 15 seconds.

  Scrub all parts of the hands including fingers, palms, and the back of hands.

  Dry your hands with a clean or disposable towel.

  Store bar soap on a soap rack to keep it dry.

  Consider using alcohol-based hand wipes or gels only when water is not available and hands are not visibly dirty. If hands are visibly dirty, then the dirt must be removed by washing before gels can be effective.

- **Keep home, work, and play areas smoke-free.** Smoking and second-hand smoke make children and everyone else in the home more susceptible to respiratory diseases. Decreasing respiratory diseases will decrease the use of antibiotics.

- **Warm, soapy water or a mild bleach solution (1 teaspoon liquid bleach to 1 quart water) is almost always the best way to clean your home.** Limit the use of "antibacterial" or "antimicrobial" products when cleaning your house. Remember, antibacterial or antimicrobial products kill both good and bad bacteria, and are almost never needed. With fewer good bacteria present, bad bacteria may have more opportunities to grow and develop antibiotic resistance.

- **Use antimicrobial products only when**

  Regular soap and water are not available,

  Someone in the household has a weakened immune system,

  Someone in the household is ill with a contagious disease, for example someone in the home has diarrhea.

- **Store and handle food properly.** It is important to store and handle food properly because bad bacteria can come into your house on the foods you buy. When handling food:

Wash your hands before and after preparing food.

Wash all raw fruits and vegetables.

Use a separate cutting board for raw meat to prevent bacteria from the raw meat touching other food.

Properly cook all meats, especially ground meat and poultry.

Clean all kitchen surfaces with disposable towels, warm soapy water, or a mild bleach solution (1 teaspoon liquid bleach to 1 quart water) after preparing food.

Regularly wash dishcloths and towels.

If sponges are used, run them through the dishwasher or washer and dryer on a frequent, regular basis.

- **Ensure your family's vaccinations are current.** Vaccines greatly reduce the risk of infection from certain diseases; thus, fewer antibiotics are needed.
- **Don't automatically ask for antibiotics from your doctor**. Antibiotics kill both good and bad bacteria but they do not kill viruses. Viruses are responsible for most common illnesses such as colds, sore throats and influenza. Taking antibiotics for an illness caused by a virus will not make you feel better and can cause bacteria to become resistant to the antibiotic. Furthermore, taking antibiotics may cause other problems such as diarrhea or yeast infections. **Let your doctor decide when antibiotics are appropriate.**
- **If your doctor prescribes antibiotics, finish all of the antibiotics even if you start to feel better.** Taking the entire prescription will kill all of the bacteria so they can't develop antibiotic resistance. If you feel the need to stop treatment early, ask your doctor first.
- **Never share your prescription with someone else, and never save antibiotics for future use.** If you take the wrong antibiotic or one that has expired, some bacteria can survive and can develop resistance to antibiotics.
- **Do not flush expired or unused antibiotics down the toilet or pour down the sink**. Unused antibiotics thrown out this way can end up in the streams, and possibly in our water supply, which can allow bacteria to develop resistance. Put all unused or expired antibiotics into a plastic bag, tie the bag shut, and place in the garbage. Consider taking them to local hazardous waste disposal site or to your pharmacist for disposal.
- **Wash your hands often when you are ill.** Washing your hands when you are ill will prevent others from catching your illness. If fewer people are ill, the need for antibiotics will decrease and so will the risk of acquiring resistant bacteria.

Methicillin-Resistant *Staphylococcus aureus*

In the U.S., *Staphylococcus aureus* is the most common cause of skin and soft-tissue infections and is also a common cause of invasive infections acquired in hospitals. Despite the growing prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) in hospitals, these strains had been uncommon in the community. Thus, MRSA infections were considered to be primarily acquired in the health care setting and were referred to as health care acquired (HA-MRSA). Treatment and control of MRSA were focused in health care facilities. In the late 1990s, clinicians began identifying patients who acquired MRSA infections in the community and who did not have the usual health care-associated risk factors. Most of these infections were skin and soft tissue infections (SSTI) but some were serious invasive infections, including necrotizing pneumonia following influenza or influenza-like illness. Patients with SSTI often had recurrent infections. Recently, investigators have reported that USA300 isolates, the most common community-associated MRSA (CA-MRSA) strain, are causing nosocomial or health care-associated infections.

Various investigators have used different definitions of CA-MRSA. Epidemiologically oriented studies often use a definition based on when the positive cultures were obtained relative to hospital admission (i.e., before admission or within the first 24-72 hours of hospitalization). Some studies also exclude patients with established risk factors for MRSA such as recent hospitalization, hemodialysis, indwelling catheters, etc. Other studies define CA-MRSA based on the MRSA strain causing the infection. See below for a discussion of CA-MRSA strains.

The incidence of CA-MRSA varies by age and several studies have found that persons infected by CA-MRSA strain are younger than patients infected with HA-MRSA. CA-MRSA strains have caused outbreaks in several discrete populations, including children (particularly those in childcare centers), high school, college, and professional athletes (e.g., fencing, rugby, football, soccer, and wrestling), soldiers, prisoners, homeless persons, intravenous drug users, and men who have sex with men. Certain ethnic groups also have been associated with outbreaks including Pacific Islanders, Native Americans/Alaska Natives, and Pacific and Canadian aboriginals.

The CA-MRSA strain identified in the U.S. was called MW2 and later identified to be in the USA400 pulsetype. Subsequently, pulsetype USA300 has become the most common CA-MRSA strain in most areas of the U.S. where the molecular epidemiology of CA-MRSA has been studied. In Iowa, USA300 now causes about 15 percent of the MRSA invasive infections reported to the State Hygienic Laboratory (SHL). CA-MRSA isolates have been identified in many countries but the pulsetypes often are different than those identified in the U.S. However, essentially all CA-MRSA strains carry the genes for methicillin-resistance on the genetic element SCC*mec* type IV and produce Panton-Valentine leukocidin (PVL), which is lethal to neutrophils. To date, investigators have not determined whether PVL is an important virulence factor.

In general, CA-MRSA isolates are susceptible to multiple other antibiotic agents. However, Han et al. and Diep, et al. recently identified CA-MRSA isolates from San Francisco and from Boston that were multiply resistant. Diep et al. found that CA-MRSA isolates from an outpatient clinic in Boston were resistant to erythromycin (96%), levofloxacin (85%), clindamycin (57%), and tetracycline (30%). Moreover 18 isolates (18%) were resistant to all four of these agents and 12 of these isolates (67%) were also high-level mupirocin resistant. These isolates were primarily among USA300-0247 subtype

and they carried the resistance determinants on a plasmid. Thus, these isolates can transmit the resistance determinants to other isolates. To date, these isolates have not been identified among invasive CA-MRSA from Iowa.

Nasal colonization with CA-MRSA, like other strains of MRSA, is a risk factor for subsequent infection with the colonizing strain. However, investigators have not determined how often nasal carriage precedes infection and how often nasal carriage is important in transmission of CA-MRSA during outbreaks. A recent study by Ellis et al. found that intranasal mupirocin did not prevent infections among soldiers who were colonized with CA-MRSA and did not prevent non-carriers from becoming colonized. At present, we do not know whether decolonizing the nares prevents infections in individual patients or prevents transmission during outbreaks. More studies are needed before routine decolonization is recommended. Readers interested in more information on decolonization are referred to the chapter by Herwaldt and Boyce in the references listed at the end of this document.

Johnson et al. found environmental contamination in an outpatient setting in which several health care workers became colonized with USA300. These investigators suggested that the environment might help transmit these strains in the hospital.

Many MRSA have inducible clindamycin resistance. The typical susceptibility test will identify these isolates as susceptible to this agent but these isolates will express resistance to oxacillin or dicloxacillin if the patient is treated with this agent. Thus, clinicians should ask their microbiologist whether the laboratory conducted a D-test before treating any patient whose isolate is reported to be erythromycin resistant and clindamycin susceptible. If the isolate is D-test negative, the patient may be treated with oxacillin or dicloxacillin. If the isolate is D-test positive, the patient should be treated with another agent.

The Infectious Diseases Society of America (IDSA) published guidelines for the diagnosis and treatment of SSTI in 2005 (an update projected for Fall, 2011) and CDC developed guidelines for management of MRSA in the community. Both IDSA and CDC indicate that furuncles (“boils”) and carbuncles often can be treated without antimicrobial agents unless the lesion is surrounded by extensive cellulitis or the patient has fever. Many of these infections will respond to moist heat or to incision and drainage. Patients with more serious abscesses, extensive cellulitis, or necrotizing fasciitis and patients who have infections such as osteomyelitis, bloodstream infections, or endocarditis must be treated with systemic antibiotic agents. Milder infections often can be treated with oral trimethoprim-sulfamethoxazole, tetracyclines, or clindamycin (D-test negative) but more serious infections, in general, should be treated with intravenous vancomycin.

Many physicians routinely treat skin and soft tissue infections (SSTIs) such as furuncles, abscesses, or cellulitis empirically with β-lactam antibiotics. As noted in the previous paragraph IDSA and CDC indicate that many of these infections can be treated successfully without antibiotic agents. Given that incidence of CA-MRSA has increased to the point that they cause over 90 percent of SSTI in many areas, β-lactam antibiotics should not be the preferred agents for patients whose infections need both local treatment and antibiotic therapy.

Prevention

Education of health care providers, patients, caregivers, high-risk populations, and appropriate organizations about CA-MRSA and adherence to basic infection prevention and control principles is key preventive strategy. CDC recommends the following preventive measures for patients with skin and soft tissue infections and their close contacts:

1. Keep wounds that are draining covered with clean, dry, bandages.
2. Clean hands regularly with soap and water or alcohol-based hand gel (if hands are not visibly soiled). Always clean hands immediately after touching infected skin or any item that has come in direct contact with a draining wound.
3. Maintain good general hygiene with regular bathing.
4. Do not share items that may become contaminated with wound drainage, such as towels, clothing, bedding, bar soap, razors, and athletic equipment that touches the skin.
5. Launder clothing that has come in contact with wound drainage after each use and dry thoroughly.
6. If you are not able to keep your wound covered with a clean, dry bandage at all times, do not participate in activities where you have skin to skin contact with other persons (such as athletic activities) until your wound is healed.
7. Clean equipment and other environmental surfaces with which the bare skin of multiple persons has contact. Use an over the counter detergent and disinfectant that specifies *S. aureus* on the product label and is suitable for the type of surface being cleaned.

CDC has also developed information for athletes and athletic programs that are similar to their general recommendations in that they emphasize maintaining good hygiene and a clean environment. In addition, CDC recommends that infected athletes should be excluded from participating in sports if their wounds cannot be properly covered during participation. CDC defines "properly covered" as:

> ". . . the skin infection is covered by a securely attached bandage or dressing that will contain all drainage and will remain intact throughout the activity."

Moreover, athletes should perform hand hygiene before and after changing bandages and should place used bandages in the trash. Athletes with active infections or open wounds should not use common-use water facilities (e.g., swimming pools or whirlpools and therapy pools that are not cleaned between athletes) until their infections and wounds are healed.

As noted previously, investigators have not determined conclusively whether decolonization prevents recurrent infections, particularly in the community setting. Clinicians have used numerous regimens in their attempts to prevent recurrences, including various combinations of topical (e.g., mupirocin) and systemic (e.g., trimethoprim-sulfamethoxazole, tetracyclines, clindamycin, linezolid) antibiotic agents and antiseptic body washes (chlorhexidine, hexachlorophene, triclosan, and dilute bleach baths). Decolonization regimens have been associated with antibiotic resistance among MRSA isolates, even among isolates obtained from patients who were not treated with the agent to which the isolates are resistant. Thus, clinicians should use these regimens prudently.

<u>Zoonotic considerations with MRSA</u>
MRSA has caused infections in companion animals including dogs, horses and less frequently, in cats. Animals can become colonized from humans then transmit to other animals or to humans.

If patients continue to have recurrent infections despite decolonization attempts and environmental cleaning, clinicians could obtain cultures from family members and try decolonizing those who are colonized. If patients continue to have infections, clinicians could ask the patients whether they have cats, dogs or horses and suggest that they have their veterinarian screen the animals for MRSA carriage.

Emerging zoonotic issues related to a new strain of MRSA

Investigators in Europe and Canada have identified a novel MRSA, known as clonal complex (CC) 398 based on multilocus strain typing (Armand-Lefeyre et al). In the Netherlands, isolates of this type have been obtained from food animals – swine, poultry and beef (veal). Transmission appears to be from direct animal contact, not through ingestion of food (e.g., as a foodborne zoonosis). MRSA CC398 consists of 8 MLST types, the predominant type being sequence type (ST)398 and a range of closely related protein A (*spa*) gene types (i.e., t011, t034, t108, and t1793).

Voss et al. reported a prevalence of MRSA, primarily CC398, in Dutch pig farmers that was greater than 760 times higher than among other patients admitted to Dutch hospitals. Molecular typing demonstrated that MRSA was transmitted from pigs to pig farmers, among pig farmers and their family members, and from a patient to a nurse. A subsequent study found that 4.6 percent of veterinarians and veterinary students were colonized with MRSA compared with the usual rate of one percent among the general population.

In the U.S., investigators are studying both the sources of MRSA in animals and the prevalence of MRSA in animal populations and the humans associated with them. A recent survey of a large swine operation in Iowa and Illinois identified CC398 in the nares of swine and their handlers. Additional studies are ongoing to provide further information about the sources, transmission and diversity of MRSA strains present among animals in the U.S. To date, MRSA CC398 has not been identified among the invasive MRSA isolates submitted to SHL from Iowa residents.

Clostridium difficile

Clostridium difficile (*C. difficile*) is a spore-forming Gram-positive anaerobic bacillus that is the most commonly identified causative agent of antibiotic-associated diarrhea and pseudomembranous colitis. This pathogen has caused numerous outbreaks of health care-associated diarrhea that were extremely difficult to control. *C. difficile* is usually not multidrug-resistant but some strains have become resistant to clindamycin and some to fluoroquinolones. Exposure to antibiotic agents is the primary risk factor for *C. difficile* associated diarrhea (CDAD) and the antibiotics most frequently associated with increased risk of *C. difficile* infection include third generation cephalosporins, clindamycin, vancomycin, and fluoroquinolones.

This organism can be transmitted within the health care setting by mechanisms similar to those transmitting MRSA, VRE, and other resistant organisms. *C. difficile* may be transmitted from patient to patient on the hands of health care workers and from the contaminated environment. *C. difficile* may cause greater morbidity in elderly persons and may be a marker for increased risk of mortality, particularly for residents of long-term-care facilities.

Epidemic Strain

Investigators recently identified a new *C. difficile* strain that has caused numerous large outbreaks of severe CDAD. The mortality, relapse, and complication rates related to this strain are higher than those for other *C. difficile* strains. This increased virulence is presumably associated with higher levels of toxin production by fluoroquinolone-resistant strains belonging to PCR ribotype 027, pulsed-field gel electrophoresis (PFGE) type NAP1, REA (restriction endonuclease analysis) type BI and toxinotype III. This strain carries the genes for binary toxin and has an 18-bp deletion and a frameshift mutation in *tcdC* that are thought to deregulate the production of toxins A and B. These strains produce 16-times more toxin A and 23-times more toxin B in vitro than toxinotype 0 strains. Despite being susceptible to metronidazole, the epidemic strain may not respond as well to this agent as do other strains, possibly because it is very virulent. Thus, clinicians must monitor patients carefully to be sure they are responding to therapy and that their condition does not deteriorate.

Drudy, et al. recently identified a mutation in *gyrA* that is associated with fluoroquinolone resistance in the epidemic *C. difficile* strain PCR-027. These investigators suggest that health care facilities may need to restrict use of all fluoroquinolones to prevent or control outbreaks caused by the epidemic strain rather than the usual practice of changing from one quinolone to another because several of these agents have been independently associated with CDAD.

Prevention

The primary prevention strategy is maintaining robust gastrointestinal normal flora by limiting use of antibiotic agents. Physicians should prescribe antibiotic agents only when they are needed and they should stop treatment as soon as possible. In addition, physicians should target the specific infecting agent with antibiotic agents that have the narrowest possible spectrum. Moreover, health care workers must practice good hand hygiene and clean the environment adequately. Agents used in antiseptic hand washes or rubs and EPA-registered environmental disinfectants do not reliably kill *C. difficile* spores. Thus, CDC's hand hygiene guideline suggests that "Washing hands with non-

antimicrobial or antimicrobial soap and water may help to physically remove spores from the surface of contaminated hands" and their FAQ sheet suggests that health care facilities that are experiencing an outbreak of CDAD use only soap and water for hand hygiene. Moreover, the CDC environmental guideline states that hypochlorite-based products should be used to disinfect environmental surfaces in patient-care areas where surveillance and epidemiology indicate ongoing transmission of *C. difficile*. Category II."

The CDC recommends that health care facilities monitor the number of CDAD cases and, especially if rates increase, the severity of disease and patient outcomes. If the infection prevention team finds that the rate of CDAD or the severity of CDAD cases has increased, they should reassess compliance with the recommended infection prevention measures including: hand hygiene, Contact Precautions, and environmental cleaning and disinfection. If compliance with infection prevention practices is optimal, CDC recommends that health care facilities review antibiotic use to determine whether particular antimicrobials are associated with cases CDAD.

C. difficile in Iowa

Investigators have not determined the incidence of CDAD in Iowa. The epidemiology of CDAD in two small hospitals has been described. In one hospital, a serious outbreak of CDAD occurred during a severe influenza season. Data from chart reviews suggested that half of the patients who received treatment for bacterial pneumonia before they developed *C. difficile* infection may not have had pneumonia. Excessive use of the hospital's new pneumonia care plan during the influenza season may have contributed to the intensity of this outbreak. In the other hospital, CDAD was not associated with exposure to antibiotic classes that are typically associated with CDAD, but was instead related to the total number of antibiotics used to treat patients. Case patients had a larger cumulative number of days of antibiotic use (P =.004) and they received a larger total number of antibiotic agents during hospitalization (P =.001) than did the control patients. Antibiotic use ratios were about 40 percent higher for both case and control patients at the smaller hospital compared with the antibiotic use ratio at the University of Iowa Hospitals and Clinics, a large academic medical center. In addition, a survey of Iowa's long-term-care facilities (LTCF) revealed that *C. difficile* is present in Iowa LTCFs, but many *C. difficile* infections probably remain undiagnosed because the facilities do not have protocols for identifying patients who have CDAD. According to CDC's posted map, the NAP1 strain of *C. difficile* has been reported in Iowa.

Resistant Gram-negative Organisms

Multidrug-resistant Gram-negative organisms have become major pathogens in many health care settings. Fortunately, they have not become common pathogens in Iowa. However, given the ease of travel, frequent over use of antibiotic agents, and use of antibiotic agents in agriculture, these organisms could become more frequent. Multidrug-resistant Gram-negative organisms can cause significant morbidity and mortality and early initiation of appropriate antibiotic therapy reduces morbidity and mortality. Because initial therapy is almost always empiric, physicians must know which multi-resistant Gram-negative pathogens are common in their facility or geographic area, which of these organisms are likely to cause infections in their patient population, and the usual antibiotic susceptibility patterns for the most common Gram-negative pathogens. For example, common resistant Gram-negatives include those that are resistant to fluoroquinolones, those that produce extended spectrum beta-lactamases [(ESBLs); e.g., *E. coli and Klebsiella spp*.], and those that produce Bush Gp. 1 (Amp C) cephalosporinases (e.g., *Serratia spp., Enterobacter spp., Citrobacter spp.)*. Moreover, multidrug-resistant non-fermenting organisms, such as *Pseudomonas aeruginosa*, *Acinetobacter* spp.,and *Stenotrophomonas maltophilia* are becoming important pathogens in many intensive care units in the U.S., particularly those where carbapenems (imipenem/meropenem) are used extensively. In fact, rates of the most important resistances - fluoroquinolone resistance, ESBL production, and multiply (i.e., pan) resistant organisms - continue to increase and development of new antibiotic agents is not keeping pace.

Gram-negative organisms often carry their resistance determinants on plasmids or transposons that can move from one bacteria to another, including moving from one species to another species. Consequently, these organisms can cause explosive outbreaks, some of which involve more than one species.

Risk factors for infection or colonization with resistant Gram-negative organisms include:

- Age,
- Duration of hospitalization,
- Intensive care unit admission,
- Renal insufficiency,
- Immunosuppression (including neutropenia, hematologic malignancy, and transplantation)
- Prior operations,
- Antibiotic use (including the number of antibiotic agents, duration of treatment, and the specific types of antibiotics (e.g., cephalosporins),
- Device use (including central venous catheters, urinary catheters, endotracheal tubes),
- Exposure to a source (including infected or colonized patients, contaminated inanimate objects, and health care workers who do not practice good hand hygiene.

In general, infection prevention precautions are the same for resistant Gram-negative organisms as for MRSA and VRE. However, less has been written about precautions for Gram-negative organisms compared with the resistant Gram-positive organisms. In non-outbreak settings, patients with multidrug-resistant Gram-negative organisms should be placed in Contact Precautions. If these

patients are readmitted they should remain in Contact Precautions if they have an active infection with a multidrug-resistant Gram-negative organism or if surveillance cultures of the previous site(s) of infection or colonization remain positive. If all of these cultures are negative, contact precautions could be lifted.

Implementing Contact Precautions, cleaning the environment well, screening patients for specific resistant Gram-negative organisms (usually with cultures of the perirectal area or stool and cultures of tracheal aspirates or sputum for organisms causing respiratory infections) and controlling use of specific antibiotic agents or classes of antibiotic agents have all been useful for controlling spread of these organisms in specific settings. Moreover, investigators stopped some outbreaks by identifying contaminated reservoirs or faulty practices. Patients who are no longer exposed to antibiotic agents may be able to clear the resistant Gram-negative organisms or the organisms may become undetectable by our current diagnostic tests. However, patients with these organisms usually cannot be decolonized by treatment with other antibiotic agents.

Glossary

Airborne Precautions: Precautions that apply to patients known or suspected to be infected with epidemiologically important pathogens that can be transmitted widely by air currents and may become inhaled by or deposited on a susceptible host within the same room or, depending on environmental factors, over a longer distance from the source patient. These precautions are designed to reduce the risk of such airborne transmission of infectious agents through personal protection devices, such as N95 masks, and special air handling and ventilation systems, such as airborne infection isolation rooms. (Adapted from CDC HICPAC guidelines).

Alcohol-Based Hand Rub: An alcohol-containing preparation designed to reduce the number of viable microorganisms on the hands. Such preparations contain 60 – 90 percent ethanol or isopropanol alcohol.

Antibiotic: (as used in IARTF Report) A chemical substance that has the capacity to inhibit the growth or to kill bacteria.

> **Narrow Spectrum Antibiotic:** An antibiotic effective against a limited number of bacterial genera often applied to an antibiotic active against either Gram-positive or Gram-negative bacteria but not both.
>
> **Broad Spectrum Antibiotic:** An antibiotic effective against a large number of bacterial genera; generally describes antibiotics effective against both Gram-positive and Gram-negative bacteria.

Antibiotic Resistance: A property of bacteria to inactivate or exclude antibiotics or a mechanism that blocks the inhibitory or killing effects of antibiotics.

Antimicrobial: (as used in IARTF Report) An agent that kills microorganisms or suppresses their multiplication or growth.

Antimicrobial Soap: Soap (i.e., detergent) containing an antiseptic agent.

Antiseptic Agent: Antimicrobial substances (e.g. alcohols) that are applied to the skin to reduce the number of microorganisms.

Asymptomatic: Without objective evidence of disease or condition.

Cohort: Any defined group of persons selected for a special purpose or study. (From the Latin cohors, warriors, the tenth part of a legion).

Cohorting: Method to isolate separate infectious persons from susceptible ones. To group persons with the same infection together. Cohorting of staff is to assign specific staff to a group of patients and not have them do care on the unaffected persons.

Colonization: Propagation of a microorganism on or within a host without causing cellular injury or infection. A colonized host can serve as a source of infection. Carriers are often said to be colonized with a pathogen.

Contact Precautions: Precautions that apply to patients known or suspected to be infected or colonized with epidemiologically important microorganisms that can be transmitted by direct or indirect contact. Direct-contact transmission involves skin-to-skin contact and physical transfer of microorganisms to a susceptible host from an infected or colonized person, while indirect-contact transmission involves contact of a susceptible host with a contaminated intermediate object. (Adapted from CDC HICPAC guidelines).

Culture: The growth of microorganisms on or in substances (especially laboratory media prepared for this purpose).

Decolonization: Administration of topical and or systemic antimicrobial agents for the purpose of eradicating carriage of particular bacteria by an individual.

Droplet Precautions: Precautions that apply to any patient known or suspected to be infected with epidemiologically important pathogens that can be transmitted by infectious droplets generated from the source person during coughing, sneezing, or talking or during the performance of certain procedures such as suctioning or bronchoscopy. Unlike airborne precautions, because droplets travel only short distances (three to six feet) and do not remain suspended in the air, special air handling and ventilation are not required to prevent droplet transmission. (Adapted from CDC HICPAC guidelines).

Hand Antisepsis: Refers to either washing hands with an antimicrobial soap or to rubbing an alcohol-based waterless product on the hands until they are dry.

Hand Hygiene: General term that applies to either hand washing with plain soap or hand antisepsis by washing with an antiseptic soap or by using an alcohol-based hand rub.

Hand washing: Cleaning hands with plain, (i.e., non-antimicrobial) soap, water and friction.

Health Care Provider: A person who is trained and licensed to give health care. Also, a place licensed to give health care. Doctors, nurses, hospitals, skilled nursing facilities, some assisted living facilities, and certain kinds of home health agencies are examples of health care providers. (From the Medicare web site).

Immunocompromising: Ability to attenuate the immune response by administration of immunosuppressive drugs, by irradiation, by malnutrition, or by some disease processes (e.g., cancer).

Infection: The entry and multiplication of an infectious agent in body tissues of man or animal, resulting in cellular injury.

Infection Prevention and Control Precautions: Measures used for decreasing the risk of transmission of microorganisms, particularly in health care facilities or when otherwise providing medical care. These fall into standard, contact, droplet, and airborne categories, which are also defined in this section. (Adapted from CDC HICPAC guidelines).

Isolation: The separation, for the period of communicability, of infected persons or animals from those that are not infected, in such places and under such conditions as will prevent the direct or indirect transmission of the infectious agent from those infected to those who may be susceptible or who may spread the agent to others.

Morbidity: Any departure from a state of well-being.

Nosocomial: A term used to denote a disease or condition acquired within a health care setting, for example a hospital-acquired infection.

Pathogen: An agent capable of causing disease.

Prophylaxis: Measures taken to prevent the development or spread of disease.

Resistance: The sum total of host mechanisms which interpose barriers to invasion or multiplication of infectious agents, or that prevent damage by the agent's toxic products.

Standard Precautions: Precautions designed for the care of all patients in health care facilities regardless of their diagnosis or presumed infection status and intended to reduce the risk of transmission of microorganisms from both recognized and unrecognized sources of infection. The main focus is on hand hygiene, the use of protective barriers, and the proper handling of clinical waste. The precautions apply to (1) blood; (2) all body fluids, secretions, and excretions (except sweat), regardless of whether or not they contain visible blood; (3) non-intact skin; and, (4) mucous membranes. (Adapted from CDC HICPAC guidelines.)

Surveillance of Disease: The continuing scrutiny of the aspects of the occurrence and spread of a disease that are pertinent to effective prevention and control.

Susceptible: A person or animal lacking sufficient resistance to a particular pathogenic agent to prevent disease if exposed.

Transmission Mode: The means by which disease organisms are spread. For the purposes of this plan, the term applies to how they are spread to humans.

Vaccine: A preparation containing killed or living whole microorganisms or a fraction of the organisms having antigenic properties. Vaccine is employed to induce, in the recipient, a specific active immunity to an infectious agent (usually an antibody response).

Virus: Minute organisms not visible with ordinary light microscopy. They can reproduce only inside of a host cell.

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The contents of this report are the result of numerous meetings and discussions among IARTF members who are listed alphabetically by the group they represent. Many of the members did extensive research, prepared draft versions of individual sections of this document, added references to the bibliography section, and provided comments and meaningful contributions to the contents of this report. The task force acknowledges the contribution of many others in the preparation of this report including: Stacy Coffman and Dr. Cindy Marek at the University of Iowa Hospitals and Clinics, Julie Gibbons and Shelley Zarling at Iowa Health System-DSM, Dr. John Olds at the Iowa Board of Medicine, and Dr. Ann Garvey, Dr. Bob Russell, Dr. Wasl Al-Adsani, Judy Goddard, Shawnice Cameron, Elizabeth Miller and Mary Rexroat at the Iowa Department of Public Health.

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BIBLIOGRAPHY and REFERENCES

Antibiotic Use

American Lung Association. Guidelines for the Prevention and Treatment of Influenza and the Common Cold. http://www.lungusa.org/lung-disease/influenza/in-depth-resources/cold-and-flu-guidelines.html (accessed 2010 Nov. 2010).

Clinical Practice Guidelines for the Treatment of Otitis Media, established by the Agency for Health Care Policy and Research, http://www.guideline.gov/content.aspx?id=6010&search=otitis+media

Culpepper L, Routine Antimicrobial Treatment of Acute Otitis Media--Is It Necessary? *JAMA* November 26, 1997;278(20):1643-45.

Dellit TH, Owens RC, McGowan JE, et al. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship. *Clinical Infectious Diseases* 2007;44:159-77.

Felmingham D. Antibiotic Resistance--Do We Need New Therapeutic Approaches? *Chest* 1995;108:70S-78S.

Gold HS, Moellering RC, Jr. Antimicrobial-Drug Resistance. *New England Journal of Medicine* 335;(19):1445-1453.

Gonzales R, Antibiotic Prescribing for Adults with Colds, Upper Respiratory Tract Infections, and Bronchitis by Ambulatory Care Physicians. *JAMA* September 17, 1997;278(11):901-904.

Gonzales R, Bartlett JG, Besser RE, et al. Principles of Appropriate Antibiotic Use for Treatment of Acute Respiratory Tract Infections in Adults: Background, Specific Aims, And Methods. *Ann Inter Med* 2001;134:479-486.

Gonzalez R, Steiner JF, Lum A, et al. Decreasing Antibiotic Use in Ambulatory Practice - Impact of a Multidimensional Intervention on the Treatment of Uncomplicated Acute Bronchitis in Adults. *JAMA*. 1999;281:1512-1519.

Mainous AG, III, Colour of Respiratory Discharge and Antibiotic Use. *The Lancet* October 11, 1997;350:1077.

McCaig LF, Trends in Antimicrobial Drug Prescribing Among Office-Based Physicians in the United States. *JAMA* January 18, 1995;273(3):214-219.

Nyquist AC, Antibiotic Prescribing for Children with Colds, Upper Respiratory Tract Infections, and Bronchitis. *JAMA* March 18, 1998;278(11):875-78.

Preventing the Emergence of Antimicrobial Resistance. *JAMA* September 17, 1997;278(11):944-45.

Principles of Judicious Use of Antimicrobial Agents for Pediatric Upper Respiratory Tract Infections. *Pediatrics* January 1998;101(1):163-184.

Rosenfeld RM, An Evidence-Based Approach to Treating Otitis Media. *Pediatric Clinics of North America* December 1996;43(6):1165-1178.

Schwartz B, Preventing the Spread of Antimicrobial Resistance Among Bacterial Respiratory Pathogens in Industrialized Countries: The Case for Judicious Antimicrobial Use. *Clin Inf Dis* 1999;28:211-3.

Steinman MA, Gonzalez R, Linder JA et al, Changing use of antibiotics in community-based outpatient practice, 1991 - 1999. *Ann Intern Med*. 2003; 138:525 -33.

Laboratory

Clinical Laboratory Standards Institute, Document MO7-A8, January 2009.

Clinical Laboratory Standards Institute, Document M100-S19, January 2009.

Primary Care

Acute Otitis Media

AAP 2009 Report of the Committee on Infectious Diseases. *Red Book* 28th ed. 741.

AAP and AAFP Guidelines – Diagnosis and Management of Acute Otitis Media. *Pediatrics*. 2004. 113:1451-1465.

Sinusitis

CDC – Careful Antibiotic Use. National Center of Immunization and Respiratory Diseases/Division of Bacterial Diseases. March 2006.

AAP – 2009 Report of the Committee on Infectious Diseases. *Red Book* 28th ed. 741.

Pharyngitis

IDSA Guidelines – Bisno AL, et al. Practice Guidelines for the Diagnosis and Management of Group A Streptococcal Pharyngitis. *Clin Infec Dis*. 2002; 35:113-125

AAP – 2009 Report on the Committee on Infectious Diseases. *Red Book*. 28th ed. 616-628.

AAFP Guidelines – Schroeder BM. Diagnosis and Management of Group A Streptococcal Pharyngitis. *Amer Family Phys*. 2003; Feb 15th.

Acute Bronchitis (nonspecific cough illness) and the Common Cold (viral rhinosinusitis)

Gonzale R. et al. Principles of Appropriate Antibiotic Use for Treatment of Uncomplicated Acute Bronchitis: Background. *Annals of Int Med*. 2001. 134; 521-529

AAP 2009 Report of the Committee n Infectious Diseases. *Red Book* 28th ed. 742.

Acute Care

Boyce JM, Jackson MM, Pugliese G, et al. Methicillin-resistant *Staphylococcus aureus* (MRSA): A Briefing for Acute Care Hospitals and Nursing Facilities. *Infect Control Hosp Epidermiol* 1994;15:105-115.

Boyce JM. Methicillin-Resistant Staphylococcus aureus in Hospitals and Long-Term Care Facilities: Microbiology, Epidemiology, and Preventive Measures. Infect Control Hosp Epidemiol 1992;13:2842-6.

Carling P, Parry MF, Von Beheren SM. Identifying Opportunities to Enhance Environmental Cleaning in 23 Acute Care Hospitals. Infect Control Hosp Epidemiol 2008;29:1-7.

Centers for Disease Control and Prevention. Nosocomial *enterococci* Resistant to Vancomycin - United States, 1989-1993. *MMWR* 1993;42:597-9.

Centers for Disease Control and Prevention. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Health-care Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. MMWR 2002;51 (no. RR-16):[1-48].

Cohen AL,Calfee D, Fridkin SK, Huang SS, Jernigan JA, Lautenbach E, Oriola S, Ramsey KM, Salgado CD, Weinstein RA, for the Society for Healthcare Epidemiology of America and the Healthcare Infection Control Practices Advisory Committee
Recommendations for Metrics for Multidrug-Resistant Organisms in Healthcare Settings: SHEA/HICPAC Position Paper. *Infect Control Hosp Epidemiol* 2008;29:901–913

Drees M, Snydman DR, Schmid CH, Barefoot L, Hansjosten K, Vue PM, Cronin M, Nasraway SA, Golan Y. Prior environmental contamination increases the risk of acquisition of vancomycin-resistant enterococci Clin Infect Dis 2008;46678-685.

Garner JS, Hospital Infection Control Practices Advisory Committee. Guideline for Isolation Precautions in Hospitals. *Infect Control Hosp Epidemiol* 1996;17:53-80.

Goodman ER, Platt R, Bass R, Onderdonk AB, Yokoe DS, Huang SS
Impact of an Environmental Cleaning Intervention on the Presence of Methicillin-Resistant *Staphylococcus aureus* and Vancomycin-Resistant Enterococci on Surfaces in Intensive Care Unit Rooms Infect Control Hosp Epidemiol 2008; 29:593–599.

Hospital Infection Control Practices Advisory Committee. Recommendations for Preventing the Spread of Vancomycin Resistance: Recommendations of the Hospital Infection Control Practices Advisory Committee (HICPAC). *Am J Infec Control* 1995;23:87-94. (also in: *MMWR* 1995;44(RR-12):1-13).

Institute for Healthcare Improvement. How-to guide: reduce methicillin-resistant *Staphylococcus aureus* (MRSA) infection, 2006.Available at: http://www.ihi.org/IHI/Programs/Campaign/MRSAInfection.htm.

Karanfil LV, Murphy M, Josephson A, et al. A Cluster of Vancomycin-Resistant *Enterococcus faecium* in an Intensive Care Unit. *Infect Control Hosp Epidemiol* 1992; 13:195-200.

Larson, EL. APIC Guideline for Handwashing and Hand Antisepsis in Health Care Settings. *Am J Infec Control* 1995;23:241-69.

Livornese LL Jr, Dias S, Samel C, et al. Hospital-acquired Infection with Vancomycin-resistant Enteroccus faecium Transmitted by Electronic Thermometers. Ann Intern Med 1992;117:112-6.

Martone WS, Spread of Vancomycin-Resistant Enterococci: Why Did It Happen in the US? Infection Control and Hospital Epidemiology 1998; 19(8):539-545.

McGowan JE, Jr, Antibiotic-Resistant Bacteria and Health-care Systems: Four Steps for Effective Response. Infection Control and Hospital Epidemiology;16(2):67-70.

Montecalvo MA, deLencastre H, Carraher M, et al. Natural History of Colonization with Vancomycin-resistant Enterococcus faecium. Infect Control Hosp Epidemiol 1995;16:680-685.

MRSA Interagency Advisory Committee. Guidelines for Management of Patients with Methicillin-resistant *Staphylococcus aureus* in Acute Care Hospitals and Long-term Care Facilities. Connecticut Department of Public Health and Addiction Services. July 1993.

Mylotte JM, Control of Methicillin-Resistant Staphylococcus aureus: The Ambivalence Persists. Infection Control and Hospital Epidemiology 15(2):73-77.

New York Department of Health. Supplemental Infection Control Guidelines. Colonized or Infected with Vancomycin-resistant *enterococci* (VRE) in Hospitals; Long-term Care and Home Health Care. Albany, New York. September 1995.

North Carolina Guidelines for Control of Antibiotic Resistant Organisms, Specifically Methicillin Resistant *Staphylococcus aureus* and Vancomycin Resistant *enterococcus*. Dr. N. MacCormack, Chief of General Communicable Disease Control Section of the Department of Environment, Health and Natural Resources.

Noskin GA, Stosor V, Cooper I, Peterson LR. Recovery of Vancomycin-resistant *enterococci* on Fingertips and Environmental Surfaces. *Infect Control Hosp Epidemiol* 1995;16:577-581.

Pestonik SL, Implementing Antibiotic Practice Guidelines Through Computer-Assisted Decision Support: Clinical and Financial Outcomes. Annals of Internal Medicine May 15, 1996;124(10):884-891.

Recommendations for the Prevention and Control of Vancomycin-Resistant *Enterococci* (VRE) in Minnesota. Recommendations of the Work Group on VRE, Division of Disease Prevention and Control, Minnesota Department of Health, December 1996.

Rosenberg J. Methicillin-resistant *Staphylococcus aureus* (MRSA) in the Community: Who's Watching? *Lancet* 1995;346(8968):132-3.

Rutala WA and the APIC Guideline Committee. APIC Guideline for Selection and Use of Disinfectants. *Am J Infect Control* 1996;24:313-342.

Siegel JD, Rhinehart E, Jackson M, Chiarello L, and the Healthcare Infection Control Practices Advisory Committee, 2007 Guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings. http://www.cdc.gov/ncidod/dhqp/pdf/isolation2007.pdf

Siegel JD, Rhinehart E, Jackson M, Chiarello L, and the Healthcare Infection Control Practices Advisory Committee. Management of Multidrug-Resistant Organisms In Healthcare Settings, 2006. The healthcare infection control practices advisory committee http://www.ihatoday.org/issues/quality/cdcmdroguide.pdf

VRE Task Force, Washington State. Vancomycin Resistant *enterococci*: Information and Recommendations. VRE Task Force, Washington State. February 1996.
Weinstein, JW, Roe M, Towns M, Sanders L, Thopre JJ, Corey GR, Sexton DU. Resistant Enterococci: A Prospective Study of Prevalence, Incidence, and Factors Associated with Colonization in a University Hospital. Infect Control Hosp Epidemiol 1996;17:36-41.

Weber SG, Huang SS, Oriola S, Huskins WC, Noskin GA, Harriman K, Olmsted RN, Bonten M, Lundstrom T, Climo MW, Roghmann M-C, MurphyCL, Karchmer TB. 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. Am J Infect Control 2007;35:73-85.

Wells CL, Juni BA, Cameron SB, Sason DR, Dunn DL, Gerrieri P, Rhame FS. Stool Carriage, Clinical Isolation, and Mortality During an Outbreak of Vancomycin-Resistant Enterococci in Hospitalized Medical and/or Surgical Patients. Clin Infec Dis 1995;21:45-50.

Wisconsin Bureau of Public Health. Management of Patients with Antibiotic Resistant Organisms in a Variety of Health Care Settings.

Long-Term Care

Boyce JM, Jackson MM, Pugliese G, et al. Methicillin-resistant Staphylococcus aureus (MRSA): A Briefing for Acute Care Hospitals and Nursing Facilities. Infect Control Hosp Epidermiol 1994;15:105-115.

Boyce JM. Methicillin-Resistant Staphylococcus aureus in Hospitals and Long-Term Care Facilities: Microbiology, Epidemiology, and Preventive Measures. Infect Control Hosp Epidemiol 1992;13:2842-6.

Centers for Disease Control and Prevention. Nosocomial enterococci Resistant to Vancomycin - United States, 1989-1993. MMWR 1993;42:597-9.

Centers for Disease Control and Prevention. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Health-care Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. MMWR 2002;51 (no. RR-16):[1-48].

Department of Health, State of Rhode Island and Providence Plantations. Guidelines for Control of Vancomycin Resistant enterococci in Nursing Homes and Extended Care Facilities. Department of Health, State of Rhode Island and Providence Plantations. April 1996.

Garner JS, Hospital Infection Control Practices Advisory Committee. Guideline for Isolation Precautions in Hospitals. Infect Control Hosp Epidemiol 1996;17:53-80.

Guidelines for Long-Term Care Facilities for the Control of Vancomycin-Resistant Enterococci (VRE). Massachusetts Department of Health. April 1997.

Infection Control Programs. Iowa Methodist Medical Center, Mercy Hospital Medical Center, Des Moines, Iowa (attachment).

Larson, EL. APIC Guideline for Handwashing and Hand Antisepsis in Health Care Settings. Am J Infec Control 1995;23:241-69.

Livornese LL Jr, Dias S, Samel C, et al. Hospital-acquired Infection with Vancomycin-resistant Enterococcus faecium Transmitted by Electronic Thermometers. Ann Intern Med 1992;117:112-6.

Mylotte JM, Control of Methicillin-Resistant Staphylococcus aureus: The Ambivalence Persists. Infection Control and Hospital Epidemiology 15(2):73-77.

New York Department of Health. Supplemental Infection Control Guidelines. Colonized or Infected with Vancomycin-resistant enterococci (VRE) in Hospitals; Long-term Care and Home Health Care. Albany, New York. September 1995.

Noskin GA, Stosor V, Cooper I, Peterson LR. Recovery of Vancomycin-resistant enterococci on Fingertips and Environmental Surfaces. Infect Control Hosp Epidemiol 1995;16:577-581.

VRE Task Force, Washington State. Vancomycin Resistant enterococci: Information and Recommendations. VRE Task Force, Washington State. February 1996.

Recommendations for the Prevention and Control of Vancomycin-Resistant Enterococci (VRE) in Minnesota. Recommendations of the Work Group on VRE, Division of Disease Prevention and Control, Minnesota Department of Health, December 1996.

Rutala WA and the APIC Guideline Committee. APIC Guideline for Selection and Use of Disinfectants. Am J Infect Control 1996;24:313-342.

Steele L, Limiting the Spread of VRE: An Educational Program for LTC. Infection Control in Long-Term Care Facilities Newsletter, APIC 8(2).

Wisconsin Bureau of Public Health. Management of Patients with Antibiotic Resistant Organisms in a Variety of Health Care Settings.

Mental Health Facility:
Inpatient, Partial Hospitalization and Day Treatment

British Columbia guidelines for control of antibiotic resistant organisms (AROs) [methicillin-resistant staphylococcus aureus (MRSA) and vancomycin-resistant enterococci (VRE)]. www.bccdc.org/downloads/pdf/lab/reports/CDManual_AROGuidelines_sep2003_nov05-3.pdf. Vancouver, BC: BC Center for Disease Control. May, 2001 [cited September 2nd, 2008].

Guidelines for control of antibiotic resistant organisms. www.doh.state.fl.us/disease_ctrl/epi/icg/icg.pdf. Tallahassee, FL: Florida Department of Health. December 20th, 1999 [cited September 2nd, 2008].

Management of multidrug-resistant organisms in heatlhcare settings, 2006. www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf. Atlanta, Ga: Center for Disease Control and Prevention. 2006 [cited September 2nd, 2008].

North Carolina guidelines for control of antibiotic resistant organisms, specifically methicillin-resistant staphylococcus aureus (MRSA) and vancomycin-resistant enterococci (VRE). http://www.unc.edu/depts/spice/guide2.html. Chapel Hill, NC: North Carolina Department of Health: Statewide Program for Infection Control and Epidemiology. January, 1997 [cited Sept 2nd, 2008].

Report of the Iowa antibiotic resistance task force. A public health guide (2nd edition). www.idph.state.ia.us/adper/common/pdf/cade/antibioticreport.pdf. Des Moines, IA: Iowa Department of Public Health. Fall, 2004 [cited September 2nd, 2008].

YBHH infection control manual. http://www.ynhh.org . New Haven, CT: Yale New Haven Hospital, Quality Improvement Support Services. October 3, 2002 [cited September 2nd, 2008].

Dental

Advisory Statement: Antibiotic prophylaxis for dental patients with total joint replacements. J Am Dent Assoc 2003; 134(7):895-9.

Gould FK, Elliott TSJ, Foweraker J, et al. Guidelines for the prevention of endocarditis: report of the working party of the British Society for Antimicrobial Chemotherapy. J of Antimicrobial Chemotherapy 2006; 57(6):1035-1042.

Lockhart PB, Loven B, Brennan, MT, et al. The evidence base for the efficacy of antibiotic prophylaxis in dental practice. J Am Dent Assoc 2007; 138:458-470.

Home Care and Hospice

Centers for Disease Control and Prevention. Guideline for Hand Hygiene in Health-Care Settings: Recommendations of the Health-care Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. MMWR 2002;51 (no. RR-16):[1-48].

Emory TG, Gaynes RP. An Overview of Nosocomial Infections, Including the Role of the Microbiology Laboratory. Clin Microbial Rev 1993;6:428-42.

Garner JS, Hospital Infection Control Practices Advisory Committee. Guideline for Isolation Precautions in Hospitals. Infect Control Hosp Epidemiol 1996;17:53-80.

Infection Control Programs. Iowa Methodist Medical Center, Mercy Hospital Medical Center, Des Moines, Iowa (chart).

Larson, EL. APIC Guideline for Handwashing and Hand Antisepsis in Health Care Settings. Am J Infec Control 1995; 23:241-69.

Luebbert, Peggy Prinz. Chapter 44: Home Care. APIC Text of Infection Control and Epidemiology, Revised Edition 2002. A publication of the Association for Professionals in Infection Control and Epidemiology, Inc.

Milleheim, E.T., Woodward, M.,Hennings, H., Evans, M.E. Managing Vancomycin-Resistant Enterococci in Home Care Setting. Journal of Home

Mulligan ME, Murray-Leisure KA, Ribner BS. Methicillin-resistant Staphylococcus aureus: A Consensus Review of the Microbiology, Pathogenesis, and Epidemiology with Implications for Prevention and Management. Am J Med 1993;94:313-328.

New York Department of Health. Supplemental Infection Control Guidelines. Colonized or Infected with Vancomycin-resistant enterococci (VRE) in Hospitals; Long-term Care and Home Health Care. Albany, New York. September 1995.

Recommendations for the Prevention and Control of Vancomycin-Resistant Enterococci (VRE) in Minnesota. Recommendations of the Work Group on VRE, Division of Disease Prevention and Control, Minnesota Department of Health, December 1996.

Rosenberg J. Methicillin-resistant Staphylococcus aureus (MRSA) in the Community: Who's Watching? Lancet 1995;346(8968):132-3.

Rutala WA and the APIC Guideline Committee. APIC Guideline for Selection and Use of Disinfectants. Am J Infect Control 1996;24:313-342.

Visiting Nurses Association. Protocol for the Management of Home Care Patients with Vancomycin Resistant Enterococcus. Homecare Education Management 1997;2:17-32.

Wisconsin Bureau of Public Health. Management of Patients with Antibiotic Resistant Organisms in a Variety of Health Care Settings.

www.idph.state.ia.us/adper/cade_content/epifacts/mrsa.pdf

www.idph.state.ia.us/adper/cade_content/epifacts/vre.pdf

www.idph.state.ia.us/adper/cade_content/epifacts/influenza.pdf

Outpatient Hemodialysis

Infection Control Programs. Iowa Methodist Medical Center, Mercy Hospital Medical Center, Des Moines, Iowa (attachment).

Recommendations for the Prevention and Control of Vancomycin-Resistant Enterococci (VRE) in Minnesota. Recommendations of the Work Group on VRE, Division of Disease Prevention and Control, Minnesota Department of Health, December 1996.

www.cdc.gov/mmwr/preview/mmwrhtml/00039349.htm

Schools and Child Care

The ABC's of Safe and Healthy Child Care - A Handbook for Child Care Providers. Centers for Disease Control and Prevention,1996.

Caring for Our Children – National Health and Safety Performance Standards, Guidelines for Early Care and Education Programs, American Academy of Pediatrics, American Public Health Association and National Resource Center for Health and Safety in Child Care and Early Education. 3rd Ed. 2011.

Handwashing Fact Sheet. Adapted from the Utah Department of Health; Epidemiology Newsletter June, 1996.

Veterinary Medicine

American Veterinary Medical Association. AVMA Judicious Therapeutic Use of Antimicrobials. JAVMA 1999; 214(2).

Community

Alliance for the Prudent Use of Antibiotics, *Antibacterial Agents* Retrieved June 30, 2004 from, http://www.tufts.edu/med/apua/Q&A/Q&A_antibacterials.html#11

Health Canada, *For Your Information: Antimicrobial Resistance* Retrieved June 30, 2004, from http://www.hc-sc.gc.ca/vetdrugs-medsvet/amr_fyi_e.html#4

Minnesota Antibiotic Resistance Collaborative, *Stop Antibiotic Misuse in Minnesota* Retrieved June 30, 2004 from http://www.minnesotaarc.org/

Sohn, A. H., Ostrowsky, B. E., Sinkowitz-Cochran, R. L., Quirk, S. B., & Jarvis, W. R. (2001). Evaluation of a successful Vancomycin-Resistant Enterococcus prevention intervention in a community of health care facilities. American Journal of Infection Control, 29(1), 53-57.

Trick, W. E., Kuehnert, M. J., Aguero, S. M., Carlson, L. A., et al. (1999). Regional dissemination of Vancomycin-Resistant *Enterococci* resulting from inter facility transfer of colonized patients. *The Journal of Infectious Diseases, 180*, 391-396.

Methicillin-Resistant *Staphylococcus aureus* (MRSA)

Anonymous. Four pediatric deaths from community-acquired methicillin-resistant *Staphylococcus aureus*: Minnesota and North Dakota, 1997-1999 MMWR 1999;48:707-710.

Anonymous. Methicillin-resistant *Staphylococcus aureus* infections in correctional facilities: Georgia, and Texas, 2001-2003. MMWR 2003;52:992-996.

Armand-Lefevre L, Ruimy R, Andremont A. Clonal comparison of *Staphylococcus aureus* isolates from healthy pig farmers, human controls, and pigs. Emerg Infect Dis. 2005;11:711–4.

Chambers H, Community-Associated MRSA — Resistance and Virulence Converge. N Engl J Med. 2005 Apr 7;352(14):1485-7.

Diep BA, Chambers HF, Graber CJ, Szumowski JD, Miller LG, Han LL, Chen JH, Lin F, Lin J, Phan TH, Carleton HA, McDougal LK, Tenover FC, Cohen DE, Mayer KH, Sensabaugh GF, Perdreau-Remington F. Emergence of multidrug-resistant, community-associated, methicillin-resistant *Staphylococcus aureus* clone USA300 in men who have sex with men. Ann Intern Med 2008;148:249-257.

Ellis MW, Duane R. Hospenthal DR, Dooley DP, Gray PJ,Murray CK. Natural history of community-acquired methicillin-resistant *Staphylococcus aureus* colonization and infection in soldiers. Clin Infect Dis 2004;39:971-979.

Ellis MW, Griffith ME, DooleyDP, McLeanJC, Jorgensen JH, Patterson JE, Davis KA, Hawley JS, Regules JA, Rivard RG, Gray PJ, Ceremuga JM, DeJoseph MA,Hospenthal DR. Targeted Intranasal Mupirocin To Prevent Colonization and Infection by Community-Associated Methicillin-Resistant *Staphylococcus aureus* Strains in Soldiers: a Cluster Randomized Controlled Trial Antimicrobial Agents Chemother 2007;51:3591-3598.

Francis JS, Doherty MC, Lopatin U, Johnston CP, Sinha G, Ross T, Cai M, Hansel NN, Perl T, Ticehurst JR, Carroll K, Thomas DL, Nuermberger E, Bartlett JG. Severe community-onset pneumonia in healthy adults caused by methicillin-resistant *Staphylococcus aureus* carrying the Panton-Valentine leukocidin genes. Clin Infect Dis 2005:40;100-107.

Gorwitz RJ, Jernigan DB, Powers JH, Jernigan JA, and Participants in the CDC Convened Experts' Meeting on Management of MRSA in the Community. Strategies for clinical management of MRSA in the community: Summary of an experts' meeting convened by the Centers for Disease Control and Prevention. 2006. http://www.cdc.gov/ncidod/dhqp/ar_mrsa_ca.html

Han LL, McDougal LK, Gorwitz RJ, Mayer KH, Patel JB, Sennott JM, Fontana JL. High frequencies of clindamycin and tetracycline resistance in methicillin-resistant *Staphylococcus aureus* pulsed-field type USA300 isolates collected at a Boston ambulatory health center. J Clin Microbiol 2007;45:1350-1352.

Harper AL, Male MJ, Moritz-Korolev ED, Kroeger JS, Tinkler GP, Herwaldt L, Diekema D, Smith TC. Prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) in swine and humans from the midwestern United States. Abstract Y-036. American Society for Microbiology General Meeting, June 1-5 2008. Boston, MA.

Herold BC, Immergluck LC, Maranan MC, Lauderdale DS, Gaskin RE, Boyle-Vavra S, Leitch CD, Daum RS. Community-acquired methicillin-resistant *Staphylococcus aureus* in children with no identified predisposing risk. JAMA1998;279:593-598

Herwaldt LA, Boyce JM. Elimination of *Staphylococcus aureus* Carriage: Importance and Strategies. In: Staphylococci in Human Disease. Ed. KB Crossley, KK Jefferson, GL Archer, VG Fowler Jr. Wiley-Balckwell, Oxford, UK, pages 541-569.

HJ Benjamin, Nikore V, Takagishi J. Practical management: Community-associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA): The latest sports epidemic. Clin J Sport Med 2007;17:393-397.

http://www.cdc.gov/ncidod/dhqp/ar_mrsa_ca.html

http://www.cdc.gov/ncidod/dhqp/ar_MRSA_AthletesFAQ.html

http://www.cdc.gov/ncidod/dhqp/ar_MRSA.html

http://www.iahsaa.org/resource_center/Sports%20Medicine%20-%20Wellness/sports_medicine.html

http://www1.ncaa.org/membership/ed_outreach/health-

safety/healthcare/sports_med_education/infectious_prevention.htm

http://www1.ncaa.org/eprise/main/playingrules/Wrestling/2008_wrestling_appD.pdf?ObjectID=50379

&ViewMode=0&PreviewState=0

http://www.ncaa.org/library/rules/2007/2007_football_rules.pdf

http://content.nejm.org/cgi/video/357/19/e20/

http://dicon.mc.duke.edu/modules/dicon_mrsa/index.php?id=2

http://www.vhsl.org/NFHSStatement-finalMRSA%20revision.pdf

http://www.charmeck.org/Departments/Health+Department/Top+News/MRSA.htm

Johnston CP, Cooper L, Ruby W, Carroll KC,Cosgrove SE, Perl TM. Epidemiology of community-acquired methicillin-resistant *Staphylococcus aureus s*kin infections among healthcare workers in an outpatient clinic. Infect Control Hosp Epidemiol 2006;27:1133-1136.

Kaplan SL, Hulten KG, Gonzalez BE, Hammerman WA, Lamberth L, Versalovic J, Mason, Jr EO. Three-Year Surveillance of community-acquired *Staphylococcus aureus* infections in children. Clin Infect Dis 2005;40:1785-1791.

Kazakova SV, Hageman JC, Matava M, Srinivasan A, Phelan L, Garfinkel B, Boo T, McAllister S, Anderson J, Jensen B, Dodson D, Lonsway D, McDougal LK, Arduino M, Fraser VJ, Killgore G, Tenover FC, Cody S, Jernigan DB. A clone of methicillin-resistant *Staphylococcus aureus* among professional football players. N Engl J Med. 2005;352:468-475.

Kowalski TJ, Berbari EF, Osmon DR. Epidemiology, Treatment, and Prevention of Community-Acquired Methicillin-Resistant Staphylococcus aureus Infections. Mayo Clin Proc. 2005;80:1201-1208 © 2005 Mayo Foundation for Medical Education and Research.

Loeb M, Main C, Walker-Dilks C, Eady A. Antimicrobial drugs for treating methicillin-resistant *Staphylococcus aureus* colonization. Cochrane Database Syst Rev. 2003(4):CD003340.

Manian FA. Asymptomatic nasal carriage of mupirocin-resistant, methicillin-resistant *Staphylococcus aureus* (MRSA) in a pet dog associated with MRSA infection in household contacts. Clin Infect Dis 2003;36:26-28.

Nguyen DM, Mascola L, Brancoft E. Recurring methicillin-resistant *Staphylococcus aureus* infections in a football team. Emerg Infect Dis 2005; 11:526-532.

Rankin S, Roberts S, O'Shea K, Maloney D, Lorenzo M, Benson CE. Panton Valentine leukocidin (PVL) toxin positive MRSA strains isolated from companion animals. Vet Microbiol 2005;108:145-148.

Seguin JD, Walker RD, Caron JP, Kloos WE, George CG, Hollis RJ, Jones RN, Pfaller MA. Methicillin-resistant *Staphylococcus aureus* outbreak in a veterinary teaching hospital: potential human-to-animal transmission. J Clin Microbiol 1999;37:1459-1463.

Sing A, Tuschak C, Hörmansdorfer S, Methicillin-resistant *Staphylococcus aureus* in a family and its pet cat. New Engl J Med 2008;358:1200-1201.

Smith, T.C., Male, M.J., Harper, A.L., Kroeger, J.S., Tinkler, G.P., Moritz, E.D., Capuano, A.W., Herwaldt, L.A., and Diekema, D.J. Methicillin-resistant Staphylococcus aureus (MRSA) Strain ST398 is Present in Midwestern U.S. Swine and Swine Workers. PLoS ONE. 2008;4(1):e4258. Epub 2008 Jan 23.

Stevens DL,Bisno AL, Chambers HF, Everett ED, Dellinger P, Goldstein EJC, Gorbach SL, Hirschmann JV, Kaplan EL, Montoya JG,Wade JC. Practice Guidelines for the Diagnosis and Management of Skin and Soft-Tissue Infections. Clin Infect Dis 2005;41:1373–1406.

Van De Griend P, Herwaldt L, Alvis B, DeMartino M, Heilmann K, Doern G, Winokur P, Diekema D. Community-Associated Methicillin-Resistant *Staphylococcus aureus* (CA-MRSA) as an Emerging

Cause of Bloodstream Infection in Iowa. Abstract C2-179, 47th Interscience Conference on Antimicrobial Agents and Chemotherapy, September 17-20, 2007, Chicago, IL.

Vandenesch F, Naimi T, Enright MC, Lina G, Nimmo GR, Heffernan H, Liassine N, Bes M, Greenland T, Reverdy ME, Etienne J. Community-acquired methicillin-resistant *Staphylococcus aureus* carrying Panton-Valentine leukocidin genes: worldwide emergence. Emerg Infect Dis 2003;8:978-984.

van Duijkeren E, Wolfhagen MJ, Heck ME, Wannet WJ. Transmission of a Panton-Valentine leucocidin-positive, methicillin-resistant *Staphylococcus aureus* strain between humans and a dog. J Clin Microbiol 2005; 43:6209-6211.

Voss A, Loeffen F, Bakker J, Klaassen C, Wulf M. Methicillin-resistant *Staphylococcus aureus* in pig farming. Emerg Infect Dis. 2005;11:1965-1966.

Weese JS, Archambault M, Willey BM, Dick H, Hearn P, Kreiswirth BN, Said-Salim B, McGeer A, Likhoshvay Y, Prescott JF, Low DE. Methicillin-resistant *Staphylococcus aureus* in horses and horse personnel, 2000-2002. Emerg Infect Dis. 2005;11:430-435.

Weese JS, Goth K, Ethier M, Boehnke K. Isolation of methicillin-resistant *Staphylococcus aureus* from the environment in a veterinary teaching hospital. J Vet Int Med. 2004;18:468-470.

Weese JS, Rousseau J, Traub-Dargatz JL, Willey BM, McGeer A, Low DE. Community-associated methicillin-resistant *Staphylococcus aureus* in horses and humans who work with horses. J Am Vet Med Assoc 2005;226:580-583.

Weese JS, Dick H, Willey BM, McGeer A, Kreiswirth BN, Innis B, Low DE. Suspected transmission of methicillin-resistant *Staphylococcus aureus* between domestic pets and humans in veterinary clinics and in the household. Vet Microbiol 2006;115:148-155.

Wulf M, van Nes A, Eikelenboom-Boskamp A, de Vries J, Melchers W, Klaassen C, Voss A. Methicillin-resistant *Staphylococcus aureus* in veterinary doctors and students, the Netherlands. Emerg Infect Dis. 2006;12:1939-1941.

Clostridium difficile

Archibald LK, Banerjee SN, Jarvis WR. Secular trends in hospital-acquired *Clostridium difficile* disease in the United States, 1987–2001. J Infect Dis 2004;189:1585–1589.

Bignardi GE. Risk factors for *Clostridium difficile* infection. *J Hosp Infec* 1998; 40:1-15.

Centers for Disease Control and Prevention. September 23, 2004. *Clostridium difficile* – Information for Healthcare Providers Fact Sheet. <http://www.cdc.gov/ncidod/hip/gastro/ClostridiumDifficileHCP_print.htm> (Accessed 2005, June 26).

Centers for Disease Control and Prevention. Guideline for hand hygiene in health-care settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. MMWR 2002;51(RR16):1-44.

Cardona D, Rand, Kenneth. Evaluation of Repeat *Clostridium difficile* Enzyme Immunoassey Testing. J. Clin. Microbiol. 2008 46(11):3686-3689.

Drudy D, Kyne L, O'Mahony, R, Fanning S. *gyrA* mutations in fluoroquinolone-resistant *Clostridium difficile* PCR-027 [letter]. Emerg Infect Dis [serial on the Internet]. 2007 Mar [*date cited*]. Available from http://www.cdc.gov/EID/content/13/3/504.htm.

Gaynes R, Rimland D, Killum E, Lowery HK, Johnson TM, Kilogore G, Tenover FC. Outbreak of *Clostridium difficile* infection in a long-term care facility: association with gatifloxacin use. Clin Infect Dis 2004;38:640-645.

Gerding DN, Johnson S, Peterson LR, Mulligan ME, Silva J. *Clostridium difficile*-associated diarrhea and colitis. *Infect Control Hosp Epidemiol* 1995; 16(8):459-477.\

Kuntz JL, Cavanaugh JE, Becker LK, Ward MA, Appelgate DM, Herwaldt LA, Polgreen PM. *Clostridium difficile*-associated disease in patients in a small rural hospital. Infect Control Hosp Epidemiol 2007;28:1236-1239.

Kuijper EJ, Coignard B, Tull P. the ESCMID Study Group for *Clostridium difficile* (ESGCD), EU Member States and the European Centre for Disease Prevention and Control (ECDC). Emergence of *Clostridium difficile*–associated disease in North America and Europe. Clin Microbiol Infect. 2006;12(Suppl 6):2–18.

Loo VG, Poirier L, Miller MA et al. A predominantly clonal multi-institutional outbreak of *Clostridium difficile*-associated diarrhea with high morbidity and mortality. N Engl J Med 2005;353:2442–2449.

Mcdonald LC, Killgore GE, Thompson A et al. An epidemic, toxin gene-variant strain of *Clostridium difficile*. N Engl J Med 2005;353:2433–2441.

Mcdonald LC, Owings M, Jernigan DB. Increasing rates of *Clostridium difficile* infection in patients discharged from US short-stay hospitals, 1996–2003. Emerg Infect Dis 2006;12:409–415.

Miller MA, Hyland M, Ofner-Agostini M, Gourdeau M, Ishak M, Canadian Hospital Epidemiology Committee. Canadian Nosocomial Infection Surveillance Program. Morbidity, mortality, and healthcare burden of nosocomial *Clostridium difficile*-associated diarrhea in Canadian hospitals. Infect Control Hosp Epidemiol 2002;23:137–140.

Pepin J, Saheb N, Coulombe MA et al. Emergence of fluoroquinolones as the predominant risk factor for *Clostridium difficile*-associated diarrhea: a cohort study during an epidemic in Quebec. Clin Infect Dis 2005;41:1254–1260.

Pepin J, Routhier S, Gagnon S, Brazeau I. Management and outcomes of a first recurrence of *Clostridium difficile*-associated disease. Clin Infect Dis 2006;42:758–764.

Pepin J, Valiquette L, Alary M-E, et al. *Clostridium difficile*-associated diarrhea in a region of Quebec from 1991 to 2003: A changing pattern of disease severity. CMAJ 2004;171:466-472.

Polgreen PM, Chen Y, Cavanaugh JE, Ward M, Coffman S, Hornick DB, Diekema DJ, Herwaldt LA. An Outbreak of Severe *Clostridium difficile*-Associated Disease Possibly Related to Inappropriate Antimicrobial Therapy for Community-Acquired Pneumonia. Infect Control Hosp Epidemiol. 2007;28:212-214.

Quinn LK, Chen Y, Herwaldt, LA. Infection control policies and practices for Iowa long-term care facility residents with *Clostridium difficile* infection. Infect Control Hosp Epidemiol 2007;28:1228-1232.

Rupnik M, Avesani V, Janc M, von Eichel-Streiber C, Delmee M. A novel toxinotyping scheme and correlation of toxinotypes with serogroups of *Clostridium difficile* isolates. J Clin Microbiol 1998;36:2240–2247.

Simor AE, Bradley SF, Strausbaugh LJ, Crossley K, Nicolle LE. *Clostridium difficile* in long-term-care facilities for the elderly. Infect Control Hosp Epidemiol 2002;23:696-703.

Simor AE, Yake SL, Tsimidis K. Infection due to *Clostridium difficile* among elderly residents of a long-term care facility. 1993;17:672-678.

Spencer RC. Clinical impact and associated costs of *Clostridium difficile*-associated disease. J Antimicrob Chemother 1998;41(suppl C):5–12.

Walker KJ, Gilliland SS, Vance-Bryan K, Moody JA, Larsson AJ, Rotschafer JC, Guay DR. *Clostridium difficile* colonization in residents of long-term care facilities: Prevalence and risk factors. J Am Geriatr Soc 1993;41:940-946.

Warny M, Pepin J, Fang A et al. Toxin production by an emerging strain of *Clostridium difficile* associated with outbreaks of severe disease in North America and Europe. Lancet 2005;366:1079–1084.

Wilcox MH, Cunniffe JG, Trundle C, Redpath C. Financial burden of hospital acquired *Clostridium difficile* infection. J Hosp Infect 1996;34:23–30.

Wilcox MH, Freeman J. Epidemic *Clostridium difficile.* N Engl J Med 2006;354:1199–1203.

Resistant Gram-negative Organisms

Berrouane YF, McNutt LA, Buschelman BJ, Rhomberg .R, Sanford M., Hollis RJ, Pfaller MA, Herwaldt LA. An Outbreak of Severe *P. aeruginosa* Infections Caused by a Contaminated Whirlpool Tub Drain. Clin Infect Dis 2000;31:1331-1337.

Gaynes R, Edwards J. Overview of nosocomial infections caused by gram-negative bacilli. National Nosocomial Infection Surveillance System. Clin Infect Dis 2005;41:848-854.

Giske CG, Monnet DL, Cars O, Carmeli Y, on behalf of ReAct-Action on Antibiotic Resistance. Clinical and Economic Impact of Common Multidrug-Resistant Gram-Negative Bacilli. Antimicrob Agents Chemother 2008:52: 813-821.

Hyle EP, Lipworth AD, Zaoutis TE, Nachamkin I, Bilker WB, Lautenbach E. Impact of Inadequate Initial Antimicrobial Therapy on Mortality in Infections Due to Extended-Spectrum -Lactamase–Producing Enterobacteriaceae. Variability by Site of Infection, Arch Intern Med 2005;165:1375-1380.

JT Watson, et al. Outbreak of Catheter-Associated *K. oxytoca* and *E. cloacae* Bloodstream Infections in an Oncology Chemotherapy Center. Arch Intern Med 2005;165:2639-2643.

Lucet JC, Decré D, Fichelle A, Joly-Guillou ML, Pernet M, Deblangy C, Kosmann MJ, Régnier B. Control of a Prolonged Outbreak of Extended-Spectrum β-Lactamase–Producing Enterobacteriaceae in a University Hospital. Clin Infect Dis 1999;29:1411–1418.

Maragakis LL, Cosgrove SE, Song X, Kim D, Rosenbaum P, Ciesla N, Srinivasan A, Ross T, Carroll K, Perl TM. An Outbreak of Multidrug-Resistant *Acinetobacter baumannii* Associated with Pulastile Lavage Wound Treatment. JAMA 2004;292:3006-3011.

Neuhauser MM, Weinstein RA, Rydman R, Danziger LH, Karam G, Quinn JP. Antibiotic Resistance Among Gram-Negative Bacilli in US Intensive Care Units: Implications for Fluoroquinolone Use. JAMA 2003;289:885-888.

Paterson D. L. Resistance in gram-negative bacteria: *Enterobacteriaceae*. Am J Med 2006;119:S20-S28.

Paterson, D. L., Bonomo RA. 2005. Extended-spectrum beta-lactamases: a clinical update. Clin. Microbiol. Rev. 18:657-686.

Paterson, D. L., Doi Y. 2007. A step closer to extreme drug resistance (XDR) in gram-negative bacilli. Clin. Infect. Dis. 45:1179-1181.

Paterson, D.L, Ko W-C, Von Gottberg A, Mohapatra S, Casellas JM, Goossens H, Mulazimoglu L, Trenholme G, Klugman KP, Bonomo RA, Rice LB, Wagener MM, McCormack JG, Yu VL. Antibiotic Therapy for *Klebsiella pneumoniae* Bacteremia: Implications of Production of Extended-Spectrum β-Lactamases. Clin Infect Dis 2004;39:31-37

Talbot GH, Bradley J, Edwards, Jr JE, Gilbert D, Scheld M, Bartlett JG. Bad Bugs Need Drugs: An Update on the Development Pipeline from the Antimicrobial Availability Task Force of the Infectious Diseases Society of America. Clinical Infectious Diseases 2006;42:657–668**.**

van ‘t Veen A, van der Zee A, Nelson J, Speelberg B, Kluytmans JAJW, Buiting AGM. Outbreak of Infection with a Multiresistant *K. pneumoniae* Strain Associated with Contaminated Roll Boards in Operating Rooms. J Clin Microbiol 2005;43:4961-4967.