

Managing the Growing Burden of Healthcare-Associated and Community-Associated MRSA Infections in the Long-Term Care Setting

Epidemiology and Recognition of MRSA

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The proportion of *S. aureus* infections that are methicillin resistant has grown alarmingly in the last 35 years, having increased from 2% of total *S. aureus* infections in 1974 to 22% in 1995 and 63% in 2004.

Between 25% and 30% of the United States population is colonized with *S. aureus*, and approximately 1% harboring MRSA.

In the LTC setting, between 2,000,000 and 4,000,000 infections occur annually resulting in between 1.6 and 12.1 courses of systemic antibiotics per 1,000 resident days. It is estimated that approximately 30% of pressure sores and 10% of urinary tract infections and pneumonias diagnosed in LTC facilities contain *Staphylococcal* isolates. In LTC facilities, approximately 60% of *S. aureus* isolates are methicillin resistant. Other organisms commonly colonizing patients in this setting are β -hemolytic streptococci, *Enterobacteriaceae* species, and *Pseudomonas aeruginosa*.

MRSA is often endemic in LTC facilities. As much as 25% of admitted individuals are colonized upon arrival and an additional 10% are likely to acquire MRSA while in residence. In this setting, the cost of managing MRSA infections is approximately double that of methicillin-sensitive *S. aureus* infections. Moreover, MRSA colonization exposes not only patients, but staff and visitors as well, to the risk of infection, adding an

unknown amount to the total direct cost.

Methicillin resistance in the United States varies by region for both HA-MRSA and CA-MRSA with the highest percentages (67-72% and 59-63%, respectively) occurring in the south and southeast, compared with 50% to 52% in the northeast. In the New England states the proportion is only approximately 15%.

The most common CA-MRSA infections are skin infections requiring surgical debridement, necrotizing fasciitis, and diabetic foot infections. In 1999-2000, of all *S. aureus*-related hospital admissions, 43% involved MRSA. The majority of these were bacteremia and pneumonia. In 1995, 22% of staphylococcal bacteremia cases were identified as MRSA, while the proportion rose to 50% just 6 years later. In 2005, invasive MRSA infections in American hospitals accounted for approximately 18,650 deaths, and 86% of these infections were attributed to hospital-associated strains.

The Centers for Disease Control and Prevention (CDC) has put forth criteria to assist in distinguishing CA-MRSA from HA-MRSA. They include diagnosis made in an outpatient setting or by culture within 48 hours of hospital admission in an individual who has no history of MRSA infection or colonization; who has not been hospitalized or admitted to nursing home, skilled nursing facility, or hospice or been subjected to surgery or dialysis within the previous 12 months; and has no permanent indwelling catheters or percutaneous medical devices. HA-MRSA is characterized by the exceptions to these criteria. ●

Introduction

At a symposium conducted in conjunction with the 39th Annual Meeting and Exhibition of the American Society of Consultant Pharmacists (ASCP), an expert panel consisting of John F. Reitan, PharmD, Alex T. Makris, MD, CMD, Kathleen Ryan Fletcher, RN, MSN, GNP-BC, FAAN, explored the growing crisis of methicillin-resistant *Staphylococcus aureus* (MRSA) in the long-term care (LTC) setting, including both hospital-associated MRSA (HA-MRSA) and community-associated MRSA (CA-MRSA). The topics covered were "Epidemiology and Recognition of MRSA," "CA-MRSA: Resistance, Virulence, and Prevalence," "Managing the Economic Burden of MRSA in LTC," and "Differences in Managing CA-MRSA and HA-MRSA Infections in LTC." The symposium was conducted in New Orleans on November 20, 2008.

Learning Objectives

At the end of this lesson, the reader should be able to:

- recognize the threat, presentation, and risk factors for HA-MRSA and CA-MRSA in the LTC setting;
- familiarize themselves with the economic burden of managing MRSA in LTC facilities;
- implement a team approach to preventing and managing MRSA infections; and
- evaluate the efficacy and safety of anti-MRSA agents for empiric and directed therapy in HA-MRSA and CA-MRSA.

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CA-MRSA: Resistance, Virulence, and Prevalence

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The first report of *S. aureus* resistance occurred in 1942, only a year after penicillin was introduced. MRSA was reported initially in 1961. By that time, resistant *S. aureus* was a well known hospital pathogen and was generally considered to be a uniquely hospital phenomenon. When outbreaks of CA-MRSA appeared in 2000, many public health officials were tempted by the hypothesis that it has “escaped” the hospitals and “invaded” the community. The subsequent elucidation of genotypic differences between HA-MRSA and CA-MRSA suggested, however, that two species had taken independent paths to methicillin resistance.

It appears that CA-MRSA developed by the incorporation of a *mecA* gene in strains that carry the Panton-Valentine leucocidin (PVL) toxin, which is known to damage the cell membranes of leukocytes. The *mecA* genes encode five varieties of altered penicillin-binding proteins from their location on the staphylococcal cassette chromosome (SCC). Of these, SCCmec Type IV is the genotypic signature of CA-MRSA, whereas Types I, II, and/or III are characteristic of HA-MRSA. Although other toxins such as enterotoxins B and C have been associated with virulence in community-associated infections, there is an especially high correlation between PVL-containing strains of MRSA and the clinical presentation of CA-MRSA, especially pyogenic soft-tissue and skin infections, necrotizing fasciitis, and post-influenzal necrotizing pneumonia. The USA300 strain, which is detected by pulsed-field gel electrophoresis, is identified most commonly in CA-MRSA infections.

Table 1 summarizes some of the principal distinctions between HA-MRSA and CA-MRSA. One important risk factor for CA-MRSA infection is omitted: close household or other physical contact with a colonized or infected individual. Also unnoted is the frequency with which early infection resembles a spider bite. Figure 1 presents the results of a prospective cohort study of

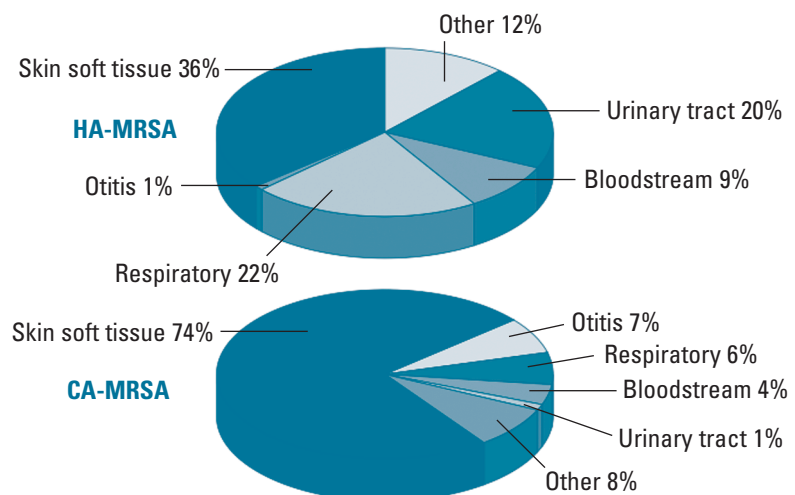
Table 1.
Characteristics of CA-MRSA vs HA-MRSA

	CA-MRSA	HA-MRSA
At-risk groups/ conditions	Children, athletes, prisoners, soldiers, selected ethnic populations, IVDA ² MSM ³	LTC ¹ facility residents, diabetics, dialysis patients, prolonged hospitalization, ICU patients, percutaneous devices
SCCmec type	IV	I, II, and III
Antimicrobial resistance	Beta-lactam alone common, Usually susceptible to TMP/SMX, clindamycin	Multidrug common; usually susceptible to TMP/SMX
PVL toxin	Common	Rare
Associated clinical syndromes	SSTI ⁴ , postinfluenza necrotizing pneumonia	Nosocomial pneumonia, catheter-related UTI ⁵ , bacteremia, SSTIs

1. long-term care; 2. intravenous drug abuser; 3. men having sex with men; 4. skin and soft tissue infections; 5. urinary tract infections.

Figure 1.
MRSA Infections by Organ System and Setting

Results of a Prospective Cohort Study of Patients with MRSA Infections Identified in 12 Minnesota Laboratories, January 1 through December 31, 2000.



Source: Naimi TS et al. *JAMA* 2003;290:2976-2984.

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patients with MRSA infections identified in 12 laboratories in Minnesota over the entirety of 2000, demonstrating the widely variant patterns of organ location between HA-MRSA and CA-MRSA. These data may provide guidance for either empiric or directed treatment in newly diagnosed *S. aureus* infection in the LTC setting.

Much as MRSA turned out not to be uniquely healthcare related, there is disturbing preliminary evidence that CA-MRSA is now arising spontaneously in the healthcare setting. In a study of 132 cases of bacteremia in 128 patients, for which 116 isolates were available for genotyping, investigators at Emory University identified 39 cases (34%) with USA300 strains with SCCmec IV positive for PVL, 29% with USA 100 strains with SCCmec II negative for PVL, 36% with USA 500 strains with SCCmec IV negative for PVL, and 1% (a single case) with USA800 strains with SCCmec negative for PVL. The first of these four groups would normally be considered typical of CA-MRSA and the other three typical of HA-MRSA. However, 92% of the 116 patients had healthcare-associated risk factors, most having been hospitalized recently and many having been catheterized. Strikingly, 42% of these patients presented upon hospitalization as nosocomial

bloodstream infections. This study appears to indicate that CA-MRSA strain USA300 may now have taken root in the setting of healthcare institution.¹

The increasing virulence of CA-MRSA is illustrated by a small study of patients with post-influenzal pneumonia in the 2004-05 season. Fifteen of 17 cases (88%) were associated with CA-MRSA. All except one patient who died upon arrival were hospitalized. Of a total of five deaths, four were due to CA-MRSA. Isolates were available for 13 patients, 11 of whom were infected with CA-MRSA. Toxin genes were detected by CDC scientists in all isolates, and 11 (85%) contained only genes for PVL. All isolates contained SCCmec type IVa. Remarkably, the median age of patients was 21 years, and with the exception of laboratory evidence of influenza virus infection in 12 of

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them (71%), only five had underlying disease that might have been risk factors for CA-MRSA².

The prevalence of CA-MRSA is no less remarkable than its virulence. Collaborators of the Emergency Net ID Group centered at the University of California, Los Angeles, studied 422 patients 18 years of age and above (median=39 years; range: 18-79 years) who sought emergency department treatment for pyogenic skin/soft tissue infections at any anatomical site that had been untreated for 7 or fewer days. All patients had purulent material available for culture and genotyping. *S. aureus* was identified in 320 cases (76%), and 249 of them (78%) were determined to be methicillin resistant. When 218 of them were studied for genetic and phenotypic characterization, 98% were found to carry the USA300 strain, 98% carried SCCmec IV, and 98% contained PVL toxin, all of which are characteristic of CA-MRSA.³ These results confirm earlier findings that CA-MRSA is the dominant organism in skin/soft tissue infections treated in emergency departments in American hospitals.

Only time will tell if the prevalence and virulence of CA-MRSA will continue to increase and whether or not it will become a significant nosocomial pathogen. ●

Managing the Economic Burden of MRSA in the LTC Environment

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Infection control in general, and the prevention and management of MRSA infection in particular, is among the greatest challenges in LTC settings. Infection contributes significantly to morbidity,

need for hospitalization and acute care, mortality, overall cost of care, and lost productivity. In extreme situations, infection statistics may threaten the certification of an LTC facility. Moreover, it is now clear that

LTC facilities are faced with potential MRSA infection from multiple sources: (i) patients who arrive already infected with either CA-MRSA or HA-MRSA, (ii) patients who are colonized with either CA-MRSA or HA-MRSA, (iii) nosocomial HA-MRSA, and (iv) the apparent emergence of nosocomial CA-MRSA strains within healthcare institutions.

Most current practices regarding infection control in LTC facilities is based on expert opinion and established practices. Four authoritative organizations have attempted to provide evidence-based practices — the Centers for Disease Control and Prevention (CDC), the Association of

Professionals in Infection Control and Epidemiology (APIC), the Society of Healthcare Epidemiology of America (SHEA), and the American Medical Directors Association (AMDA) — but their evidence is taken almost exclusively from acute care settings. A recently attempted meta-analysis that examined existing data from all randomized and controlled clinical trials, controlled before and after studies, and interrupted time series studies of infection control interventions in nursing homes for older people concluded that because “no studies met the selection criteria, neither a meta-analysis nor a narrative description of studies was possible.” The authors cautioned that

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infection-control strategies based on data generated in acute care settings may not be transferable to the LTC facilities, because they serve as both a healthcare setting and a resident's home.⁴ In addition, LTC residents generally experience longer stays than do hospitalized individuals, and residents are in closer proximity to one another. These institutions also tend to have fewer resources for deploying dedicated infection-control personnel.

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The lack of sound data for formulating evidence-based infection-control practices is especially dismaying because the Omnibus Budget Reconciliation Act (OBRA) of 1987 — 22 years ago — mandated infection control as part of the Nursing Home Reform Act. Although multiple statistical studies comparing outcomes between the pre- and post-OBRA eras have identified important improvements in long-term care, the body of LTC-specific data on infection control remains inadequate for formulating definitive practice guidelines.

The vast majority of infection transmission occurs through person-to-person contact. Aerosol transmission, while much less common, does occur. Generally accepted interventions that are thought to reduce transmission apply to both infected and colonized individuals. Most common among them are:

- selective screening to identify MRSA carriers;
- hand hygiene with soap and water or non-aqueous cleaning gels following each contact;
- contact precautions via gloves, gowns, and surgical drapes for certain procedures such as insertion of percutaneous devices and in-dwelling catheters and for wound care;
- decontamination of the environment, especially in high-touch areas such as beds, toilet facilities, bedside stands, dining tables, light switches, and door knobs;

- decontamination of equipment including staff phones, computers, and pagers;
- the use of dedicated equipment, including such common instruments as stethoscopes and sphygmomanometers, in the rooms of residents infected or colonized with MRSA;
- staff education and teamwork;
- monitoring rates of antibiotic use and resistance;
- private rooms or cohorting of colonized residents;
- and defined contact precaution zones.

Staff education must include all personnel including volunteers. Although computer-based training systems have been devised, they are not an effective substitute for real-time live training. Education must include a cultural change that permits any employee to alert another to lapses in infection-control measures. Targeted staff education, reminders and refreshers, incentives and sanctions, and staff accountability are essential for continuous monitoring of infection control. Having unit-based champions of infection control may provide a constant reminder of the importance or reducing transmission.

Handwashing is the single most important means of preventing the spread of infection, yet studies indicate that routine compliance is no higher than 60%. It may be somewhat higher with non-aqueous gels because they can be used while in transit from site to site and they are self-drying, thus sharply reducing time consumption. However, providing and maintaining dispensers in all patient rooms, at nursing stations, in staff facilities, and dining facilities is expensive, and their use in nursing homes is not at present up to the requisite standard. Moreover, the burden of heavy work loads, interruptions, distractions (such as pages), and other factors frequently prevent personnel from complying with hand hygiene procedures.

Daily decontamination of the environment is another essential factor in infection control, as bacteriological monitoring has demonstrated that most Gram-positive bacteria including MRSA can survive on dry inanimate surfaces and be a source of transmission for months. Other factors that enhance transmission from such objects are low temperature, high humidity, and increased inoculum. Housekeeping staff should be trained and required to use checklists to ensure thorough daily decontamination. A microbiology group has recently

reported the development of a paint that releases titanium dioxide when exposed to light that is capable of killing surface bacteria including MRSA. It is not yet available for widespread use.

Screening to identify carriers of MRSA has been recommended by several organizations including the Five Million Lives campaign centered in Cambridge, Massachusetts. The Campaign recommends screening of high-risk populations; the use of preemptive isolation; prompt reporting of lab results and rapid follow-up; and education of residents, families, visitors, volunteers, and staff.⁵ Unfortunately, however, implementing routine screening of staff is not feasible in LTC facilities principally because of cost, the potential for disruption, and both the cost and potential adverse effects of decolonization. Some observers have suggested that pre-employment screening of staff and pre-admission screening of residents might be cost-effective. The Veterans Administration now conducts pre-admission screening at all of its facilities. A Canadian study concluded that the annual MRSA screening cost for a single hospital was \$109,813.

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Interventions involving healthcare employees that are designed to reduce MRSA transmission are more controversial. In a paper entitled "Health-care workers: source, vector or victim in MRSA?" Albrich and Harbarth reported the results of a literature search spanning from 1980 through mid-2006 to determine the likelihood of MRSA colonization and infection in healthcare workers and to assess their role in MRSA transmission. In 127 published investigations with a total of 33,318 screened healthcare employees, the colonization and clinical infection rates were 4.6% and 5.1%, respectively. Risk factors included chronic skin disorders, poor hygiene practices, and having worked in countries with endemic MRSA. Subclinical infections and colonization of extranasal sites were associated with persistent carriage. Both transiently and persistently

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colonized individuals were responsible for multiple MRSA clusters. Transmission from personnel to patients was likely in 93% of the studies (N=63) that undertook genotyping. MRSA eradication was achieved in 88% (449 of 510) workers in whom it was attempted.⁶ While it is important to point out that the personnel involved in this study were not employed specifically in LTC settings, the data are relevant nonetheless, particularly because so many employees of LTC facilities come from densely-populated urban areas and/or have previously resided in countries with relatively low commitments to public health.

The management of CA-MRSA skin and soft-tissue infections in LTC consists of incision and thorough drainage, culturing, aggressive wound care, and the selective and judicious use of antibiotic therapy. High-risk candidates for antibiotics include individuals with systemic infections, those whose infections are not easily accessible for incision and drainage, and those who are particularly frail or have diabetes or cellulitis. If infection recurs, an infectious disease specialist should be consulted. In general, geriatricians have insufficient experience with infectious disease to manage recurrent infections independently.

Pet therapy has become a popular means of maintaining morale in LTC, but in rare cases it may contribute to MRSA infection. It has been demonstrated that several species of animal, including dogs and cats, can be infected or colonized with the same strains of MRSA as humans, and there have been scattered reports of human-to-animal and animal-to-human transmission.

The economic burden of antibiotic resistance is huge, ranging from \$4 billion to \$30 billion in the United States annually. One study demonstrated that after controlling for other potential causes of death, there was a statistically significant increase in mortality from MRSA bacteremia than from antibiotic-sensitive strains of *S. aureus*. Resistance is associated with longer hospital stays costing an additional \$5,000 to \$40,000, in part because of delays in transferring patients to LTC. One strategy for reducing these added costs may be to replace intravenous vancomycin with oral linezolid to accelerate discharge. Even though the oral drug is more expensive, earlier transfer together with the lower cost of administering oral medication might reduce the overall cost of care.

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Too often, however, the debate about the prevention and control of MRSA centers on cost rather than on cost-effectiveness. Four studies suggest that the cost is well invested. In one, a British orthopedic unit reported screening each patient admitted in 2003 and isolated those with MRSA colonization. The result was a decreased incidence of MRSA of 56% among trauma patients and of 70%

among those admitted for elective surgery. In a second study, cost-effective aggressive control of an MRSA outbreak in an American neonatal unit lasting 10 months cost \$58,000, compared with less aggressive control of an outbreak lasting 51 months at a cost of \$306,600. Third, a “search and destroy” approach of screening and aggressive control in The Netherlands reduced the cost of MRSA by half. Finally, a French cost-benefit analysis of ICU infection control programs that involved universal screening and preventive isolation found that the programs had a net value of between \$600 and \$700 (U.S.) These studies, together with those indicating an increased mortality rate from MRSA compared with antibiotic-sensitive strains of *S. aureus*, suggest that the combined cost of screening for MRSA and combating it preemptively may reduce the overall cost of care in LTC facilities. ●

Differences in Managing CA-MRSA and HA-MRSA Infection in LTC

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CA-MRSA and HA-MRSA strains have very different susceptibility patterns, as is indicated in **Table 2**, necessitating different strategies when selecting pharmacologic interventions. As the table indicates,

CA-MRSA was generally more susceptible to antibiotic therapy than was HA-MRSA in the study reported. Fluoroquinolones are often used to no avail in MRSA; and clindamycin, which was formerly thought to be the Gram-

Table 2.
MRSA Antimicrobial Susceptibility Profiles (% Susceptible)

Antibiotic	CA-MRSA (N=106)	HA-MRSA (N=211)
Oxacillin	0	0
Ciprofloxacin	79	16
Clindamycin	83	21
Erythromycin	44	9
Gentamicin	94	80
Rifampin	96	94
Tetracycline	92	92
TMP/SMX	95	90
Vancomycin	100	100

Source: Naimi TS et al. *JAMA* 2003;290:2976-2984.

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positive drug of choice in patients allergic to beta-lactams was effective in only 83% of cases of CA-MRSA and 21% of HA-MRSA. Erythromycins had a similar reputation, but also provide little benefit in the management of both CA-MRSA and HA-MRSA.

The CDC has made recommendations for the empiric treatment of CA-MRSA. First-line treatment for skin and soft-tissue infections consists of a beta-lactam agent (antistaphylococcal penicillin or cephalosporin) in a patient with mild to moderate illness and no significant comorbidities provided the local prevalence of CA-MRSA is low, defined loosely as below 10-15%.

There are five alternatives to beta-lactams for outpatient treatment of these infections when an oral regimen with activity against MRSA is desired.

There are five alternatives to beta-lactams for outpatient treatment of these infections when an oral regimen with activity against MRSA is desired. (i) Clindamycin is indicated by the FDA for *S. aureus* infections, but not for MRSA because of inadequate study. Moreover, MRSA organisms may develop resistance to clindamycin in the course of therapy. Because of this inducible resistance, if a sensitivity panel shows erythromycin resistance, clindamycin may not be a useful alternative. (ii) Tetracyclines including doxycycline and minocycline may be of value in patients who are mildly to moderately ill, but they too are not FDA approved specifically for MRSA. They may be of no value for combating cellulitis caused by Group A *Streptococcus*, as the activity against this organism is unknown. There is insufficient information on the efficacy of tetracyclines to be recommended in the treatment of invasive infections. (iii) Trimethoprim/sulfamethoxazole (TMP/SMX) is not approved by the FDA for *S. aureus* skin infections, but it is widely used based on favorable results attained in an outbreak of *S. aureus* endocarditis in intravenous drug users. (iv) Rifampin should be used only in combination with other antibiotics, and even then there is no solid evidence that it adds

synergistically to the efficacy of other anti-staphylococcal agents. Drug interactions are relatively common with rifampin, and its prolonged single-agent use contributes to resistance. (v) Linezolid should be used in consultation with an infectious disease specialist. It has FDA approval for use in treating complicated skin infections and HA-MRSA in adults. It has been associated with myelosuppression, neuropathy, and lactic acidosis during prolonged therapy.

MRSA resistance to fluoroquinolones (ciprofloxacin, levofloxacin, moxifloxacin, and gatifloxacin) is a class phenomenon. Therefore, they have no role in the treatment of infection due to either CA-MRSA or HA-MRSA.

At present there are no data concerning the use of macrolides (erythromycin, clarithromycin, and azithromycin) in treating MRSA skin infections. However, resistance to macrolides is common among MRSA isolates, including CA-MRSA.

The current treatment options for HA-MRSA are intravenous vancomycin, intravenous and oral linezolid, intravenous daptomycin, and intravenous tigecycline. Quinpristin/dalfopristin is active *in vitro* against HA-MRSA, but it does not have FDA approval.

Vancomycin, the standard treatment for years, is approved for use in serious or severe infections caused by susceptible strains of MRSA. The most common adverse effects are infusion reactions and renal failure. Linezolid

The current treatment options for HA-MRSA are intravenous vancomycin, intravenous and oral linezolid, intravenous daptomycin, and intravenous tigecycline.

is approved for diabetic foot infections caused by both MRSA and methicillin sensitive *S. aureus* (MSSA) in patients without osteomyelitis, and for nosocomial pneumonia, community-acquired pneumonia, and uncomplicated skin and soft tissue infections. In addition to use in soft tissue and skin infections, daptomycin is indicated for bacteremia caused by both MRSA and MSSA. It has been associated with myalgia. Tigecycline is approved for the treatment of complicated skin and soft tissue infections caused by MRSA and MSSA, and intra-abdominal infections caused by methicillin-sensitive *S. aureus* strains. Side effects with tigecycline include nausea and vomiting.

In summary, there are different antibiotic sensitivity patterns for CA-MRSA and HA-MRSA. Community-associated MRSA can often be treated with oral antibiotics. In spite of the CDC recommendations for differentiation, the line between CA-MRSA and HA-MRSA is not clearly defined. ●

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Continuing Education Examination

To receive continuing education (CE) credit, follow the instructions on the following page.

1. Community-associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA) and healthcare-associated *S. aureus* (HA-MRSA) are:
 - a. two names given to the same infection based solely on where it is believed to have been contracted
 - b. two strains of the same organism that manifest nearly identically across populations but differ in the organs they infect
 - c. two strains of the same organism that infect the same organ systems but differ in the populations they tend to colonize
 - d. two separate species that are contracted in different settings, manifest in populations, and infect organ systems differently.
2. What percentage range of admitted residents in long-term-care (LTC) facilities is colonized by MRSA?
 - a. 3% to 5%
 - b. 10% to 15%
 - c. 20% to 25%
 - d. 30% to 50%
3. Management of CA-MRSA skin and soft-tissue infections in patients receiving long-term care includes:
 - a. complete incision and drainage
 - b. selective and judicious antimicrobial therapy
 - c. culturing
 - d. all of the above
4. Making supplies (gowns/gloves) readily accessible, using private rooms, and cohorting are examples of:
 - a. contact precautions
 - b. decontamination of the environment
 - c. education and teamwork
5. In an effort to determine the impact of infection control strategies on preventing MRSA transmission in nursing homes, a systematic review of the literature published in 2008 found no studies that were specific to nursing homes. This is problematic because evidence-based guidelines generated in acute care settings:
 - a. have been shown not to apply in nursing home settings
 - b. may not be transferable to nursing home settings
 - c. are unknown in nursing home settings
 - d. may not be legal in nursing home settings
6. Which of the following is NOT a generally accepted intervention that reduces MRSA colonization and infection?
 - a. selective screening to identify carriers
 - b. hand hygiene
 - c. antibiotics
 - d. decontamination of the environment
7. According to recommendations of the Centers for Disease Control and Prevention, staphylococcal resistance is common among all of these drugs EXCEPT:
 - a. linezolid and vancomycin
 - b. fluoroquinolones
 - c. β -lactams
 - d. macrolides
8. Which of the following drugs is/are NOT specifically approved by the US Food and Drug Administration for the treatment of MRSA infections?
 - a. fluoroquinolones
 - b. clindamycin
 - c. tetracyclines
 - d. all of the above

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Faculty Disclosures

Kathleen Ryan Fletcher, RN, MSN, GNP-BC, FAAN, discloses that she is or has been a member of advisory boards and speakers bureaus for Forest Pharmaceuticals, Inc. and Pfizer Inc.

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