

The Prevalence of Community-Acquired Methicillin-Resistant *Staphylococcus Aureus* (CA-MRSA) in Skin Abscesses Presenting to the Pediatric Emergency Department

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Abstract

Background: Community-acquired methicillin resistant *Staphylococcus aureus* (CA-MRSA) infections have been increasing. The most common of these infections present as skin abscesses. The objectives of this study were to prospectively determine the prevalence of CA-MRSA in abscesses in the population of a pediatric emergency department, to determine antibiotic sensitivity patterns of the CA-MRSA isolates, and to describe the patient population that presented with skin abscesses.

Methods: We conducted a prospective study of children under the age of 18 years who presented to our pediatric emergency department with a skin abscess that required incision and drainage. Pus from these abscesses was sent for culture to determine the causative agent, and antibiotic sensitivities were reported. Characteristics of the patient population that presented with these abscesses were examined.

Results: Sixty-eight patients were enrolled over an 18-month period. Of these, 60 (88%) had cultures positive for *Staphylococcus aureus* (*S. Aureus*). Of these 60 patients, 51 (85%) were identified as CA-MRSA by their resistance patterns. All of the CA-MRSA isolates were sensitive to trimethoprim/sulfamethoxazole; 6 (10%) were either resistant or intermittently resistant to clindamycin.

Limitations: The study was conducted on a convenience sample of patients and enrolled a relatively small number of patients.

Conclusions: CA-MRSA is responsible for the vast majority of skin abscesses presenting to the pediatric emergency department. CA-MRSA isolates are likely to be sensitive to trimethoprim/sulfamethoxazole or clindamycin, although there is some resistance to clindamycin.

Key Words: Skin abscess; CA-MRSA; *Staphylococcus aureus*

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a well-known public health problem that emerged shortly after the introduction of methicillin, nafcillin, and oxacillin antibiotics. Until the 1990s, however, most resistant isolates arose in hospitalized patients or in patients who had health care-related risk factors. More recently, strains distinct from the nosocomial pathogen began to appear in the community and cause infections in young, otherwise healthy patients without identifiable risk factors.¹

These community-acquired MRSA (CA-MRSA) strains have unique clinical and microbiological characteristics that distinguish them from the traditional hospital-based organisms.² In fact, CA-MRSA appears to be more closely related to methicillin-susceptible *Staphylococcus aureus* (MSSA). Genetic studies have

revealed that CA-MRSA isolates most likely arose from acquisition of a staphylococcal cassette chromosome (SCC) *mec* type IV element by MSSA strains in the community.³ SCC_{mec} is the mobile genetic element that carries the gene encoding the altered penicillin binding protein that confers methicillin resistance. In children, the presence of risk factors predisposing to methicillin resistance was found to be the same for CA-MRSA and MSSA infections.⁴

Methicillin sensitive *S. Aureus*, hospital acquired MRSA (HA-MRSA), and CA-MRSA can all cause severe and invasive infections. However, CA-MRSA tends to be a more aggressive organism. It is associated with more frequent serious complications⁵ and can cause sepsis, bone and joint infections, and even death.^{6,7} It often carries the Panton Valentine Leukocidin

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(PVL) virulence factor, which is associated with epidemic furunculosis and severe necrotizing pneumonia.³ Despite its pathologic potential, however, most (~70%) infections caused by CA-MRSA are skin and soft tissue infections.⁸

Community-acquired MRSA is a growing problem in the United States. In areas where prevalence is high, it must be considered a potential cause for infection and treated accordingly. When not treated properly, it has the potential to cause serious disease. The suspicion of CA-MRSA infection should lead the clinician to prescribe specific antibiotics and consider hospital admission when appropriate. The primary goal of this investigation was to prospectively determine the prevalence of CA-MRSA in drained abscesses in our pediatric emergency department population. The secondary goal was to provide descriptive statistics regarding the patient population that presented with CA-MRSA abscesses.

Methods

The study emergency department is a tertiary care pediatric emergency department in a small urban community in central North Carolina. The department sees approximately 27,000 patients under the age of 18 annually. Approximately 85% of these patients are estimated to come from the city and surrounding suburbs and 15% from rural communities. Approximately 20% of patients who present to the department are Hispanic and 40% are African American. The study design was a case series. The enrollment period was April 2005 through September 2006. Children under the age of 18 years who presented with a skin abscess that was determined by the attending physician to require incision and drainage in the department were included in the study. Exclusion criteria included previous known MRSA infection or hospitalization within the past month. In order to determine the number of patients that were missed during the enrollment period, we conducted a chart review for the 18-month study period to find patients who had abscesses drained in the emergency department but were not enrolled in the study. We searched medical records using the ICD-9 procedure code for abscess incision and drainage. Sixty-eight out of 140 eligible patients (49%) were enrolled. (See Figure 1.)

Material obtained from the abscess was sent to the hospital's laboratory for microbiologic culture and antibiotic sensitivity

Laboratory Standards Institute. The MicroScan Automated System (Behring, Sacramento, CA) was used for the identification and susceptibility testing of *Staphylococcus aureus* species. If isolates were initially found to be resistant to erythromycin, inducible macrolide–lincosamide–streptogramin resistance testing was done (the disk diffusion or “D-test”) to look for inducible resistance to clindamycin.

Approval for this study was obtained from the institutional review board of the Wake Forest University School of Medicine. Because this was an observational study, the institutional review board waived the requirement for informed consent.

For each patient enrolled in the study, a questionnaire was completed by the enrolling physician that included the following data: patient age, race, length of symptoms before presentation, presence and degree of fever, abscess size, and which, if any, antibiotics were prescribed.

Data were analyzed by Dr. David Cline and Rebecca Neiberg, MS, from the institution's department of biostatistics using SAS 8.0 (SAS, Cary, NC). SAS procedures utilized were the frequency function for categorical variables and the means functions for continuous variables. All statistical analyses were descriptive.

Results

Sixty-eight patients were enrolled in an 18-month period. Characteristics of the enrolled patients are shown in Table 1. The mean age of enrolled patients was 7 years, with a range from 2 weeks to 17 years old. Forty of 68 (59%) enrolled patients were African American, 16 (24%) were white, and 12 (17%) were of other races. Abscess and symptom characteristics are shown in Table 2. The mean duration of symptoms at the time of presentation was 4 days, with a range from 1 to 21 days. Twenty of 68 (29%) patients had fever at the time of presentation. Among patients under the age of 5, 22 of 30 (72%) had fever; of patients 5 years of age or older, 4 of 38 (11%) had fever. The mean abscess size was 3.9 cm, with a range from 1 to 14 cm. The enrolled population did not differ significantly from the non-enrolled population regarding the age or race of the patients. The mean age of the non-enrolled patients was 6.4 years, and 52% were African American, which did not differ from the enrolled population using the Student's t-test and the chi-square test, respectively. Other data (duration of symptoms, abscess size, volume of pus drained) were not consistently available for the non-enrolled patients.

Regarding abscess management, 34 of 68 (50%) were packed with gauze at the emergency department visit. Fifty-eight of 68 (85%) of patients received antibiotics. Of these, 24 of 58 (41%) received clindamycin and 22 of 58 (38%) received trimethoprim/sulfamethoxazole. Other antibiotics prescribed included cephalexin and doxycycline.

Figure 1.
Recruitment Flow Chart



determination. Using the agar dilution technique, organisms were identified and reported as “resistant,” “susceptible,” or of “intermediate” resistance to specific antibiotics based on mean inhibitory concentration (MIC) standards of the Clinical and

**Table 1.
Demographics of Enrolled Patients**

Variable (N=68)	Percent
Race	
African American	59
White	24
Other	17
Age	
<1	15
1-4	29
>4	56

**Table 2.
Clinical Characteristics and Treatment**

Variable (N=68)	Percent
Symptom Duration, d	
<3	33
3-7	56
>7	11
Abscess Size, cm	
<4	40
>4	60
Presence of Fever	
Yes	29
No	71
Abscess Packing	
Yes	50
No	50
Antibiotic Prescription Given	
Yes	85
No	15

Isolated organisms and their characteristics are shown in Table 3. Sixty of 68 (88%) of the isolates grown from the incised abscesses were *Staphylococcus aureus*. Others isolates included proteus, bacteroides, and strep species, and there was no bacterial growth in 4 cases. Fifty-one of 60 (85%) of the *Staphylococcus aureus* isolates were resistant to oxacillin and therefore characterized as CA-MRSA. Of these, 54 of 60 (90%) were sensitive to clindamycin (this includes only those isolates that were “D-test” negative) and 60 of 60 (100%) were sensitive to trimethoprim/sulfamethoxazole. Two isolates were initially found to be sensitive to clindamycin but were D-test positive and therefore identified as clindamycin resistant.

**Table 3.
Characteristics of Isolated Organisms**

Organisms (N=68)	Percent
Staphylococcus aureus	
MSSA	15 (9/60)
MRSA	85 (51/60)
Clindamycin sensitive	90 (46/51)
Trimethoprim/sulfamethoxazole sensitive	100 (51/51)
Other Organism	6
No Growth	6

Discussion

Since its emergence, CA-MRSA has become increasingly prevalent and particularly important in the pediatric population. One study cites up to a 20-fold increase in the frequency of CA-MRSA infections in children since 1988.⁹ A 14-year study at Driscoll Children’s Hospital found that the number of CA-MRSA cases ranged from 0 to 9 per year from 1990 through 1999 and then increased exponentially from 36 in 2000 to 459 in 2003.¹⁰ There have been reports of clusters and outbreaks among children in daycare centers, competitive athletes, homeless youth, Native Americans, men who have sex with men, jail inmates, and military recruits.¹¹ With increasing awareness of CA-MRSA, it is possible that detection bias has played a role in the reporting of its increasing prevalence.

With this recent increase in prevalence and because of its potential virulence, it is becoming increasingly important to recognize CA-MRSA as a possible cause of infection. In addition, there should be a change in the empiric therapy of infections suspected to be caused by *S. aureus* because of the unique antibiotic susceptibilities of community-acquired infections. It is resistant to most of the commonly used beta lactams, including cephalosporins, but it is usually susceptible to clindamycin, trimethoprim/sulfamethoxazole, rifampin, vancomycin, tetracyclines, and sometimes erythromycin and fluoroquinolones. Inducible macrolide–lincosamide–streptogramin resistance (the “D-test”) is possible in a subset of CA-MRSA, however, and could be problematic when clindamycin is used.⁸

Not all infections require antibiotics. In fact, one study examined the management and outcome of children with skin and soft tissue abscesses.¹² They found that incision and drainage of CA-MRSA abscesses less than 5 cm in size was effective without adjunctive antibiotic treatment, but a lesion greater than 5 cm in size was a strong predictor of a need for hospitalization. Similarly, Sattler and colleagues found that many CA-MRSA infections resolved despite treatment with antibiotics to which the organism was not susceptible.⁴ This suggests that antibiotics may be less critical in less serious infections or in immunocompetent hosts.

The present study shows a large prevalence of CA-MRSA in skin abscesses in the pediatric population presenting to an urban emergency department in central North Carolina. Of 68 patients with drained abscesses, 88% had infection with CA-MRSA. Although antibiotics were prescribed in the majority of cases, it is not clear that this is a necessary practice, and in fact this practice may further increase antibiotic resistance. Given the high prevalence of CA-MRSA in our study population, if empiric antibiotics are prescribed for an abscess in the pediatric population, they should be tailored to cover CA-MRSA infection. Currently CA-MRSA infections show favorable resistance patterns to clindamycin and trimethoprim/sulfamethoxazole in our hospital population. Clinicians should remain aware of resistance patterns in their communities. We did not have any Group A streptococcus isolates in our study population. This organism is known to cause invasive skin disease, and empiric treatment with trimethoprim/sulfamethoxazole would not cover this organism.

This study was a case series conducted on a convenience sample of patients. As in all such studies, selection bias is a possibility. It is possible that the patients chosen to participate in the study had abscess features such as size, location, or duration of symptoms, which were different from those patients who were excluded, therefore biasing the results. It is also true that there are likely many patients in the community with CA-MRSA skin infections who do not present to the emergency department for care, which may have led us to underestimate the prevalence of the infection in the community.

In addition, it is possible that some of the isolates that we

considered to represent CA-MRSA were actually hospital-acquired. Although we excluded patients who had been hospitalized in the month prior to presentation, it is possible that some of our patients had contact with hospitals or hospitalized patients. Our rate of CA-MRSA may be biased upwards by including patients who may have been hospitalized in the last year. We did not quantify the number of patients who were excluded from our study for this reason. It is also possible that we should have excluded patients who may have been hospitalized prior to our one-month exclusion period. The study was also conducted on a relatively small number of children.

Because of our sampling strategy, data that we collected could not identify risk factors that increased the likelihood that a specific skin infection was caused by CA-MRSA. We did not specifically ask about known close contacts with skin infections. We also did not collect data on abscess location, and it is possible that certain locations may indicate an increased likelihood of CA-MRSA infection. Because we did not collect detailed statistics regarding the general population presenting to the emergency department during the study period, we were unable to analyze how our study population differed from this general population. CA-MRSA caused infection across all age and racial groups, and in any given patient with an abscess, CA-MRSA was overwhelmingly likely to be the causative agent.

Further areas of study might include randomized controlled trials of the use of antibiotics after drainage of abscesses as well as randomized trials to determine whether packing abscesses with gauze improves outcome. **NCMJ**

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