

The prevalence of asymptomatic methicillin-resistant *Staphylococcus aureus* in school-age children

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Abstract. To investigate the prevalence of asymptomatic methicillin-resistant *Staphylococcus aureus* (MRSA) in school-age children, we conducted a cross-sectional study. We investigated the prevalence of asymptomatic MRSA in children at a single, private school serving a low-income population in 2009. The school possesses Kindergarten through 8th grade classes. We excluded all children currently on antibiotics effective against MRSA and all children treated for a skin infection in the previous month. We sampled a single surface culture from both anterior nares. Each swab was then tested for MRSA utilizing a polymerase chain reaction test. We collected the following data on each child: age, grade, gender, recent abscess, current antibiotics, family member with a recent abscess, health care worker living with student, and participation in sports. Our study included 87 school-age children (57% of the total population). The participants had a mean age of 9.5 years, 50.6% were female, 4.6% reported an abscess in the last year, 9.2% had a family member with an abscess in the last year, 26.4% had a healthcare worker at home, and 64.4% participated in organized sports. Six (6.9%) of the 87 children tested positive for MRSA. There was no significant difference between MRSA positive students and MRSA negative students for age, grade, gender, abscess in last year, family member with an abscess, healthcare worker in the family and sports participation. The prevalence of MRSA in asymptomatic school-age children was seven percent. Compared to other point prevalence studies, the prevalence of MRSA colonization appears to be rising.

Key words: Children, MRSA, carrier

1. Introduction

Community acquired methicillin resistant *Staphylococcus aureus* (CA-MRSA) has emerged as an important pathogen in the community. CA-MRSA is the cause of serious infections in many sites on the body but most commonly causes skin and soft tissue infections. Although there are several known risk factors for CA-MRSA, there are none that have a good predictive value. Some of the suspected risk factors include: skin trauma, frequent skin to skin contact, limited access to healthcare, and frequent exposure to antibiotics. An important predictor was discovered in a 2002 study by Nakamura et al. (1) they swabbed 500

asymptomatic children presenting at well-child visits in Nashville, Tennessee. Six patients (1.2%) were colonized with CA-MRSA. They also found a healthcare worker in the home as the only significant predictor variable (odds ratio 9.6, $p < 0.01$) for nasal colonization of CA-MRSA.

Individuals colonized with CA-MRSA serve as a reservoir for infection. The most common location for colonization is the anterior nares, however the axillae and groin can also be colonized. In a 2004 study by Davis et al. (2) they performed nasal cultures on 758 prospective adult patients admitted to five hospitals and followed them prospectively. They found 3.4% of patients colonized with CA-MRSA. Nineteen percent of people colonized with CA-MRSA at admission and 25% of people who became colonized later went on to develop CA-MRSA infections.

Surveillance by the National Health and Nutrition survey in 2003-2004 estimated that the prevalence of nasal colonization in children aged 1-19 was 1.9% in the US. This has increased from 0.6% in 2001-2002 (3).

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Along with colonization, CA-MRSA infections are on the rise. In a 14-year retrospective study of pediatric inpatients and outpatients by Purcell et al.(4), the number of cases of CA-MRSA infections ranged from 0 to 9 per year from 1990 through 1999 and then increased exponentially from 36 in 2000 to 459 in 2003. Ninety percent of these cases occurred in children without risk factors for infection.

Nasal colonization of CA-MRSA is a relatively new epidemic in both children and adults. There is inadequate data available about the prevalence of CA-MRSA colonization, particularly in children. Our objective was to investigate the prevalence of asymptomatic CA-MRSA colonization in a low-income, school-age population.

2. Materials and methods

We conducted a cross-sectional study. We investigated the prevalence of asymptomatic MRSA in children at a single school in the greater Cincinnati, Ohio metropolitan area. The school is a private institution serving a surrounding low-income population. The school possesses Kindergarten through 8th grade classes. The 2006 average adjusted gross income (AGI) for the area served by the school was \$28,843 that represents a national AGI ranking of 12% (5). Approximately 87.9% of the population in the area are of Caucasian race and 9.7% are African American (6). Health Insurance Portability and Accountability Act (HIPAA) consent. In addition, all students received an informed consent written to their level of understanding. All children at the school whose parent signed the study consents were included. On the day of the study, (Spring 2009), we excluded all children currently on antibiotics that could be effective against MRSA (sulfamethoxazole/trimethoprim, Doxycycline, Clindamycin) and all children treated for a skin infection/abscess in the previous month. Exclusions were determined by interview on the day of data collection. We cultured all of the children on the same day during school hours utilizing four clinicians, (three physicians, and one registered nurse). We sampled a single surface culture from both anterior nares (one swab rotated in both nostrils). Each swab was then tested for CA-MRSA utilizing a polymerase chain reaction (PCR) test. We collected the

following data on each child: age, grade, gender, abscess in the last year, current antibiotics, family member with an abscess in the last year, health care worker living with student, and participation in sports. The data was collected on the day of nasal MRSA sampling from each student. Our outcome of interest was the prevalence of students with asymptomatic CA-MRSA by PCR testing reported as a percentage of the total number of children studied. We utilized Pearson chi-square, Fischer's exact test and T-tests to compare the CA-MRSA positive students to CA-MRSA negative students for categorical and continuous predictor variables respectively.

The primary investigator notified the parents of all students with asymptomatic CA-MRSA by telephone within one week of the testing. Each parent of a positive child was notified of the current recommendations for asymptomatic CA-MRSA and potential eradication options.

3. Results

Out of the 156 total students at the school, 89 parents (57%) gave us permission to include their child in the study. Two of these students were absent on the only day of testing. No students were excluded for having an abscess in the previous month. Four students reported being on antibiotics on the day of testing. All four were taking amoxicillin. These students were not excluded since amoxicillin lacks coverage against CA-MRSA. Thus, our study population included 87 school-age children. The participants had a mean age of 9.5 years, 50.6% were female, 4.6% reported an abscess in the last year, 9.2% had a family member with an abscess in the last year, 26.4% had a healthcare worker at home, and 64.4% participated in organized sports. Six (6.9%) of the 87 children tested positive for CA-MRSA. There was no significant difference between CA-MRSA positive students and CA-MRSA negative students for age, grade, gender, abscess in last year, family member with an abscess, healthcare worker in the family and sports participation (Table 1).

4. Discussion

It is likely that CA-MRSA infections are increasing in incidence, and it is probable that asymptomatic colonization is also increasing in the community. The data from investigators

Table I. School-age children and CA-MRSA

	Positive CA-MRSA (N=6)	Negative CA-MRSA (N=81)	p value
Age	8.50 ±2.6 years	9.6±2.6 years	0.31
Grade	2.83±2.4	3.87±2.5	0.33
Gender			1
Male	3 (50%)	40 (49.4%)	
Female	3 (50%)	41 (50.6%)	
Abscess in last year			1
Yes	0 (0.0%)	4 (4.9%)	
No	6 (100%)	77 (95.1%)	
Family member abscess/1 yr			0.09
Yes	2 (33.3%)	6 (7.4%)	
No	4 (66.7%)	75 (92.6%)	
Healthcare worker/home			0.18
Yes	3 (50%)	20 (24.7%)	
No	3 (50%)	61 (75.3%)	
Sports			0.66
Yes	3 (50%)	53 (65.4%)	
No	3 (50%)	28 (34.6%)	

Nakamura, Davis and Gorwitz suggest increasing colonization (1-3). Another study investigating colonization in children, Creech et al. (7) swabbed 500 children presenting at health maintenance visits. They found the rate of CA-MRSA colonization in a healthy pediatric population in Nashville, TN to be 9.2%. This rate was significantly higher than a previous investigation at the same institution, three years earlier. Similar to Nakamura, they found having a healthcare worker in the family as the only significant predictor for CA-MRSA (OR 2.0, 95% CI 1.03-4.10).⁵ In contrast, a 2009 study by Malik et al. (8), in which they swabbed 259 subjects from the community, showed the rate of colonization among persons aged 2-65 was only 1.2%. Malik et al. only included individuals who were low-risk for CA-MRSA colonization. Individuals with elevated risk, (nursing home, recent hospitalization, healthcare worker, emergency room visit, etc.) were excluded from their investigation. Our study focused on a low-income, moderate CA-MRSA risk, pediatric population. The seven-percent prevalence of CA-MRSA is very comparable to that found in the pediatric population by Creech et al. (7) in Nashville, TN. These two studies suggest that asymptomatic colonization of CA-MRSA has increased in the pediatric population over the last decade. Although our study possessed no

significant predictors of colonization, two variables were almost significant even with the relatively small study population. Both having a “healthcare worker at home” and “family member with an abscess/last year” were almost significant, a slightly larger study population with the same prevalence would have yielded different statistical results. It is also interesting that all four students who reported an abscess on themselves in the last year were all negative for CA-MRSA at the time of our investigation.

Currently there are no recommendations for children who are found to be carriers of CA-MRSA. In our study, we notified the parents of any child who tested positive. Participants were given information and treatment options on being a CA-MRSA carrier. In the interim between testing and the available results (seven days later), one of the six positive children developed a skin abscess. When we notified the parent of this child, they informed us they were already on topical nasal and systemic treatment for a suspected CA-MRSA infection. The other five children were without symptoms when they were contacted about their results.

CA-MRSA colonization of the nose is an endemic risk factor for serious infections like bacteremia and abscess formation. Most CA-MRSA infections are caused by the patient’s own bacteria. Autoinfection rates are very high in

MRSA carriers (9,10), What is not clear is whether treating carriers prevents skin and soft tissue infections. Although there are reports of CA-MRSA resistance, decolonization with mupirocin is typically very effective immediately post-treatment (9,11,12). However, following eradication with mupirocin, studies have not found a decrease in subsequent infections long-term (3,13). Re-colonization of patients could be playing a considerable role in these cases since several investigators have found that a healthcare worker at home as the greatest risk factor for colonization. A clinical trial eradicating CAMRSA from both the carrier and all household contacts has yet to be conducted.

There are important limitations to our study. The school we sampled may not be representative of the general pediatric population. Our population was from a low-income area. The prevalence of CA-MRSA carriers is unknown for most geographical locations, however most investigations suggest it has been increasing for the last decade (1-3,7). In addition, the population for our study is from a low-income area, students from middle or high-income school district may be different. Finally, our study utilized only anterior nasal swabs for investigating CA-MRSA. Although this has been the standard used by most investigators, a few studies have utilized swabs from multiple sites including the axillae and groin in addition to the nares. It is possible that the actual prevalence of CA-MRSA in our population was higher than seven percent, however our results are limited to nasal colonization only.

5. Conclusion

The prevalence of CA-MRSA colonization in asymptomatic school-age children was seven percent. Compared to previous prevalence data, the prevalence of CA-MRSA colonization appears to be rising over the last decade.

Human subject approval statement

TriHealth Institutional Review Board approval was obtained prior to any data collection.

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