Nationwide Trends in Pediatric *Staphylococcus aureus* Head and Neck Infections

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**Objectives:** To evaluate the epidemiologic manifestations of pediatric *Staphylococcus aureus* head and neck infections nationwide and to identify possible trends in the antibiotic drug susceptibility of *S aureus* during a 6-year period.

**Design:** Retrospective review of microbiologic data from a peer-reviewed national database.

**Setting:** More than 300 hospitals nationwide.

**Patients:** All pediatric patients with head and neck infections involving *S aureus*.

**Main Outcome Measures:** Anatomic sites were divided into oropharynx/neck, sinonasal, and otologic infection categories. Demographic and antimicrobial drug susceptibility patterns were reviewed.

**Results:** A total of 21,009 pediatric head and neck *S aureus* infections that occurred between January 2001 and December 31, 2006 were gathered from the database. Predominance was observed in the oropharyngeal/neck category (60.3%). For all sites, the mean patient age was 6.7 years (range, 0–18 years), with a 51.7% male predominance. There was a high occurrence in the North East Central region of the United States. Overall, methicillin-resistant *S aureus* was seen in 21.6% of all patient isolates (n = 4,534), with rates of 11.8%, 12.5%, 18.1%, 27.2%, 25.5%, and 28.1% for 2001 through 2006, respectively. This represents a 16.3% increase in methicillin-resistant *S aureus* during these 6 years for all pediatric head and neck *S aureus* infections.

**Conclusions:** There is an alarming nationwide increase in the prevalence of pediatric methicillin-resistant *S aureus* head and neck infections. Disparities in the treatment of various head and neck infections nationwide may contribute to the regional differences in the prevalence of such infections. Judicious use of antibiotic agents and increased effectiveness in diagnosis and treatment are warranted to reduce further antimicrobial drug resistance in pediatric head and neck infections.

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*The first outbreaks of methicillin-resistant *Staphylococcus aureus* (MRSA) were reported in the 1960s. Today, MRSA accounts for 50% to 70% of all *S aureus* isolates, with a $4.2 billion annual financial impact in the United States.*

*Staphylococcus aureus* is a pathogen commonly seen in many infections involving the head and neck. In recent years, there have been increasing reports of CA-MRSA infections in children. Studies of otolaryngologic infections involving CA-MRSA emerged in the 1990s. Most of these studies regarding such infections in the pediatric population have lacked sufficient numbers, and regional discrepancy has not been established. In light of the clinical and epidemiologic concerns regarding the increasing reports of MRSA nationally, we believed that an evaluation of national trends in prevalence and microbiologic susceptibility was warranted.

**METHODS**

After receiving approval from the Emory University institutional review board, we obtained a retrospective microbiologic data query targeting all pediatric *S aureus* head and neck
infections from January 1, 2001 to December 31, 2006. The data were acquired from The Surveillance Network (Eurofins Medinet, Chantilly, Virginia), a peer-reviewed national electronic microbiology database that collects strain-specific antimicrobial drug resistance test results daily from clinical laboratories representing more than 300 hospitals across the United States. The query search included demographic information, such as age, sex, region and state, report date, source, and inpatient vs outpatient status at the time of culture. In addition, susceptibility results were obtained for various antimicrobial agents. The US regional representation was divided into 9 areas: East North Central, East South Central, Mid-Atlantic, South Atlantic, Mountain, New England, Pacific, West North Central, and West South Central.

The results included specimens obtained from various head and neck infections from 9 locations: middle ear, external auditory canal, cervical lymph node, mandible, nasopharynx, nasal cavity, oral cavity, sinus cavity, and oropharynx. For analysis, data from each head and neck subsite were allocated into 1 of the following 3 categories: oropharynx/neck, sinonasal, and otologic. Comparisons were made using the Marascuillo statistical analysis procedure with 95% confidence intervals; P < .05 was considered statistically significant.

## RESULTS

A total of 21,009 patients aged 0 to 18 years were obtained from The Surveillance Network query. The mean patient age was 6.7 years, with a male predominance (10,861 [51.7%]). The sex of 296 patients was not reported. Most of the results were obtained from an outpatient setting (15,229 [72.5%]) vs an inpatient setting (5780 [27.5%]). There was significant variance in the number of results in the different regions: East North Central, 4202 [20.0%]; East South Central, 1878 [8.9%]; Mid-Atlantic, 2429 [11.6%]; South Atlantic, 2602 [12.4%]; Mountain, 1555 [7.4%]; New England, 562 [2.7%]; Pacific, 3051 [14.5%]; West North Central, 2626 [12.5%]; and West South Central, 2104 [10.0%]. The oropharynx/neck group included most of the patients, with a total of 12,673 (60.3%). This was followed by the sinonasal group, totaling 7896 (37.5%), and then by the otologic group (n = 440; 2.0%).

A total of 4534 samples (21.6%) were MRSA, based on oxacillin sodium resistance. The breakdown for the 6 study years is shown in the Figure. Methicillin-susceptible isolates totaled 16,333. An additional 26 isolates were intermediate susceptible, and 116 isolates had no results for susceptibility testing and were excluded from the calculations. Among the 3 head and neck groups, the highest proportion of MRSA was found in the otologic group (34%), followed by the sinonasal (28.3%) and oropharynx/neck (14.2%) groups. Clindamycin hydrochloride hydrate resistance was seen in 3714 (18%) of all S aureus samples. However, in considering MRSA samples only, there were 2118 (47%) with resistance to clindamycin.

## COMMENT

The growing concern about the recent worldwide MRSA epidemic has fueled the curiosity of the scientific community to gain insight into the clinical and epidemiologic manifestations of this microbe. Presently, physicians assume MRSA to be the cause of almost every skin infection, leading to an overall change in the empirical treatment of such infections. In doing so, selection of resistant organisms emerges in CA-MRSA and hospital-acquired MRSA. The data presented in this study corroborate with other regional data, specifically demonstrating an increasing trend of MRSA prevalence in all regions of the United States between January 1, 2001 and December 31, 2006.

Previous studies have established that most skin and soft tissue infections in many US communities are due to CA-MRSA. In the pediatric population, there have been several institutional observations of a significant rise in CA-MRSA in head and neck infections. Almost 60% of all MRSA pediatric head and neck infections in this study were from outpatient sources, suggestive of CA-MRSA. This points to the possibility that CA-MRSA is more common than MRSA from a nosocomial source (hospital-acquired MRSA). In 2001, approximately 12% of all isolated S aureus in this study was methicillin resistant (336 of 2842). During the ensuing 5 years, this number steadily rose to more than 28% (1124 of 3998), a 16.3% increase. The largest increase, approximately 9%, was seen between 2003 and 2004.

Among the 3 head and neck infection groups, the highest rate of MRSA was seen in the otologic group, which also demonstrated the highest prevalence of antimicrobial drug resistance. The most resistant antimicrobial drug pattern is typically seen in hospital-acquired MRSA and seldom in CA-MRSA. Similarly, 93% of CA-MRSA has been shown to be susceptible to clindamycin. In this study, more than 46% of all MRSA isolates were resistant to clindamycin. This finding suggests increasing antimicrobial drug resistance in CA-MRSA.

Grouping of the samples into hospital-acquired MRSA vs CA-MRSA was based on treatment location data given as inpatient (also rehabilitation and intensive care unit) and outpatient (also clinic and emergency department). The lack of detail pertaining to microbiologic characterization of isolates, in addition to the related clinical circumstances surrounding the culture acquisition, may represent a bias in some samples in each of these groups.
The differences in the numbers in each geographic region occurred because of the unequal hospital participation in The Surveillance Network. This presented a bias in the ability to accurately determine each regional incidence or prevalence of such infections. Nevertheless, proportional comparisons within the regions were possible, showing a significant increase in MRSA prevalence in each region between January 1, 2001 and December 31, 2006. Characterization of specific strain patterns using pulsed-field gel electrophoresis would provide additional insight into the clonal distribution of these infections.

In conclusion, the results of this study depict an alarming increase in MRSA in the United States. There is an increasing trend of clindamycin resistance among MRSA isolates. Exquisitiously culture of suspected head and neck infections leading to more appropriate antimicrobial drug selection is highly recommended to avoid further resistant patterns. Further studies linking the microbiologic and clinical behaviors of MRSA are warranted to gain additional insight into the dynamic existence of this organism.

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REFERENCES