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Methicillin-resistant *Staphylococcus aureus* colonization among pediatric health care workers from different outpatient settings

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Abstract

Staphylococcus aureus colonization rates in pediatric health care workers from different types of outpatient settings were determined from December 2008 through May 2010. Colonization rates for *Staphylococcus aureus* and, specifically, methicillin-resistant *Staphylococcus aureus* (MRSA) rates were similar to the rates that have been reported for the general population. The predominant MRSA pulsed-field gel electrophoresis type associated with colonization in these health care workers is not MRSA USA300.

Keywords

MRSA; Skin and soft tissue infection; Bacterial carriage; Children; Health occupation risk

The number of skin and soft-tissue infections (SSTIs) treated in outpatient settings have increased, and most are due to community-associated methicillin-resistant *Staphylococcus aureus* (MRSA) (CA-MRSA).^{1,2} It is estimated that 74% of staphylococcal SSTIs treated in emergency departments in the United States are caused by MRSA USA300.³ In the United States, 32.4% of the general population is colonized with *S aureus* with 0.8% colonized with MRSA.⁴ Little information is available on outpatient health care workers' (HCW) MRSA

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colonization rates or associated risks. This is the first reported study on MRSA colonization rates among HCWs who work in different types of pediatric outpatient settings.

Materials and Methods

Observational study was conducted from December 2008 through May 2010 on HCWs from different outpatient settings in Atlanta, GA (2 emergency departments, a hospital-based clinic, and 9 community-based practices). HCWs who had direct patient contact were eligible and were asked to complete a brief survey. Study staff then collected a specimen from the HCWs' anterior nares to assess for presence of *S aureus*. Volume of SSTIs at each site was determined based on actual number of patient encounters seen for SSTIs in 2009 per site and total patient encounters seen during this same period, factoring in the number of eligible HCWs at each site.

Nasal swabs were streaked onto BBL CHROMagar MRSA medium (BD Diagnostics, Sparks, MD) and Mannitol salt agar (Remel, Lenexa, KS). Typical colonies were subcultured onto 5% sheep blood agar plates (Remel) and tested for the presence of clumping factor and/or protein A (Staphaurex; Remel). Antimicrobial susceptibility testing was performed using MicroScan (Siemens Healthcare, Deerfield, IL). Pulsed-field gel electrophoresis,⁵ staphylococcal chromosome cassette *mec* (SCC*mec*) *element* to identify SCC*mec* types II and IV only,⁶ and Panton Valentine leukocidin (PVL) toxin by coamplification of *lukS-PV* and *lukF-PV*⁷ were conducted as previously described.

The χ^2 tests or *t* tests were used to determine the association between *S aureus* colonization and potential risk factors. Because of the small number of HCWs colonized with *S aureus*, exact *P* values with a mid-*P* correction are reported. *S aureus* colonization rates were correlated with the number of SSTIs using Spearman's rank correlation (r_s) and the associated 95% confidence intervals were constructed using the Fisher-Z transformation. All statistical analyses were performed with SAS 9.2 (SAS Institute, Cary, NC).

Results

Table 1 shows the number and proportion of participants, the number who were colonized with *S aureus*, SSTIs seen for a site, and the number of SSTIs per 1,000 patients per site. Among 438 eligible HCWs, 53% (234) participated, 7 withdrew, resulting in 97% (227/234) completing the study. The *S aureus* colonization rate was 16.7% (38/227), MSSA colonization rate was 13.7% (31/227), and MRSA colonization rate was 3.1% (7/227). Number of SSTIs did not correlate with the number ($r_s = 0.304$, $P = .336$) or percentage ($r_s = -0.313$, $P = .322$) of HCW respondents colonized with *S aureus* at each site. The SSTI rate per 1,000 patients did not correlate with the number ($r_s = 0.179$, $P = .598$) or the percentage ($r_s = -0.311$, $P = .353$) of HCW respondents colonized with *S aureus* at each site. HCWs with MRSA colonization had an average of 8 (± 3.5) risk factors, whereas HCWs with MSSA colonization had an average of 4 (± 2.3) risk factors, $P < .001$. Among HCWs (3.1%, 7/227) colonized with MRSA, 85.7% (6/7) were women and white; all were 21 to 60 years of age and worked at least 20 hours per week; 3 were physicians (42.8%, 3/7); 3 were nurses (42.8%, 3/7); and 1 was a nurse practitioner (14.4%, 1/7). Risk factors were surveyed for *S aureus* colonization, MRSA colonization, and MSSA colonization (data not shown but available on request), and only prior surgery was associated with MRSA colonization (71.4%, 5/7, $P = .026$).

There were 36 *S aureus* colonization isolates available for molecular typing. For MRSA isolates, USA300 accounted for 28.6% (2/7); both were from physicians who did not recall treating anyone with MRSA in the previous 12 months. Other MRSA isolates were USA100

(57.1%, 4/7) and USA800 (14.3%, 1/7). MRSA USA300 isolates had a SCC*mec* type IV element and were positive for PVL genes. MRSA USA100 isolates were SCC*mec* type II and negative for the PVL genes and the MRSA USA800 was SCC*mec* type IV and negative for the PVL genes (Table 2). 28.6% (2/7) of MRSA isolates were susceptible to ciprofloxacin and 42.9% (3/7) to clindamycin, compared with 96.8% (30/31) of MSSA isolates found susceptible to ciprofloxacin and clindamycin.

Discussion

Our results suggest that working in settings where the majority of SSTIs are evaluated is not associated with higher risk for *S aureus* colonization and, specifically, not a higher risk for MRSA colonization among HCWs. The rates of *S aureus* colonization among our sample of HCWs were no higher than what has been reported for the general population nationally.^{4,8} Although Graham et al reported MRSA colonization rate of 0.84% based on 2001-2002 National Health and Nutrition Examination Survey data,⁴ our 3.1% MRSA colonization rate was similar or lower to what has been reported more recently⁹ and in our own *S aureus* colonization surveillance of children accessing care in outpatient settings for non-SSTI conditions (unpublished findings). Moreover, our MRSA colonization rate is within the range (2%-15%) found for non outbreak MRSA colonization rates among HCWs reported by Hawkins et al.¹⁰

We did find a significant association between MRSA colonization and prior surgery. All but one of these MRSA were non-USA300, suggesting that non-USA300 isolates are still contributing to health care-acquired infections and colonization even as we continue to see more and more health care-associated MRSA USA300 infections.¹¹

The majority of MRSA colonization isolates demonstrated resistance to ciprofloxacin (71.4%, 5/7), and over half were resistant to clindamycin (57.1%, 4/7). These high resistance rates may reflect the widespread use of both of these anti-infectives in response to high rates of CA-MRSA infections seen in the outpatient settings.¹² Further studies are needed for us to ascertain whether this is indeed an explanation for the high rates of clindamycin and ciprofloxacin resistance among these isolates. The majority of MRSA colonization isolates were USA100. Although these strains have been traditionally associated with health care-associated infections, they have recently been reported to cause CA-MRSA skin and other types of infections.¹¹

We were not able to quantify the number of SSTIs seen by each HCW. This study was a point-prevalence determination of *S aureus* colonization, and, thus, we were not able to distinguish the transient from the persistent *S aureus* colonizing HCW. Our cultures were from nares only, and did not use an enrichment step, and, hence, it is possible that our *S aureus* colonization rates may be an underestimation of the true *S aureus* prevalence rate in our study population.

Results provide baseline MRSA colonization rates for HCWs from outpatient settings. Current recommendations in the United States and other parts of the world do not suggest routine screening of HCWs in these settings.¹⁰ This study's findings suggest that current standards for infection prevention and control in the different pediatric outpatient settings included in our study are adequate and that HCWs from these outpatient settings are not necessarily at higher risk for *S aureus* or MRSA colonization.

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Table 1
Health care work setting characteristics

Ambulatory setting type	Participants enrolled, n (%) [*]	Participants with <i>S aureus</i> colonization, n	Number of SSTIs seen (per 1,000 patient visits)
Pediatric ED 1	49 (49.1)	6	2,350 (61)
Pediatric ED 2	33 (80.8)	7	2,757 (54.7)
Hospital-based clinic	18 (87.5)	4	112 (4.1)
Community-based clinic 1	12 (85.7)	1	5,603 (133)
Community-based clinic 2	9 (50.0)	2	105 (5.9)
Community-based clinic 3	7 (46.7)	1	187 (6.7)
Community-based clinic 4	12 (42.9)	3	385 (13.6)
Community-based clinic 5	12 (48.0)	1	277 (10.8)
Community-based clinic 6	8 (25.8)	0	320 (10.2)
Community-based clinic 7	28 (48.3)	5	600 [†]
Community-based clinic 8	25 (73.5)	5	273 (7.6)
Community-based clinic 9	14 (33.3)	3	385 (11.8)
Total	227	38	13,354 (309.4) [‡]

ED, Emergency department.

^{*}The percentage of those HCWs enrolled among who were eligible from each site.

[†]This community clinic declined to provide data on total number of patient visits for the site.

[‡]Total number of SSTIs per 1,000 patient visits is an underestimation because of one clinic (community-based clinic 7) declining to provide total patient visits for the time period.

Table 2

Characteristics of health care workers with MRSA colonization

Risk factor category										
HCW	Work site	Profession	Years as HCW	PFGE type	PVL status	SCC <i>mec</i>	Work (2)	Medical (7)	Lifestyle (2)	Household member (7)
1	ED 1	Nurse	>10	USA 100	-	II	2	3	0	1
2	CC 9	Other	>10	USA 800	-	IV	2	4	1	1
3	H Clinic	Doctor	1-5	USA 300	+	IV	1	0	0	1
4	CC 7	Doctor	>10	USA 300	+	IV	2	3	0	0
5	ED 1	Nurse	>10	USA 100	-	II	2	5	0	1
6	CC 8	Nurse	1-5	USA 100	-	II	1	6	0	3
7	CC 9	Nurse	>10	USA 100	-	II	2	2	0	0

CC, Community clinic; ED, emergency department; *H clinic*, hospital-based clinic; *PFGE*, pulsed-field gel electrophoresis; *PVL*, Panton Valentine leukocidin.

NOTE. Risk factor categories were divided into work related, personal medical, lifestyle, and household members. For each category, there were 2 work risks, 7 personal medical risks, 2 lifestyle risks, and 7 household member risks.