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Surveillance Cultures for Detection of Methicillin-Resistant *Staphylococcus aureus*: Diagnostic Yield of Anatomic Sites and Comparison of Provider- and Patient-Collected Samples

Ebbing Lautenbach, MD, MPH, MSCE^{1,2,3,4}, Irving Nachamkin, PH, MPH⁵, Baofeng Hu, MD^{3,5}, Neil O. Fishman, MD^{1,4}, Pam Tolomeo, MPH³, Priya Prasad, MPH⁶, Warren B. Bilker, PhD^{2,3,4}, and Theoklis E. Zaoutis, MD, MSCE^{2,3,4,6}

¹Division of Infectious Diseases of the Department of Medicine, University of Pennsylvania School of Medicine, Philadelphia, PA

²Department of Biostatistics and Epidemiology, University of Pennsylvania School of Medicine, Philadelphia, PA

³Center for Clinical Epidemiology and Biostatistics, University of Pennsylvania School of Medicine, Philadelphia, PA

⁴Center for Education and Research on Therapeutics, University of Pennsylvania School of Medicine, Philadelphia, PA

⁵Department of Pathology and Laboratory Medicine, University of Pennsylvania School of Medicine, Philadelphia, PA

⁶Division of Infectious Diseases, Department of Pediatrics, The Children's Hospital of Philadelphia, Philadelphia, PA

Abstract

We studied provider- and patient-collected samples from multiple anatomic sites to determine yield for detecting MRSA. Sampling multiple sites was required to achieve a sensitivity <90% for MRSA colonization. Groin and perineum samples were significantly more often positive in community-onset MRSA. Agreement rates between provider- and patient-collected swabs were excellent.

Keywords

MRSA; sampling; anatomic sites

INTRODUCTION

The prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) has increased markedly. Although historically limited to healthcare settings, MRSA infections have also been increasingly reported in individuals in the community [1,2]. Infection control interventions and epidemiologic studies of MRSA rely heavily on the ability to accurately detect MRSA colonization. The nares represent the dominant ecological niche for *S. aureus* [3] and have typically been the sole anatomic site sampled when assessing *S. aureus* or MRSA colonization

Address correspondence to: Ebbing Lautenbach, M.D., M.P.H., M.S.C.E., University of Pennsylvania School of Medicine, Center for Clinical Epidemiology and Biostatistics, 825 Blockley Hall, 423 Guardian Drive, Philadelphia, PA 19104-6021, Telephone: (215) 898-6977, Fax: (215) 573-5315, Email: ebbing@mail.med.upenn.edu.

[4,5]. However, the nares are not uniformly positive in subjects with MRSA colonization [6, 7] suggesting that sampling of other anatomic sites may be important. However, the relative contribution of sampling other anatomic sites for detecting MRSA colonization is unclear [6–9]. Finally, the efficiency of community surveillance and research efforts could be substantially improved if patients could self-collect swab specimens. However, the yield of patient-collected swabs, compared to provider-collected swabs is unknown.

The goals of this study were to determine the sensitivity of different anatomic sites when assessing MRSA colonization and to compare the sensitivity of patient-collected swabs with provider-collected swabs to detect MRSA colonization.

METHODS

This study was conducted at two institutions: 1) the Hospital of the University of Pennsylvania (HUP), a 725-bed academic tertiary care adult medical center; and 2) The Children's Hospital of Philadelphia (CHOP), a 418-bed pediatric tertiary care hospital. The Institutional Review Boards at both institutions approved this study.

We employed a cross sectional study design to address the specific aims of this study. We identified all consecutive inpatients at HUP and CHOP known to be MRSA-colonized based on a prior positive clinical culture for MRSA during the same hospitalization or on a positive MRSA culture obtained during active surveillance (limited to admission nares swabs on patients admitted to the ICUs at HUP). Only those adult patients deemed able to self-collect samples and those pediatric subjects for whom a parent was able to collect the samples were considered eligible. Finally, each patient was included in the study only once.

For each study subject, research staff obtained swabs from the following anatomic sites: nares, axillae, throat, groin, and perineum. Immediately thereafter, the subject (or a parent), swabbed these same anatomic sites after receiving instruction from the research staff. To identify MRSA, swab samples were directly plated to ChromAgar MRSA (BD, Sparks, MD) plates [10].

The following data were obtained on all study subjects: age, sex, hospital location, and duration of hospitalization prior to date of sampling. Subjects identified as MRSA colonized based on clinical or surveillance cultures within 72 hours of hospital admission were considered to have community-onset MRSA (CO-MRSA). All other subjects were considered hospital-onset MRSA (HO-MRSA).

The sensitivity (and 95% confidence interval) of each specific anatomic site in identifying MRSA colonization was compared to the gold standard of identification of MRSA at any site. The sensitivity of MRSA detection was also calculated for various combinations of anatomic sites. These calculations were conducted separately for provider- and patient-collected swabs. Finally, we assessed the agreement between provider- and patient-collected swabs for each anatomic site. All statistical analyses were conducted using STATA version 10 (Stata Corp, College Station, TX).

RESULTS

From January 23, 2008 through May 1, 2008, 56 subjects with swabs positive for MRSA were identified and included in the study. Of these 56 subjects, 49 were identified from prior clinical cultures positive for MRSA while 7 were identified from prior positive MRSA cultures from active surveillance. Fifty subjects were from HUP while six were from CHOP. The median age of subjects was 62 (interquartile range, IQR = 45–71) and 41 (73%) were male. The median number of days from hospital admission to enrollment in the study was 10 (IQR = 6–18). Among the 56 study subjects, 55 were positive by provider-collected swabs while 55 were

positive on patient-collected swabs. One subject was positive only on provider-collected swabs and one subject was positive only on patient-collected swabs.

The nares were the most commonly colonized site for both provider- and patient-collected samples (Table 1). However, in order to achieve sensitivities of greater than 90%, sampling a combination of at least two sites was required. Nearly 25% of subjects would not have been identified as MRSA colonized if the nares had not been sampled while approximately 5% of subjects would have been missed had the throat not been sampled (Table 1).

The agreement between provider- and patient-collected swabs was excellent for all anatomic sites (Table 2). When there were discordant results between swabs collected by the provider and the patient, more often the patient-collected swabs were positive.

Eight subjects had swabs representing CO-MRSA. Sensitivities of MRSA detection in nares, throat, and axillae swabs did not differ significantly when comparing subjects with CO-MRSA and HO-MRSA. However, groin and perineum swabs were significantly more often positive for CO-MRSA isolates than HO-MRSA: 12 of 16 (75%) groin and/or perineum swabs were positive in CO-MRSA subjects compared to 31 of 94 (33%) swabs for HO-MRSA subjects ($p=0.002$, Fisher's exact test). Similar results were noted for patient-collected samples.

Results were not substantively different when restricting analyses to males vs. females. Finally, only six subjects were from CHOP. The results of all analyses described above were not substantively different when excluding these subjects (i.e., including only the adult subjects.)

DISCUSSION

We found that while the nares represent the most common site of MRSA colonization, multiple anatomic sites must be sampled to achieve a sensitivity $\geq 90\%$ for MRSA detection. We also noted a high level of agreement between patient- and provider-collected swabs. Finally, we found that CO-MRSA and HO-MRSA may differ with regard which anatomic sites are colonized.

Consistent with past work, we found that the anatomic site most often positive was the nares [6,9]. Indeed, given the number of patients for whom the nares were the only positive site, our results strongly emphasize the importance of sampling the nares in detection of MRSA. We found the throat to be the second most commonly colonized site. However, only a small proportion (i.e., 5–7%) of subjects would have been missed had the throat not been sampled. This differs from a recent report suggesting a more substantial role for sampling of the throat specifically [9]. Overall, our results are consistent with past reports, which demonstrated that substantially higher detection rates can be achieved by sampling a greater number of sites [7, 8,11]. Of course, this increased detection must be weighed against available resources for obtaining and evaluating swab samples.

We also noted that groin and perineum swabs were significantly more often positive in CO-MRSA isolates than HO-MRSA. Although it has been suggested that specific epidemic strains may have a predilection for certain anatomic sites [12], differences in colonization characteristics of CO-MRSA vs. HO-MRSA have not been well described. Although preliminary, our results suggest that sampling strategies may need to take into account the epidemiology of the organism under study.

Finally, we found a strong agreement between patient- and provider-collected samples. These results support the use of patient-collected sampling, which may improve considerably the efficiency of community-based surveillance and research. Indeed, it has been suggested that

well-designed community-based studies are required to further elucidate the epidemiology of MRSA and to improve strategies to control MRSA [13].

Our study had several potential limitations. The small sample size limited the ability to provide great precision around the sensitivities and 95% confidence intervals. In addition, although we defined CO-MRSA using accepted epidemiologic definitions, we did not further characterize MRSA isolates (e.g., *SCCmec* type). Our study was conducted in two institutions in one geographic region and focused on an inpatient population, some of whom had prior clinical cultures positive for MRSA. Generalizing the results to dissimilar institutions and populations should be undertaken with caution. Finally, the small number of pediatric subjects compared with adults limits the ability to draw conclusions about sampling in the pediatric population specifically.

This study demonstrates that multiple anatomic sites must be sampled to achieve a sensitivity $\geq 90\%$ for MRSA detection. Furthermore, the yield of different anatomic sites may differ for HO-MRSA and CO-MRSA. Finally, there is a high correlation between patient- and provider-collected samples. These results are important in better defining an accurate and efficient approach to MRSA detection in future surveillance and research efforts.

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Table 1

Sensitivities of Different Anatomic Sites

Provider-Collected Swabs		Patient-Collected Swabs	
Site	# positive (sensitivity; 95% CI) (n=55)	Site	# positive (sensitivity; 95% CI) (n=55)
<u>Single Sites</u>		<u>Single Sites</u>	
Nares	46 (84%; 71–92%)	Nares	50 (91%; 80–97%)
Throat	36 (65%; 51–78%)	Throat	37 (67%; 53–79%)
Axillae	17 (31%; 19–45%)	Axillae	20 (36%; 24–50%)
Groin	21 (38%; 25–52%)	Groin	29 (53%; 39–66%)
Perineum	22 (40%; 27–54%)	Perineum	23 (42%; 29–56%)
<u>Combinations of Sites</u>		<u>Combinations of Sites</u>	
Nares, throat	50 (91%; 80–97%)	Nares, throat	53 (96%; 87–100%)
Nares, axillae	47 (85%; 73–94%)	Nares, axillae	49 (89%; 78–96%)
Nares, groin	47 (85%; 73–94%)	Nares, groin	50 (91%; 80–97%)
Nares, perineum	48 (87%; 76–95%)	Nares, perineum	49 (89%; 78–96%)
Nares, throat, axillae	51 (93%; 82–98%)	Nares, throat, axillae	53 (96%; 87–100%)
Nares, throat, groin	54 (98%; 90–100%)	Nares, throat, groin	55 (100%; 93–100%)
Nares, throat, perineum	52 (95%; 85–99%)	Nares, throat, perineum	54 (98%; 90–100%)
<u>Only One Site Positive</u>		<u>Only One Site Positive</u>	
Nares only	12 (22%; 12–35%)	Nares only	13 (24%; 13–37%)
Throat only	4 (7%; 2–18%)	Throat only	3 (5%; 1–15%)
Axillae only	0 (0%; 0–6%)	Axillae only	0 (0%; 0–6%)
Groin only	1 (2%; 0–10%)	Groin only	1 (0%; 0–10%)
Perineum only	1 (2%; 0–10%)	Perineum only	0 (0%; 0–6%)

Table 2

Comparison of Provider- and Patient-Collected Swabs

Site	Agreement rate (%)	Number Identified only in Provider-Collected Swab	Number Identified only in Patient-Collected Swab
Nares	46/56 (82%)	3	7
Throat	51/56 (91%)	2	3
Axillae	49/56 (88%)	2	5
Groin	53/56 (95%)	2	1
Perineum	49/56 (88%)	3	4