PRELIMINARY REPORTS

PREVALENCE OF METHICILLIN-RESISTANT *Staphylococcus aureus* ON THE STETHOSCOPES OF EMERGENCY MEDICAL SERVICES PROVIDERS

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ABSTRACT

Objective. The investigation seeks to determine the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) on the stethoscopes of emergency medical services (EMS) providers. While stethoscopes are known fomites for MRSA, the prevalence of MRSA in the prehospital setting is not well documented in the literature. **Methods.** This was a prospective, observational cohort study of 50 stethoscopes provided by consecutive, consenting EMS providers at our academic emergency department (ED). Stethoscopes were swabbed with saline culture applicators and samples were cultured on a commercial MRSA test kit containing mannitol salt agar with oxacillin. After 72 hours of incubation at 37°C, two emergency physicians and one microbiologist analyzed the plates independently. MRSA colonization was recorded as positive if all three reviewers agreed that colonization had occurred. **Results.** Of 50 stethoscopes, 16 had MRSA colonization, and 16 (32%) EMS professionals had no recollection of when their stethoscopes had been cleaned last. Reported length of time since last cleaning was grouped into six categories: one to seven days, eight to 14 days, 15 to 30 days, 31 to 180 days, 181 days to 365 days, and unknown. The median time frame reported since the last cleaning was one to seven days. In the model, an increase from one time category to the next increased the odds of MRSA colonization by 1.86 (odds ratio = 1.86, p = 0.038). **Conclusions.** In this ED setting, MRSA was found on approximately one in three stethoscopes of EMS professionals. A longer length of time since the last stethoscope cleaning increased the odds of MRSA colonization. **Key words:** staphylococcus; methicillin resistance; stethoscopes

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INTRODUCTION

Background

Methicillin-resistant *Staphylococcus aureus* (MRSA) was first described in 1961 in the United Kingdom and is believed to have emerged because of widespread antibiotic use in hospitals.[1,2] The first known community-acquired MRSA (CA-MRSA) infection occurred in 1980 and was speculated to have spread from the hospital into the community.[1] Subsequently, CA-MRSA infections appeared without a connection to hospital or long-term health care centers. Some authors believe that MRSA infections began in the community without a hospital source.[3] Community outbreaks have occurred in intravenous drug users, athletes, nursing home patients, and prison inmates.[1]

Importance

The incidence of MRSA infections has significantly increased in the last several years. A recent review of the literature demonstrated that the incidence rate of invasive MRSA was 31.8 per 100,000 patients. The standardized mortality rate was 6.3 per 100,000 patients. The highest rates were found among persons over 65 years of age, African Americans, and males.[4] MRSA within the community has become so prevalent that one study demonstrated that 26% of community-acquired hand infections were MRSA-positive. The incidence increased to 47% in the last seven months of the study.[5]

While stethoscopes are known fomites for MRSA, the prevalence of MRSA in the prehospital setting is

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not well documented in the literature. Hospital literature has shown that 0.03% of stethoscopes contain MRSA.[6] Sanders evaluated 50 stethoscopes of general practice physicians in London and found that 22 carried coagulase-negative staphylococci; however, none carried MRSA.[7] This is in direct contrast to the study by Smith et al. in 1996, in which 2% of stethoscopes were positive for MRSA on medical and surgical wards as well as outpatient clinics.[8] Sanders concluded that stethoscopes containing MRSA were not a vector in the community but confined to the hospital. Cohen et al. demonstrated that zero of 50 communal stethoscopes had MRSA on the bell/diaphragm and one had MRSA on the earpiece.[9] One study actually found that stethoscopes with antimicrobial diaphragm covers impregnated with silver ions had higher bacterial colony counts than stethoscopes without covers.[10] Recently, ambulances have been shown to be a source of MRSA contamination, making them a potential vector of transmission to patients.[11] Thirteen samples were isolated from ten of 21 ambulances.

Goals of This Investigation

In our study, we sought to determine MRSA prevalence on the stethoscopes of emergency medical services (EMS) providers and evaluate if the period since the last cleaning is associated with the prevalence of MRSA. The existence of MRSA on any stethoscopes is a potential vector of transmission to patients. Identification of mechanisms by which MRSA is entering the hospital is crucial to decreasing its spread. Cross-contamination between patients is of particular concern.

METHODS

Study Design

A prospective, observational cohort of 50 stethoscopes provided by convenience sampling of consecutive, consenting EMS providers at our academic emergency department (ED) was studied for MRSA colonization. Institutional review board (IRB) permission was obtained from our medical school, and a collaborative agreement was established with our university hospital. Verbal consent was obtained from all individuals who participated in the study prior to swabbing stethoscopes. Providers were excluded if their stethoscopes had already been swabbed the same day.

Setting

Our tertiary care center evaluates 80,000 patients per year in an urban area surrounded by multiple suburban towns. EMS personnel entering the ED were both paid and volunteer from multiple municipalities. They consisted of paramedics, emergency medical technicians, and mobile intensive care nurses.

Method of Measurement

The diaphragms of the stethoscopes were swabbed with sterile Dacron cotton-tipped applicators with 0.85% saline. Samples were cultured on a commercially available plate containing 6.5% mannitol salt agar with 4 μg/mL oxacillin (Hardy Diagnostics, Santa Maria, CA). Cultures were plated immediately after swabbing each individual stethoscope.

Selection of Participants

Stethoscopes were swabbed as EMS providers entered the ED with patients or exited after patients were brought into the hospital. EMS professionals had no knowledge prior to their arrival that a study was being completed, and were queried upon sampling as to when they had cleaned their stethoscopes last.

Primary Data Analysis

Plated cultures were incubated for 72 hours at 37°C. Two emergency physicians and one microbiologist analyzed the plates independently. Two of the authors, who were inexperienced in identification of MRSA, used the expertise of an available microbiologist. MRSA contamination was considered positive if all three agreed that at least one colony forming unit (CFU) was present. Samples were not sent to the laboratory to reduce costs and because it was felt that independent verification by the emergency physicians and microbiologist was adequate. The interrater reliability between the three was 1.0. A univariate logistic regression with robust standard errors was created to predict positive MRSA colonization based on categorical time since the last cleaning.

RESULTS

Fifty stethoscopes were sampled, and all plates were incubated. Reported length of time since the last cleaning was grouped into six categories: one to seven days, eight to 14 days, 15 to 30 days, 31 to 180 days, 181 to 365 days, and unknown. No consistent cleaning methods were determined from the EMS providers. These categories were used out of convenience, since almost no provider could determine an exact date of last cleaning. The median reported length of time since the last known cleaning was one to seven days. Sixteen of the 50 plates (32%) grew MRSA after 72 hours of incubation time. Four of 23 (17.39%) stethoscopes cleaned in the preceding one to seven days tested positive for MRSA, as did one of three (33.33%) stethoscopes cleaned in the

Table 1. Cleaning of Stethoscopes and Rate of Positivity for Methicillin-Resistant*Staphylococcus aureus* (MRSA)

Reported Last Cleaning	MRSA Positive
1–7 days	4/23 (17.39%)
8–14 days	1/3 (33.33%)
15–30 days	3/3 (100%)
31–180 days	0/3 (0%)
181–365 days	2/2 (100%)
Unknown	6/16 (37.5%)
Total	16/50 (32%)

Odds ratio (standard error) = 1.859 (0.557); p = 0.038.

preceding eight to 14 days, three of three stethoscopes (100%) cleaned in the preceding 15 to 30 days, zero of three stethoscopes (0%) cleaned in the preceding 31 to 180 days, two of two stethoscopes (100%) cleaned in the preceding 181 to 365 days, and six of 16 stethoscopes (37.5%) with an unknown length of time since the last cleaning. The data from the 16 stethoscopes with an unknown length of time since the last cleaning were excluded from the model. Logistic regression revealed that an increase from one time category to the next increased the odds of positive MRSA colonization by 1.86 (odds ratio = 1.86, p = 0.038, 95% confidence interval = 1.05–17.71). Overall, 16 of the 50 (32%) stethoscopes tested positive for MRSA. Thirty-two percent of EMS providers did not know the last time they had cleaned their stethoscopes. Results are summarized in Table 1.

Discussion

The prevalence and antimicrobial resistance of MRSA are increasing problems in the United States. The medical community must take action to identify both appropriate antimicrobial agents and sources of infection. Despite a lack of controlled clinical evidence, outpatient MRSA infections can be managed with a variety of older antimicrobial agents. Trimethoprim–sulfamethoxazole, in addition to incision and drainage when indicated, is commonly used for outpatient management of many skin and soft-tissue infections because of a high rate of microbial susceptibility. Clindamycin may also be effective, although its use is limited because of the presence of a high risk of inducible resistance in the United States.[11]

In this study nearly one-third of stethoscopes were positive for MRSA. An increased length of time since the last reported cleaning was associated with increased odds of positive MRSA colonization. Additionally, nearly one-third of EMS professionals did not recollect when they had cleaned their stethoscopes last. The decision was made to exclude these stethoscopes from the analysis of time since the last cleaning. We could have included them in a category of greater than 365 days; however, we believed that if a person could not remember when his or her stethoscope was last cleaned, it would be false to assume that the cleaning was done more than 365 days ago. Although categorizing the stethoscopes into these groups assumes a linear relationship, we thought that these categories were necessary. Most providers were unsure about when they cleaned the stethoscope last. Most had to be prompted to provide an answer and were able to be specific only when the categories were read.

Limitations and Future Studies

Our study is limited by several factors. First, our sample size is relatively small. Attempting to have a researcher stay in the ED for longer periods of time results only in return of the same providers bringing in patients. We excluded use of the same stethoscopes a second time in our study, so we were limited to the geographic range of EMS providers coming into the ED. Our study also used a single hospital, although the providers were from multiple different regions surrounding the hospital. The results need to be duplicated at a different facility in a different region. Finally, by categorizing time periods into groups of days, we are assuming linear relationships in the data. Although this relationship may not exist, most providers needed categories to specify the amount of time since the last cleaning of their stethoscopes.

Conclusion

These findings suggest that MRSA is prevalent in the prehospital care environment; many EMS professionals are not taking action to prevent MRSA colonization. In most busy EMS systems, the concept of cleaning an entire ambulance after every patient is not practical. Cleaning a stethoscope, however, is not labor-intensive, does not require much time, and does not require any special equipment beyond currently stocked items.

This is the first recent study in the literature attempting to culture MRSA on prehospital stethoscopes. We found a source by which MRSA can be transmitted to patients and between patients. With the increasing incidence of MRSA, regular cleaning of hospitals' surfaces has grown in importance. We have initiated the availability of alcohol wipes at entrances for emergency service personnel. An additional research study is being completed in our institution evaluating the best method for cleaning stethoscopes. Also, we provide continuing education regarding the importance of cleaning stethoscopes after each patient. Continuing education is conducted by providing reminders from supervisors and hospital infection control. We will retest EMS providers after additional education regarding this finding and after initiating a campaign of "Don't forget to clean your hands and stethoscopes between every patient."

EMS professionals bridge in-hospital and out-of-hospital care. MRSA that is found in the prehospital

environment straddles the definitions of community-acquired and hospital-acquired MRSA. Hospital infection control policies need to include local EMS systems and evaluate them as vectors of patient infections.

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