Final Project Report
Ohio Division of EMS Injury Prevention Research Grant

"MRSA Colonization in EMS Personnel and Equipment as a Risk Factor for Secondary Injury in Ohio Trauma Patients"

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Introduction

Infection with methicillin resistant *Staphylococcus aureus* (MRSA) has become a significant problem in healthcare and community settings in the United States during recent years. Infection with this organism can result in significant morbidity and mortality and is recognized as a major public health threat. These organisms are capable of causing significant skin and soft tissue infections in patients with open wounds, such as trauma patients, or more severe infections such as bloodstream infections. In a recent study, the mortality rate of patients with invasive MRSA infection was 20%. It has been recognized that these organisms can be spread person to person on the hands or skin of healthcare workers or others and from the contaminated healthcare environment.

Since Emergency Medical Services (EMS) personnel are frequently the first level of healthcare that is provided to traumatically injured patients, they or their equipment could come into contact with open wounds or patients at high risk for infection. If the EMS personnel are colonized on their skin or their equipment contaminated with MRSA, they could serve as the entry point for MRSA to these susceptible patients. There are limited data on the prevalence of EMS colonization or contamination of EMS equipment with MRSA.

The purpose of the outlined research study was to systematically assess a representative sample of EMS agencies, personnel, and equipment from all 10 regions in Ohio to determine the prevalence of MRSA colonization among personnel and contamination of equipment to determine the potential risk of MRSA transmission to patients and to determine if further preventive interventions are warranted.

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Executive Summary

This study represents the first large statewide analysis of MRSA colonization among EMS personnel and contamination of ambulances. It is unique in that randomly selected agencies in all 10 regions with equal representation of urban and rural sites are included. Thus, the results are representative of the entire state. The most significant findings are that 50.6% of all agencies had an ambulance that was contaminated with MRSA. This rate is consistent with other studies cited [1] [2] but represents the estimated status across all of Ohio rather than one agency or region. The MRSA colonization rate of EMS workers is 4.6%, higher that the rate published for the general population [3] but in the range reported for other healthcare settings [4] [5] [6]. EMS personnel with MRSA colonization are more likely to have open wounds, have received antibiotics in the last year, and may have worked longer as an EMS worker. These data provide support for additional studies such as efforts to increase training in infection control and environmental cleaning. Molecular epidemiology methods can be applied to determine the actual risk of a patient acquiring MRSA from EMS personnel and equipment and further support interventions to prevent such transmission.

Investigator Qualifications

Kurt B. Stevenson, MD, MPH (Principal Investigator [PI]) is a specialist in clinical infectious disease and healthcare epidemiology and is Associate Professor of Medicine and Epidemiology in the Colleges of Medicine and Public Health at The Ohio State University. He is currently the PI on a 5 year CDC-funded Prevention Epicenter which focuses on developing strategies for enhanced surveillance and prevention of healthcare-associated infections (see http://www.cdc.gov/ncidod/dhqp/epicenter.html). One focus of the Epicenter grant has been to elucidate mechanisms of MRSA transmission. His Epicenter team has collected and genotyped >1600 MRSA isolates from across Ohio. He has completed a 5 year term on the Center for Disease Control and Prevention (CDC) Healthcare Infection Control Practices Advisory Committee (HICPAC). He has extensive experience working with both rural and urban health communities on many quality improvement efforts, most particularly improving antimicrobial prescribing and infection control.

Christopher Bell, **BA, NREMT-P, MPH** (Field Liaison and Research Assistant), formerly teaching in Emergency Medical Services at Columbus State Community College, is now a Program Manager for the Columbus Department of Health. He has been a paramedic since 1995 and the paramedic instructor since 2000. He recently completed a Masters of Public Health at the Ohio State University College of Public Health. He has served as the field research liaison with the all of the participating EMS agencies in this study.

Armando Hoet, DVM, PhD, (Laboratory Support) is an Assistant Professor in Veterinary Preventive Medicine at Ohio State University. He is trained as a Veterinarian and researcher and is engaged in research into MRSA in pet owners and companion animals. He has expertise in processing nasal and environmental samples and microbiologic laboratory expertise in identifying MRSA. His laboratory performed all of the MRSA culturing and identification for this study.

Bo Lu, Ph. D. (Statistical Support) is Assistant Professor in the Division of Biostatistics at College of Public Health, the Ohio State University. He is an expert on survey sampling and statistical analysis of observational studies and also has extensive experience on analyzing large public surveys, including Behavioral Risk Factor Surveillance System (BRFSS), Health Interview Survey (HIS), National Inpatient

Survey (NIS), and National Longitudinal Survey Youth (NLSY). Dr. Lu has provided the statistical support on survey design and data analysis.

Literature Review and Significance of the Topic

Methicillin resistant *Staphylococcus aureus* (MRSA) is an extremely prevalent bacterial pathogen that has been increasing as the most common healthcare-associated infection (HAI) and an important cause of community-acquired infections [7]. MRSA rates in hospitals in the United States have been increasing. Currently, more than 50% of *S. aureus* infections are caused by MRSA [8]. It accounts for more than 278,000 hospitalizations and 56,000 septic episodes annually [9]. In the hospital, MRSA infections are associated with longer length of stay, higher mortality, and increased costs [10]. MRSA was long considered a pathogen only acquired in the hospital [7]. Other healthcare settings, such as nursing homes and dialysis centers, have also been linked with MRSA infections [11]. Community-associated MRSA (CA-MRSA) infections, however, have recently been described in patients without any prior healthcare exposure [7 12 13]. Initial studies demonstrated that CA-MRSA isolates have a distinct molecular profile [14] that allows for molecular verification of CA-MRSA beyond a clinical or epidemiologic definition.

These community strains have been linked with high rates of emergency department (ED) visits [15 16]. In one study, MRSA was isolated from 320/422 ER patients (76%) and most of the isolates were the community strain [15]. In another study, emergency room visits for skin and soft tissue infections from all 50 states were examined from the National Hospital Ambulatory Medical Care Survey for 1993-2005 [16]. The number of ED visits for these infections increased from 1.2 million in 1993 to 3.4 million in 2005 correlating temporally with the emergence of community MRSA infections. Thus, ED and EMS workers likely have high exposure to and opportunity for colonization with MRSA. EMS equipment is also at high risk for contamination with MRSA given the increase of MRSA in the community and the high prevalence in the ED setting. Recent studies have demonstrated that community strains can establish residence in hospitals and are responsible for an increasing numbers of healthcare-associated infections [17 18 19].

The prevalence of MRSA in EMS personnel and equipment, however, is essentially unknown with data from only 2 small studies. In the first very small study of one ambulance fleet from the western USA, 10 of 21 (48%) ambulances cultured positive for MRSA [1]. An additional recent study examined 51 ambulances in southern Maine and demonstrated that 25 (49%) had at least one positive area for MRSA

contamination [20]. No other similar studies were found upon review of the existing medical literature. To date, there has not been a study to our knowledge that has examined the prevalence of MRSA colonization in EMS personnel. MRSA colonization has usually been determined by culturing the anterior nares of asymptomatic individuals [21 2 4 5 6]. A classic surveillance study of the general population often cited in this context showed an overall *S. aureus* colonization rate of 32.4% with MRSA colonization rate of 0.8% [3]. More recent studies have shown MRSA colonization rates of 7.4% in college students [2], 7.8% in ICU patients [4], 12.7% in home care patients [5], and 22% in long-term care [6]. The EMS personnel colonization rate, however, remains unknown. The current study examined both the EMS personnel colonization rate and the contamination rate of ambulances.

Research Methods

EMS agencies were randomly selected within each of the 10 EMS regions in Ohio. Each region was randomized separately to assure that our sample was representative of the entire state, proportionally representing urban and rural locations. Probability sampling with a geographically stratified two-stage cluster design was conducted. Within each of the 10 regions, we conducted a one-stage cluster sampling. The primary sampling unit was the EMS agency. We randomly selected a fixed number of EMS agencies. Given that the previous studies suggested that the prevalence for ambulance is about 50% and for statistical modeling, we estimated personnel prevalence of about 5%. To achieve the desired statistical accuracy, the calculated sample size was 440 ambulances and 740 persons in total, if we assume that the EMS agencies are quite similar [22]. Given the increased expense in culturing materials noted during the study, the sample size was reassessed and proportionally decreased to maintain culturing costs within budget and to preserve he statistical accuracy of the randomization.

All agencies randomized for inclusion were contacted and consented to participate. The field liaison, with the assistance of other members of the investigative team, traveled to each participating EMS agency, obtained informed consent from each of the personnel, performed nasal swabs of EMS personnel, followed by environmental swabs of the ambulance and equipment including items such as cot, backboard, patient care area to the right of the patient, bench seat, tourniquet, stethoscope and the blood pressure cuffs on each ambulance in the participating department. All samples were coded with a unique identifier code that protects the identity of the agency and EMS personnel. Each participant was

asked to complete an anonymous questionnaire collecting baseline demographic information as well as information related to length of certification, personal history of infection or hospital admission, residence with another healthcare provider, antibiotic exposure, and other information to determine whether the individual has any other risk factors for MRSA colonization aside from EMS occupational exposure (Survey is attached in the Appendix). There was no identifying information collected from the EMS personnel. All data were associated only by sample number to the location where the test was performed. This will provide protection of privacy and protected health information of the EMS personnel.

The nasal swab is a simple, non-invasive collection method and is the standard method for detecting MRSA colonization [23] [24]. These nasal swabs were placed immediately in Stuart's media for transport for transport to Dr. Hoet's laboratory at Ohio State University College of Veterinary Medicine where they were processed to determine the presence of MRSA following standard methods [25] [26]. Initial incubation was in tryptone soy broth media followed by culturing on mannitol salt agar supplemented with 2 µg/mL of oxacillin. After incubation, 3 typical MRSA colonies were plated on blood agar and confirmatory testing completed according to standard protocols (standard colony morphology on mannitol salt agar and blood agar, gram stain reaction, catalase reaction, coagulase reaction, and latex agglutination reaction for selected *S. aureus* antigens/proteins). Final confirmation for MRSA was confirmed by Mueller-Hinton agar supplemented with 4% NaCl and oxacillin (6µg/ml) incubated at 35-36°C for 24-48 hours. All positive isolates were be stored for future analysis. In addition to this study, participants who consented have their samples and data related to the samples stored for future research on MRSA and other organisms.

Analysis of Research Findings

In this statewide study, EMS agencies from each of the 10 EMS regions were sampled. This included 21 counties with 1-9 agencies per county sampled. There were a total of 155 ambulances at 83 agencies and 280 EMS personnel included in the analysis. At the first 30 departments (54 ambulances), we collected 12 samples in each ambulance for a total of 648 samples. In the remaining 53 departments (101 ambulances), we collected 3 pooled samples in each ambulance for a total of 303 samples. Each of these samples was incubated and 3 exemplar colonies were taken from each of those 951 samples for a total of 2853 colonies from ambulances grown and tested n the laboratory. Of the 83 departments we

sampled, 42 had at least one MRSA positive sample in an ambulance used in that department for an overall prevalence of 50.6% of agencies with at least one positive ambulance. In total, there were 48 positive ambulances out of the total 155 ambulances sampled (31%). All ambulances at each agency were tested and many of the second ambulances at each department were used as backup ambulances and had much less use than the primary unit.

Among the 280 EMS personnel who completed the survey and consented to be tested, 13 had positive anterior nares cultures for an overall colonization rate of 4.6%. This rate is higher than the large general population study previously cited [3] but is in the same range as other studies from healthcare settings [4 5 6]. Among the 13 colonized individuals, 6 (46%) worked at an agency with a contaminated ambulance. Future studies will examine the molecular typing of the MRSA in these settings to determine if there is clonal identity suggesting that the personnel may have directly acquired their MRSA colonization from the equipment. The colonized EMS workers had a mean age of 41 years compared to the non-colonized workers with a mean age of 37 (p=0.0305, t test) (See full data table in the Appendix). Most of the EMS workers surveyed were white (99%) and were male (88%).

We examined many parameters to attempt to ascertain a risk factor profile for the colonized workers (See Survey in Appendix). When comparing the survey results between colonized and non-colonized patients, the Fisher's exact test was applied to all proportionate data and significance was set at p value<0.1. These survey data represent unweighted results. As the data are further analyzed for publication in peer reviewed journals, additional statistical modeling will be applied and the survey will be weighted based on type of agency, location, etc. Thus the results may be modified in those analyses. The only significant differences between the colonized and non-colonized EMS workers can be noted on the data table. MRSA colonized personnel were more likely to have worker longer number of years (>26) than non-colonized workers (p=0.048). MRSA colonized individuals were more likely to have had an antibiotic prescription in the last year (p=0.072), specifically 9-12 months (p=0.073). Individuals with an open wound were more likely to been MRSA colonized (15% vs 2%, p=0.037). Interestingly, individuals who performed hand hygiene >12 times per day were more likely to be in the non-colonized group (p=0.038).

Conclusions

This study represents the first large statewide analysis of MRSA colonization among EMS personnel and contamination of ambulances. It is unique in that it randomly selected agencies in all 10 regions with equal representation of urban and rural sites. Thus, the results are representative of the entire state. The most significant findings are that about one half of all agencies had an ambulance that was contaminated with MRSA. This rate is consistent with other studies cited [1] [2] but represents the status across all of Ohio rather than one agency or a specific region. The MRSA colonization rate of EMS workers is 4.6%, higher that the rate published for the general population [3] but in the range reported for other healthcare settings [4] [5] [6]. EMS personnel with MRSA colonization are more likely to have open wounds, have received antibiotics in the last year, and may have worked longer as an EMS worker. Manuscripts for publication in peer reviewed journals will be result in further statistical modeling and analysis and will be submitted to the Ohio Division of EMS Injury Prevention as they are prepared.

Recommendations

Given the high rate of ambulance contamination, an intervention that focuses on improved infection control and ambulance equipment environmental cleaning has the potential of reducing the risk of MRSA transmission. This is the focus of our currently funded project from this agency. We are culturing ambulance equipment at baseline and after education sessions directed at infection control and environmental cleaning to determine if the contamination rates can be reduced by these interventions. We are also examining the molecular typing of MRSA isolates to determine if the same clones on equipment are colonizing EMS personnel. Future studies addressing the actual risk of acquiring MRSA from an ambulance or EMS worker with the subsequent development of infection could be considered given the sophistication of the molecular epidemiology methods currently available.

Appendix

Reference List

(1) Roline CE, Crumpecker C, Dunn TM. Can methicillin-resistant Staphylococcus aureus be found in an ambulance fleet? *Prehosp Emerg Care.* 2007;11:241-244.

(2) Rohde RE, Denham R, Brannon A. Methicillin resistant Staphylococcus aureus: carriage rates and characterization of students in a Texas university. *Clin Lab Sci.* 2009;22:176-184.

(3) Leithauser D. Urinary Tract Infections. *APIC Text of Infection Control and Epidemiology*. (RCT): APIC; 2005:-25-15.

(4) Kypraios T, O'Neill PD, Huang SS, Rifas-Shiman SL, Cooper BS. Assessing the role of undetected colonization and isolation precautions in reducing methicillin-resistant Staphylococcus aureus transmission in intensive care units. *BMC Infect Dis.* 2010;10:29.

(5) Lucet JC, Paoletti X, Demontpion C et al. Carriage of methicillin-resistant Staphylococcus aureus in home care settings: prevalence, duration, and transmission to household members. *Arch Intern Med.* 2009;169:1372-1378.

(6) Barr B, Wilcox MH, Brady A, Parnell P, Darby B, Tompkins D. Prevalence of methicillin-resistant Staphylococcus aureus colonization among older residents of care homes in the United Kingdom. *Infect Control Hosp Epidemiol.* 2007;28:853-859.

(7) Chambers HF. The changing epidemiology of Staphylococcus aureus? *Emerg Infect Dis.* 2001;7:178-182.

(8) National Nosocomial Infections Surveillance (NNIS) System Report, data summary from January 1992 through June 2004, issued October 2004. *Am J Infect Control.* 2004;32:470-485.

(9) Klein E, Smith DL, Laxminarayan R. Hospitalizations and deaths caused by methicillin-resistant Staphylococcus aureus, United States, 1999-2005. *Emerg Infect Dis.* 2007;13:1840-1846.

(10) Cosgrove SE, Qi Y, Kaye KS, Harbarth S, Karchmer AW, Carmeli Y. The impact of methicillin resistance in Staphylococcus aureus bacteremia on patient outcomes: mortality, length of stay, and hospital charges. *Infect Control Hosp Epidemiol.* 2005;26:166-174.

(11) Drinka PJ, Gauerke C, Le D. Antimicrobial use and methicillin-resistant Staphylococcus aureus in a large nursing home. *J Am Med Dir Assoc.* 2004;5:256-258.

(12) Naimi TS, LeDell KH, Como-Sabetti K et al. Comparison of community- and health care-associated methicillin-resistant Staphylococcus aureus infection. *JAMA.* 2003;290:2976-2984.

(13) Stevenson KB, Searle K, Stoddard GJ, Samore M. Methicillin-resistant Staphylococcus aureus and vancomycin-resistant Enterococci in rural communities, western United States. *Emerg Infect Dis.* 2005;11:895-903.

(14) Fey PD, Said-Salim B, Rupp ME et al. Comparative molecular analysis of community- or hospital-acquired methicillin-resistant Staphylococcus aureus. *Antimicrob Agents Chemother.* 2003;47:196-203.

(15) Moran GJ, Krishnadasan A, Gorwitz RJ et al. Methicillin-resistant S. aureus infections among patients in the emergency department. *N Engl J Med.* 2006;355:666-674.

(16) Pallin DJ, Egan DJ, Pelletier AJ, Espinola JA, Hooper DC, Camargo CA, Jr. Increased US emergency department visits for skin and soft tissue infections, and changes in antibiotic choices, during the emergence of community-associated methicillin-resistant Staphylococcus aureus. *Ann Emerg Med.* 2008;51:291-298.

(17) Berg M. Implementing information systems in health care organizations: myths and challenges. *Int J Med Inf.* 2001;64:143-156.

(18) Patel M, Kumar RA, Stamm AM, Hoesley CJ, Moser SA, Waites KB. USA300 genotype community-associated methicillin-resistant Staphylococcus aureus as a cause of surgical site infections. *J Clin Microbiol.* 2007;45:3431-3433.

(19) Popovich KJ, Weinstein RA, Hota B. Are community-associated methicillin-resistant Staphylococcus aureus (MRSA) strains replacing traditional nosocomial MRSA strains? *Clin Infect Dis.* 2008;46:787-794.

(20) Brown R, Minnon J, Schneider S, Vaughn J. Prevalence of methicillin-resistant Staphylococcus aureus in ambulances in southern Maine. *Prehosp Emerg Care.* 2010;14:176-181.

(21) Kuehnert MJ, Kruszon-Moran D, Hill HA et al. Prevalence of Staphylococcus aureus nasal colonization in the United States, 2001-2002. *J Infect Dis.* 2006;193:172-179.

(22) Lohr S. *Sampling: Design and Analysis*. Pacific Grove, CA : Duxbury Press; 1999.

(23) Muto CA, Jernigan JA, Ostrowsky BE et al. SHEA guideline for preventing nosocomial transmission of multidrug-resistant strains of Staphylococcus aureus and enterococcus. *Infect Control Hosp Epidemiol.* 2003;24:362-386.

(24) Huang SS, Platt R. Risk of methicillin-resistant Staphylococcus aureus infection after previous infection or colonization. *Clin Infect Dis.* 2003;36:281-285.

(25) Weese JS, DaCosta T, Button L, Goth K, Ethier M, Boehnke K. Isolation of methicillin-resistant Staphylococcus aureus from the environment in a veterinary teaching hospital. *J Vet Intern Med.* 2004;18:468-470.

(26) Kampf G, Lecke C, Cimbal AK, Weist K, Ruden H. Evaluation of mannitol salt agar for detection of oxacillin resistance in Staphylococcus aureus by disk diffusion and agar screening. *J Clin Microbiol.* 1998;36:2254-2257.

EMS Personnel MRSA Study Questionnaire Sample Number _____-_____

Age _____ Gender_____ Race_____

Height_____ Weight_____

EMS certification level **First Responder** EMT-Basic EMT-Intermediate EMT-Paramedic

How many years have you worked or volunteered in EMS at any certification level?

0-5 6-10 11-15 16-20 21-25 26 or more

Do you provide EMS at more than one transport agency? Yes No

How many hours in a typical week do you work or volunteer at an EMS transport agency?

0-20 21-40 41-60 61-80 81-100 over 100

Do you work in any other healthcare setting (doctor's office, hospital, nursing home, etc) besides EMS?

Yes No

Do you have any medical conditions for which you regularly visit a healthcare setting outside of work? (For instance: diabetes, kidney failure, serious heart disease, serious lung disease)

Yes No

Do you take any medications that suppress your immune system (corticosteroids, anti-rejection) ?

Yes No

In the last year, have you been admitted to (spent the night as a patient) the hospital? Yes No

0-3 months ago 3-6 months ago 6-9 months ago 9-12 months ago N/A

In the last year, have you taken a prescription antibiotic? Yes No

0-3 months ago 3-6 months ago 6-9 months ago 9-12 months ago N/A

In the past year, have you been diagnosed with a staph infection? Yes No

0-3 months ago 3-6 months ago 6-9 months ago 9-12 months ago N/A

Do you have any implanted medical device such as an artificial joint or pacemaker? Yes No

Do you have any skin lesions, boils, bumps, open wounds or skin infections? Yes No

In the last year, have you lived with anyone who works in a healthcare setting (doctor's office, hospital, nursing home, etc)?

Yes No

In the last year, has anyone you live with been diagnosed with a staph infection? Yes No

0-3 months ago 3-6 months ago 6-9 months ago 9-12 months ago N/A

In the last year, has anyone you live with been admitted to the hospital? Yes No

0-3 months ago 3-6 months ago 6-9 months ago 9-12 months ago N/A

In the last year, has anyone you live with taken a prescription antibiotic? Yes No

0-3 months ago 3-6 months ago 6-9 months ago 9-12 months ago N/A

How many times per day do you wash your hands?

0-3 4-7 8-11 12 or more

How often do you wash your hands after taking off gloves at your EMS work?

Never Rarely Sometimes Usually Always

If you wash your hands after taking off gloves at your EMS work, how do you usually wash your hands?

N/A Water alone Soap and water Alcohol-based handwash Other _____

If you clean your EMS equipment after use, how often do you wear gloves?

Never Rarely Sometimes Usually Always I don't clean the equipment

Do you share razors, towels, or work-out equipment with anyone else? Yes No

If yes, where (YMCA/health club, home, work)? _____

Do you have any pets at home? Yes No

If yes, what kind and how many of each pet?_____

Thank you for participating in this study!

Emergency Medical Services Personnel Survey Results

Characteristc	All EMS Personnel (n=280)	MRSA-colonized Personnel (n=13)	Non-colonized Personnel (n=267)	p value*
Age (Mean)	37	41	37	**0.0305**
Gender-Male	246/280 (88%)	13/13 (100%)	233/267 (87%)	NS
Race				
White	278/280 (99%)	13/13 (100%)	265/267 (99%)	NS
Black	1/280 (0.5%)		1/267 (0.5%)	NS
Hispanic	1/280 (0.5%)		1/267 (0.5%)	NS
Asian				
Presence of an ambulance within the agency contaminated with MRSA	142/280 (51%)	6/13 (46%)	136/267 (51%)	NS
EMS Certification Level				
First Responder	3/280 (1%)	0/13 (0%)	3/267 (1%)	NS
EMT-Basic	79/280 (28%)	5/13 (38%)	74/267 (28%)	NS
EMT-Intermediate	14/280 (5%)	1/13 (8%)	13/267 (5%)	NS
EMT-Paramedic	184/280 (66%)	7/13 (54%)	177/267 (66%)	NS
Years worked in EMS agency				
0-5	61/280 (22%)	3/13 (23%)	58/267 (22%)	NS
6-10	67/280 (24%)	3/13 (23%)	64/267 (24%)	NS
11-15	50/280 (18%)	2/13 (15%)	48/267 (18%)	NS
16-10	56/280 (20%)	1/13 (8%)	55/267 (20%)	NS
21-15	14/280 (5%)	0/13 (0%)	14/267 (5%)	NS
>26	32/280 (11%)	4/13 (31%)	28/267 (11%)	**0.048**
Worked at more than one EMS agency	114/280 (41%)	6/13 (46%)	108/267 (40%)	NS
Typical number of hours worked per week				
0-20	20/280 (7%)	2/13 (15%)	18/267 (7%)	NS
21-40	22/280 (8%)	2/13 (15%)	20/267 (8%)	NS
41-60	142/280 (51%)	5/13 (39%)	137/267 (51%)	NS
61-80	61/280 (22%)	4/13 (31%)	57/267 (21%)	NS
81-100	25/280 (9%)	0/13 (0%)	25/267 (10%)	NS
>100	10/280 (3%)	0/13 (0%)	10/267 (3%)	NS
Work in any other healthcare setting (doctor's office, hospital, nursing home, etc) besides EMS	32/280 (11%)	0/13 (0%)	32/267 (12%)	NS
Medical conditions requiring medical care (diabetes, kidney failure, serious heart disease, serious lung disease)	26/280 (9%)	1/13 (8%)	25/267 (9%)	NS
Ongoing immunosuppressive therapy	4/280 (1%)	1/13 (8%)	3/267 (1%)	NS
Recent hospitalization	17/280 (6%)	2/13 (15%)	15/267 (6%)	NS
Within the last 3-6 months	4/280 (1%)	1/13 (8%)	3/267 (1%)	NS
3-6 months ago	4/280 (1%)	0/13 (0%)	4/267 (2%)	NS
6-9 months ago	5280 (2%)	1/13 (8%)	4/267 (2%)	NS
9-12 months ago	4/280 (1%)	0/13 (0%)	4/267 (2%)	NS
Antibiotic prescription in the last year	100/280 (36%)	8/13 (62%)	92/267 (34%)	**0.072**
Within the last 3-6 months	33/280 (12%)	2/13 (15%)	31/267 (12%)	NS
3-6 months ago	22/280 (8%)	0/13 (0%)	22/267 (8%)	NS
6-9 months ago	26/280 (9%)	1/13 (8%)	25/267 (9%)	NS
9-12 months ago	10/280 (4%)	2/13 (15%)	8/267 (3%)	**0.073**

*T test or Fisher's Exact Test comparing MRSA-colonized with non-colonized personnel. Pvalue<0.1 considered significant.

Characteristc	All EMS Personnel (n=280)	MRSA-colonized Personnel (n=13)	Non-colonized Personnel (n=267)	p value*
Diagnosis with staphylococcal infection in the past year	3/280 (1%)	0/13 (0%)	3/267 (1%)	NS
Within the last 3-6 months	0/280 (0%)	0/13 (0%)	0/267 (0%)	NS
3-6 months ago	0/280 (0%)	0/13 (0%)	0/267 (0%)	NS
6-9 months ago	0/280 (0%)	0/13 (0%)	0/267 (0%)	NS
9-12 months ago	1/280 (1%)	0/13 (0%)	1/267 (1%)	NS
Undetermined time of infection	2/280 (1%)	0/13 (0%)	2/267 (1%)	NS
Presence of implanted medical device	5/280 (2%)	0/13 (0%)	5/267 (2%)	NS
Presence of open wounds and skin infections	7/280 (3%)	2/13 (15%)	5/267 (2%)	**0.037**
Living with any person working in healthcare setting	92/273 (34%)	4/13 (31%)	88/260 (34%)	NS
Living with any person with staphylococcal infection in past year	16/273 (6%)	1/13 (8%)	15/260 (6%)	NS
Living with anyone admitted to the hospital in the last year	42/273 (15%)	2/13 (15%)	40/260 (15%)	NS
Living with anyone taking an antiobiotic prescription in the past year	142/273 (52%)	7/13 (54%)	135/260 (52%)	NS
Number of times performing hand hygiene per day				
0-3	12/273 (4%)	2/13 (15%)	10/260 (4%)	NS
4-7	78/273 (29%)	6/13 (46%)	72/260 (28%)	NS
8-11	88/273 (32%)	4/13 (31%)	84/260 (32%)	NS
>12	95/273 (35%)	1/13 (8%)	94/260 (36%)	**0.038**
Washing hands after taking off gloves at EMS work				
Never	0/273 (0%)	0/13 (0%)	0/260 (0%)	NS
Rarely	7/273 (3%)	1/13 (8%)	6/260 (2%)	NS
Sometimes	29/273 (11%)	4/13 (31%)	25/260 (10%)	**0.037**
Usually	117/273 (43%)	4/13 (31%)	113/260 (43%)	NS
Always	122/273 (45%)	4/13 (31%)	118/260 (45%)	NS
Frequency of wearing gloves when cleaning EMS equipment				
Never	2/273 (1%)	0/13 (0%)	2/260 (1%)	NS
Rarely	5/273 (2%)	1/13 (8%)	4/260 (2%)	NS
Sometimes	35/273 (13%)	3/13 (23%)	32/260 (12%)	NS
Usually	102/273 (37%)	2/13 (15%)	100/260 (38%)	NS
Always	126/273 (46%)	7/13 (54%)	119/260 (46%)	NS
Not responsible for cleaning equipment	3/273 (2%)	0/13 (0%)	3/260 (1%)	NS
Sharing razors, towels, or workout equipment	96/273 (35%)	4/13 (31%)	92/260 (35%)	NS
Pets at home	212/273 (78%)	7/13 (54%)	205/260 (79%)	**0.045**

*T test or Fisher's Exact Test comparing MRSA-colonized with non-colonized personnel. Pvalue<0.1 considered significant.