Methicillin-resistant *Staphylococcus aureus* colonization among health care workers in a downtown emergency department in Toronto, Ontario

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BACKGROUND: Methicillin-resistant *Staphylococcus aureus* (MRSA) acquired in the community, otherwise known as community-acquired MRSA, has emerged rapidly in recent years. Colonization with MRSA has been associated with an increased risk of symptomatic and serious infections and, in some settings, health care workers (HCWs) exhibit a higher prevalence of MRSA colonization.
OBJECTIVE: To determine MRSA colonization in emergency department (ED) HCWs in the setting of a moderate prevalence of MRSA in skin and soft tissue infections.
METHODS: The present study was conducted at a downtown ED in Toronto, Ontario. ED HCWs completed a brief questionnaire and swabs were taken from one anterior nare, one axilla and any open wounds (if present). Swabs were processed using standard laboratory techniques.
RESULTS: None of the 89 staff (registered nurses [n=55], physicians [n=15], other [n=19]) were MRSA positive and 25 (28.1%) were colonized with methicillin-susceptible *S aureus*.
CONCLUSIONS: Contrary to common belief among HCWs and previous studies documenting MRSA colonization of HCWs, MRSA colonization of this particular Canadian ED HCW cohort was very low and similar to that of the local population.

Key Words: *Emergency department; Health care workers; MRSA colonization*

La colonisation par le *Staphylococcus aureus* résistant à la méthicilline chez les travailleurs de la santé d'un département d'urgence du centre-ville de Toronto, en Ontario

HISTORIQUE : Le *Staphylococcus aureus* résistant à la méthicilline (SARM) d'origine non nosocomiale, ou SARM d'origine communautaire, a émergé rapidement ces dernières années. La colonisation par le SARM s'associe à une augmentation du risque d'infections graves et symptomatiques. Dans certains milieux, les travailleurs de la santé (TdS) présentent une prévalence plus élevée de colonisation par le SARM.
OBJECTIF : Déterminer la colonisation par le SARM desTdS d'un département d'urgence (DU) où l'on observe une prévalence modérée de SARM en cas d'infections de la peau et des tissus mous.
MÉTHODOLOGIE : Les chercheurs ont mené la présente étude dans un DU du centre-ville de Toronto, en Ontario. Les TdS du DU ont rempli un bref questionnaire et effectué un prélèvement dans une narine, sous l'aisselle et dans leurs plaies ouvertes (le cas échéant). Les prélèvements ont été traités au moyen de techniques de laboratoire standard.
RÉSULTATS : Aucun des 89 employés (infirmières diplômées [n=55], médecins [n=15], autres [n=19]) n'était positif au SARM, mais 25 (28,1 %) étaient colonisés par le *S aureus* susceptible à la méthicilline.
CONCLUSIONS : Contrairement aux idées reçues chez les TdS et aux études antérieures étayant la colonisation des TdS par le SARM, la colonisation par le SARM de cette cohorte de TdS d'un DU canadien était très faible et similaire à celle de la population locale.

While methicillin-resistant *Staphylococcus aureus* (MRSA) has traditionally been associated with nosocomial infections, in recent years, community-acquired MRSA (CA-MRSA) has emerged rapidly worldwide (1). While initially based on epidemiological criteria, MRSA is now classified into hospital-acquired MRSA and CA-MRSA based on phenotypic and genotypic information (2). However, because CA-MRSA strains are now more likely to be transmitted in hospital, this distinction is again becoming less clear. CA-MRSA is most commonly associated with skin and soft tissue infections (SSTIs), but has also been associated with virulent staphylococcal disease including necrotizing pneumonia, sepsis and central line infections (2-4). The prevalence of MRSA in SSTIs in the Greater Toronto Area (Ontario) has been recently documented to be 19% and appears to be on the rise across Canada (5,6).

In the United States, where CA-MRSA is the most commonly isolated bacteria from purulent SSTIs encountered in emergency departments (EDs), MRSA colonization in the general population is between 0.8% and 1.5% (7-9). In Canada, we recently documented MRSA colonization in ED patients at 1.9% (10); this 2009 study was the first to document MRSA colonization in Canadian ED patients. The high prevalence of CA-MRSA in clinically significant infections has brought the issue of colonized health care workers (HCWs) acting as vectors in transmission of MRSA infection to the attention of hospital infection-control practitioners (11-14).

At present, little is known regarding MRSA colonization in HCWs in Canada, and estimates of worldwide HCW carriage vary widely. Some studies have shown increased colonization in HCWs compared with the general population, whereas other studies have documented similar prevalence (11-14). Therefore, the purpose of the present study was to determine MRSA colonization of HCWs in an urban Canadian ED where both baseline MRSA colonization of patients and the prevalence of MRSA in SSTIs are known.

METHODS

The present prospective, observational study was conducted at a downtown teaching hospital in Toronto, Ontario. The study was approved by the hospital's research ethics board. From June 23, 2009 to August 6, 2009, ED staff (physicians, nurses and other ED staff)

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TABLE 1
Participants in the study

		Swabs, n			
	n	Nasal/ axillary	Wound	MSSA n (%)	MRSA n (%)
Emergency department staff (total)	89	178	0	25 (28.1)	0 (0)
Registered nurses	55	55			
Physicians	15	15			
Other (clerks, service assistants)	19	19			

MRSA Methicillin-resistant Staphylococcus aureus*; MSSA Methicillin-susceptible* S aureus

were approached during daytime shifts at nursing stations throughout the unit. Potential participants were also informed about the study through bulletin boards and e-mails. Appropriate informed consent was obtained from all participants after a discussion of the nature of the study, including study methodology and the risks and benefits of participation. All information collected remained entirely confidential and participants could withdraw from the study at any time. Participants were provided the option of ascertaining their MRSA colonization status on an individual basis if requested. Study participants were assured by hospital infection control that, in addition to maintaining their confidentiality, they would neither be penalized nor be forced to undergo decolonization treatment (if they did not choose to) if they were found to be colonized with MRSA. Study participants completed a questionnaire capturing demographics and MRSA risk factors (Appendix 1). Swabs were taken from one anterior nare, one axilla and any open wounds (if present), using Starswab II SP130X collection and transport system containing charcoal-free Amies gel transport medium (Starplex Scientific Inc, Canada).

Swabs were placed in 2 mL brain heart infusion broth and incubated for approximately 18 h at 37°C to enrich for all bacteria. Overnight cultures were plated on chromogenic staph agar to select for *S aureus* and on denim blue agar to select for MRSA. All media and kits were obtained from Oxoid (Canada). MRSA were differentiated from methicillin-susceptible *S aureus* (MSSA) using the MRSA monoclonal kit to detect PBP2a (confers methicillin resistance) and by observing growth on oxacillin screen agar.

All statistics were calculated using basic descriptive statistical techniques. Additionally, to protect the privacy and confidentiality of study participants, all questionnaires and laboratory information were identified using numbers only and a personal identifier log was stored in a locked cabinet located in the hospital's ED research office.

RESULTS

Nasal and axillary swabs were obtained from 89 of approximately 150 hospital employees working in the ED during the study period. No staff member declined participation in the study after being approached, and most of the participants were aware of the study through the distribution of recent flyers and e-mails. None of the study participants had open wounds, and all participants wished to be informed if they were found to be colonized with MRSA. Of the 89 ED staff participants, 55 (61.8%) were registered nurses, 15 (16.9%) were physicians and 19 (21.3%) were other ED staff (including unit clerks, service assistants, etc). The mean age was 30 years (range 23 to 55 years). Overall numbers of specimen types and staff job descriptions are summarized in Table 1.

While none of the 89 staff were MRSA positive, 28.1% (25 persons) were colonized with MSSA (20 nasal, five axillary, zero wounds), as would be expected in a general population.

DISCUSSION

The present study, which found no HCWs in the sample of 89 ED staff to be colonized with MRSA, and 28.1% MSSA colonization, is the first to document the prevalence of MRSA and MSSA colonization in ED HCWs in Canada. These data are compared with the MRSA and MSSA per cent colonized of 1.9% and 25.9%, respectively, documented in the aforementioned cohort study being conducted in the same ED during the study period (10), and at a time when the prevalence of MRSA in SSTIs at this centre was 30% (15). These population percentages of MRSA colonization are also consistent with recent estimates of MRSA colonization in the general population of the United States (9).

Several studies have investigated MRSA colonization rates among HCWs. In their review of 127 studies published between 1964 and 2007, Albrich and Harbarth (11) determined that the overall carriage of MRSA in HCWs was 4.6%, although their review did not specifically address the MRSA carriage in ED staff. Our search of the most recent literature revealed significant variability in the colonization of HCWs, much of which appeared to be attributable to the prevalence of MRSA in the local population (estimated by either the percentage of MRSA in SSTIs, the percentage of admitted patients colonized with MRSA or the proportion of all local *S aureus* laboratory results that are MRSA). However, there is variability in other studies as to whether HCWs are more likely to be colonized than the local population.

For example, a study at an adult, tertiary care teaching hospital in Baltimore (USA) in 2007 (16) found MRSA colonization among HCWs to be 2%, similar to the local population, and to that observed in the sample of ED patients in Toronto tested during the time of our study (10). In areas where MRSA represents a higher percentage of laboratory *S aureus* isolates, HCW colonization has been reported to be higher (17-19).

Background carriage of MRSA in the local population may not be the only determinant of HCW colonization. For example, Cesur and Cokca (20) used a methodology similar to the present study and evaluated the MRSA carriage in HCWs and hospital outpatients simultaneously. They observed that 6% of HCWs were colonized with MRSA while only 2.6% of their outpatient population carried MRSA. In our study, no HCWs were colonized, suggesting that other factors may play a role in HCW colonization and require further investigation.

The present study had several limitations. First, the study was performed at a single Canadian institution and the results may not be representative of other EDs in Toronto or Canada. Second, the results may not be generalizable to nonurban, nonhospital-based HCWs. Third, the sampling technique may have led to the exclusion of higher-risk subjects, or despite anonymous results, potential participants who may have feared job security if diagnosed as a carrier. This potential selection bias may have led to a falsely low colonization rate. However, it should be noted that none of the ED staff approached to participate in the study declined to do so, and the majority of ED staff work both daytime and nighttime shifts. In addition, the number of ED staff (n=89) participating in the study, while significant (ie, more than 50% of RNs swabbed), did not include all staff. A larger sample size from multiple ED sites may be necessary to more accurately determine the rates of MRSA colonization among ED staff. Finally, only one axilla and one nostril of the study participants were sampled. Although the sensitivity may have increased by sampling both nares and axillae, this sampling technique did not likely affect the MRSA colonization rate given the MSSA colonization rate was as expected in this population.

In conclusion, the present study documented that none of the ED HCWs in this urban ED were colonized with MRSA. Additional studies are necessary to further characterize MRSA colonization in the general population and among HCWs in different regions of Canada as well as further evaluate infection control practices to help prevent MRSA infection and colonization.

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APPENDIX 1

Seaton House/Mount Sinai Hospital Staff Interview Tool

Study number: _____ Patient Initials: _____

Date of interview: Interviewer:

SECTION I: INTRODUCTION

I.1) Hi. My name is <interviewer name> and I am conducting a survey on behalf of the Department of Family and Community Medicine of Mount Sinai Hospital regarding the prevalence of specific bacteria called MRSA, which can live on your skin. This survey will take no more than XXXX min to complete. Can I tell you more about this study?

1. Yes (go to I.1b)
2. No – later (go to I.3)
3. No – never: Okay, thank you for your time. Good-bye

Some of these questions may not make sense or apply to you- I will ask you about known risk factors associated with MRSA. Please feel free to stop me and ask questions at any time.

Do you have any questions or concerns about the survey?

1. Yes (answer questions)
2. No (Go to I.2)

I.2) Are you willing to complete the survey with me now/after your doctor's appointment?

1. Yes (Go to A.1)
2. No – later (Go to I.3)
3. No – never/refused: Okay, thank you for your time. Good-bye

SECTION II: INTERVIEW

Please answer the questions as best you can and feel free to ask me any questions you have at any time.

A. Demographics

I'd like to begin by asking you some questions about yourself

A1) What is your date of birth? (dd/mm/yyyy)

A2) Gender: Male □ Female □

B. Potential Risk Factors

The following questions are about settings, activities, and other factors that have been linked with MRSA skin infections in the past.

B.1 Have you been to the Emergency Department at any time in the past 12 months?
No Yes Refused

B.2 Have you been to a hospital or community outpatient Clinic in the past 12 months?
No Yes Refused

B.3 Have you been admitted to the hospital at any time in the past 12 months?
No Yes Refused

If yes,

a. How many nights did you spend in the hospital?

b. When was your discharge/most recent discharge from the hospital? (dd/mm/yyyy)

c. Were you in isolation at any time when you were in the hospital
No Yes Refused

B.4 Have you had any skin infections or abscesses on your skin within the last 12 months?
No Yes Refused

B.5 Has anyone ever told you that you were colonized or infected with MRSA?
No Yes Refused

If yes,

a. Were you prescribed antibiotics for the infection?
No Yes →B. 6b Refused

b. Was this prescription for the antibiotics filled?
No Yes →B.6cd Refused

c. Did you have any trouble taking the antibiotics?
No Yes Refused

d. Did you complete the full course of antibiotic treatment?
No____ Yes___ Refused

B.6 Have you taken any antibiotics in the past 3 months?
No Yes, which one? Refused

a. If yes, for what infection was the antibiotic given to you?

B.7 Have you lived in a home with other people in the past year?
No Yes Refused

If yes: Have any of the individuals that you live with had a skin infection/abscess in the past 12 months?
No Yes Refused

B.8 Do you currently share personal items (towels, soap, razor, clothes) with another person?
No Yes Refused

If yes, a. which items?

The next few questions are personal in nature and may be particularly sensitive. I remind you at this time that all your information is private and will be combined with all other respondents before any analysis is conducted as part of the study.

B.11 Do you consider yourself a member of the gay/lesbian or bisexual community?
No Yes Refused

B.12 Have you ever used intravenous drugs?
No Yes Refused

If yes,

a. When did you last use IV drugs? (mm/dd/yyyy)

B.13 Are you HIV positive? No Yes Don't Know Refused

B.14 Do you have a chronic skin condition like Psoriasis?
No Yes Don't Know Refused

If yes, specify condition

B.15 Do you have an immunosuppressive condition, or take medicine which may affect your immune system?
No Yes Don't know Refuse

B.16 Are you in contact with any animals?
No Yes Refused

If yes,

a. Have any of these animals been known to be MRSA positive?
No Yes Don't know Refused

B.17 Do you partake in any team activities more than once a month?
No Yes Refused

If yes,

a. What do you play? _____

B.18 Have you spent any time in the military?
No Yes Refused

If yes,

a. When were you in the military? (mm/dd/yyyy)

B.19 Have you been in prison in the past year?
No Yes Refused

B.20 I am going to ask you some questions about the people you spend time with. When I say 'spend time with', I mean that you spend time with them socially, or professionally. Have you spent time with a person who:

A) Uses intravenous drugs
No Yes Don't Know Refused

B) Was in prison in the past year
No Yes Don't Know Refused

C) Is HIV positive
No Yes Don't Know Refused

B.21 I will list certain ethnic or cultural groups and I would like you to tell me to which you belong to

Caucasian African-American
Native American/Aboriginal Latino
Asian/Pacific Islander Mixed (more than 1 race)

The last few questions are similar to census questions asked by the government.

B.22 Are you currently employed?

No Yes Refused

B.23 What is the highest level of education you have completed?

Less than high school
Graduated from high school
Some post-high school education
College/University diploma/degree
Refused

This completes the interview. Thank you for your time.

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