

# Prevalence of methicillin-resistant *Staphylococcus aureus* in a Canadian inner-city shelter

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**BACKGROUND:** Methicillin-resistant *Staphylococcus aureus* (MRSA) colonization is increasingly of concern in community settings. However, despite a recent outbreak in Calgary, Alberta, data on the prevalence of MRSA in Canadian communities are lacking. Globally, few studies have been performed in high-risk groups such as inner-city populations.

**METHODS:** A cross-sectional study of the prevalence of MRSA among residents and staff at three Ottawa, Ontario, shelters was conducted. All participants completed a questionnaire, and provided nasal swabs as well as one of rectal, anal or groin swabs.

**RESULTS:** Among 84 participants, the prevalence of MRSA colonization was 2.4%. Among the resident subgroup, the prevalence was 4.5%, while no MRSA isolates were found among 40 staff participants. All isolates were USA100 (CMRSA-2) subtypes.

**CONCLUSIONS:** The prevalence of MRSA colonization among residents is higher than baseline population rates, but is consistent with other inner-city populations. Although community outbreaks of USA300 and USA400 strains are increasingly reported, movement of nosocomial strains (ie, USA100 [CMRSA-2]) into communities remains an important avenue in the spread of MRSA and underscores the importance of nosocomial MRSA control.

**Key Words:** Community; Methicillin-resistant *Staphylococcus aureus*; Prevalence; Shelter

Methicillin-resistant *Staphylococcus aureus* (MRSA) is an increasingly common cause of serious health care-acquired infections. More recently, community-acquired MRSA (CA-MRSA) outbreaks have further increased the notoriety of this organism. Nosocomial and community strains not only differ in genetic composition, but studies (1-3) have also identified clinical sequelae that are unique to community-acquired strains of MRSA, including skin and soft tissue infections and necrotizing pneumonia.

Several risk factors for CA-MRSA have been identified, including intravenous drug use (IVDU), hospitalization within the past year, increasing age, being of Hispanic origin, incarceration and chronic illness (4-9). Outbreaks have been reported in inner-city populations, prisons and sports teams

## Prévalence du *staphylocoque doré* résistant à la méthicilline dans un refuge d'un centre-ville canadien

**HISTORIQUE :** La colonisation par le *staphylocoque doré* méthicillino-résistant, ou MRSA (*pour methicillin-resistant Staphylococcus aureus*), représente un problème croissant en médecine communautaire. Par contre, malgré une récente écloison à Calgary, en Alberta, les données sur la prévalence du MRSA dans les collectivités canadiennes sont peu nombreuses. Dans l'ensemble, peu d'études ont été réalisées auprès de groupes à haut risque comme les populations hébergées dans des refuges en milieu urbain.

**MÉTHODES :** Une étude transversale a été réalisée pour mesurer la prévalence du MRSA chez les résidents et le personnel de trois refuges, à Ottawa, Ontario. Tous les participants ont répondu à un questionnaire et ont fourni des échantillons de sécrétions nasales et un échantillon rectal, anal ou inguinal.

**RÉSULTATS :** Parmi les 84 participants, la prévalence de la colonisation par le MRSA a été de 2,4 %. Parmi le sous-groupe des résidents, la prévalence était de 4,5 %, tandis qu'aucun isolat de MRSA n'a été observé chez les 40 participants appartenant au personnel. Tous les isolats étaient du sous-type USA100 (CMRSA-2).

**CONCLUSIONS :** La prévalence de la colonisation par le MRSA est plus élevée chez les résidents que chez les populations de base, mais concorde avec celle d'autres populations urbaines. Bien que des écloisions des souches USA300 et USA400 aient été signalées dans certaines collectivités, l'évolution des souches nosocomiales (c.-à-d., USA100 [CMRSA-2]) dans les collectivités reste une importante voie de propagation du MRSA et rappelle l'importance des mesures de lutte contre le MRSA nosocomial.

(7,10-13). However, estimates of the prevalence of MRSA in community settings vary from 0.2% to 7.4% (6), with few studies addressing the prevalence in inner-city populations, where rates of MRSA are expected to be highest (8-10). Most studies have included only culturing of nasal swabs, which may underestimate the prevalence. Because gastrointestinal carriage is not uncommon, rectal swabs may increase the yield by up to 15% (14). Although a recent report (7) of a CA-MRSA outbreak in Calgary, Alberta, has raised concerns of community spread, there are currently no published Canadian data on CA-MRSA prevalence.

The Ottawa Inner City Health (OICH) is a nonprofit organization operating three of four shelters in downtown Ottawa. Residents are provided access to medical care, beds

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**TABLE 1**  
**Demographic characteristics and risk factors for methicillin-resistant *Staphylococcus aureus* in three inner-city homeless shelters**

Characteristic	Residents (n=44)	Staff (n=40)	Total (n=84)
Mean age, years (range)	52 (36–77)	39 (22–62)	49 (22–77)
Sex, n (%)			
Male	38 (86.4)	10 (25.0)	48 (57.1)
Female	6 (13.6)	30 (75.0)	36 (42.9)
Ethnicity, n (%)			
White	38 (86.4)	35 (87.5)	73 (86.9)
Black	6 (13.6)	4 (10)	10 (11.9)
Other	0 (0)	1 (2.5)	1 (1.2)
Last hospital admission*, n (%)			
Never	2 (4.5)	9 (23.7)	11 (13.1)
Within 12 months	20 (45.5)	1 (2.5)	21 (25.0)
>12 months	20 (45.5)	28 (70)	48 (57.1)
Last outpatient clinic visit*, n (%)			
Never	3 (6.8)	0 (0)	3 (3.6)
Within 12 months	26 (59.1)	31 (77.5)	57 (67.9)
>12 months	13 (29.5)	9 (22.5)	22 (26.2)
Last time received antibiotics*, n (%)			
Never	3 (6.8)	0 (0)	3 (3.6)
Within 12 months	29 (65.9)	21 (52.5)	50 (59.5)
>12 months	9 (20.5)	19 (47.5)	28 (33.3)
History of IVDU?, n (%)			
Yes	24 (54.5)	2 (5.0)	26 (31.0)
Within the past year	5 (11.4)	1 (2.5)	6 (7.1)
No	20 (45.5)	38 (95.0)	58 (69.0)
History of cocaine use, n (%)			
Yes	19 (43.2)	4 (10.0)	23 (27.4)
Within the past year	11 (25.0)	2 (5.0)	13 (15.5)
No	25 (56.8)	36 (90.0)	61 (72.6)
History of being in prison, n (%)			
Yes	23 (52.3)	1 (2.5)	24 (28.6)
Within the past year	2 (4.5)	1 (2.5)	3 (3.6)
No	21 (47.7)	39 (97.5)	60 (71.4)
Chronic diseases, n (%)			
Diabetes	4 (9.1)	0 (0)	4 (4.8)
Hepatitis	18 (40.9)	1 (2.5)	19 (22.6)
HIV	6 (13.6)	0 (0)	6 (7.1)
Cancer	2 (4.5)	0 (0)	2 (2.4)
End-stage renal disease	1 (2.3)	0 (0)	1 (1.2)
Swab sites collected, n (%)			
Nasal	44 (100)	40 (100)	84 (100)
Rectal	25 (56.8)	33 (82.5)	58 (69.0)
Anal	9 (20.5)	1 (2.5)	10 (11.9)
Groin	9 (20.5)	5 (12.5)	14 (16.7)

\*Incomplete questionnaire responses. IVDU Intravenous drug use

and regular meals. The OICH employs physicians, nurses and nonmedical staff to provide ongoing care for residents and to assist in the maintenance of the shelters.

The goal of the present study was to determine the prevalence of MRSA colonization and the frequency of risk factors for colonization within three OICH-operated shelters, in the absence of an identified outbreak.

## METHODS

Participants were either residents or staff members at one of the three OICH shelters. To be included, participants had to

be known to the OICH staff for at least seven days, and staff members must have had direct contact with residents within the past year. All persons meeting these inclusion criteria were asked to participate in the study by a study nurse; all participants gave written consent.

Participants completed the questionnaire; there were separate questionnaires for residents and staff. Along with basic demographic information, residents and staff were asked about antibiotic use, illicit drug use, incarceration, and length of residence or employment at the OICH shelters.

After completion of the questionnaire, participants were asked to provide a nasal swab and one of the following: a rectal swab, a surface anal swab or bilateral inguinal swabs. The questionnaire was completed by, and the swabs were performed on, each participant once, with no follow-up testing.

Swabs were cultured on a chromogenic agar, MRSA *Select* (Bio-Rad Laboratories [Canada] Ltd). Any pink colonies were further investigated and *S aureus* was confirmed by Gram stain, catalase production and positive tube coagulase. Methicillin resistance was demonstrated by growth on oxacillin (6 mg/L) salt agar screen plates, resistance to cefoxitin by disk diffusion and by production of the penicillin-binding protein 2' (PBP2') as detected by latex agglutination testing (Oxoid Ltd, Canada).

Genotyping of MRSA isolates by pulsed-field gel electrophoresis was performed as previously described (15). Restriction fragment profiles were compared visually and interpreted based on the guidelines of Tenover et al (16). Isolates were classified according to both American (17) and Canadian (18) nomenclature.

Data were entered and analyzed using Epi Info 2000 (Centers for Disease Control and Prevention, USA). Descriptive statistics were generated and qualitative variables were compared using  $\chi^2$  test or Fisher's exact test as appropriate; OR and 95% CIs were also calculated. Associations between study variables and a positive MRSA swab were assessed using univariate analyses.

Ethical approval was obtained from the Ottawa Healthcare Research Regional Ethics Board and Ottawa Public Health before initiation of the study.

## RESULTS

In April 2006, a total of 98 eligible participants, including staff and residents, were identified within the OICH. Consent was obtained from 84 participants (86%), consisting of 44 residents and 40 shelter staff. The demographic characteristics and MRSA risk factors of the study participants are shown in Table 1. In univariate analysis, no variable was statistically linked to the presence of MRSA colonization.

The mean age of study participants was 49 years (range 22 to 77 years). The mean age of the staff and residents were 39 years and 52 years, respectively. Among the staff, 19 people (48%) reported prior contact with an MRSA-affected person. Staff had worked at one (n=26), two (n=4) or all three (n=10) shelters within the past year. Thirty-three staff (83%) had worked at the OICH for more than one year. With respect to sports teams, 14 staff (35%) reported active participation.

Among the residents, two participants (5%) reported having contact with a person with MRSA. Thirty-eight residents (86%) reported living in Ottawa longer than one year, while 27 residents (61%) had been staying at the OICH shelters

for at least one year. Within the shelter, nine residents reported having a private room, while 34 residents (77%) had a shared room (incomplete questionnaire response from one resident). On average, these residents shared their room with three other people (range one to six people).

Only one resident was culture-positive for MRSA. No MRSA-positive staff were found. The resident's isolate was identified as a USA100 (CMRSA-2) subtype (17,18). He had been released three months earlier from a two-month prison term, during which he had shared a dormitory with over 30 other inmates. While incarcerated, he reported having a skin boil which was treated with self-incision and an unknown antibiotic. He denied IVUD over the past year, but regularly used cocaine. He had been hospitalized 12 months prior for antibiotics and surgical drainage of a methicillin-susceptible *S aureus* prostate abscess.

Overall, three participants (one staff and two residents) responded that they had a previous history of MRSA infection or colonization. On review of each participant's medical records, two did not have any history of a positive MRSA culture. The final respondent, a shelter resident, had been colonized with a USA100 (CMRSA-2) subtype in 2004, which was acquired during admission to a local hospital. His other risk factors included IVUD, recent incarceration and antibiotic use within the preceding year.

During the study, another resident received decolonization therapy for MRSA at the time screening cultures were taken, thus his swab cultures were negative. He had confirmed MRSA colonization one month earlier with a USA100 subtype (16). This had been discovered during an admission to a local hospital (different from the one mentioned above) that was experiencing an MRSA outbreak. No subsequent screening swabs were performed after decolonization therapy to confirm eradication.

Comparison of the pulsed-field gel electrophoresis profiles of the MRSA isolates from the three residents with current or previous MRSA showed that they were three different subtypes of CMRSA-2, differing from each other by one to two bands. Among these three residents, no epidemiological link could be identified. At no time were they together at the same shelter, prison or hospital, and their only access to health care was via the OICH or local hospitals. They were not known to be friends, although contact outside the shelter cannot be excluded.

Overall, two MRSA carriers were identified for an overall MRSA prevalence of 2.4%; however, among shelter residents alone, the prevalence was 4.5%.

## DISCUSSION

We documented a low MRSA prevalence at three Ottawa homeless shelters, with 2.4% of all participants found to be MRSA carriers. There was a reassuringly low prevalence of colonization among the staff (0%), while among residents the rate was 4.5%.

Community-based studies have documented MRSA prevalence rates of between 0.2% and 7.4% (6); however, Canadian data are lacking. While several studies (4-6) have determined the prevalence in healthy outpatient settings to be 0% to 3%, few studies (8-10) have assessed the prevalence of MRSA in an inner-city population, where MRSA risk factors commonly include IVUD, overcrowding, hospitalization, recent incarceration and antibiotic use. In a study of the San Francisco urban

poor by Charlebois et al (8), 2.8% of participants were colonized with MRSA; however, two years later, the rate among the same population had increased to 6.2% (9). In a study of colonization among heroin and methadone users in Switzerland by Bassetti et al (10), no isolates of MRSA were found among the 252 participants. Although we had fewer participants, our study suggests that the MRSA prevalence in the Ottawa inner-city population is higher than in outpatient settings, but intermediate compared with other inner-city centres (4.5%).

Although our self-reported rates of hepatitis and HIV among the shelter residents were similar to the other two studies, we found higher rates of recent hospitalization (48% versus 18.1% [8-10]; OR 3.69, 95% CI 1.9 to 7.1) and antibiotic use (71% versus 45% [8]; OR 1.43, 95% CI 0.7 to 3.0). These higher rates may be due to the universal access to medical care in Canada and the increased accessibility to health care provided by the OICH staff. Also, only the study by Pan et al (9) previously addressed recent incarceration, the presumed source of our single MRSA-positive resident. Their study found that only 32.1% of participants were previously incarcerated compared with 52.3% of residents in our study (OR 2.3, 95% CI 1.2 to 2.2).

Our study was the first to measure colonization rates among staff at inner-city shelters. Although only one staff (2%) had been hospitalized within the past year, many of the staff also worked as health care practitioners within local hospitals or frequently accompanied residents to hospitals when needed. These factors were not accounted for in the study, thus, the reported rate of health care exposure among the staff may be grossly underestimated. Despite this fact, there was a reassuringly low (0%) prevalence of MRSA among the staff.

Unlike some studies of CA-MRSA outbreaks in which USA300 (CMRSA-10) or USA400 (CMRSA-7) strains have predominated (7,19,20), all three isolates of MRSA identified in our study were health care-associated (USA100, CMRSA-2), which may reflect the avenue of spread into communities. There was no epidemiological link identified to suggest transmission within the shelters, although factors such as direct contact on the street or indirect spread via a third party cannot be accounted for. In a United States national prevalence study in 2001 to 2002 by Kuehnert et al (21), only 8% of MRSA strains were USA300, while 45% were USA100, highlighting the importance of effective control of nosocomial MRSA transmission.

Our population provides an estimate of 'worst-case' prevalence in our city, given that there were high rates of IVUD (31%), incarceration (29%), recent hospitalization (26%) and recent antibiotic use (62%). Similarly, 80% of residents shared rooms with up to six other people, which may have increased the rates of MRSA transmission (22,23). However, evidence of overcrowding, impacting MRSA transmission, is largely from prisons and hospitals. This factor should be addressed in future studies of communities in which overcrowding may be an important risk, such as in shelters.

The present study may not be representative of all homeless persons in Ottawa, because only those known to the OICH shelters were included. Homeless persons who do not use shelters may be at a higher risk of MRSA, given a higher likelihood of incarceration, drug use or poor hygiene. Conversely, they are less likely to be in overcrowded living conditions.

Additional prevalence studies in high-risk community populations are needed to define the changing epidemiology of MRSA and to guide empirical treatment of suspected *S aureus* infections in these populations.

**CONTRIBUTORS:** Dr Szakacs led the study conception, design, on-site implementation and drafting of the manuscript. Drs Muckle and Turnbull helped in study conception, data collection and institutional facilitation. Drs Toye and Roth were involved in study conception, design, data analysis and drafting of the manuscript.

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