Community-associated methicillin-resistant Staphylococcus aureus in Indigenous communities in Canada

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Abstract
Community-associated methicillin-resistant Staphylococcus aureus (CA-MRSA) infections have emerged as a significant issue in some Indigenous communities (including First Nations, Inuit and Métis) in Canada. Primarily associated with skin and soft-tissue infections, this organism can also result in significant morbidity and mortality. Canadian and American guidelines for managing CA-MRSA infections have been published. The specific epidemiology, microbiology and susceptibility patterns, and the social/environmental circumstances of CA-MRSA infections in Indigenous communities need to be considered for strategies to reduce transmission. While reducing household crowding and improving in-home potable water supply are optimal strategies to reduce the impact of this illness, implementing Canadian guidelines along with increased prevention strategies are recommended as interim measures.

Key Words: Canada; Community-acquired infections; Indigenous populations; Methicillin-resistant S. aureus (MRSA); SSTI

Over the past several years, national guidelines have been published in Canada [1] and the United States [2][3] for community-associated methicillin-resistant Staphylococcus aureus (CA-MRSA) infections generally. However, there are no published guidelines specifically for Indigenous (including First Nation, Inuit and Métis) communities. Approaches to CA-MRSA infections in Indigenous communities require consideration of epidemiology, microbiology and social/environmental circumstances.

Background
CA-MRSA is an emerging pathogen with some characteristics differentiating it from the MRSA usually associated with health care environments. CA-MRSA generally refers to an MRSA infection with onset in the community in a person and without the risk factors for health care-associated MRSA (HCA-MRSA) [1]. In comparison with HCA-MRSA, CA-MRSA strains are generally more susceptible to antimicrobials, with the exception of the beta-lactam derived drugs [1]. They have been associated primarily with skin and soft tissue infections (SSTIs) but cause significant morbidity and mortality when invasive infections occur [4].

The differences between CA-MRSA and HCA-MRSA are also reflected in dissimilar genetic make-up of strains. CA-MRSA strains exhibit specific virulence factors that produce cytotoxins capable of inducing tissue necrosis. Strain-typing is determined by pulse-field gel electrophoresis. MRSA types most frequently associated with community infections in Canada are CMRSA10 (USA300) and CMRSA7 (USA400) [5][6].

The distinction between CA-MRSA and HCA-MRSA is imprecise because it is difficult to accurately identify the actual location of transmission. As community strains have moved into the hospital setting, with subsequent spread, and as hospital strains move into the community, the distinction has become even cloudier.
Epidemiology of MRSA in Northern and Canadian Indigenous communities

CMRSA10 and CMRSA7 strains have a different geographical distribution in Canada, although there is some overlap.

In an Alberta hospital investigating an MRSA outbreak in 1986, the majority of cases were acquired prior to hospitalization with links to one Indigenous community [7]. A subsequent study identified prior hospitalization as a risk factor but confirmed that ongoing transmission occurred in that community even in individuals who had not been hospitalized within the previous year [8]. A retrospective survey of five teaching hospitals in the Prairie provinces between 1990 and 1992 found that First Nations patients accounted for 62% of those who were MRSA-positive on hospital admission [9]. In the years following, CA-MRSA was increasingly reported in Alberta, predominately of the CMRSA10 strain, although CMRSA7 has caused community outbreaks in Aboriginal populations [10]. A recent outbreak in Calgary noted that 70% of cases were in marginalized individuals with a history of homelessness, drug use and/or incarceration [11].

In the Northwest Territories, CMRSA10 has also predominated. In a recent study 267 cases were detected, with 89% being CMRSA10 [12]. Eighty-three percent of these cases were Aboriginal people, who comprise about 50.6% of the population. Since 2003, the incidence of CMRSA7 has increased in small Indigenous communities in northern Manitoba [13], northern Saskatchewan [14] and in a remote Inuit community in Nunavut [15]. The cases in these areas revealed similar epidemiological profiles with a predominance in younger age groups presenting with SSTIs.

In northern Saskatchewan, where 84.3% of the population have self-identified as Indigenous, testing has been encouraged and positive MRSA laboratory tests are reportable to public health. The annual rate there increased from 8.2 to 142.6 per 10,000 in 2001-2008, with rates as high as 482 per 10,000 in one Indigenous community [16]. Of the identified cases of Staphylococcus aureus infections, 54% were due to MRSA and, of these, 97.4% were CMRSA7.

Risk factors for CA-MRSA

Common risk factors that have been identified in CA-MRSA outbreaks include overcrowding, frequent skin-to-skin contact between people, participation in activities that result in abraded or compromised skin surfaces, sharing of potentially contaminated skin items, challenges in maintaining personal cleanliness and hygiene, and limited access to health care [17]. Many patients do not have any of these traditional risk factors, but children and youth from lower socio-economic circumstances are disproportionately affected. Exposure to antibiotics has also been suggested to facilitate MRSA acquisition [18].

In remote Australian Indigenous communities, CA-MRSA strains have seemed to emerge from communities themselves rather than from a movement of HCA-MRSA strains into the communities [19]. Conditions in socially disadvantaged populations may have facilitated emergence. Steven Tong et al noted that the "unfettered use of antimicrobial agents in disadvantaged communities without addressing underlying socioeconomic conditions is likely to further promote the emergence of microbial resistance" [20].

In Alaska, higher rates of hospitalization for SSTIs and MRSA for Alaska Natives occurred in people from communities with lower levels of in-home water and sanitation services [21].

In Canadian Indigenous communities, household crowding increases close contact and makes maintaining a clean environment, personal hygiene and the separation of personal items significantly more challenging. Some homes are without indoor piped potable water or have water hauled to cisterns. The amount of water delivered to cisterns is limited, which may make it difficult for people to maintain personal and environmental hygiene [22]. Household crowding is about ten times more frequent among First Nations people living on reserve (26%), and among the Inuit (31%), than for the non-Indigenous Canadian population (3%) [23].

Treatment, management and prevention in Indigenous communities

Overall, the general principals for treating and managing CA-MRSA infections are the same for Indigenous individuals as those laid out in Canadian [1] and American [2][3] guidelines, and in other CPS position statements [24]. Each of these treatment regimes encourages incision and drainage for abscess management and the judicious use of antibiotics (Table 1).

Present Canadian guidelines [1] suggest that decreasing microbial carriage (commonly referred to
as microbial decolonization) may be considered for patients with recurrent infections, but only in well-defined, closely-associated cohorts where repeated review and reinforcement of hygiene measures can be implemented, and where there is not a high prevalence of CA-MRSA in the community. The biggest challenges are posed by high-prevalence Indigenous communities when overcrowding and ready access to potable water are issues. Even in the general population there is little or inconsistent evidence that decreasing microbial carriage reduces the recurrence of CA-MRSA, although some interventions have shown transient reduction in carriage [25]. While further study and the results of recent randomized trials will probably provide a better understanding of the potential benefit of various strategies [26], an appropriate regime for decreasing microbial carriage has yet to be established [2]. Most regimes include some combination of nasal mupirocin, antiseptic baths (including chlorhexidine or dilute bleach baths), and oral rifampin combined with other antibiotics [26]. Some Indigenous communities in Canada have reported MRSA (particularly CMRSA7) with significant rates of high-level mupirocin resistance [14], a complication which could be aggravated with repeated use. Also, the repeated use of rifampin could potentially increase drug-resistant tuberculosis in high-risk communities. Some studies suggest the potential effectiveness of dilute bleach baths; randomized trials on the safety and effectiveness of using dilute bleach baths are both warranted and underway [27].

Recent evidence suggests that person-to-person transmission, a contaminated environment and fomites (exogenous infection) may play a greater role in CA-MRSA transmission and infection than carriage (endogenous infection) [26][28]. This infection route would influence the choice of strategies in overcrowded settings.

An intervention in Japan to raise awareness of antimicrobial resistance in the general public and among health care staff resulted in a decrease in MRSA prevalence in one community setting over a ten-year period [29]. A recent, similar observational study in northern Indigenous communities in Saskatchewan suggests that educational interventions are effective in reducing CA-MRSA infections [16]. Local initiatives included: providing physicians and nurse practitioners with organism identification and susceptibility data from active surveillance; the development of MRSA treatment guidelines based on local sensitivity patterns; community education through Indigenous radio messaging, presentations and workshops, as well as general public education; and interventions aimed at children in kindergarten to Grade 2 (‘Do Bugs Need Drugs?’) and in Grades 4 to 6 (‘Germs Away’). Further strategies used in communities in the Northwest Territories have included making trucked water more available to homes with cisterns, providing home-kits with items like cloth and paper towels, hand laundry soap, alcohol-based hand gel, disinfectant spray and alcohol-chlorhexidine wipes, as well as educational materials, and increasing access to washing machines and driers [12]; however, to date, the effectiveness of these additional interventions has not been fully documented.

**Recommendations**

To protect children and youth in Indigenous communities from CA-MRSA, the Canadian Paediatric Society recommends that paediatricians and primary health care workers:

**Build awareness**

• Ensure that health centre staff know that the emergence of CA-MRSA is a cause of infection in affected communities.

**Monitor resistance**

• Collect specimens for culture from purulent drainage of abscesses to monitor resistance patterns and guide empirical management.

**Be advocates**

• Get involved with efforts to improve in-home potable water services and housing conditions for Indigenous and other marginalized populations, at both the federal and provincial/territorial government levels. (For information on advocacy approaches, see [www.cps.ca/en/advocacy-defense/how-to-advocate](http://www.cps.ca/en/advocacy-defense/how-to-advocate).)
• Practice and promote hand hygiene, starting with young children.

• Encourage seasonal influenza vaccination for all children. There is added benefit in MRSA-endemic communities because of the risk for severe MRSA pneumonia following an influenza infection [30].

Practice infection control in health centres and clinics

• Model and reinforce proper hand hygiene before and after each completed patient contact by all staff and volunteers.

• Make alcohol-based handwashing supplies easily available wherever sinks and running water are less accessible.

• Implement routine infection control practices in health centres and appropriate preventive measures following the assessment of a client with an MRSA infection [31].

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<th>Condition</th>
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| Infected scratches, furuncles, impetigo | Wet warm compresses  
Washing with warm water and soap  
Consider topical antibiotics depending on local sensitivity patterns or, for more severe infections, oral antibiotics |
| Abscesses | Incision and drainage  

Use management strategies[1][2][3]

• Engage community health staff, clients and communities in preventive approaches.

• Educate patients and families about how to manage MRSA SSTIs, including:
  – Keeping wounds covered with clean, dry bandages; if unable to cover, exclude from contact sports or child care until wound drainage stops or wounds are healed.
  – Dispose of used dressings in a plastic-lined garbage container with a sealed lid immediately after they are removed.
  – Practice proper hand hygiene using soap and water or an alcohol-based hand gel before and after changing dressings.
  – Bathing regularly, and washing clothes and bedding often.
  – Avoiding sharing personal items, especially towels, bedding, clothing and bar soap.
  – Seeking medical attention if fever or other signs of illness develop, or if a local lesion does not improve within 48 h of starting treatment.
  – Regular cleaning of contact surfaces in the home with a standard household cleaner or detergent.

• Consult public health about a recurrent infection (three or more infections in the same individual within a six-month period) or if an outbreak in a closed population, such as a day care or athletic team, is suspected.

• Avoid the following strategies, which are generally NOT recommended:
  – Determining carriage rates among asymptomatic household contacts.
  – Reducing microbial carriage for routine management of CA-MRSA infections, in either endemic infection conditions or during an outbreak.
Engage in community-level interventions
Visit the Northern Antibiotic Resistance Partnership (www.narp.ca) and www.germsaway.ca.

- Provide education and raise awareness about:
  - self-care for cuts, scrapes and insect bites,
  - hand hygiene, personal hygiene and regular household cleaning, and
  - frequent laundering of clothes and bedding.
- Improve access to inexpensive laundry services in remote communities.

Follow research
- Evaluate the effect of community-level interventions to reduce microbial carriage in reducing CA-MRSA infections in endemic communities.

Recommended resources
- Northern Antibacterial Resistance Partnership: www.narp.ca
- ‘Germs Away’: Cough etiquette and hygiene activities: An educational tool developed for Grades 4 to 6 students (www.narp.ca/edu.htm). See also www.germsaway.ca for an interactive computer game for Grades 4 to 6 students.
- Do Bugs Need Drugs? A community program for the wise use of antibiotics. See www.dobugsneeddrugs.org

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References

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