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BACTERIAL SKIN INFECTION BURDENS IN NORTHERN AND RURAL CANADIAN INDIGENOUS COMMUNITIES: A REVIEW OF NATIONAL AND REGIONAL DATA, AND EVIDENCE-BASED SOLUTIONS

Introduction

As a visible organ, the skin reveals powerful information about both internal and external health. Canada is the world's second largest country landmass, and approximately 60% of Canadian Indigenous peoples reside in Northern and/or Rural Communities (NRCIC),[1] which are generally underserviced. Barriers such as lack of health care access lead to skin health disparities, which are evident in the literature documenting high burdens of bacterial skin and soft tissue infections (SSTIs) in NRCIC across Canada, mainly caused by *Staphylococcus aureus* (including methicillin-resistant *Staphylococcus aureus* [MRSA]) and Streptococcus. A review of national and regional data published over the last 15 years is included, followed by narrative synthesis of evidence-based solutions.

National Data

A retrospective review by Jeong et al in 2020[2] of 372 randomly selected adult charts from 12 First Nation community nursing stations across five provinces (Alberta, Saskatchewan, Manitoba, Ontario and Quebec) demonstrated that 60% had received at least one antibiotic prescription in the past year. Of these, 37% represented SSTIs, in which 40% represented community-acquired (CA)-MRSA. Almost one-third of those with SSTIs had experienced more than one episode during the 12-month period. The majority of prescriptions were oral antibiotics, often provided by nurses. Of the SSTI cases, 61% of clinical outcomes were considered "unknown,". This high one-year prevalence rate of SSTIs and antibiotic use far exceeded those reported by the Canadian Antimicrobial Resistance Surveillance System Report.[3] Although no pediatric charts were included, national MRSA surveillance data among pediatric hospitalized patients in Canadian acute care facilities (1995-2007) reported that the majority of MRSA infections represented SSTIs, in which the Indigenous population was over-represented among pediatric cases, compared to other racial/ethnic groups (the data on NRCIC was not analyzed).[4]

Canadian Regional Data

Northwestern Ontario

The majority of NRCIC in Ontario are located in northwestern regions, with many individuals residing in remote, fly-in communities. A five-year retrospective review of laboratory and clinical data from 2,985 MRSA isolates at Sioux Lookout Meno Ya Win Health Centre (SLMHC), serving a wide catchment of primarily Indigenous peoples, demonstrated that the majority of isolates were from SSTIs. The number of *Staphylococcus aureus* stains representing MRSA increased by 31% between 2008 and 2012.[5] Reinfection rates accounted for 25% of CA-MRSA infections. The calculated incidence rate in 2011 was 2482/100,000 population, one of the highest in Canada, and was comparable to rates reported in northern Saskatchewan.

Invasive Group A streptococcal (iGAS) infections also show higher burdens in NRCIC. A chart review of iGAS infections conducted between 2009 and 2014 at SLMHC calculated the incidence at 37.2 cases per 100,000, eight times higher than the estimated 2013 Canadian incidence rate of 4.72 per 100,000.[6] SSTIs were the second most common clinical focus of iGAS infections (28%), second only to bacteremia without focus, and included necrotizing fasciitis. "Skin conditions" were the most common co-morbidity (46%), followed by diabetes (42%). Almost half of patients required transfer to urban tertiary centres for treatment, with a case fatality rate of 4.6%. Authors questioned the possibility of skin as an entry point for more invasive disease. A separate review by Bocking et al in 2016[7] of iGAS cases at SLMHC identified high incidence rates of 56 cases per 100,000. Cellulitis accounted for 55% of these cases, with almost one-fifth representing toxic shock syndrome or necrotizing fasciitis. Skin conditions (38.5% comprising wounds, chronic dermatitis) and diabetes were also the two most common comorbidities reported. No further sub-analyses on skin conditions were included.

Other studies conducted out of northwestern Ontario identify high incidence of iGAS infections, with disproportional presentations among First Nations individuals.[8] Serious morbidity from untreated group A Streptococcal infections (GAS) infections has been observed. Acute rheumatic fever and sequelae have been reported in the remote northwestern Ontario Indigenous population at the greatest incidence in Canada by Gordon et al in 2015[9] at 21/100,000, estimated at 75-times greater than in other Canadian demographics. Additionally, pediatric post-streptococcal glomerulonephritis from GAS skin and throat infections has recently been reported in a Northwestern Ontario First Nations community.[10]

The only telemedicine study found, included a prospective observational study of 76 infectious disease patients (representing 98.6% Indigenous patients) from SLMHC in 2014, including adult and pediatric patients. It reported that SSTIs were the second most commonly observed infection behind musculoskeletal (e.g., osteomyelitis), with infected diabetic foot ulcers accounting for almost half of cases.[11]

Other Regions

The incidence of iGAS infections reported in a study conducted by Ya et al in 2016[12] from 2006 to 2013 in northern Canada (Yukon, NWT, Nunavut, Labrador, Quebec Cree, and Nunavik), where the majority of the population is Indigenous, demonstrated that annual incidence rates were highest for infants under age 1, and adults >60, followed by children aged 1-4. Overall incidence rates were higher for Indigenous peoples (range 2.25 to 20.44) compared to 0 to 6.80 for non-Indigenous ($p<0.0001$). Septicemia/bacteremia (41%) and cellulitis (32%) were the most common presentations of iGAS, and the overall case fatality rate was 7.8%. The study authors commented on existing literature, and concluded that northern populations, especially Indigenous, have higher rates of invasive bacterial disease, and called for enhanced surveillance, prevention and control strategies. In 2008, in northern Nunavut, Dalloo et al[13] reported that the majority of CA-MRSA infections were from SSTIs, of which 55% represented abscesses. Children aged 5-9 years, and 20-29 year-olds faced the highest age-specific cumulative incidence rate. Chronic skin conditions, including eczema and "chronic skin conditions," were reported as risk factors in 37% of subjects.

In western Canada, similar findings including those for northern remote communities in Saskatchewan, have demonstrated that most MRSA (98%) and methicillin-sensitive *Staphylococcus aureus* (MSSA) (91%) isolates are obtained from SSTIs in those areas, where the majority of the population is Indigenous. Community incidence ranged from 1,460 to 4,820 infections per 100,000 in 2011.[14] In northern rural Manitoba, clinical MRSA observations by nursing as primary clinical staff working in several First Nations communities identified increasing crude rate trends of MRSA infections in children and adolescents.[15] Non-infectious skin conditions, including eczema, were suspected to play a role.

Rural Barriers and Determinants of Health

Recurrent barriers to care and determinants of health associated with bacterial SSTI in NRCIC were mentioned in all of the above articles, broadly encompassing limited travel and transportation, lack of healthcare access, overcrowded housing conditions, high prevalence of comorbidities, sanitation, language, and travel barriers (poor road access, fly-in). A lack of infrastructure for microbial laboratory analysis and IV antibiotics, inconsistent use of, and long transportation times for, culture and sensitivity samples, as well as antibiotic stewardship were also identified.[16] Nasal colonization of MRSA may be a significant risk factor for SSTIs in NRCIC, as demonstrated through a cross-sectional prevalence study by Daley et al in 2016[17] in a rural Newfoundland Indigenous community. Further studies are needed to clarify the presence of nasal colonization and risk of SSTIs in Canadian Indigenous populations.

Actionable Steps

Despite layered barriers relevant to health disparities seen in NRCIC, important opportunities to address

such high rates of SSTIs have been reported, although a concerted effort is needed. Many clinical studies identify chronic skin conditions, such as eczema and ulcers, as recurrent themes and potential infectious portals of entry. However, there is an observed lack of further analysis on the role of skin conditions. Further data analyses of their contributions are needed.

Regional community-based interventions may prove beneficial. In northern Saskatchewan, where high rates of MRSA infections have been observed (the majority representing SSTIs), Golding et al[18] described a decrease in infection rates by nearly half after initiating "Do Bugs Need Drugs?" and "Germs Away" programs. These included prescriber therapy algorithms and educational materials promoting antibiotic stewardship and hygiene. A three-phase NRCIC community-based response protocol involving screening for skin lesions to detect, control, treat and contact trace in response to a pediatric post-streptococcal glomerulonephritis outbreak was successful.[10] Physician telemedicine videoconference consultations conducted from urban Ontario to remote northwestern Ontario to SLMHC, such as those described by Mashru et al in 2017[11] may also help address disease burdens.

Other inclusive research engagement strategies in NRCIC in the literature include: community studies; consultation with community members and health care practitioners with ongoing community relationships in all phases of study; strict confidentiality and privacy requirements; local Institutional Review Board (IRB) approval by Indigenous ethics boards; multi-stakeholder engagement; Indigenous authorship; community mobilization (e.g., educational events, radio announcements); participant honoraria; oral translations into local languages for consent and educational forms; and interventions tailored to community needs. Values and preferences concerning household practice acceptability on boil prevention in a rural Alaskan Indigenous community involved tailored engagement to address *Staphylococcus aureus* boils caused by steam baths.[19] Community surveys on knowledge, attitudes and practices toward SSTIs in rural Alaskan Indigenous communities were described by Raczniak et al in 2016.[20]

Regional and national multi-stakeholder approaches inclusive of NRCIC medical leadership and community involvement are needed to reduce gaps. In light of the extensive published data, updated guidelines on managing these infectious burdens are considered an area of need, as current guidelines on skin infection therapy may not fully integrate the unique needs and layered barriers to healthcare faced by NRCIC. Stakeholders may benefit from referring to Australian parallels of skin infections in NRCIC, such as the "National Healthy Skin Guideline: For the Prevention, Treatment and Public Health Control of Impetigo, Scabies, and Tinea for Indigenous Populations and Communities in Australia."[21]

Conclusion

The evidence has shown that there is a high burden of disease for SSTIs among NRCIC in Canada. While SSTIs are communicable and curable diseases, it is imperative to educate both clinicians and NRCIC community leaders to enhance awareness of the current disparities and to look for strategies to address this problem, including the increased use of telemedicine, public health education and community studies.

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