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Hospital admission for community-acquired pneumonia in a First Nations population

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Introduction: Northwestern Ontario is a large rural area with a high concentration of remote First Nations communities. In Ontario, the highest hospital admission rates for pneumonia are reported from northern and rural regions. However, data are lacking on the epidemiology of community-acquired pneumonia in northwestern Ontario. We sought to characterize cases of community-acquired pneumonia requiring admission at the Sioux Lookout Meno Ya Win Health Centre, which serves a primarily First Nations population of 28 000.

Methods: We undertook a 3-year review of cases of community-acquired pneumonia requiring hospital admission at the centre. We used multivariable logistic regression to identify independent variables predictive of adverse outcomes.

Results: The annual incidence of hospital admissions related to community-acquired pneumonia was 3.42 per 1000 population. Of the 287 patients, 87% were First Nations and 52% were female. There was a high prevalence of diabetes, and chronic cardiovascular, renal and pulmonary diseases. Hospital admissions for community-acquired pneumonia were most prevalent among young children and older adults; both age groups had low coverage with recommended pneumococcal vaccines. Adverse outcomes included 10 deaths (3%) and 35 transfers to an intensive care facility (12%). Chronic renal disease and nonreceipt of azithromycin at initial presentation were identified as 2 independent predictors of an adverse outcome; there was a trend toward an increased risk of an adverse outcome in individuals with chronic obstructive pulmonary disease.

Conclusion: Our findings emphasize the importance of preventing pneumonia in First Nations communities in northwestern Ontario. Research focusing on the distinct epidemiology of community-acquired pneumonia in this population is needed.

Introduction : Le Nord-Ouest de l'Ontario est une vaste région rurale où se trouve une forte concentration de communautés éloignées des Premières Nations. En Ontario, les taux les plus élevés d'hospitalisation en raison d'une pneumonie sont observés dans les régions du Nord et en milieu rural. On manque cependant de données sur l'épidémiologie de la pneumonie extrahospitalière dans le Nord-Ouest de l'Ontario. Nous avons cherché à caractériser les cas de pneumonie extrahospitalière nécessitant une admission au Centre de santé Sioux Lookout Meno Ya Win, qui dessert une population de 28 000 habitants principalement composée de membres des Premières Nations.

Méthodes : Nous avons entrepris une revue répartie sur 3 ans des cas de pneumonie extrahospitalière ayant nécessité une admission à ce centre. Nous avons utilisé une méthode de régression logistique à variables multiples pour identifier des variables indépendantes permettant de prévoir la survenue d'événements défavorables.

Résultats : L'incidence annuelle des hospitalisations reliées à la pneumonie extrahospitalière était de 3,42 pour 1000 habitants. Parmi les 287 patients, 87 % étaient des membres des Premières Nations et 52 % étaient de sexe féminin. On a enregistré une prévalence élevée de diabète, de maladie cardiovasculaire chronique, de maladie rénale et de maladie pulmonaire. La prévalence des hospitalisations en raison d'une pneumonie extrahospitalière était particulièrement élevée chez les jeunes enfants et les adultes âgés; dans ces deux groupes d'âge, le taux de couverture par les vaccins recommandés contre

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le pneumocoque était faible. Les événements défavorables ont été 10 décès (3 %) et 35 transferts vers l'unité de soins intensifs (12 %). Deux variables indépendantes relevées chez les patients au moment de l'hospitalisation ont été prédictives d'événements indésirables : la maladie rénale chronique et la non-réception d'azithromycine; on a observé une tendance à un risque accru d'événements indésirables chez les personnes atteintes de maladie pulmonaire obstructive chronique.

Conclusion : Nos observations soulignent l'importance de la prévention de la pneumonie dans les communautés des Premières Nations du Nord-Ouest de l'Ontario. Il faudrait mener des études sur les particularités épidémiologiques de la pneumonie extrahospitalière dans cette population.

INTRODUCTION

Northwestern Ontario is a large geographic area with distinct environmental, socioeconomic and demographic characteristics that may challenge the maintenance of optimal health and health care services. The area shares many social determinants of health and negative health-related factors typical for rural Canada, such as higher prevalence of people with low income and lower education, less healthy dietary practices and lower levels of physical activity, compared with urban Canadians.[1] The health status of the northwestern Ontario population is also influenced by the vast geography of remote First Nations communities, with challenging access to comprehensive medical services and adverse social determinants of health (e.g., overcrowding, poverty, limited access to potable water).[2–4]

First Nations people in Canada experience a disproportionate burden of numerous health problems, including infectious and respiratory diseases.[5] Previous studies identified increased rates of hospital admission for community-acquired pneumonia among First Nations people in Alberta and Labrador, compared with the non–First Nations population.[6,7] In Ontario, the highest reported admission rates for pneumonia and influenza were found in northern and rural regions;[8] however, data are lacking on the epidemiology of community-acquired pneumonia in northwestern Ontario. We sought to characterize cases of community-acquired pneumonia requiring hospital admission in a primarily First Nations population.

METHODS

This 3-year retrospective population-based study examines all cases of community-acquired pneumonia requiring hospital admission at the Sioux Lookout Meno Ya Win Health Centre, in Ontario. The centre serves a primarily First Nations population of 28 000 in 28 remote communities[9] (Fig. 1).

We specifically identified the medical risk factors and comorbidities associated with community-acquired pneumonia and those associated with an unfavourable clinical course of the disease, such as all-cause mortality associated with the admission or transfer to a tertiary care centre with an intensive care unit (ICU). We compared our centre's admission rates and lengths of stay with provincial averages.

All cases of pneumonia involving admission for at least 24 hours between January 2007 and December 2009 were retrospectively identified by the International Classification of Diseases, 9th revision (ICD-9) codes. The patients' charts were reviewed to exclude health care–associated or hospital-acquired pneumonia. We excluded any patients who had been admitted within the preceding 30 days or transferred to the hospital from a long-term care facility. We also excluded any nosocomial infections with onset of the symptoms more than 72 hours after admission. All discharge diagnoses of pneumonia were included in the study. Data on 41 variables were collected, including patient demographics, medical conditions, current medications and clinical course of disease. Pneumococcal vaccination status as well as microbiology data (blood and sputum culture) were also recorded where available.

Outcomes of interest included all-cause mortality, transfer to another hospital (for admission to intensive care facilities) or a summary outcome of death or transfer. We evaluated the association between patient characteristics and outcome risk, using univariable logistic regression models. Because of the relatively small number of specific outcomes (deaths and transfers) models were built to assess risk of summary outcomes. Candidate covariates ($p \leq 0.15$) were used to build a multivariable logistic regression model, with covariates removed in a stepwise fashion to maximize Akaike information criterion.

The Meno Ya Win Research and Ethics Review Committee gave ethics approval for the study.

RESULTS

Patient characteristics

During the study period, 287 cases of community-acquired pneumonia resulted in admission at the

Sioux Lookout Meno Ya Win Health Centre, for an annual incidence of 3.42 per 1000 population. Of these, 91.3% had radiographic confirmation of the clinical diagnosis. The mean age of patients was 37.2 years with a clear bimodal distribution; 126 patients were under 20 years of age (mean 2.8 yr) and 161 patients were over 20 years of age (mean 64.1 yr) (Figs. 2 and 3). Of the patients, 52% were female, 87% were First Nations, and 71% were obese (body mass index [BMI] > 30) or overweight (BMI > 25). Among adults, 41% smoked or formerly smoked, 47% had diabetes, 31% had chronic obstructive pulmonary disease (COPD), 46% had either congestive heart failure or coronary artery disease, and 20% had chronic renal disease. A total of 40% of patients had received treatment or been admitted for a previous case of pneumonia. The largest number of cases of community-acquired pneumonia were in children aged 1–24 months (n = 80) and in adults aged 70–79 years (n = 42).

Vaccination status was low. Of the whole cohort, 22% had received a pneumococcal vaccine. Of the children aged 2 months to 14 years, 25% had received the 7-valent conjugate pneumococcal vaccine, and 41% of adults aged 65 years or older had received the 23-valent pneumococcal polysaccharide vaccine.

The mean length of hospital stay was 5.32 (95% confidence interval [CI] 4.68–5.96) days. Ten patients (3%) died as a direct result of pneumonia (either in hospital or within 30 days of discharge);

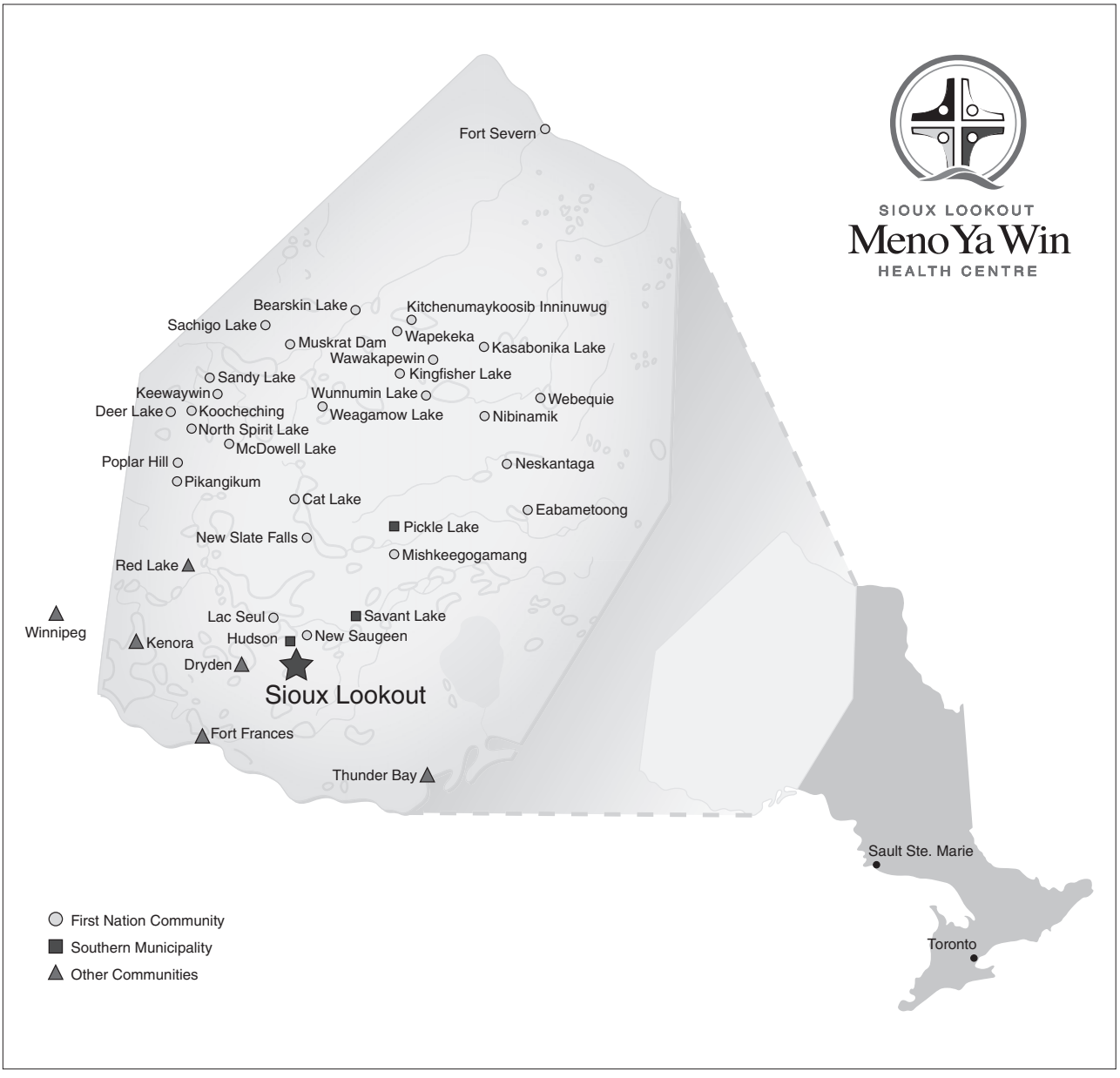


Fig. 1. The service area of the Sioux Lookout Meno Ya Win Health Centre (www.slmhc.on.ca/service-area; reproduced with permission from the Sioux Lookout Meno Ya Win Health Centre).

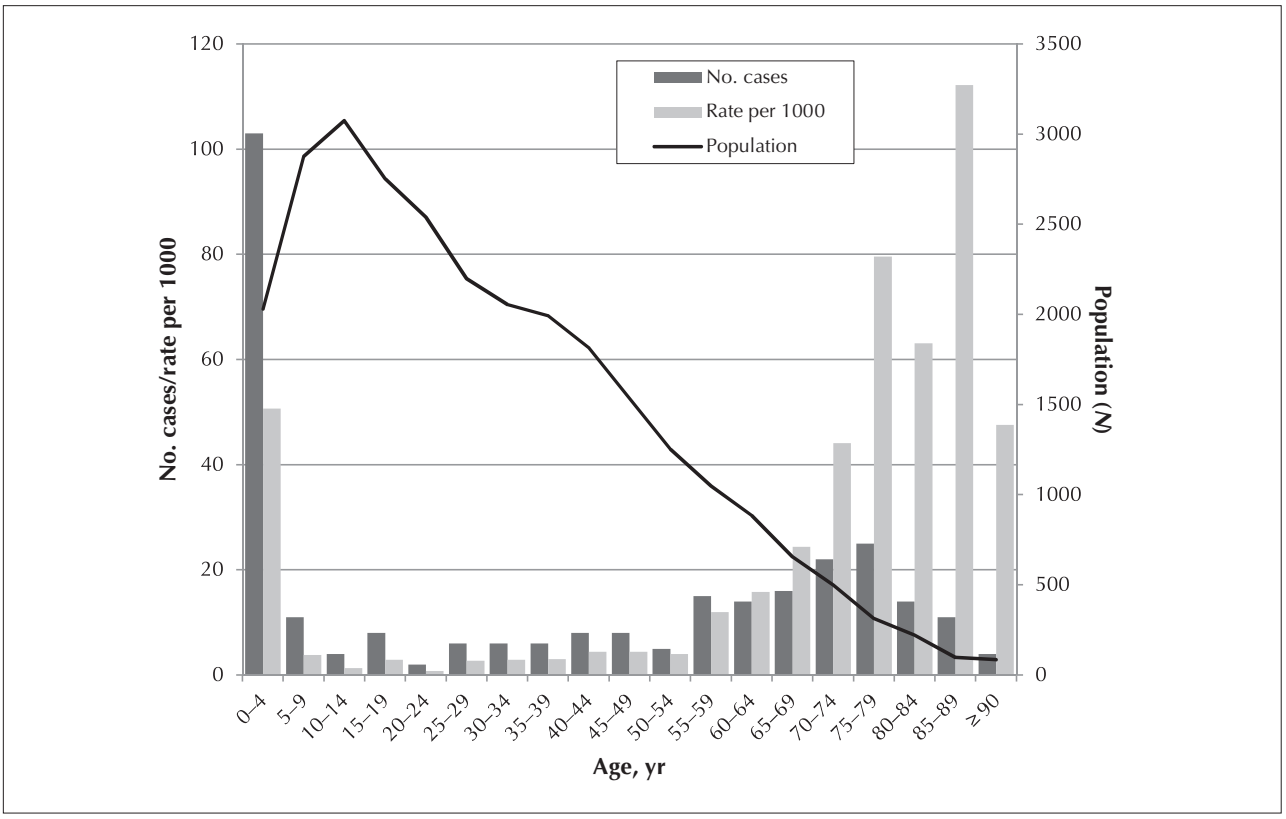


Fig. 2. Distribution of cases and incidence rates of community-acquired pneumonia involving hospital admission, by patient age.

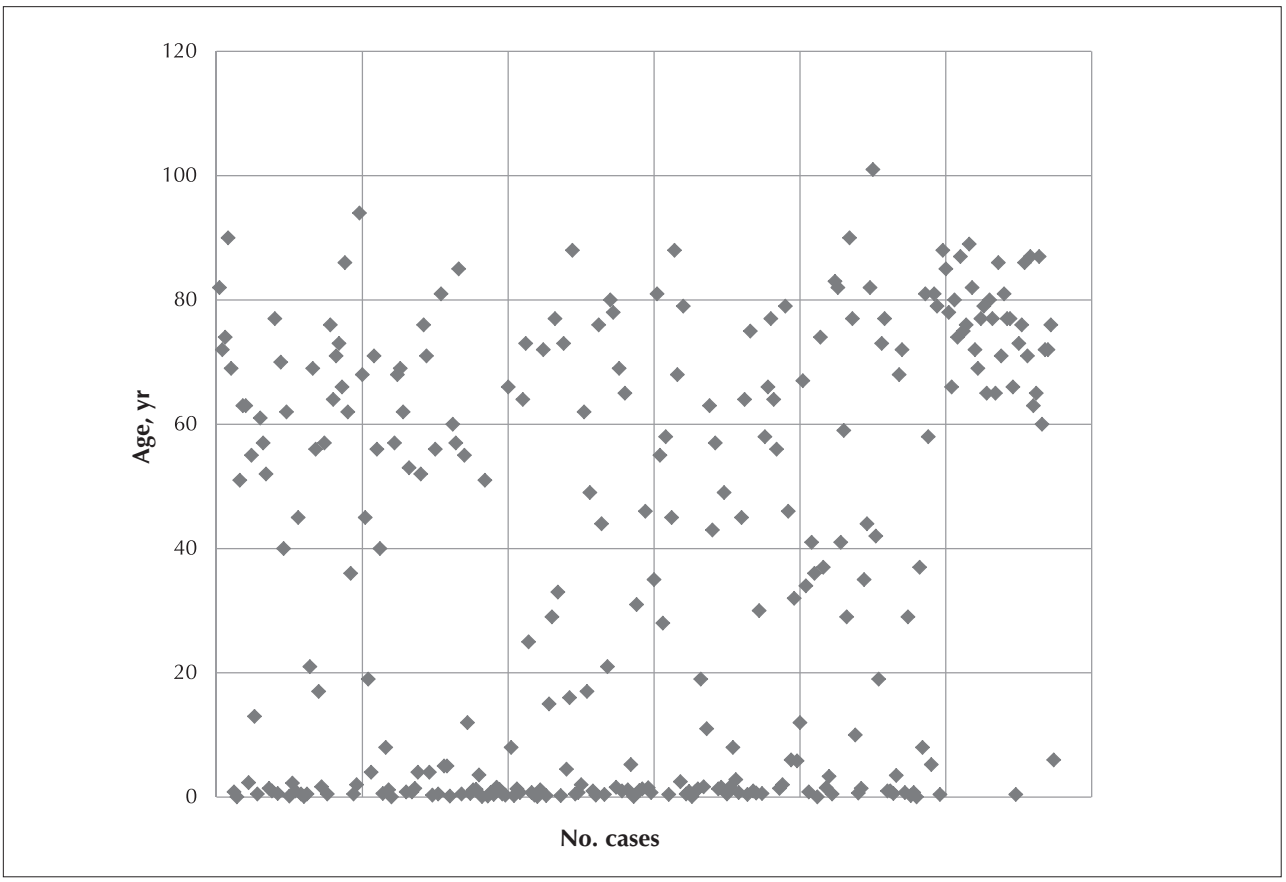


Fig. 3. Age distribution in 287 hospital admissions for community-acquired pneumonia.

35 patients (12%) were transferred to a tertiary care centre for admission to the ICU. The most common treatment courses were cefuroxime, azithromycin, or levofloxacin, with 9% of the patients receiving antibiotics before the hospital admission. Microbiological information from sputum samples were almost universally absent.

Risk factors for unfavourable outcomes

Our analysis identified 2 independent predictors of adverse outcomes: chronic renal disease (odds ratio [OR] 3.14, 95% CI 1.37–7.25, $p = 0.007$) and nonreceipt of azithromycin at the initial presentation (OR 2.17, 95% CI 1.10–4.30, $p = 0.03$). In addition, we found a trend toward an increased risk of adverse outcomes in patients with COPD (OR 1.95, 95% CI 0.90–4.16, $p = 0.09$). Other factors that have been previously identified as predictive of poor outcomes in individuals with community-acquired pneumonia, including nonreceipt of a pneumococcal vaccine and advanced age, were not found to be predictors of poor outcome in this analysis.

DISCUSSION

During the 3 years of this study, the annual incidence of pneumonia-related hospital admission at the Sioux Lookout Meno Ya Win Health Centre was 3.42 per 1000 population. In comparison, the provincial rate for 1992–2001 was 2.42 per 1000 population.[8,10] Our catchment area population constitutes 10% of the population of Local Health Integration Network no. 14, which also has high rates of hospital admission for pneumonia (3.38/1000 v. provincial rates of 1.82/1000 for 2008–2012).[11]

High rates of hospital admission for community-acquired pneumonia in northwestern Ontario may be due to several factors. Canadian and American studies have found community-acquired pneumonia to be more common among Aboriginal populations, with higher admission rates than the general population.[6,7,12–14] In 1995–2001, the admission rate due to pneumonia for the Innu and Inuit communities in Labrador was 11.6 per 1000 population compared with 3.0 per 1000 population in non-Aboriginal communities on the Northern Peninsula of Newfoundland.[7]

Unsatisfactory living standards in rural Aboriginal communities due to poverty, overcrowding, indoor pollution from smoking and wood-burning, poor ventilation and shortage of clean water are recognized as major determinants of increased morbidity in Aboriginal Canadians.[15,16] Limited access to primary care is also a characteristic factor among many rural Aboriginal communities.[17] Indeed, community-acquired pneumonia is considered an ambulatory care–sensitive condition (i.e., a disease that can be effectively managed in an ambulatory setting).[3] A 2003 study by Shah and colleagues[3] addressed the frequencies of preventable hospital admissions in northern Ontario and found a high admission rate for ambulatory care–sensitive conditions in Aboriginal populations compared with non-Aboriginal populations residing in the same geographic area, even when matched by socioeconomic status.

Although pneumonia is the leading cause of admission to the Sioux Lookout Meno Ya Win Health Centre, the proportion of patients whose hospital stay was 2 days or less was about 6 times the provincial average.[11] More frequent admissions for community-acquired pneumonia with shorter hospital stays have also been reported from rural hospitals in Alberta and in Innu and Inuit patients in Labrador, in comparison with non-Aboriginal patients.[7,18] In addition, studies have found that non-Aboriginal patients have less severe pneumonia, with lower in-hospital mortality, than non-Aboriginal patients.[6,7] In a 2004 study from Alberta, Marrie and colleagues[6] found that in-hospital mortality in First Nations patients was 3.1%, compared with 6.9% in age-matched non–First Nations patients.

Mortality from pneumonia varies by study. Recently short-term mortality as high as 9% has been reported in patients admitted to hospital with community-acquired pneumonia.[19] In our study, 30-day mortality was 3.5%, which suggests that pneumonia had a less severe course in our patients. Limited access to primary care follow-up and outpatient supports may lead to admission of patients who present with less severe disease, because patients often live hours away by air travel from the hospital.

Age is recognized as a major risk factor for community-acquired pneumonia, with higher incidence rates in people aged 65 years or older.[20] However, children under the age of 4 years are also at an increased risk.[7,21] Aboriginal infants have the highest rate of hospital admission, whereas non-Aboriginal patients with pneumonia are primarily older adults.[7] The bimodal age distribution in our study is consistent with these previous studies. In our study, the largest number of cases ($n = 80$) was found in children aged 1–24 months, and the second largest group ($n = 42$) consisted of adults aged 70–79 years. Because of the large number of childhood cases, the mean age of patients in our study was lower than that from another

Canadian report of community-acquired pneumonia in First Nations populations (37 yr v. 53.5 yr).[6]

Typical comorbidities of community-acquired pneumonia as well as medical risk factors described in the literature were present in our study: a high prevalence of diabetes, cardiovascular disease, COPD, chronic renal disease, previous episodes of pneumonia and smoking.[22–24]

Chronic renal failure is a recognized risk factor for community-acquired pneumonia.[25–28] In Canada, the prevalence of severe chronic kidney disease is almost twofold higher among First Nations than non–First Nations people.[29] The First Nations population of northwestern Ontario is disproportionately affected by chronic renal failure.[30,31] In our study, it was found to be an independent risk factor associated with an unfavourable outcome of pneumonia. The presence of diabetes and COPD is known to have a negative impact on the immune system[32,33] and was seen in 47% and 31% of our participants, respectively. A trend to an increased risk of an unfavourable outcome of pneumonia was observed in patients with COPD, but not in patients with diabetes.

Microbiological data were absent from most of the patient charts in our study, as is often the case in pneumonia studies. In our study participants, coverage of children and older adults with recommended pneumococcal vaccines was low (the 7-valent pneumococcal conjugate vaccine, Pneu-C-7; and the 23-valent pneumococcal polysaccharide vaccine, Pneu-P-23, respectively).[34] The Pneu-C-7 vaccine recommended by the Public Health Agency of Canada for all children under 2 years of age has been part of the routine Ontario vaccination program since 2005.[35] In our cohort, the average vaccination rate in children between 2 months and 14 years of age was only 25%, whereas 35% would have been eligible by age given the timing of the introduction of the vaccine in Ontario.

Pneu-P-23 is recommended for all adults older than 65 years in Canada.[36] Although there is conflic - ing evidence that the administration of the Pneu-P-23 vaccine reduces rates of pneumonia, the administration of this vaccine in at-risk populations is supported by data demonstrating improvement in clinical outcomes, including shorter hospital stays, reduced occurrence of bacterial sepsis or transfer to intensive care, and reduced mortality.[37–39] Our vaccination rate in this population was 41%; improved vaccination practices might decrease infection rates and hospital admissions in the older portion of our population.

We also found that nonreceipt of azithromycin at the initial presentation was a predictor of a negative outcome. This may speak to the possibility of high rates of susceptible organisms, including atypical causes of pneumonia, but also may be indicative of the immune-modulating properties of this antibiotic.[40] In 2012, a meta-analysis of 23 studies found a 22% reduction in mortality with this antibiotic; the authors hypothesized that some of the benefit may be due to its anti-inflammatory properties.[40] The Canadian Paediatric Society has recently recommended against its use in pneumococcal pneumonia (the cause of 25%–50% of community-acquired pneumonia in some studies) due to the association with the development of resistance.[35,41] The absence of microbiological data inhibit us from speculating on whether we are encountering more atypical causes of community-acquired pneumonia.

Short hospital stays are often seen as unnecessary or "social" admissions. In our setting, with patients travelling long distances back to their home community, prudent management may lead to short admissions to ensure the patient is safe to travel and to receive treatment back in their distant home community. Hospital admission and length of stay aside, the standardized mortality for respiratory disorders (excluding neoplasms) in northwestern Ontario is almost twice that of the rest of the province (0.7/1000 v. 0.4/1000, respectively).[10] More research is needed to understand the role that social determinants of health, vaccination status and treatment play.

Limitations

Community of origin was not noted in our study. Therefore, we could not distinguish between members of the population who had easier access to the hospital and local clinics, and those in more remote areas. Sputum culture results were rarely available on the charts, particularly in the pediatric population.

CONCLUSION

Medical and socioeconomic risk factors for community-acquired pneumonia exist in rural First Nations populations. The etiology of community-acquired pneumonia in this population requires further study for better prevention. Increased microbiological surveillance, as well as community-specifi variables (e.g., housing and air quality) would enhance our understanding of risk factors and best treatment options for community-acquired pneumonia in this region. Renal failure and nonreceipt of azithromycin were independently associated with poor outcomes of community-acquired pneumonia

in our study population. Pneumococcal vaccination in our region should be made a priority.

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