

# COSTS ASSOCIATED WITH INFANT BRONCHIOLITIS IN THE BAFFIN REGION OF NUNAVUT

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## ABSTRACT

**Objective.** Although infants living in the north of Canada have been reported to have one of the highest rates of hospital admission for bronchiolitis in the world, the economic effects of this condition have not been reported. Passive immunization against the Respiratory Syncytial Virus, the most common causative agent of infant bronchiolitis, is available.

**Methods.** We tabulated transportation, in-hospital care and family accommodation costs for infants of less than 12 months of age residing in the Baffin Region of Nunavut aged who were admitted to Baffin Regional Hospital in Iqaluit, Nunavut, and the Children's Hospital of Eastern Ontario in Ottawa, Ontario, with a primary diagnosis of bronchiolitis or viral pneumonia, over a 36-month period, between April 1999 and March 2002.

**Results.** One hundred fifty-nine infants were admitted a total of 210 times, with 196 admissions to Baffin Regional Hospital, and 14 to the Children's Hospital of Eastern Ontario, during the study period. The overall, annual, population-based admission rate for the Baffin Region of Nunavut was 197 admissions per thousand infants per year. Total costs were \$2,997,373 (\$2,357,747 for Baffin Regional Hospital, \$639,625 for the Children's Hospital of Eastern Ontario). Overall average costs were \$14,273 per admission, \$12,029 for infants admitted to Baffin Regional Hospital and \$45,688 for infants admitted to the Children's Hospital of Eastern Ontario.

**Conclusions.** Infant bronchiolitis in the Baffin Region of Nunavut represents a significant burden on the territorial health care system. (*Int J Circumpolar Health* 2005;64(1):38-45. )

**Keywords:** Bronchiolitis, Inuit, Nunavut, cost, Baffin region

## INTRODUCTION

Bronchiolitis is the most common respiratory disease during the first year of life (1), and infants living in northern communities are at increased risk for bronchiolitis compared to infants in southern climates. Infants in the Baffin Region of Nunavut have been reported to have one of the highest rates of bronchiolitis-related hospitalization in the world (2-4).

The Baffin Region consists of 13 communities in eastern Nunavut, including the capital, Iqaluit. In 1999, the Baffin Region had a total population of 13,565, with a projected 2000 population of 13,900 (5). Many of the communities are isolated and can be reached only by air in the winter. The birth rate of Nunavut was 25.6 per 1000 in 2001-2002, more than twice the overall Canadian rate of 10.6 per thousand (6).

Infants living in the Baffin Region of Nunavut who require hospitalization are transferred to the Baffin Regional Hospital (BRH) in Iqaluit, Nunavut. Approximately 7-10% of Inuit infants with bronchiolitis require mechanical ventilatory support and, hence, are transferred to a southern Pediatric Intensive Care Unit (PICU) (3) (Creery, unpublished data). The Children's Hospital of Eastern Ontario (CHEO), located in Ottawa, Ontario, is the southern tertiary referral hospital for the Baffin Region of Nunavut and is associated with the University of Ottawa.

Between 50 and 80% of infant bronchiolitis is associated with Respiratory Syncytial Virus (RSV). Palivizumab, a humanized IgG antibody directed against the F protein of RSV, has been shown to be effective in preventing infection with RSV in high-risk pop-

ulations (7-9). In a before-after cohort design, Palivizumab was shown to be effective in high-risk Native infants in Alaska (4). Given its high cost and the logistical challenges of monthly intramuscular injections, use of Palivizumab in Canada's north has not been widespread to date. Health policy decisions regarding implementation of focused, or generalized preventative therapies, such as Palivizumab, will depend on accurate cost-analysis studies in this population. We undertook the current study to estimate the transportation, in-hospital and accommodation costs associated with bronchiolitis among infants living in the Baffin Region of Nunavut. The study was designed to provide pilot/feasibility information for use in planning a comprehensive, prospective cost analysis study.

## METHODS

### Study Design

This retrospective pilot project was designed to estimate transportation, in-hospital care and family accommodation costs associated with bronchiolitis among Inuit infants living in Nunavut. Costs included and not included are listed in Table I. The study was approved by the Research Ethics Committee of the Children's Hospital of Eastern Ontario and the Nunavut Research Institute.

We studied infants under 12 months of age residing in the Baffin Region of Nunavut, admitted to Baffin Regional Hospital in Iqaluit, Nunavut, or to CHEO in Ottawa, Ontario, with a primary diagnosis of bronchiolitis, or viral pneumonia (ICD 9 codes 466.11, 466.19, 480.8 and 480.9 or ICD-10 codes J20 or J12),

**Table 1.**

Costs Included and Not Included.

Costs Included	Costs Not Included
Medevac transportation for the infant from the home community to Iqaluit	Itemized costs related to in-hospital care at BRH or CHEO (including health care provider costs)
Non-Medevac transportation for the infant and one parent from Iqaluit to the home community	Health care provider costs during Medevac transport
Medevac transportation for the infant from Iqaluit to Ottawa	Actual (per kilometre) costs of transports, including weather delays
Non-Medevac transportation for the infant and one parent from Ottawa to Iqaluit	Cost of stabilization at BRH for infants not admitted there (i.e. transferred directly to CHEO)
Non-Medevac transportation for the infant and one parent from Iqaluit to the home community	Cost of family accommodation in Iqaluit
In-hospital <i>per diem</i> costs at BRH and CHEO	Loss of parental income
Family accommodation costs in Ottawa	

during the 36-month period from April 1999 to March 2002. Ethnicity was not recorded. Infants were identified by searching the Medical Transportation Database of the Government of Nunavut based on the ICD-9 and ICD-10 codes for bronchiolitis. This electronic database includes patients residing in Iqaluit, as well as infants residing in outlying communities. Infants over 12 months of age at admission were excluded. The list was then cross-referenced by searching the CHEO Health Records database in a similar manner. In order to study the same time period for both institutions, infants admitted to CHEO prior to the first entry in the BRH database (April 1999) were excluded.

### In-Hospital Costs

The *per diem* costs of in-hospital care at BRH and CHEO were obtained from the Government of Nunavut (Rankin Inlet office) and the Accounting Manager at CHEO, respectively. They include all hospital-associated costs, including diagnostic testing, drugs, medical, or

surgical supplies, and employee costs other than physician costs. The CHEO *per diem* does not include MRI, or CT scans. The BRH *per diem* was \$1490. The CHEO *per diem* was \$1934 for an ICU bed and \$567 for a ward bed.

### Transportation Costs

The transportation costs were based on the costs of emergency Medevac to Iqaluit and to Ottawa, and non-medical flights on the return to Iqaluit, or to the home community. The cost of flights from home communities to Iqaluit was provided as aggregate average costs by the Department of Finance, Government of Nunavut (Iqaluit office). The cost of transport by Medevac includes transport of a parent within the air-ambulance. SkyServices, the medical transport company under contract to the Government of Nunavut for Medevac transportation between Iqaluit and Ottawa, provided the cost information for these flights. These costs were specific to the individual patient.

### Costs of Family Accommodation

Costs related to accommodation in Iqaluit were not included, as many of the families stay with other family members, or friends. Larga House provided costs related to family accommodation in Ottawa. Larga House is a boarding house for Inuit patients from Nunavut with outpatient appointments in the Ottawa region and for families of admitted patients. The \$110 daily rate covers a bed, meals, transportation to and from the airport, and transportation to and from the hospital.

### Other considerations

Some infants were not officially admitted to BRH, although all infants are stabilized there prior to transfer to CHEO; these costs were not captured. Community population projections for the year 2000 based on 1999 data were used (Table II).

### Analysis

Data was summarized using descriptive statistics. Age and Hospital Length of Stay com-

parisons were made between BRH and CHEO patients using a two-sided student's *t* test.

Using the Statistics Canada 2000-2001 birth rate of 25.6 per thousand and the projected 2000 total Baffin Region community population of 13,900, 356 infants were born in the Baffin Region in 2000. We calculated the annual population-based admission rate (expressed as admissions per thousand children under 1 year of age per year) by multiplying the total number of admissions by one thousand and dividing by the product of the length of the study period in years and the total number of births per year. This methodology was used in a similar study involving this population (10).

## RESULTS

### Admission Data

One hundred fifty-nine infants were admitted a total of 210 times (196 admissions to BRH, 14 to CHEO) during the 36-month study period. One patient was admitted 6 times, one patient 4 times, 11 patients 3 times, and 21 patients twice. Four patients were admitted to both BRH and CHEO but no patient was admitted to CHEO more than once.

We estimated that 356 infants were born in the Baffin Region in 2000. The overall annual population-based admission rate was therefore 197 admissions per thousand children of less than 1 year of age per year.

The mean age at admission was 129 days (range 10 to 362) and the average length of hospital stay was 5.7 days (range 1 to 50). As expected from their higher level of acuity, CHEO patients had longer hospital stays

**Table II.**

Admission Rates by Community.

Community	2000 population (projected)	Total Admissions*
Arctic Bay	730	11
Cape Dorset	1,213	22
Clyde River	771	10
Grise Fiord	145	1
Hall Beach	635	15 (1)
Igloolik	1,379	48 (6)
Iqaluit	4,762	39 (2)
Kimmirut	450	6
Nanisivik	230	0
Pangnirtung	1,506	8
Pond Inlet	1,314	43 (4)
Qikiqtarjuaq	522	6 (1)
Resolute Bay	243	1
<b>Totals</b>	<b>13,900</b>	<b>210</b>

\* CHEO Admissions in brackets

(17.6 versus 4.9 days,  $p < .001$ ) than BRH patients. CHEO patients also showed a trend towards being younger (96 days vs. 131 days,  $p = .07$ ). Admissions were clustered in the winter-spring months (data not shown).

The community of Igloolik had the highest number of admissions (48 total, 42 to BRH and 6 to CHEO). Of the 13 Baffin Region communities, only Nanisivik had no infants admitted during the study period.

**Cost Data**

Total costs were \$2,997,373 (\$2,357,747 for BRH, \$639,625 for CHEO). Annualized costs were \$785,916 for BRH and \$213,208 for CHEO. Overall average costs were \$14,273 per admission, \$12,029 for infants admitted to BRH and \$45,688 for infants admitted to CHEO. Total in-hospital costs for CHEO were \$287,685, \$208,872 for ICU care and \$78,813 for ward care. For in-patient care at BRH, per-patient costs ranged from \$1,490 to \$47,205. For in-patient care at CHEO, per-pa-

tient costs ranged from \$6,136 to \$40,948. For travel from the home community to Iqaluit, costs ranged from \$1,148 to \$7,981. For travel from Iqaluit to Ottawa, costs ranged from \$9,776 to \$23,346. Larga House costs ranged from \$660 to \$5,500 per patient. The distribution of costs for BRH and CHEO patients is shown in Figure 1.

**Table III.**

Total and Average Costs (\$) by Community.

Community	Total Costs*	Average Costs**
Igloolik	953,987 (289,071)	19,875
Pond Inlet	776,242 (189,975)	18,052
Iqaluit	324,875 (97,166)	8,330
Cape Dorset	221,758	10,080
Hall Beach	198,085 (34,558)	13,206
Arctic Bay	183,346	16,668
Clyde River	144,195	14,419
Qikiqtarjuaq	62,437 (2 8,856)	7,805
Kimmirut	51,336	8,556
Pangnirtung	42,692	7,115
Grise Fiord	21,617	21,617
Resolute Bay	16,803	16,803
Totals	953,987	

\* CHEO Costs in brackets

\*\* Total Costs per Admission

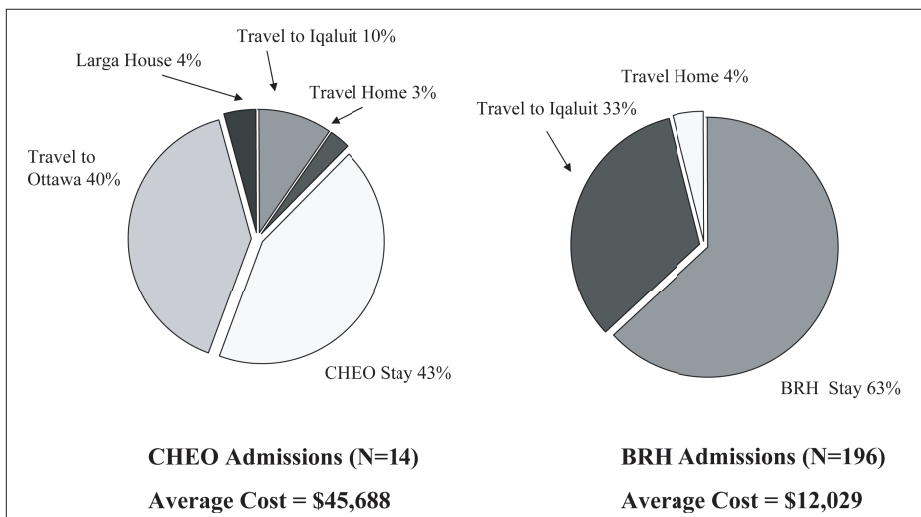


Figure 1. Cost Distribution. The distribution of transportation, in-hospital care and accommodation costs are shown for Baffin Regional Hospital (BRH) and the Children's Hospital of Eastern Ontario (CHEO).

The community of Igloodik had the highest total cost (\$953,987), and the second highest average cost (\$19,874 per admission) after Grise Fiord (\$21,617), which had only one admission (Table III).

## DISCUSSION

Inuit infants living in Baffin Island, Nunavut, have the highest incidence of severe bronchiolitis requiring hospital admission in the world (2,3). Residents of the Baffin Region of Nunavut are served by a single hospital, located in Iqaluit, so hospitalization of infants from remote communities requires medical evacuation. In the most severe cases, infants with bronchiolitis need intubation and mechanical ventilation, requiring an additional medical evacuation to the PICU at CHEO, in Ottawa. At CHEO and the three other Canadian institutions serving as southern referral hospitals for Nunavut, Inuit infants comprise between 12 and 36% of infant PICU admissions for bronchiolitis (Creery, unpublished data). Thus northern infants with bronchiolitis constitute a significant burden on the Canadian health care system.

In the one-year period between March 1995 and February 1996, 94 infants of less than one year of age were admitted to Baffin Regional Hospital with bronchiolitis (3). Likewise, between October 1997 and June 1998, 41 infants were admitted to Baffin Regional Hospital for LRTI, some of them more than once, corresponding to an annual incidence rate of 484 per 1000 (3). Twelve percent of infants in that study required intubation and transport to a tertiary care centre.

A retrospective analysis of Indian Health Service hospitalization data from 1990 through 1995 revealed that the hospitalization rate for bronchiolitis in Alaskan native infants aged under one year was 78.1 per 1000, which is almost twice the rate for infants in the continental U.S. in 1995 (11). A 3-year prospective study between 1993 and 1995 in the Yukon Kuskokwim Delta of Alaska, where the aboriginal population is predominantly Inuit, found that annual hospitalization rates for RSV bronchiolitis in children of under one year ranged from 53 per 1000 to 249 per 1000 (2).

A retrospective cohort study of Alaskan native children by Singleton et al. analyzed rates of admission with bronchiolitis before and after introduction of a program to provide Palivizumab prophylaxis to high-risk infants (e.g. premature infants or those with chronic lung disease) (4). A significant reduction in admission rates among premature infants was noted after introduction of Palivizumab. Among the general Alaskan native population, they reported an admission rate of 144 per thousand births between 1998 and 2001. Our overall admission rate of 197 admissions per thousand infants is similar to this, but is lower than that reported by Banerji (3) for a similar Baffin Region population in 1997-1998.

Providing health care to isolated northern communities is associated with high costs. The concentration of medical care in regional centres necessitates costly medical transportation, often under challenging circumstances and over large distances. Maintaining health care facilities in remote communities requires high personnel and ongoing

administrative costs. Isolated communities may also experience high attack rates for certain conditions, such as pneumonia, or bronchiolitis, also adding to the high costs. Another challenge facing the northern health care system is the maintenance of adequate health personnel, due to difficulties with recruitment and retention.

The current study was designed to estimate the costs of transportation, in-hospital care and accommodation of infants suffering from bronchiolitis in the Baffin Region of Nunavut. Admissions to Baffin Regional Hospital and the Children's Hospital of Eastern Ontario cost approximately \$12,029 and \$45,688, respectively, and the overall cost was \$2,997,373. These costs are likely to be underestimates (see Limitations of Study). These findings suggest that prospective, comprehensive cost analysis studies are warranted in this population.

Infants living in the community of Igloolik were over-represented in this study. Despite being approximately the same size as a number of other Baffin Region communities (Table II), Igloolik had the highest numbers of admissions to both BRH and CHEO, and had the highest overall cost and second highest average cost. Pond Inlet also had high rates of total admissions and total cost. Although the current study did not document RSV-positivity rates, Igloolik and Pond Inlet may, in the future, be identified as good candidate communities for Palivizumab prophylaxis in the future.

### Limitations of the Study

This study is limited by a number of factors. Costs associated with bronchiolitis not re-

quiring admission to hospital, but requiring care at the local Community Health Centre, were not captured. Given the retrospective nature of the study, it is possible that the patient list is not comprehensive. Admissions to Baffin Regional Hospital were obtained by searching the Government of Nunavut Medical Transport Database. The reliability and validity of this database has not been formally analysed. It was not possible to cross-reference this list with the BRH Health Records database, so it is possible that admissions were missed. Also, infants from the Baffin Region may have been transferred to a southern referral hospital other than CHEO, although this is not the usual practice.

There are a number of reasons why we may have underestimated the true costs of in-hospital bronchiolitis in this population. Not all cost data was recorded (Table I), and some of the cost estimates provided are likely to be imprecise (e.g. Medevac transports were provided as averages rather than actual per kilometre costs). The cost of family accommodation in Ottawa was calculated to be the number of days that the patient was admitted times the daily rate; it is unlikely that the family flew home on the exact date of patient discharge. Patients from Arctic Bay are transported through Nanisivik, and patients from Grise Fiord through Resolute Bay: for patients from Arctic Bay and Grise Fiord, study costs only reflect costs for transportation from and to Nanisivik and Resolute Bay.

In summary, this study reported high costs associated with high rates of hospitalisation for bronchiolitis among infants living in the Baffin Region of Nunavut. To our knowledge, this is the first report of transportation, in-hos-

pital care and family accommodation costs associated with this condition. We believe that a prospective, comprehensive cost analysis study in this population is feasible and warranted. The results of this study will be important in the planning of cost-benefit analyses of Palivizumab prophylaxis for infant bronchiolitis in the Baffin Region of Nunavut.

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