



Treatment of Preventable Dental Cavities in Preschoolers: A Focus on Day Surgery Under General Anesthesia



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Table of Contents

About the Canadian Institute for Health Information	iii
Acknowledgements	v
Executive Summary	vii
Introduction	1
What Is Early Childhood Caries?	1
How Does ECC Progress?.....	2
Methods	3
Identifying ECC-Related Day Surgery Operations	3
Calculation of Rates	4
Cost Estimates	5
Travel Time	5
Study Limitations.....	5
How Often Does Day Surgery for ECC Occur?	6
Rates by Jurisdiction	8
ECC Day Surgery by Facility Type (Hospitals Versus Private Clinics)	9
Rates by Health Region	9
Are Some Populations at Higher Risk?.....	10
How Much Does It Cost?	12
Hospital Costs	12
Anesthesia Costs	13
Travel Time	13
Conclusion	14
Appendix A: Rate of Day Surgery for ECC by Province/Territory and Health Region	17
Appendix B: Publicly Funded Dental Programs	21
Appendix C: Methods.....	25
References.....	31

About the Canadian Institute for Health Information

The Canadian Institute for Health Information (CIHI) collects and analyzes information on health and health care in Canada and makes it publicly available. Canada's federal, provincial and territorial governments created CIHI as a not-for-profit, independent organization dedicated to forging a common approach to Canadian health information. CIHI's goal: to provide timely, accurate and comparable information. CIHI's data and reports inform health policies, support the effective delivery of health services and raise awareness among Canadians of the factors that contribute to good health.

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Executive Summary

Each year, 19,000 day surgery operations are performed to treat cavities (due to caries) among children younger than age 6. This is despite the fact that early childhood caries (ECC) is generally preventable and, when caught early, is treatable in community-based settings. ECC is an infectious disease resulting in decay of a child's primary teeth. The consequences of ECC can be dire. Pain, difficulty eating and sleeping, speech difficulties and poor self-esteem may occur, affecting growth and the ability to concentrate and function. Quality of life can be seriously impaired.



Day surgery for ECC occurred about once for every 100 children age 1 to younger than 5 during the two-year period 2010–2011 to 2011–2012. These operations to fill or treat cavities and extract teeth were almost always conducted under general anesthesia (99%). Day surgery for ECC constituted 31% of all day surgery for children age 1 to younger than 5, making it the leading cause of day surgery for children this age. The estimates of ECC's impact on children's well-being and demands on the health care system provided in this report represent the tip of the iceberg, because only procedures performed as day surgery were included. Comprehensive data on care provided to children with ECC and seen in community-based settings was not available for analysis.

Day surgery rates

- Were 8.6 times as high for children from neighbourhoods with high (versus low) Aboriginal populations;
- Were 3.9 times as high for children from the least (versus the most) affluent neighbourhoods; and
- Were 3.1 times as high for children from rural (versus urban) neighbourhoods.

The public cost associated with one aspect of day surgery for ECC—hospital care—is considerable: \$21.2 million per year for children age 1 to younger than 5. This is a fraction of the total cost of care for ECC because it excludes costs associated with care providers, such as dental surgeons and anesthesiologists, as well as costs associated with travel to care.

- The average hospital cost per surgery ranged from \$1,271 in New Brunswick to \$1,963 in Alberta.
- Among the four western provinces, the average anesthesia cost per surgery ranged from \$240 in Manitoba to \$361 in Saskatchewan.
- In more than one in five ECC day surgery visits (22.3%), families travelled two or more hours for care.

The scope, design and financing of public programs in place to improve access to dental services among children from low-income families vary greatly by jurisdiction.

Introduction

The development of cavities in the primary teethⁱ of children due to early childhood caries (ECC) represents a significant burden in both human and financial terms. The oral pain and infection associated with ECC can result in lost sleep, poor growth, behavioural problems and poor learning.^{1,2} Dental problems may also undermine a child's self-esteem and interfere with communication and socialization. Tooth extraction may affect the alignment of the permanent teeth and increases the risk of dental problems later in life. Dental caries is a preventable infectious disease and is the most common chronic disease of childhood.¹ Minimizing the risk of dental caries among children can be accomplished in large part by maintaining good oral health starting at an early age (such as brushing teeth and having healthy dietary habits), using proven preventive techniques (such as topical fluoride treatments) and ensuring access to fluoridated water.

What Is Early Childhood Caries?

Caries is a biofilm (plaque)-induced acid demineralization of enamel or dentin, mediated by saliva. The disease of ECC is the presence of one or more decayed, missing (due to caries) or filled tooth surfaces in any primary tooth in a preschool-aged child (that is, younger than age 6). A more serious form of the disease, severe ECC, is defined by age and the extent of disease.^{ii, 3, 4}

In its mildest form, ECC can generally be treated in ambulatory settings and without general anesthesia. The need for care involving general anesthesia is more likely when more teeth are involved, the procedures needed to treat the child are more invasive and the time to treat is lengthened.

This report focuses on day surgery for ECC. Data was not available to report specifically on severe ECC.



Source

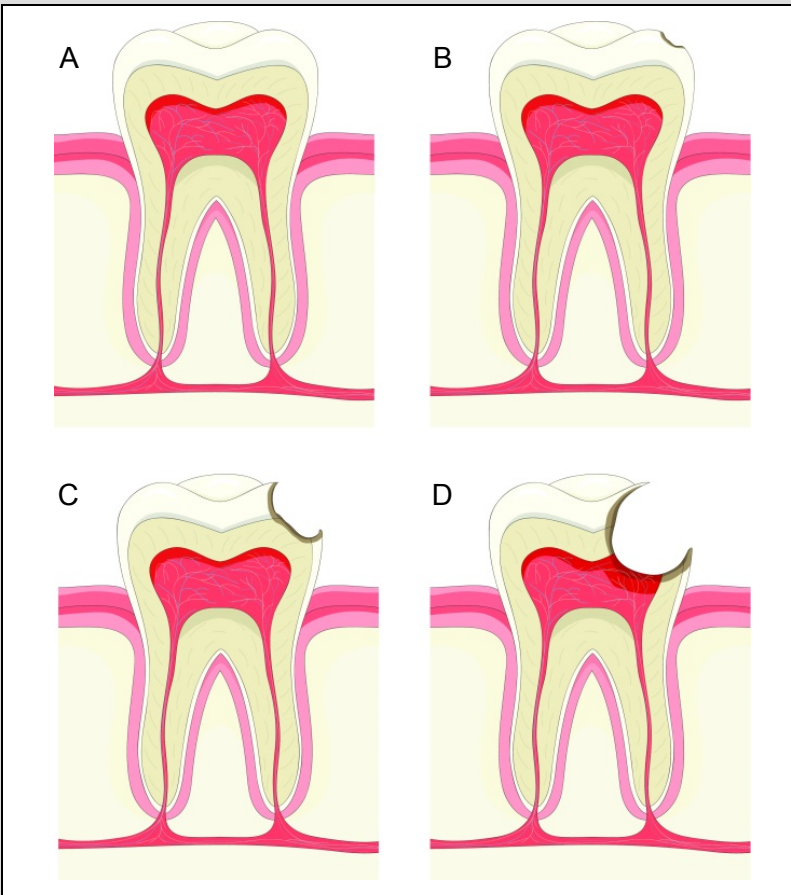
Courtesy of Dr. Jim Tennant, Northwest Territories & Nunavut Dental Association Member and Dentist, Hay River, Northwest Territories.

- i. Primary teeth erupt from the gums of infants starting at approximately 6 months of age, and most children have a complete set of primary teeth by age 3.⁴⁸ Children begin to lose their primary teeth and permanent teeth generally begin to erupt between ages 6 and 7 years.⁴⁹ Most children have 28 of their 32 permanent teeth by age 13. The last four teeth, the wisdom teeth, usually begin to erupt between ages 17 and 21.
- ii. In children younger than 3 years, any sign of smooth-surface caries is indicative of severe ECC. From ages 3 to 5, one or more cavitated, missing (due to caries) or filled smooth surface in primary maxillary anterior teeth or a decayed, missing or filled score of 4 or more (age 3), 5 or more (age 4) or 6 or more (age 5) surfaces constitutes severe ECC.^{3, 4}

How Does ECC Progress?

Dental caries is caused by bacteria that digest dietary carbohydrates (sugars and starches) to produce acid that leads to tooth mineral loss (demineralization) and the formation of cavities. The caries process is reversible and can be halted at any stage. The body has a natural repair mechanism that is enhanced when minerals such as fluoride and calcium diffuse from saliva back into caries lesions. Brushing teeth helps remove plaque, the sticky film of bacteria that forms on teeth.

Figure 1: Progression of ECC



In its early stages, caries may affect only enamel (B, top right), the outer layer of the tooth structure. When decay progresses, it reaches a deeper layer called dentin (C, bottom left). Beyond the dentin is the pulp. When decay extends into the pulp (D, bottom right), extraction or procedures involving the pulp or root of the tooth are necessary.

Sources

Kagihara LE, et al. and Zafar S, et al.^{5,6}

Most Canadian children are treated for caries in community-based dental offices or clinics. There are mounting concerns, however, that young children are not benefiting from known prevention strategies and are instead developing serious dental conditions necessitating surgery in hospital under general anesthesia.^{1,7} General anesthesia is undertaken with some risk and is indicated only when such risks are counterbalanced by clear clinical benefit.⁸ In most cases, surgery for ECC can be avoided with a combination of preventive strategies and restorative practices. Early dental care can help prevent the development of cavities or at least delay the age of their onset. Most dental conditions in children are most appropriately handled in ambulatory settings without such intensive care.

This report focuses on dental caries among young children that have progressed to such an extent that their dental care occurs as day surgery, almost exclusively under general anesthesia. The volumes and rates of day surgery reported here underestimate the true burden of ECC. The true prevalence of ECC was not measurable with available data sources. For example, data on care provided to children with ECC in community-based settings was not available. However, this report profiles the extent of day surgery for serious cases of ECC being provided by health authorities and provides details on the following aspects of such care among young children:

- The magnitude of the problem—numbers and rates by province, territory and health region;
- The identification of populations at higher risk; and
- Costs associated with care.

The purposes of the report are to

- Quantify the burden of day surgery for ECC being provided by hospitals and health authorities;
- Raise awareness of the size of the problem and key groups at risk; and
- Encourage health care decision-makers to improve children's well-being and achieve health system savings by adopting preventive strategies and interventions.

Methods

This section describes data sources, how day surgery operations for ECC were identified and how ECC rates and related costs were calculated (see Appendix C for further information on methods).

Identifying ECC-Related Day Surgery Operations

Day surgery abstracts for ECC were extracted from CIHI's Discharge Abstract Database (DAD) and National Ambulatory Care Reporting System (NACRS). Given the potential for small numbers of day surgery operations in remote health regions, data was pooled for fiscal years 2010–2011 and 2011–2012. Records for children younger than age 6 containing both a diagnosis of dental caries (K02, K04.7) and an identified surgical dental procedure (filling, extraction and/or other)ⁱⁱⁱ were included in the analysis. Records with a diagnosis of dental trauma were excluded. Quebec elected to not participate in this study.

iii. Canadian Classification of Health Interventions (CCI) codes 1.FE.57.JA, 1.FF.56, 1.FF.89, 1.FE.89, 1.FE.29, 1.FE.53.JA-RV, 1.FF.59.JA, 1.FD.52, 1.FE.87.JA-H1, 1.FF.53, 1.FF.80 and 1.FF.87.

Calculation of Rates

Rates were calculated by dividing the number of procedures found in the pooled two-year cohort (2010–2011 and 2011–2012) by the sum of the combined two-year subpopulation estimate.

Subpopulation Estimates

Population estimates for 2010 and 2011 age- and gender-specific rates were obtained using census projections for 2010 and 2011 from Statistics Canada CANSIM Table 051-0001.

Rates of day surgery for ECC are reported by the following characteristics of a child's neighbourhood: percentage Aboriginal (First Nations, Metis or Inuit) population, Material Deprivation Index (MDI), rural/urban character and immigrant profile. Population counts for these rates were derived using Statistics Canada's Postal Code Conversion File (PCCF+) version 5J, based on the 2006 Census. The MDI was developed and is maintained by the Institut national de santé publique du Québec (INSPQ).

Neighbourhood Percentage Aboriginal: Children living in neighbourhoods where the proportion of individuals who self-identified as Aboriginal is high (that is, where one-third or more of residents self-identified according to census terms "North American Indian," "Inuit" or "Metis" in the 2006 Census) were compared with those who live in neighbourhoods where the Aboriginal population is relatively low (that is, where less than one-third of residents self-identified as Aboriginal).

Neighbourhood MDI: Children's neighbourhoods were categorized into quintiles according to three characteristics:

- The proportion of the population age 15 and older without a high school diploma or equivalent;
- The employment-to-population ratio for the population age 15 and older; and
- The average income of the population age 15 and older.

Neighbourhood Rural/Urban: Urban neighbourhoods were defined as those within a census metropolitan area or census agglomeration of at least 10,000 residents. Neighbourhoods within areas with a population of less than 10,000 persons (not in any census metropolitan area or census agglomeration) were considered rural.

Neighbourhood Immigrant Tercile: Neighbourhoods were categorized into terciles according to the relative size of their immigrant (and non-permanent resident) population. The immigrant tercile divides the Canadian immigrant population into three roughly equal parts, with approximately 2 million immigrants in each tercile. For the highest tercile, the average neighbourhood immigrant concentration was 63%, for the middle tercile it was 37% and for the lowest tercile it was 10%.

Cost Estimates

Hospital costs were calculated using cost per weighted case (CPWC), accounting for factors using CIHI's 2013 Comprehensive Ambulatory Classification System (CACS) methodology.

Anesthesia costs for fee-for-service providers were calculated using CIHI's National Physician Database (NPDB) from 2010–2011 and 2011–2012. Total billings (including premiums associated with practising in rural and remote areas) were divided by the number of anesthesia services (that is, the number of day surgery operations).

Travel Time

MapQuest was used to calculate one-way drive time, in minutes, between the child's residence and the location where day surgery occurred based on postal codes. The use of drive time may over- or underestimate travel time in remote communities because it assumes travel by road.

Study Limitations

As defined, ECC is a condition that affects preschool-aged children, that is, children younger than age 6. The estimate of the number of day surgery visits for children younger than 6 in Canada (excluding Quebec) over the two-year period is 38,031, or roughly 19,000 per year. Because census data for the youngest age groups is grouped as younger than 1, 1 to younger than 5 and 5 to younger than 9, the age interval used to define our study cohort was restricted to day surgery visits among children age 1 to younger than 5 so that rates could be calculated. This split the population younger than 6 into the following groups:

- Records for children younger than 1 were omitted due to small volume (13 day surgery procedures over the two years).
- In the two-year period 2010–2011 to 2011–2012, there were 29,258 operations for ECC among children age 1 to younger than 5. This group constitutes the study cohort.
- Among children age 5 to younger than 6, there were 8,760 day surgery operations.

The numerator for rates is ECC-related day surgery operations. There may be cases of children undergoing repeated dental surgery operations over the two-year study period. The rates presented are therefore day surgery operations per population.

Some of the day surgery rates for ECC are presented by selected characteristics of the neighbourhoods where children reside, for example, the percentage of their neighbourhood comprised of Aboriginal or immigrant residents, rural residents or residents considered materially deprived (as measured by the MDI). These rates do not measure characteristics of the individual children that do, or do not, undergo day surgery for ECC. Instead, they describe the neighbourhoods in which the children reside.

This report is limited to day surgery treatment for ECC. In some jurisdictions, ECC is treated in the community. Children on waiting lists for ECC-related day surgery are also not captured in these analyses. Therefore, in terms of estimating the prevalence of interventions for ECC, the report, in effect, identifies the tip of the iceberg—those undergoing day surgery for ECC.

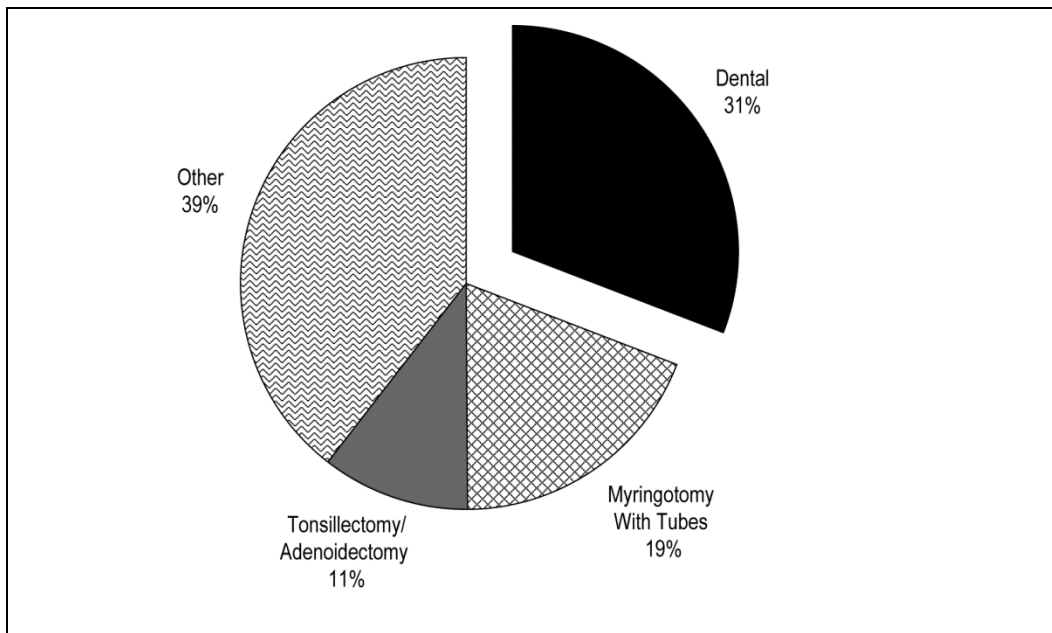
Although fluoridation of public water systems is a proven intervention to curb dental caries, information was not available for this report to evaluate the effect of access to such systems on reducing the use of day surgery for ECC.

Although ECC among children with disabilities is an important area of investigation, analyses of day surgery operations associated with a diagnosis of a developmental handicap were not possible due to small numbers (preliminary analysis identified 297 records for day surgery for ECC among children younger than 6).

How Often Does Day Surgery for ECC Occur?

There were 12.5 day surgery operations for ECC per 1,000 children age 1 to younger than 5 during the two-year study period (2010–2011 to 2011–2012). Day surgery operations for ECC accounted for 31% of all day surgery for children age 1 to younger than 5, and ECC was the leading cause of day surgery in this age group (Figure 2). ECC as an indication for day surgery was more common than myringotomy (ear tube insertion) or tonsillectomy/adenoidectomy (Figure 2).

Figure 2: Percentage of Day Surgery Operations by Type of Procedure, Selected Provinces/Territories, Children Age 1 to Younger Than 5, Two-Year Pooled (2010–2011 to 2011–2012)



Notes

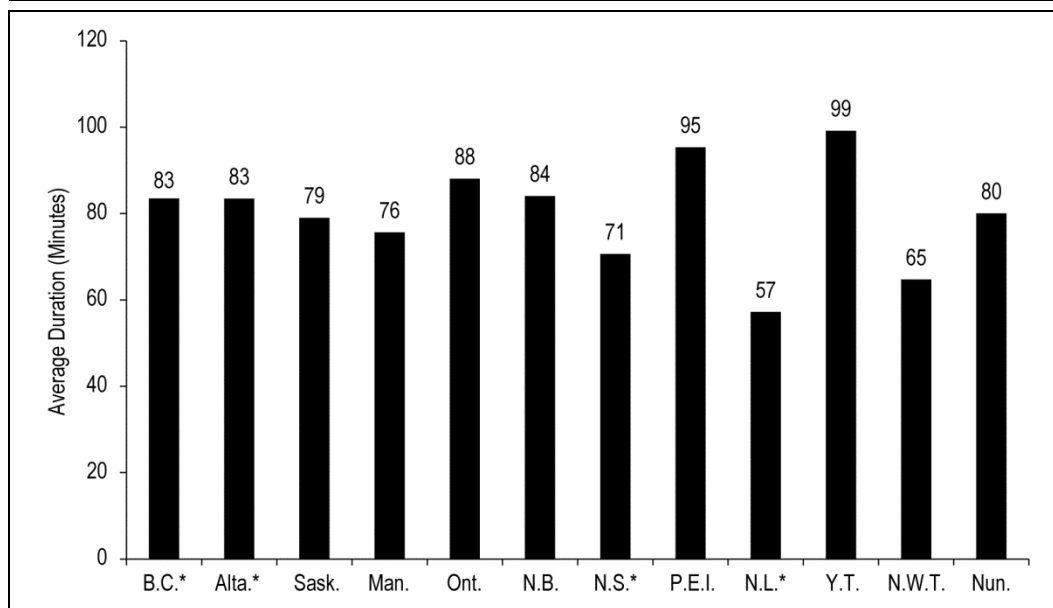
Quebec elected to not participate in this study.
Based on 2013 CACS grouper.

Sources

Discharge Abstract Database and National Ambulatory Care Reporting System, 2010–2011 and 2011–2012, Canadian Institute for Health Information.

Virtually all (99.6%) children in the study cohort received anesthesia while undergoing day surgery for ECC. Children spent an average of 82 minutes in the operating room, but this varied from 57 minutes for children living in Newfoundland and Labrador to 99 minutes for children living in Yukon (Figure 3).

Figure 3: Day Surgery Duration by Location of Residence, Selected Provinces/Territories, Children Age 1 to Younger Than 5, Two-Year Pooled (2010–2011 to 2011–2012)



Notes

* Interpret with caution: Coding of duration of day surgery is optional in Alberta and Nova Scotia and may not be uniformly defined across jurisdictions (NACRS). Coding of intervention episode start/end time, used to calculate duration of day surgery, is mandatory in B.C. and Newfoundland and Labrador, but there was significant reporting of unknown time in these two jurisdictions for the cohort of interest (DAD).

Quebec elected to not participate in this study.

Sources

Discharge Abstract Database and National Ambulatory Care Reporting System, 2010–2011 and 2011–2012, Canadian Institute for Health Information.

A total count of procedures performed during surgery could not be calculated because the hospital record indicates only that a particular procedure occurred, not the total number of each procedure that was performed. For example, if, according to the record, fillings were performed during surgery, there is no indication of the number of fillings that were performed. However, information on the number of unique procedures (most commonly fillings and extractions^{iv}) and the length of time that children spent in the operating room was used to gauge the intensity of treatment.

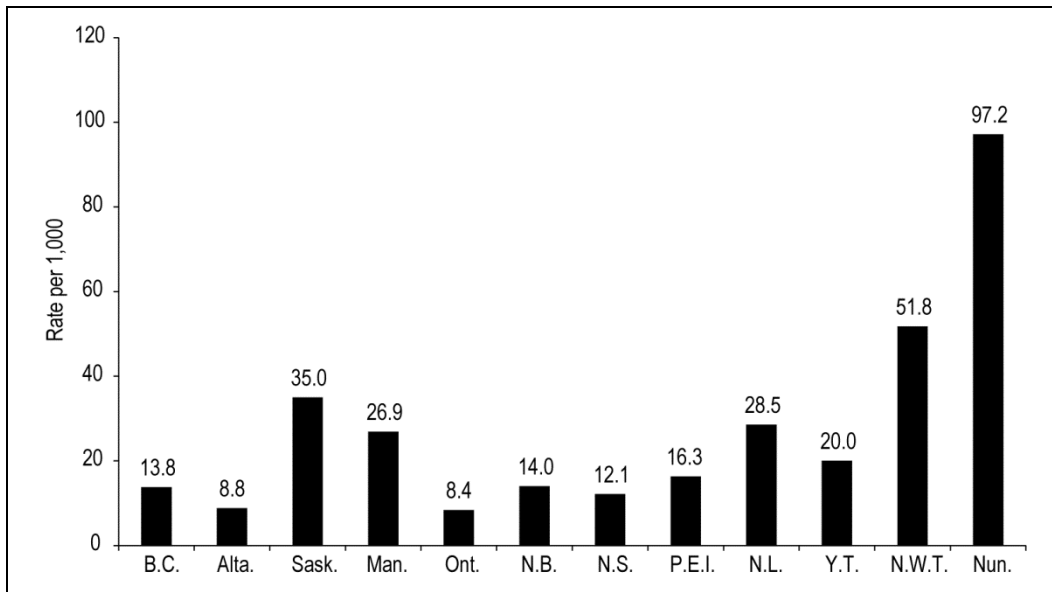
iv. Almost all (99.6%) visits involved at least one filling and/or extraction. Of the remaining procedures (N = 124), 96.0% were primary pulp therapy.

Overall, 53.8% of day surgery operations (15,744) involved more than one type of procedure. The average length of time in the operating room for visits of this type was 83 minutes. Of the remaining 46.2% of day surgery operations (13,514) involving a single type of procedure, visits involving only fillings predominated (12,224, or 90.4%). The average time in the operating room for visits where only fillings were performed (85 minutes) was nearly double that for visits where only extractions were performed (46 minutes). Given this relatively lengthy treatment time, it is likely that day surgery operations exclusively for fillings almost always involved the treatment of multiple cavities.

Rates by Jurisdiction

The use of ECC-related day surgery among children age 1 to younger than 5 by province/territory of residence ranged from 8.4 per 1,000 in Ontario to 97.2 per 1,000 in Nunavut (Figure 4). The estimates shown in Figure 4, by location, refer to the child's province/territory of residence and not the location of the treatment.

Figure 4: Rate of Day Surgery for ECC by Location of Residence, Selected Provinces/Territories, Children Age 1 to Younger Than 5, Two-Year Pooled (2010–2011 to 2011–2012)



Notes

Quebec elected to not participate in this study.

Rates were calculated by dividing the number of procedures found in the pooled two-year cohort by the sum of the combined two-year subpopulation estimate.

Sources

Discharge Abstract Database and National Ambulatory Care Reporting System, 2010–2011 and 2011–2012, Canadian Institute for Health Information; 2006 Census, Statistics Canada.

ECC Day Surgery by Facility Type (Hospitals Versus Private Clinics)

In British Columbia, Alberta and Saskatchewan, health authorities contract with private clinics to perform day surgery for ECC. For children living in these provinces, the share of operations performed in private clinics ranged from 7.2% in Saskatchewan to 33.7% in Alberta (Table 1).

Table 1: Volume and Percentage of Day Surgery Operations for ECC by Facility Type, Selected Provinces/Territories, Children Age 1 to Younger Than 5, Two-Year Pooled (2010–2011 to 2011–2012)

Hospitals Versus Private Clinics			
	Private Clinic	Hospital	Total
	N (%)	N (%)	N
B.C.	1,324 (26.8)	3,611 (73.2)	4,935
Alta.	1,168 (33.7)	2,295 (66.3)	3,463
Sask.	280 (7.2)	3,606 (92.8)	3,886

Notes

Quebec elected to not participate in this study.

The values in Table 1 are restricted to private clinics contracted by health authorities. They do not include procedures performed in non-contracted private clinics, dentists' offices or other sites.

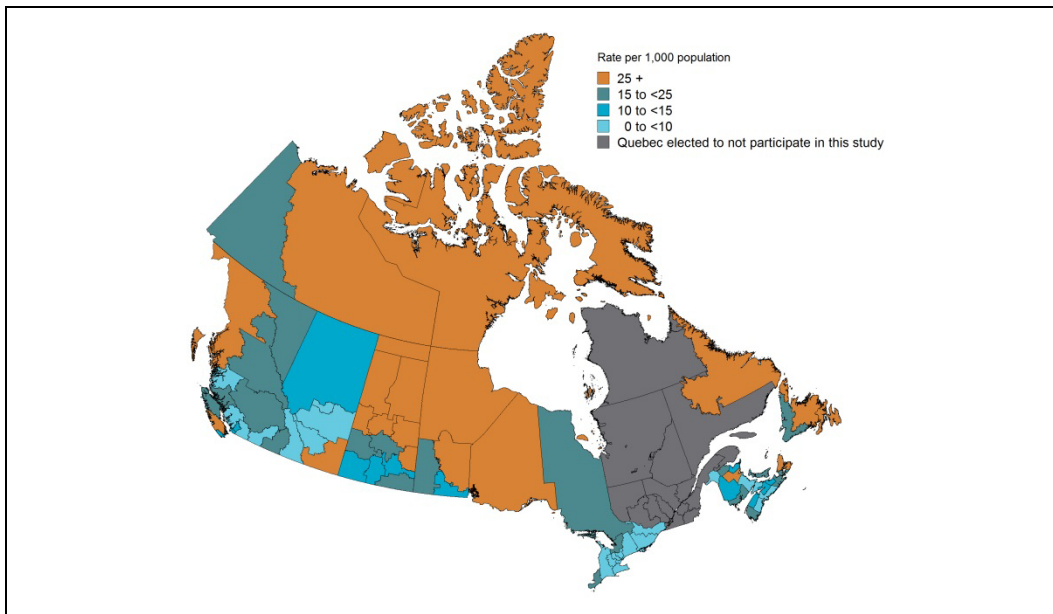
Sources

Discharge Abstract Database and National Ambulatory Care Reporting System, 2010–2011 and 2011–2012, Canadian Institute for Health Information.

Rates by Health Region

Across the health regions, there was considerable variation in ECC day surgery rates. For example, 33.2% of day surgery operations occurred among children living in 20 health regions with a rate of 25 or more per 1,000 (Figure 5). In Saskatchewan, where the provincial rate was 35.0 per 1,000, two health regions had particularly high rates per 1,000 (132.9 in Mamawetan Churchill River Regional Health Authority and 227.4 in Athabasca Health Authority). In Manitoba, the Northern Regional Health Authority had a rate of 115.8 per 1,000 (Table A1, Appendix A).

Figure 5: Rate of Day Surgery for ECC by Health Region, Selected Provinces/Territories, Children Age 1 to Younger Than 5, Two-Year Pooled (2010–2011 to 2011–2012)



Notes

Quebec elected to not participate in this study.

Ranges are approximate quartiles for regional rates.

Rates were calculated by dividing the number of procedures found in the pooled two-year cohort by the sum of the combined two-year subpopulation estimate.

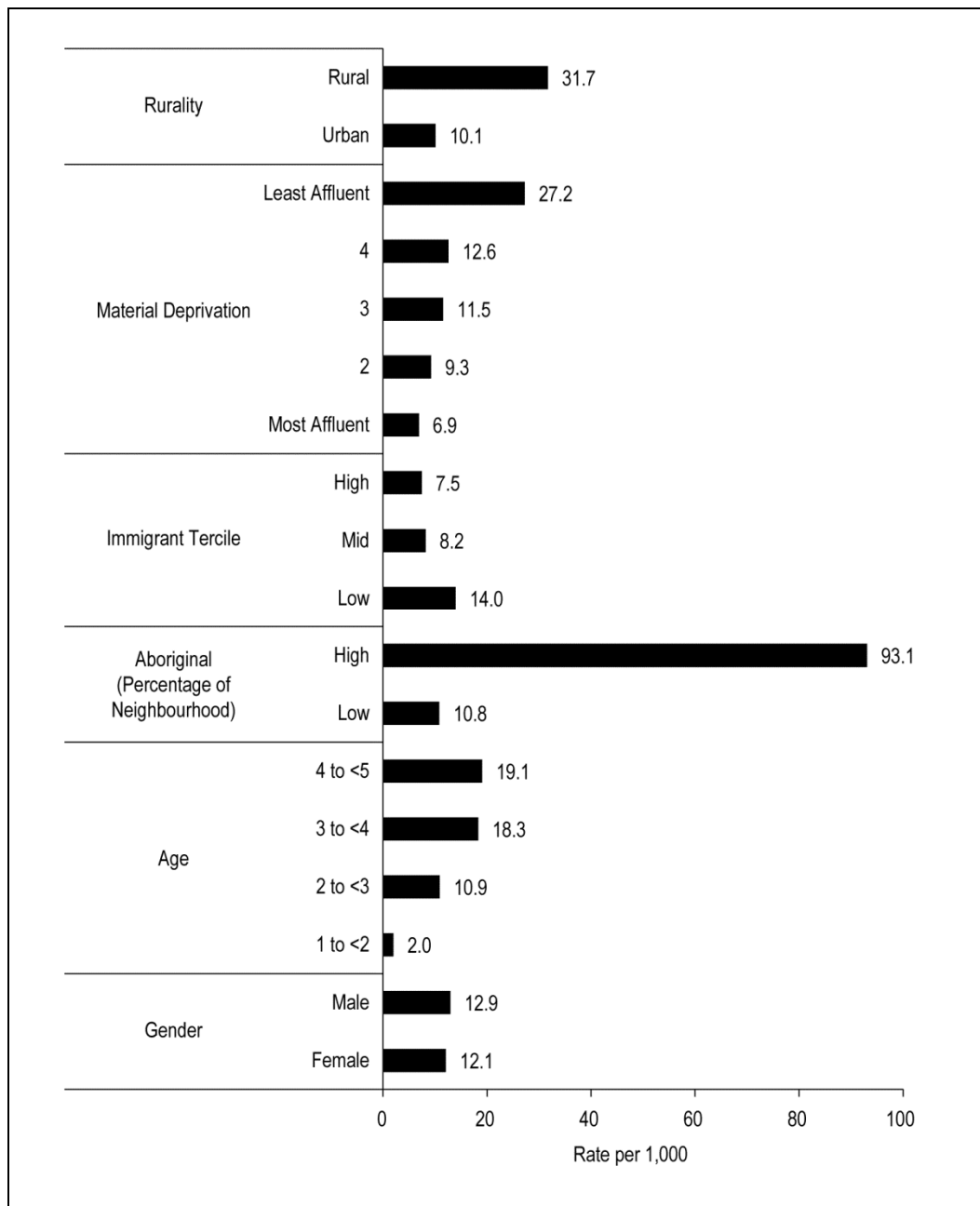
Sources

Discharge Abstract Database and National Ambulatory Care Reporting System, 2010–2011 and 2011–2012, Canadian Institute for Health Information; 2006 Census, Statistics Canada.

Are Some Populations at Higher Risk?

The use of day surgery for ECC was 8.6 times as high among children age 1 to younger than 5 who lived in neighbourhoods where there was a high, compared with a low, proportion of Aboriginal residents (Figure 6). Rates increased according to socio-economic status as measured by the Material Deprivation Index (MDI), a measure of a neighbourhood's residents' income, employment and education. Rates of surgery for ECC were 3.9 times as high when children came from the least, compared with the most, affluent neighbourhoods. Rates of surgery for ECC were also higher in rural areas, with rates 3.1 times as high among children living in rural than urban neighbourhoods. Surgical rates appeared to be somewhat higher in neighbourhoods with relatively few immigrants.

Figure 6: Rate of Day Surgery for ECC by Socio-Demographic Factors, Selected Provinces/Territories, Children Age 1 to Younger Than 5, Two-Year Pooled (2010–2011 to 2011–2012)



Notes

Quebec elected to not participate in this study.

Analyses of ECC day surgery visits by neighbourhood attributes (rurality, MDI and size of the immigrant or Aboriginal population) exclude residents for whom these attributes could not be calculated.

Rates were calculated by dividing the number of procedures found in the pooled two-year cohort by the sum of the combined two-year subpopulation estimate.

Sources

Discharge Abstract Database and National Ambulatory Care Reporting System, 2010–2011 and 2011–2012, Canadian Institute for Health Information; CANSIM Table 051-0001, Geozones Aboriginal File and 2006 Census, Statistics Canada.

How Much Does It Cost?

The costs of day surgery for young children with ECC include those borne by the health care system, provincial/territorial/federal programs targeted to families on welfare and low-income families, private insurance and out-of-pocket costs that families bear themselves. In this section of the report, estimates of health system financial costs are limited to those associated with the hospital and, for a few jurisdictions, anesthesia. Estimates of travel time to care provide some insight into the costs that families experience when accessing ECC day surgery for their child. Provincial/territorial travel policies can help defray the costs related to such travel, but these policies vary in their eligibility requirements and coverage.

Hospital Costs

Each year, hospital-related costs totalled \$21.2 million for day surgery for young children with ECC (Table 2). The average cost for day surgery for ECC among children age 1 to younger than 5 ranged from \$1,271 in New Brunswick to \$1,963 in Alberta. The costs shown in Table 2, by location, refer to the child's province/territory of residence and not the location of the hospitalization.

Table 2: Hospital Cost of Day Surgery for ECC by Location of Residence, Selected Provinces/Territories, Children Age 1 to Younger Than 5, Two-Year Pooled (2010–2011 to 2011–2012)

	Cost (\$)		
	Average Annual	Average per Day Surgery	Total (Two-Year Pooled)
B.C.	3,516,560	1,515	7,033,121
Alta.	2,281,077	1,963	4,562,155
Sask.	3,292,791	1,699	6,585,582
Man.	2,767,564	1,643	5,535,127
Ont.	6,506,893	1,408	13,013,786
N.B.	448,047	1,271	896,094
N.S.	730,607	1,657	1,461,214
P.E.I.	136,151	1,441	272,302
N.L.	971,998	1,734	1,943,996
Y.T.	61,193	1,912	122,386
N.W.T.	188,881	1,379	377,761
Nun.	282,784	1,454	565,567
Total	21,184,545	1,564	42,369,090

Sources

Discharge Abstract Database, National Ambulatory Care Reporting System and Canadian MIS Database, 2010–2011 and 2011–2012, Canadian Institute for Health Information.

Anesthesia Costs

The costs for fee-for-service anesthesia providers were available for the four Western provinces. They ranged from an average of \$240 in Manitoba to \$361 in Saskatchewan (Table 3).

Table 3: Average Anesthesia Cost of Day Surgery for ECC by Location of Residence, Selected Provinces/Territories, Children Age 1 to Younger Than 5, Two-Year Pooled (2010–2011 to 2011–2012)

	Average Cost per Day Surgery (\$)
B.C.	267
Alta.	329
Sask.	361
Man.	240

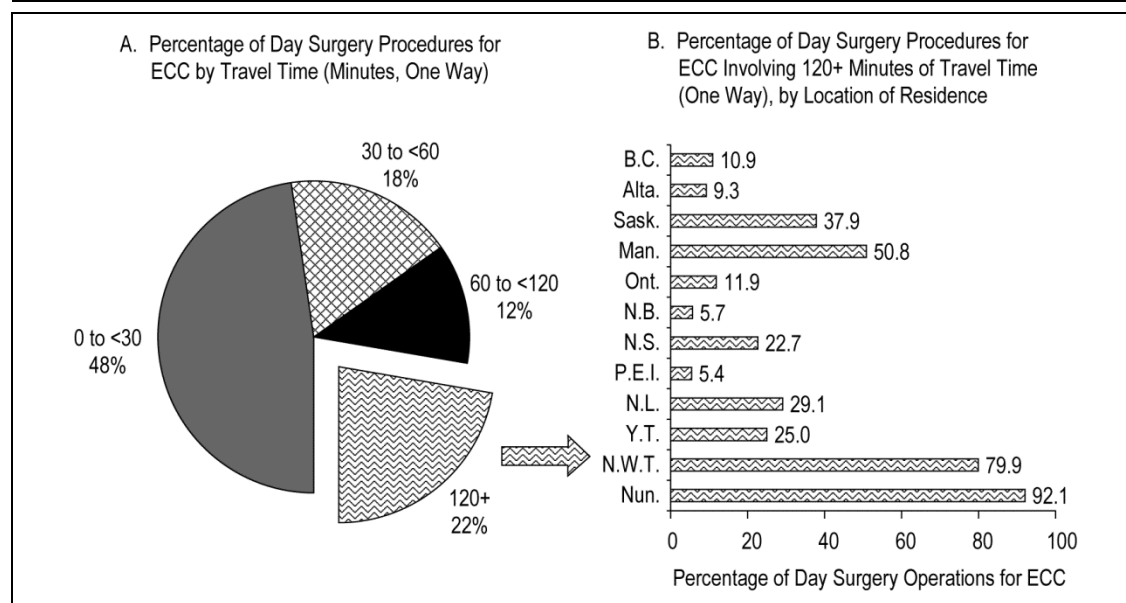
Source

National Physician Database, 2010–2011 and 2011–2012, Canadian Institute for Health Information.

Travel Time

In more than one in five day surgery visits (22.3%), families spent two or more hours travelling to care (Figure 7). For the vast majority of ECC day surgery operations in Nunavut (92.1%) and the Northwest Territories (79.9%), families travelled two or more hours for their surgery.

Figure 7: Travel Time for Day Surgery for ECC, Selected Provinces/Territories, Children Age 1 to Younger Than 5, Two-Year Pooled (2010–2011 to 2011–2012)



Notes

Quebec elected to not participate in this study.

Excludes records for which travel time could not be calculated. Day surgery operations for children receiving care out of province are counted within the jurisdiction of the child's residence.

Sources

Discharge Abstract Database and National Ambulatory Care Reporting System, 2010–2011 and 2011–2012, Canadian Institute for Health Information.

Conclusion

ECC is the most common reason for day surgery among young children. The roughly 19,000 day surgery operations for children younger than age 6 each year pose potential health risks to children and can be traumatic for both children and their families.^{2, 9} These day surgery operations represent the tip of the iceberg in terms of the prevalence of ECC among young children. Reported here are only operations for those children cared for by health authorities. Uncounted are the many children receiving care in the community or waiting for care. The number of children who receive care for ECC in the community varies by jurisdiction, in part in response to the structure of public programs that finance care for at-risk children.

The health burden for children and their families and the considerable financial costs to the system associated with ECC-related day surgery should theoretically be entirely avoidable. Good oral hygiene and early access to preventive dental services are among the interventions that can effectively prevent this common condition. Remaining cavity free in early childhood is achievable. Among children age 6 to 11 who participated in the Canadian Health Measures Survey (2007 to 2009), 43% had never had a cavity.¹⁰ Considerable cost savings are realized when young children get dental care early, as is recommended by the Canadian Dental Association (CDA).^{4, 11}

Even while day surgery for ECC is considered an example of preventable health care use and costs, there are concerns that children suffering from ECC do not have timely access to care. A recognized lack of timely dental treatment for young children resulted in the identification of dental treatment under general anesthesia as one of six pediatric surgical areas included in the Canadian Paediatric Surgical Wait Times Project in 2007.^{12, 13} To put this into context, there were approximately 2,490 ECC-related day surgery operations performed annually in B.C. from 2010–2011 to 2011–2012. As of June 30, 2013, there were 1,303 children awaiting pediatric dental surgery in B.C. Some of these children had to wait six months or longer for their care. Half of the children on the waiting list received surgery within 6.3 weeks, and 90% received surgery within 27.6 weeks.¹⁴ While timely access to dental care for children is necessary, the use of hospital resources for ECC has contributed to prolonged wait times for other urgent pediatric care.⁴

A major finding of this report is that living in a rural or remote community, a neighbourhood with a high proportion of Aboriginal residents or a neighbourhood characterized by material deprivation is a strong risk factor for day surgery for ECC. These findings are consistent with those reported in the literature.^{2, 4–6, 15, 16–24}

In this report, ECC day surgery rates were lower among children from neighbourhoods with a relatively high number of immigrants. Previous studies that have found higher rates of ECC among immigrant groups have tended to focus on particular immigrant communities within jurisdictions.^{25–27} The findings from this study could be explained if, from a pan-Canadian perspective, immigrants had relatively high socio-economic status, allowing them to access preventive care. Alternatively, children from immigrant communities may not have been represented in the ECC day surgery cohort because they were less likely to be treated because of difficulties accessing the dental care system.

There have been many efforts to address problems of access to oral health care for Canadian children and youth. In part, such efforts are especially needed because dental care falls outside of the scope of the *Canada Health Act*, leaving most Canadian families responsible for financing their own dental care.¹ Most (62%) Canadians have private dental insurance (personal or employment-granted), 6% have public insurance and 32% have no dental insurance coverage.¹⁰ A lack of coverage is particularly prevalent among lower-income Canadians (50%). Children in low-income families or families on income assistance, children in foster care and children with disabilities may benefit from provincial/territorial dental programs. The Non-Insured Health Benefits (NIHB) Program, a federal program available to eligible First Nations and Inuit, includes a dental benefit that covers diagnostic, preventive, restorative and other services not covered by other programs (that is, it is a payer of last resort).²⁸ These publicly funded programs vary widely in terms of their coverage and focus on treatment-based, rather than preventive, care. Some examples of public programs targeted to low-income children are shown in Table B1 (Appendix B).

“Sadly, there is a strong association between poverty and dental decay and families of children at high risk usually have low incomes among a myriad of other challenges. Unfortunately, dental benefit programs offer very limited help for many of the families in this situation because of other difficulties that hinder their access to dental care. Some public health programs provide care directly through school programs. Other successful strategies identify high risk children through infant inoculation programs to provide the necessary support for their parents and caregivers.”¹⁵

The existence of such public programs, however, does not necessarily ensure access to dental care or eliminate socio-economic disparities in rates of ECC.^{29, 30} How public programs are structured can greatly affect the ability of families to access them.

The CDA and the Canadian Paediatric Society are among organizations advocating for improvements in oral health care for Canadian children.^{1, 4, 31} The CDA recommends that infants see a dentist within six months of the eruption of the first tooth or by one year of age. Thereafter, a dental exam every six months will help catch small problems early.^{4, 32} Implementing this recommendation is impeded in northern and rural communities by a scarcity of dental specialists.³³ Likewise, among families with limited financial resources and private insurance, accessing publicly financed programs and dental providers who participate in such programs may be difficult.³⁴

Recommendations made by the CDA go well beyond financial assistance to focus on public health, educational and surveillance activities to improve children’s oral health.

Canadian Dental Association Recommendations to Improve Children’s Oral Health¹⁵

- Educate and support expectant and new mothers.
- Include oral health as an integral part of early childhood development programs.
- Fluoridate public drinking water.
- Examine targeted preventive programs for the population.
- Ensure accurate measures for determining disease level and monitoring program outcomes.
- Coordinate public health programs, including outreach programs.

The CDA has also recommended that the problem of ECC be monitored in Canada to chart the progress of public health and clinical interventions. The Canadian Paediatric Society, in a joint statement with the American Academy of Pediatrics, has issued recommendations to address ECC in indigenous communities that pertain to clinical care, community-based promotion initiatives, workforce and access issues, and advocacy and research.³¹

Programs and coordinated approaches to address and promote good dental health, such as the Canadian Oral Health Strategy, can help focus efforts on reducing the number of dental surgery operations for young children across Canada. The Federal, Provincial and Territorial Dental Working Group is now in the process of developing a new oral health strategy for 2012 to 2017. Provincial/territorial and regional health authorities have investigated the status of oral health within their communities, promulgated recommendations and put in place preventive and early intervention programs to reduce the health burden of ECC.³⁵⁻⁴⁴

The magnitude of the problem of ECC requiring day surgery in Canada as described in this report provides further impetus to act and prevent pain and suffering among young children. Such efforts will also realize opportunities for cost savings and improved health system efficiency.

Appendix A: Rate of Day Surgery for ECC by Province/Territory and Health Region

Table A1: Volume and Rate of Day Surgery for ECC by Location of Residence, Selected Provinces/Territories, Children Age 1 to Younger Than 5, Two-Year Pooled (2010–2011 to 2011–2012)

	Volume	Rate per 1,000
B.C.	4,980	13.8
East Kootenay Health Service Delivery Area	58	8.3
Kootenay-Boundary Health Service Delivery Area	113	19.6
Okanagan Health Service Delivery Area	247	9.5
Thompson/Cariboo Health Service Delivery Area	349	19.7
Fraser East Health Service Delivery Area	193	6.9
Fraser North Health Service Delivery Area	540	11.1
Fraser South Health Service Delivery Area	824	12.5
Richmond Health Service Delivery Area	123	8.4
Vancouver Health Service Delivery Area	470	10.5
North Shore/Coast Garibaldi Health Service Delivery Area	173	8.5
South Vancouver Island Health Service Delivery Area	347	13.8
Central Vancouver Island Health Service Delivery Area	553	29.4
North Vancouver Island Health Service Delivery Area	191	20.4
Northwest Health Service Delivery Area	377	51.6
Northern Interior Health Service Delivery Area	282	20.6
Northeast Health Service Delivery Area	140	17.0
Alta.	3,492	8.8
South Zone	799	25.5
Calgary Zone	1,201	8.4
Central Zone	341	7.0
Edmonton Zone	337	2.9
North Zone	814	14.7
Sask.	3,878	35.0
Sun Country Regional Health Authority	131	23.1
Five Hills Regional Health Authority	63	12.8
Cypress Regional Health Authority	45	11.5
Regina Qu'Appelle Regional Health Authority	317	12.4
Sunrise Regional Health Authority	167	32.1
Saskatoon Regional Health Authority	751	24.1
Heartland Regional Health Authority	99	22.1
Kelsey Trail Regional Health Authority	231	56.5
Prince Albert Parkland Regional Health Authority	617	66.9
Prairie North Regional Health Authority	608	63.2

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Table A1: Volume and Rate of Day Surgery for ECC by Location of Residence, Selected Provinces/Territories, Children Age 1 to Younger Than 5, Two-Year Pooled (2010–2011 to 2011–2012) (cont'd)

	Volume	Rate per 1,000
Mamawetan Churchill River Regional Health Authority	550	132.9
Keewatin Yatthé Regional Health Authority	191	85.9
Athabasca Health Authority	108	227.4
Man.	3,368	26.9
Winnipeg Regional Health Authority	860	14.1
Prairie Mountain Health	246	15.0
Interlake–Eastern Regional Health Authority	386	31.7
Northern Regional Health Authority	1,583	115.8
Southern Health-Santé Sud	293	13.4
Ont.	9,610	8.4
Erie St. Clair Local Health Integration Network	1,165	21.2
South West Local Health Integration Network	558	6.9
Waterloo Wellington Local Health Integration Network	387	5.5
Hamilton Niagara Haldimand Brant Local Health Integration Network	488	4.2
Central West Local Health Integration Network	472	5.7
Mississauga Halton Local Health Integration Network	390	3.4
Toronto Central Local Health Integration Network	379	3.8
Central Local Health Integration Network	886	5.7
Central East Local Health Integration Network	664	5.1
South East Local Health Integration Network	344	9.4
Champlain Local Health Integration Network	974	9.3
North Simcoe Muskoka Local Health Integration Network	590	16.0
North East Local Health Integration Network	1,055	25.0
North West Local Health Integration Network	1,258	60.9
N.B.	829	14.0
Zone 1 (Moncton area)	111	6.9
Zone 2 (Saint John area)	319	21.4
Zone 3 (Fredericton area)	184	12.2
Zone 4 (Edmunston area)	29	8.5
Zone 5 (Campbellton area)	25	15.1
Zone 6 (Bathurst area)	67	14.4
Zone 7 (Miramichi area)	94	28.5
N.S.	882	12.1
South Shore District Health Authority	33	9.4
South West Nova District Health Authority	78	18.9
Annapolis Valley District Health Authority	74	12.0
Colchester East Hants Health Authority	63	10.4
Cumberland Health Authority	18	7.8
Pictou County Health Authority	43	12.0

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Table A1: Volume and Rate of Day Surgery for ECC by Location of Residence, Selected Provinces/Territories, Children Age 1 to Younger Than 5, Two-Year Pooled (2010–2011 to 2011–2012) (cont'd)

	Volume	Rate per 1,000
Guysborough Antigonish Strait Health Authority	63	20.1
Cape Breton District Health Authority	322	34.5
Capital District Health Authority	188	5.4
P.E.I.	189	16.3
N.L.	1,121	28.5
Eastern Regional Integrated Health Authority	633	26.3
Central Regional Integrated Health Authority	194	30.1
Western Regional Integrated Health Authority	96	18.1
Labrador–Grenfell Regional Integrated Health Authority	198	57.1
Y.T.	64	20.0
N.W.T.	274	51.8
Nun.	571	97.2

Notes

Quebec elected to not participate in this study.

Rates were calculated by dividing the number of procedures found in the pooled two-year cohort by the sum of the projected population in each respective group combined for the two years.

Sources

Discharge Abstract Database and National Ambulatory Care Reporting System, 2010–2011 and 2011–2012, Canadian Institute for Health Information; 2006 Census, Statistics Canada.

Appendix B: Publicly Funded Dental Programs

Non-Insured Health Benefits Program

The federal NIHB Program provides eligible First Nations and Inuit with a limited range of medically necessary health-related goods and services not provided through private insurance plans, provincial/territorial health or social programs, or other publicly funded programs. The dental benefit includes diagnostic, preventive, restorative, endodontic, periodontal, prosthodontic, oral surgery, orthodontic and adjunctive services.²⁸

Provincial/Territorial Programs

Table B1 provides examples of provincial/territorial programs targeted to children from low-income families. It is limited to programs that are province-/territory-wide. The table does not include coverage for children whose families are on income assistance, for whom all provinces and territories make some provision.

Table B1: Examples of Provincial/Territorial Publicly Funded Dental Programs Targeted to Children From Low-Income Families

Province/Territory	Program	Eligibility	Services Covered
B.C.	Healthy Kids	Age 0 to 19 in receipt of premium assistance through the Medical Services Plan	\$1,400/two years of basic dental services \$1,000/year toward general anesthesia fees (hospital or private facility) Emergency treatment for pain relief (beyond \$1,400 limit) No orthodontic
Alta.	Alberta Child Health Benefit	Age 0 to 18 from low-income families	Basic coverage: Dental exams, cleaning, X-rays, fillings and extractions
Sask.	Family Health Benefits	Age 0 to 18 from low-income families	Basic coverage
Man.	Healthy Smile Happy Child Intersectoral Partnership	At-risk infants and preschool children and their families	Oral health promotion using community development approaches
Ont.	Healthy Smiles	Younger than age 18 when family net income is less than \$20,000 per year and without other dental care access	Preventive and basic treatment services
	Children in Need of Treatment	Younger than age 18 and requiring emergency or essential dental care Parents have no dental insurance, or the cost of treatment would result in financial hardship (no income verification)	Includes diagnostic, preventive, restorative, prosthodontic, endodontic and oral surgery services, and pays for adjunct services such as general anesthesia and conscious sedation Intended for one-time coverage; no ongoing care

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Table B1: Examples of Provincial/Territorial Publicly Funded Dental Programs Targeted to Children From Low-Income Families (cont'd)

Province/Territory	Program	Eligibility	Services Covered
N.B.	Dental care for low-income families	Younger than age 18 from low-income families	Examination, basic diagnostic, extractions and some preventive treatment Up to a maximum of \$1,000/year
N.S.	MSI Children's Oral Health Program	Age 13 and younger; families required to access private coverage first	Diagnostic (dental exam), preventive (one sealant application) and treatment services (fillings, fluoride application in some cases) General anesthesia covered in hospital settings only
P.E.I.	Children's Dental Care Program (Treatment Services)	Age 3 to 17 Annual registration fee of \$15/child to a maximum of \$35/family (waived for low-income families) Parent pays 20% of treatment cost, unless annual income is less than \$30,000/year	Diagnostic and basic treatment services
	Children's Dental Care Program (Prevention)	All school-aged children age 3 to 17	Oral health education, screening, scaling, topical fluoride, sealants
	Pediatric Specialist Services Dental Program	Children in medical and financial need Annual registration fee of \$15/child	Diagnostic, treatment and some preventive services
	Early Childhood Dental Initiative	Age 15 to 18 months seen at public health immunization clinics	Screening, risk assessment by dental hygienists
N.L.	Children's Dental Health Program	Age 0 to 12 Families required to access private coverage first Youth age 13 to 17 in low-income families or on social assistance	Children's component: Diagnostic, preventive periodontal, restorative services (exams, cleanings, fillings, fluoride application, extractions, sealants) Social assistance component: Exams, fillings, extractions and emergency treatment
Y.T.	Children's Dental Health Program (Yukon Health and Social Services)	Two programs: Preschool children All school-aged children from kindergarten to Grade 8 or Grade 12, depending on the place of residence	Preventive, restorative, periodontal and oral surgery services Emergency (accidental) not covered in school-aged children's plan

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Table B1: Examples of Provincial/Territorial Publicly Funded Dental Programs Targeted to Children From Low-Income Families (cont'd)

Province/Territory	Program	Eligibility	Services Covered
N.W.T. and Nun.	Non-Insured Health Benefits Program	Registered First Nations and Inuit	Emergency, diagnostic, restorative, endodontic, periodontal, prosthodontic, oral surgery and orthodontic services

Note

Quebec elected to not participate in this study.

Source

Adapted from Rowan-Legg. 2013. Canadian Paediatric Society, Community Paediatrics Committee. *Paediatr Child Health*. 18(1):37-43. <http://www.cps.ca/en/documents/position/oral-health-care-for-children>. Accessed July 13, 2013.

Appendix C: Methods

Data Sources

1. Canadian Institute for Health Information
 - Discharge Abstract Database, 2010–2011 and 2011–2012
 - National Ambulatory Care Reporting System, 2010–2011 and 2011–2012
 - National Physician Database, 2010–2011 and 2011–2012
 - Canadian MIS Database (CMDDB), 2010–2011 and 2011–2012
2. Statistics Canada
 - Postal Code Conversion File version 5J
 - Geozones Aboriginal File based on 2006 Census
 - Population projections by health region for July 1, 2010, and July 1, 2011
 - CANSIM Table 109-5325^v
 - Population projections by age group and gender for July 1, 2010, and July 1, 2011
 - CANSIM Table 051-0001^{vi}
 - 2006 Census population counts by dissemination area (DA)
 - 2006 Census file (census_merged)
3. MapQuest
 - Travel time variables calculated by MapQuest from cohort and facility postal codes
4. Institut national de santé publique du Québec
 - Material Deprivation Index Equivalence Table, Canada, 2006

Methods Used to Define the Cohort

The cohort was constructed using the following criteria:

Inclusion Criteria

- Day surgery records from Hospital Morbidity Database, DAD and NACRS
- Age younger than 6 years
 - For population-based rates, the cohort was restricted to age 1 to younger than 5
- Discharge records containing an identified diagnosis of dental caries anywhere in the abstract
- Discharge records containing an identified dental intervention anywhere in the abstract

v. Accessed June 20, 2013.

vi. Accessed June 20, 2013.

Exclusion Criteria

- Potential duplicate discharge records
- Discharge records containing an identified diagnosis of dental trauma anywhere in the abstract
- Discharge records containing an identified diagnosis of a developmental handicap anywhere in the abstract
- Discharge records that could not be assigned valid provincial and regional information in PCCF+ based on patient postal code
- Quebec elected to not participate in this study.

Methods Used to Define Certain Key Analytical Variables and Concepts

The following variables are key to the analysis in this report and require special treatment or calculation.

Immigrant Tercile

The immigrant tercile was assigned using PCCF+ and grouped discharge records into terciles based on DA, the smallest geographical census unit. The immigrant (foreign-born) terciles were constructed using the following thresholds:

- High immigrant concentration: DAs with an immigrant concentration of 51.8% or higher
- Mid immigrant concentration: 27.0% to 51.8%
- Low immigrant concentration: Less than 27.0%⁴⁵

Discharge records that could not be assigned an immigrant tercile were excluded from the immigrant tercile analysis.

Aboriginal Concentration

Aboriginal concentration was assigned using the Aboriginal Geozones File developed at Statistics Canada and grouped discharge records into high- and low-Aboriginal areas based on DA. The Aboriginal concentration flag was constructed using the following thresholds:

- High Aboriginal concentration: 32.5% or higher
- Low Aboriginal concentration: Less than 32.5%

It should be noted that there were 22 incompletely enumerated Indian reserves and settlements in the 2006 Census, which will lead to under-coverage of the overall Aboriginal population. The term “Aboriginal” refers to people who identified themselves as North American Indian, Inuit, Métis and other Aboriginal or as having multiple Aboriginal identities in the 2006 Census.⁴⁶

Discharge records that could not be assigned an Aboriginal concentration were excluded from the Aboriginal concentration analysis.

Material Deprivation Index

The MDI was developed and is maintained by the INSPQ and groups discharge records into quintiles based on DA. In this analysis, the most recent 2006 version was used, and the variable was a composite of three indicators:

- Education: Ratio of individuals age 15 and older with no high school diploma to the population age 15 and older
- Employment: Ratio of individuals age 15 and older who are employed to the population age 15 and older
- Income: Average personal income for the population age 15 and older⁴⁷

Discharge records that could not be assigned an MDI were excluded from the MDI analysis.

Travel Time

Road network travel times were calculated using MapQuest based on patient and facility postal codes. Discharge records were divided into four travel time groups: 0 minutes to less than 30 minutes, 30 minutes to less than 60 minutes, 60 minutes to less than 120 minutes and 120 minutes or more. MapQuest returns a travel time of 0 minutes both if there is a true travel time of 0 and also if a travel time cannot be assigned. The as-the-crow-flies distance between the two postal codes was used to group these instances based on the following criteria:

- If the distance was less than 5 km, the discharge record was assigned to the lowest travel time group.
- If the distance was greater than the maximum distance in the group 60 minutes to less than 120 minutes, the discharge record was assigned to the highest travel time group.

Discharge records that could not be assigned a travel time, including those that fit neither criterion above, were excluded from the travel time analysis.

Location of Procedure (Hospital or Private Clinic)

In some jurisdictions, dental day surgery can occur in private institutions, which then report discharge records to the DAD or NACRS. Day surgery operations occurring in private institutions were identified in the following provinces:

- Alberta: Private institutions apply for the designation of “non-hospital surgical facilities.” These facilities report to NACRS and are identified with a unique facility identifier.
- B.C.: Day surgery operations that occur in private institutions are reported to the DAD by the public facility through which the procedure is contracted. These can be identified using the Special Project Field in the DAD, specifically Project Number 225.
- Saskatchewan: The process is very similar to that in B.C., except that private institutions are identified with Project Number 925.

Anesthetic Technique

The type of anesthetic is mandatorily recorded in the DAD and NACRS. This report groups these anesthetic types into the following groups based on the CACS methodology:

Group	Table Code	Description
1	1, 2, 3, 4	General/Spinal/Epidural/Neuraxial
2	5, 6	Other Nerve Block/Monitored Care
3	9	Unmonitored
4	7	Local
5	8	No Anesthetic

Anesthetic group 1 is considered “general anesthetic” in this report.

Length of Procedure

This variable was calculated using the start date, start time, end date and end time variables from the DAD and NACRS. These variables are mandatory for all procedures completed in the main operating room for all jurisdictions except Alberta and Nova Scotia.

Discharge records from Alberta and Nova Scotia are not included in the length of procedure analysis, as the coding of these variables is not mandatory.

Methods Used to Calculate Rates of Day Surgery for ECC

By Health Region, Age and Sex

Rates were calculated by dividing the number of procedures found in the pooled two-year cohort (2010–2011 and 2011–2012) by the sum of the projected population in each group on July 1, 2010, and July 1, 2011. The populations are taken from Statistics Canada’s CANSIM tables 051-0001 and 109-5325 and are summed since the procedures are taken over a two-year period.

By Material Deprivation Index, Immigrant Tercile, Aboriginal Concentration and Rurality

Projected populations broken down by these variables are not produced by Statistics Canada. As such, the most recent available census data (2006) was used as the denominators when calculating these rates. Each of these variables was assigned at the DA level, and DA populations were taken from the full 2006 Census DA file, with the exception of immigrant tercile. The immigrant tercile denominators were taken from a file associated with the PCCF+ (the QAIPPE file within PCCF+).

Methods Used to Calculate Costs of Day Surgery for ECC

Hospital Cost

Facility-level CPWCs were derived based on the CMDB. Discharge record–level Resource Intensity Weights (RIWs) were calculated using CIHI’s CACS, which groups discharge records into homogenous resource groups. Discharge record–level hospital cost estimates were then derived using the following formula:

- Discharge record–level hospital cost = facility-level CPWC × discharge record–level RIW

These results were then aggregated based on the patient’s jurisdiction.

Discharge records from Nunavut facilities were not included, as Nunavut does not report to the CMDB. Discharge records that could not be assigned a facility-level CPWC were excluded from the hospital cost analysis.

Anesthesia Cost

Total billed anesthesia costs and number of procedures were calculated where possible using data from the NPDB. The jurisdictions for which data existed and costs were calculated were B.C., Alberta, Saskatchewan and Manitoba. An average cost was calculated by dividing the total cost by the total number of procedures.

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