



# THE SCHOOL OF PUBLIC POLICY

## SPP Briefing Paper

Volume 9 • Issue 14 • April 2016

## IT'S NOT JUST ABOUT BABY TEETH: PREVENTING EARLY CHILDHOOD CARIES

Jennifer Zwicker, Carolyn Dudley and Herb Emery

### SUMMARY

Early Childhood Caries (ECC) is a serious disease that is about much more than cavities on baby teeth. In Canada, it is a growing public health problem with adverse long-term effects on children's physical, emotional and intellectual well-being. The failure to invest in preventive care has resulted in reactive, rather than proactive, measures against this disease. These measures are expensive and a needless drain on costs in the public health-care system.

Children with severe ECC end up in hospital; in fact, in Canada, this disease is the most common reason children undergo day surgery. From 2010 to 2012, one in 100 children under age five required day surgery for ECC, with approximately 19,000 of these surgeries performed each year on children under age six. Canadian hospital costs for ECC day surgery in children aged one to five ranged from \$1,271 to \$1,963 per child, totalling \$21.2 million between 2010 and 2012. Children from low-income families, along with aboriginal, immigrant and refugee children are disproportionately affected by dental disease, with between 50 per cent and 90 per cent of suffering from some form of ECC. This compares to an average of 57 per cent of children affected in the general population.

A recent Alberta study indicates that when municipalities cease fluoridating their water supplies, children suffer increased levels of tooth decay. This has reignited the discussion around whether municipalities should add fluoride to the drinking water, or reinstate it in places where the water used to be fluoridated. While fluoridation can be an effective prevention strategy, this study also shows that fluoride alone is not enough. To reduce the costs and developmental consequences associated with severe ECC and improve well-being, oral health policies focused on disease prevention and health promotion are still necessary. This briefing paper provides background on the etiology, risk factors and prevalence of ECC in Canada to provide scope for the magnitude of this preventable disease in children. To address the avoidable socio-economic costs, three areas require policy development.

First is the need for increased public education and access to ECC prevention services for at-risk populations. Parents need to know they should reduce their children's intake of sweet drinks, and avoid filling bottles with sugar water, juice or soft drinks, especially at night. They should also clean an infant's gums with a soft toothbrush or cloth and water starting at birth. When the baby's first tooth erupts, parents should commence daily brushing with toothpaste and book a first dental visit.

Second is the need to empower health-care professionals to integrate ECC prevention in their early visits with parents of young children. Such visits are more common in family medicine, and these primary care providers can play a critical role in educating parents and promoting children's oral health. Curriculum and continuing education for these health professions should be enhanced to emphasize ECC's long-term health effects.

Third, government should invest in preventive oral health services for children rather than relying on emergency dental care. Children should have access to early preventive dental services to instill in them habits for lifetime oral health. Provinces without universal public funding for children's preventive dental health should remove the access barriers that children without dental insurance face.

## WHAT IS EARLY CHILDHOOD CARIES

Early Childhood Caries (ECC, formerly called “baby bottle decay”) is characterized by severe decay in the teeth of infants or young children and is the most common chronic infectious disease in children under five years of age in North America, five times more common than asthma in the U.S. [2, 3]. This disease is defined as the presence of one or more decayed, missing or filled tooth surfaces in preschool-age children between birth and age six [4]. ECC is a complex disease due to the intertwined physical and biological risk factors, lifestyle and behavioural factors, as well as socioeconomic factors. The causative triad for dental caries includes<sup>1</sup> presence of the cariogenic bacteria,<sup>2</sup> exposure to sugars and low tooth resistance [5].

With the emergence of the first tooth around six months after birth, young children are susceptible to caries. However, ECC is an entirely preventable chronic infectious disease that develops from lifestyle and behavioural factors. Determinants of ECC are poor oral hygiene (not brushing teeth with fluoridated toothpaste, irregular dental visits), poor dietary habits (frequent exposure to dietary sugar and refined carbohydrates) and inappropriate methods of feeding (prolonged bedtime use of bottles with sweet content, excessive juice consumption or prolonged and nocturnal breastfeeding) [7, 8] (For review of risk factors see Leong, Gussy [9]). When left untreated, ECC can progress rapidly and become painful, moving from enamel to the dentin to the pulp tissue, which is rich in nerves and blood vessels.

ECC is a disease that is about more than just baby teeth [10]. Severe ECC (or S-ECC) is a form of dental infection that can lead to abscess, destruction of bone and spreading of the infection and inflammatory proteins in the bloodstream. If undetected, infection from S-ECC may result in a medical emergency requiring hospitalization, antibiotics and extraction of the offending tooth [11]; however, not all chronic pulpal infections are treated in children. When left untreated, S-ECC can be very painful and detrimental to a child’s development [12]. It is important to implement prevention methods at an early age. The prevention of S-ECC starts with regular dental visits,<sup>3</sup> daily teeth brushing and not providing bottles at bedtime with sweet drinks.

## WHO IS AFFECTED: PREVALENCE AND RISK FACTORS OF ECC

ECC is a serious and growing public health problem, with some estimates suggesting prevalence rates for ECC have increased to 28 per cent of children between two and five years of age in the United States, with only a quarter of these cases receiving treatment [14].

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<sup>1</sup> The development of dental caries in children is an infectious process whereby oral bacteria colonize in plaques on the surfaces of the teeth and metabolize sugars and refined carbohydrates, a process which produces acid that breaks down tooth enamel, resulting in tooth decay 5. R. H. Selwitz, A. I. Ismail, and N. B. Pitts, *Dental Caries*, *Lancet*, 369(9555): 51-9, 6, 2007. J. D. Featherstone, *The Science and Practice of Caries Prevention*, Journal of the American Dental Association, 131(7): 887-899, 2000.

<sup>2</sup> Mainly *Streptococcus mutans*.

<sup>3</sup> A first dental visit should occur within six months of primary tooth eruption and no later than one year 13. L. E. Kagihara, V. P. Niederhauser, and M. Stark, *Assessment, Management, and Prevention of Early Childhood Caries*, Journal of the American Academy of Nurse Practitioners, 21(1): 1-10, 2009.

Unfortunately, no current national data are available for the prevalence of ECC in Canadian preschool children. Smaller Canadian population studies suggest rates similar to the U.S., with rising prevalence and wide variation among different subpopulations. A 2010 Canadian Health Measures Survey reported that 57 per cent of Canadian children aged six to 11 years have had a cavity (with an average of 2.5 teeth affected by decay) [15].

Children at high risk of ECC are typically from low socio-economic status (SES) backgrounds. It is estimated that 50 to 90 per cent of preschool-aged children are affected in high-risk demographics, including children from indigenous communities [16-19], new immigrants [20], children with single mothers [21], parents with low educational levels [22], rural regions [23] and those from low-income families [24]. One Canadian study estimated that the prevalence of ECC in Canadian aboriginal children is 1.9-2.3 times higher than that of non-aboriginal children in the general population [25]. A lack of knowledge and cultural sensitivity reduce adherence to preventive measures for these children [19]. In addition, these marginalized populations often have little to no access to oral health care for treatment [26, 27].

ECC and child maltreatment are both the result of a combination of the socio-economic factors associated with poverty, dysfunctional families and parenting behaviour [28-30]. It is difficult to tease apart the nutritional and socio-economic factors connected with dental caries [31]. Dysfunctional families and parenting behaviour do play a big role, as abused and neglected children have a higher incidence of tooth decay and a higher level of need for dental treatment and oral health promotion than the general population. For example, a study looking at a preschool population in Toronto found a 58 per cent prevalence rate of ECC in confirmed cases of child maltreatment [28].

## HIGH SOCIAL COSTS ASSOCIATED WITH ECC

ECC is the most common reason for day surgery in children, with approximately 19,000 dental day surgeries performed in Canada each year on children under the age of six [1]. It is estimated that one of every 100 children under age five required day surgery for ECC from 2010-2012, with 99 per cent of these surgeries requiring general anaesthesia<sup>4</sup> [1]. These day surgery rates are 8.6, 3.9 and 3.1 times higher for children from neighbourhoods with high aboriginal populations, low affluence or from a rural location respectively, compared to neighbourhoods without these demographics [1]. These statistics are concerning because there are risks associated with anaesthesia and tooth extraction early in childhood [32]. Within Canada, the hospital cost for day surgery for ECC in children aged one to five ranged from \$1,271 to \$1,963, totaling \$21.2 million in Canada between 2010 and 2012 [1]. In addition to this, there are anaesthesia costs, estimated to range from \$240 to \$361 per surgery and a surgeon's fee, which was unavailable.

ECC adds unnecessary costs to the health system as a result of a high number of emergency room visits. Untreated dental decay is one of the most common reasons caregivers seek emergency department support for their children. Dental pain is a common pediatric

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<sup>4</sup> These estimates reflect treatment provided in the pediatric hospitals across the country (not including Quebec), but do not address the numbers done in private facilities.

admission symptom in hospital emergency departments [33, 34]. Beyond the increased burden on the health-care system, ECC impacts a child's development with health implications that extend much further than simply cavities on baby teeth. Dental disease can diminish the health and quality of life of children both in the short and long term. If ECC is left untreated, children suffer from toothache pain (acute and chronic), potential loss of teeth, chronic infection and inflammation,<sup>5</sup> sleep deprivation, malnutrition and compromised immune systems. This can impact child development, resulting in a higher lifelong risk of chronic disease, obesity and failure to thrive [36-41].

It is intuitive that preventing children from having their early years of development punctuated by pain is imperative; however, dental pain in young children can often be mistaken or difficult to detect. It is estimated that at least 48 per cent of children with ECC have pain (reduced to three per cent complaining of pain after removal of caries) [42]; however, preschool children often manifest the effects of pain by changing their eating and sleeping habits. Some of the most common behaviours indicative of a toothache in young children can include reaching for the cheek while eating, pushing away something nice to eat, problems brushing upper or lower teeth and problems chewing [43]. Reduction of pain was the most improved quality-of-life outcome from dental surgery for ECC. Strikingly, many children had mistaken dental pain as typical prior to surgery, having no other reference for normal [44, 45].

There are long-term consequences, as children who have both poor oral health and general health are more likely to have poor school performance [46]. Dental pain can manifest as sleep disturbances, malnourishment and exhibiting negative behaviour, which can result in poor school performance [47-49]. Chronic pain and/or sleep deprivation during childhood result in children being distracted at school, learning difficulties and absenteeism [50]. Children with ECC often have more behaviour problems than caries-free children, including increased anxiety, aggressive behaviour, externalizing and attention deficit/hyperactivity [51]. The World Health Organization (WHO) suggests that oral health-related problems such as ECC can be related directly to quality of life.

## **POLICY RECOMMENDATION: PREVENTION OF EARLY CHILDHOOD TOOTH DECAY THROUGH EDUCATION AND IMPROVING ACCESS TO PREVENTIVE ORAL HEALTH CARE**

Prevention strategies include parental education regarding dietary and feeding practices, oral hygiene instruction, exposure to fluoride, access to dental care and limiting transmission of bacteria from mom to babe [56]. Prevention programs often include a

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<sup>5</sup> Research into the mechanism of these relationships is either absent or of low quality, and further investigation is needed 35. R. J. Schroth, R. L. Harrison, and M. E. Moffatt, *Oral Health of Indigenous Children and the Influence of Early Childhood Caries on Childhood Health and Well-Being*, *Pediatric Clinics of North America*, 56(6): 1,481-1,499, 2009. Suggested mechanism by which S-ECC may contribute to chronic disease is through iron deficiency due to chronic inflammation (sometimes referred to as anemia of chronic disease) 36. R. J. Schroth, et al., *Association Between Iron Status, Iron Deficiency Anaemia, and Severe Early Childhood Caries: A Case-Control Study*. *BMC Pediatrics*, 13: 22, 37, 2013. H. Colak, et al., *Early Childhood Caries Update: A Review of Causes, Diagnoses, and Treatments*, *Journal of Natural Science, Biology and Medicine*, 4(1): 29-38, 2013, or malnutrition from painful infection 38. M. Clarke, et al., *Malnourishment in a Population of Young Children with Severe Early Childhood Caries*, *Pediatric Dentistry*, 28(3): 254-259, 39, 2006. G. Acs, et al., *Effect of Nursing Caries on Body Weight in a Pediatric Population*, 14(5): 302-305, *Ibid.*, 1992.

combination of these approaches. Water fluoridation has been shown to be effective for preventing caries in populations [57] and has recently been shown to reduce tooth decay in Canadian children [58]. While fluoridation of drinking water can be effective, it is only a supplement to other oral health prevention approaches encouraging preventive behaviours. Notably, if oral health prevention were done effectively, fluoridation of drinking water would not be needed.

A Health Canada Oral Health Report Card identified that Canadians without access to regular dental care have poor oral health, with a disproportionate burden on those from low socio-economic status [59]. Income and lack of dental insurance coverage are the main barriers in access to dental care in Canada [60]. Without access to preventive dental services, the public health-care system pays for the downstream effects in dental emergency hospital-based treatment. To address this, the Canadian Oral Health Strategy identified the immediate need for improved oral health policy to increase individual and community oral health knowledge, while encouraging greater access. These strategies need to specifically focus on preventive oral health care and address the needs of the populations most at risk including children and youth, low-income families, those with special needs, aboriginal peoples, and immigrants and refugees [61].

When public dental insurance and preventive oral hygiene (brushing, flossing and regular checkups) are provided, there is a decrease in the need for reactive dental care [62]. Prevention efforts are critical and must occur before eruption of the first tooth and thereafter while baby teeth are emerging. In the following section, we recommend that preventive oral health care needs to become an integral part of general health and well-being measures in our health-care system by: 1) Increasing educational efforts to improve utilization of and access to preventive oral health practices; 2) Empowering health-care professionals to integrate ECC prevention; and 3) Reducing cost barriers to preventive dental health.

## 1. Improve Community-Based Education and Access for Early Preventive Oral Health Care

Improved public education about the importance of early preventive oral health must be an ongoing part of early parenting education. Key messages to be communicated to parents of young children include: to reduce intake of sweet drinks, to avoid filling bottles with sugar water, juice or soft drinks, particularly at night, and to clean an infant's gums with a soft toothbrush or cloth and water starting at birth. With first tooth eruption, parents should be encouraged to commence daily brushing with toothpaste and book a first dental visit. Education for parents about these behavioural adjustments can ensure children are on track for a lifetime of healthy dental habits.

While proper oral hygiene is an effective intervention when adhered to strictly, parents' behaviours are not easily changed. Encouraging innovative methods of reaching high-risk populations, and building in the time to include ECC education as part of family-based programming is needed. Influencing the individual, community and cultural factors that dictate these oral practices can be challenging [22, 63, 64]; however, public education can be a powerful prevention strategy, reducing the need for emergency dental services.



Community-based programs, such as home visits from community health nurses, can be tailored to individual needs based on communication preference, learning style, and sensitivity to cultural and demographic differences [65]. The home-visit model has been a successfully integrated and implemented program using non-dental health professionals such as nurses [66]. This strategy has been used for breastfeeding education, with in-hospital and post-partum visits being shown to increase breastfeeding duration and reduce health services utilization<sup>6</sup> [67, 68].

Creating healthy practices early on instead of modifying unhealthy ones is critical to the success of ECC prevention. Oral health education can be emphasized in existing home visitation strategies to achieve reductions in ECC. For example, in Alberta, all newborns receive at least one home visit from a public health nurse within the first 10 days of life and home visits are offered through the Healthy Beginnings post-partum program. These public health programs are opportunities to incorporate oral health as a component of their counselling topics. When infants are over two months of age, care is transferred to nurse-run well-baby clinics and visits occur in tandem with immunization schedules at two, four, six, 12 and 18 months (Government of Alberta, Alberta Health, 2015). These visits could better incorporate oral health screenings, provide education and conduct referrals.

Public education and prevention programs need to reach rural and remote communities, who are often at higher risk of ECC and have limited access to preventive dental services. Access is more than just an issue of affordability; geography and cultural understanding impact access, particularly in First Nations and Inuit communities in Canada [69]. The recent *Unleashing Innovation: Excellent Healthcare for Canada* report notes that although basic costs are covered for dental care for those registered members of First Nations and Inuit through Health Canada's non-insured health benefits (NIHB) program, remote communities face long-distance travel to access preventive dental services<sup>7</sup> [71]. Complaints about the NIHB specific to dentistry were noted by a stakeholder: "Under the NIHB program with regards to dentistry, we have a predetermined system which is centralized and which takes weeks to provide decisions to dentists. This requires patients with complex issues to travel once for a diagnosis and a second time and possibly more to receive treatment." [71]

To improve aboriginal Canadians' oral health, the adoption of a holistic strategy that reflects aboriginal culture and traditional health practices is needed [72]. The Children's Oral Health Initiative (COHI) is a promising national early childhood tooth decay prevention program, funded by the NIHB program, designed to improve the oral health of First Nations and Inuit children aged zero to seven. The services are delivered on reserve by dental therapists or dental hygienists with the assistance of a COHI aide (who is a community member). In 2013, the First Nations Health Authority assumed administrative

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<sup>6</sup> The Starting Well program in Scotland found positive effects on oral care after general health education about parenting skills, home safety and play. The program delivered home-based services to improve overall child health. After the intervention, 19.1 per cent more Starting Well toddlers were registered with a dentist at six months compared to the control (Shute & Judge, 2005).

<sup>7</sup> For example, many children in rural settings with ECC can wait 6.3- nine weeks for surgery and one in five families drives over two hours for care in B.C. 70. B.C. Ministry of Health, *Pediatric Summary of Totals: Dental Surgery*, 2013.

responsibility for the Health Canada NIHB program and COHI for First Nations residing in British Columbia.<sup>8</sup> Developing this type of local administration capacity within other provinces will help optimize this program's outcomes.

## 2. Empower Health-Care Professionals to Integrate ECC Prevention

Public health nurses, family physicians, pediatricians, emergency doctors, and emergency and maternity nurses are often the first point of entry into the health system for young children with ECC. Early and frequent preventive care visits for children are much more common in family medicine, and these primary-care providers can play a critical role in educating parents and promoting oral health in children [73]. Curriculum and continuing education for these health professions should be enhanced to emphasize the far-reaching health impacts of ECC. Chair-side person-to-person information is often more effective than community campaigns, and is an important way to communicate preventive oral health behaviours [56, 74]. Armed with the knowledge of this serious and costly health issue, professionals must then also be given the time to provide appropriate education to new parents.

This integration of care has been effective in the United States, with the American Academy of Pediatrics advocating for expansion of public health coverage for caries-prevention services performed by primary care, non-dental professionals. The services include an oral health exam, risk assessment, anticipatory guidance, application of fluoride varnish and referral to a dentist by age one [75]. This intervention implies that non-dental professionals can successfully incorporate preventive oral health activities into practice; however, the time it takes to provide these services would likely be a major barrier for implementing efficient and cost-effective care [76]. With legislation in the Canada Health Act restricted to medically necessary services, each province is left to determine what public funding is available and who is eligible for dental care funding. This results in substantial variation within provinces, with delivery for the majority of Canadians left largely to the private market dental professionals [73].

## 3. Invest in Preventive Oral Health Services Rather than Emergency Dental Care for Children

While education can help raise awareness, there is a need for a medical system that is responsive to children's health needs, providing access to early remedial oral health care when necessary. Currently, emergency department visits are often the first contact a child with S-ECC has with a dentist. One study looking at caries-related emergency visits at a children's hospital found 27 per cent of all patients and 52 per cent of children 3.5 years and younger first saw a dentist in the emergency department [11]. This escalation of what is an entirely preventable disease is often due to a combination of lack of education and access-to-care challenges (financial or distance). Consequently, the child's condition advances to a point where dental care requires publicly funded day surgery with general anesthesia [77].

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<sup>8</sup> <http://www.fnha.ca/what-we-do/maternal-child-and-family-health/childrens-oral-health-initiative>

Public insurance improves access to care and has been shown to increase the odds of receiving dental care [78]. Children living in low-income families, whether the families are in receipt of financial assistance or not, are typically entitled to some level of support for accessing dental services. Across the country, each province and territory (with the exception of the Northwest Territories<sup>9</sup>) provides some basic dental services to children from low-income families. The low-income cutoff is different among provinces. For example, Alberta has one of the highest maximum qualifying income levels of all the provincial programs offering dental care to children (using an income cutoff).<sup>10</sup> The Alberta Child Health Benefit program provides dental care to single-parent, one-child families, and to a couple with one child, with a maximum qualifying income of \$26,023 or \$31,237 per year, respectively [79]. Maximum qualifying income levels are higher for families with more children. Some jurisdictions also specifically deal with the provision of financial assistance to families of children with disabilities or special needs. Children in the care of a province or territory may also be entitled to dental care paid for by the province or territory.

It is clear that funding is not the only barrier to accessing preventive dental care, as children from low-income families under-utilize the available dental benefits and continue to have higher than average rates of ECC [80]. Parental perception of need is the primary determinant of use of dental care services for this group of insured children, and it is recommended that oral health promotion interventions should be directed at enhancing perception of the need for services to prevent the onset of dental problems or to detect them at an early stage [81].

For those above the maximum qualifying income or eligibility criteria, a lack of public funding for preventive dental care can be a barrier to access. Children should have access to preventive oral care, including regular dental visits, starting with their first tooth eruption. Achieving this through public health coverage is proposed as a possible way for provincial health-care systems to save millions of dollars in surgery and hospital costs. This is based on the premise that when public dental insurance and preventive oral hygiene (brushing, flossing and regular checkups) are provided, there is a decrease in the need for emergency dental care [62].

Publicly delivered pediatric dental programs in Canada differ greatly among provinces and territories in terms of the services covered, age restrictions and limits on frequency of visits [73]. Nova Scotia, Prince Edward Island, Newfoundland and Quebec provide public funding for preventive dental care for children with no dental coverage under 14, 13, 12 and 10 years of age respectively. The Yukon government funds a first free visit to the dentist for children under the age of five and a school-based public dental health program for children up to Grade 8. Some provinces providing more universal coverage have seen higher use of dental services and reduced deficits in health associated with other determinants.<sup>11</sup> Without these supports, the public system ends up paying for more of the downstream costs

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<sup>9</sup> Northwest Territories is addressing this issue in the *Brushing Up on Oral Health Northwest Territories 2014 report*.

<sup>10</sup> For a summary of provincial dental benefit programs for low-income families, see the Canadian Oral Health Clearinghouse website <http://www.oralhealthroundtable.ca/provincial-oral-health-programs/>

<sup>11</sup> James Leake, *Why Do We Need an Oral Health-Care Policy in Canada?* Journal of the Canadian Dental Association, 2006.



associated with dental surgery in hospitals resulting from ECC. Provinces without universal public funding for children's preventive dental health should consider the access barriers children without dental insurance face.

## PREVENTION PROGRAMS ARE COST EFFECTIVE

Dental caries prevention programs have been shown to be cost effective when the numbers of avoided/reduced restorative or surgical treatment visits are considered<sup>12</sup> [85]. A recent economic evaluation of a pilot hospital-based disease management program in the United States showed that a program to prevent and manage ECC was associated with fewer hospital-based restorative or surgical treatment visits and lower overall cost compared to baseline [86]. Another cost-effectiveness study showed that implementation of a program encouraging repeat oral health visits in medical offices reduced hospitalizations and office visits for dental caries-related treatment [85]. These studies identify the importance of the medical provider's and family's participation for these types of preventive oral health services to be cost effective [85]. Notably, most cost estimates only account for the service provision costs associated with ECC and don't take into consideration the pain, suffering and indirect costs (such as lost parental work time) connected with severe ECC [77].

## CONCLUSION

ECC is a preventable chronic infectious disease that develops from lifestyle and behavioural factors. Municipal water fluoridation is one strategy that is proposed to reduce children's tooth decay. However, education to change behaviour and access to preventive oral health services is the only way to fully prevent the costs for the public health-care system and severe negative impact on childhood development and well-being that comes with ECCs. To address this preventable disease and its associated burden, policy action is needed. Health policies need to recognize the importance of oral health in a child's development in terms of general health and well-being. Education of health professionals who interact with parents of young children on early oral health best practices is critical to improve uptake of early prevention of oral health disease.

The occurrence of ECC is strongly influenced by socio-economic status, with much of the burden of disease concentrated in marginalized populations with no access to oral health care such as low-income families, aboriginal populations, new immigrants and the working poor. Public education and access improvements for oral health preventive care in these

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<sup>12</sup> Community/school-based dental caries intervention programs can also be cost-effective uses of public funding 82. S. J. Crowley, A. C. Campain, and M. V. Morgan, *An Economic Evaluation of a Publicly Funded Dental Prevention Programme in Regional and Rural Victoria: An Extrapolated Analysis*, *Community Dental Health*, 17(3): 145-151, 2000. Community-based interventions have been associated with cost savings for society, with a per-diseased tooth averted estimated savings of between \$8.55 to \$21.30 US 83. R. Marino, J. Fajardo, and M. Morgan, *Cost-Effectiveness Models for Dental Caries Prevention Programmes Among Chilean Schoolchildren*, *Ibid.*, 29(4): 302-8, 2012. Aside from the potential for an estimated \$21.2 million in cost savings in Canada suggested by these studies, gains in improved patient health, utility and quality of life are important intermediate outcomes 84. M. R. Gold, J. E. Siegel, L. B. Russell, M. C. Weinstein, *Cost-Effectiveness in Health and Medicine*, (New York: Oxford University Press, 1996).

high-risk populations require co-ordinated, multi-dimensional prevention efforts targeting high-risk populations and the behavioural and socio-economic factors that create barriers to change.

While prevention really is the best medicine, there is a need to ensure that children who need dental care don't see their first dentist in the emergency department. Reducing cost and access barriers to early preventive oral care requires better education, awareness and integration of oral health into the health-care system. Aside from undisputed health benefits to the child, investing in an oral health prevention strategy for children by ensuring all children have access to preventive dental care is the most cost-effective and efficient long-term strategy for oral health problems.

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## About the Authors

**Jennifer Zwicker** is Manager in health policy at the University of Calgary, School of Public Policy. Her research interests include assessment of the socioeconomic impact of research and policy for chronic disease prevention and health care reform. Dr. Zwicker received her PhD in neurophysiology from the University of Alberta and her Masters of Public Policy from the University of Calgary. She is a 2014/2015 Action Canada Fellow, a public member on the council of the Alberta College of Optometrists and a co-chair for the Canadian Science Policy Centre.

**Carolyn Dudley** is a Research Associate at The School of Public Policy, University of Calgary. She holds a Masters in Nursing, and has worked on the issues of transportation, caregiver costs and employment for individuals with ASD. She has a background in public health, project management and women's health.

**Herb Emery** is a Professor of Economics, as well as the Director for Research, and the Program Director, Health Policy at The School of Public Policy. Dr. Emery currently teaches a statistics/math foundations course in the Masters of Public Policy program.



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#### **ISSN**

1919-112x SPP Research Papers (Print)  
1919-1138 SPP Research Papers (Online)

#### **DATE OF ISSUE**

April 2016

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