



Community-Based Dental Health Programs

Options for Your Community

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Purpose

This document was created at the request of the Federal Dental Care Advisory Committee (FDCAC) in response to the Inuit Oral Health Survey 2008-2009 results. This document provides a list of various dental preventive programs that can be offered at the community level. Each program is described with the supporting evidence, the pros and cons and suggestions for human resources. These programs can be implemented by the community or can be integrated into a larger oral health initiative. Implementation of preventive programs also provides an opportunity for data collection (pre-implementation and at various points during the programs use), to be used for program evaluation.

Background

Both the Inuit Oral Health Survey (2008-2009) and the Canadian Health Measures Survey (2007-2009) have provided recent data on the oral health status of our nation. The surveys have allowed for comparisons between Inuit communities and their southern counterparts. The results have shown that our Inuit communities are suffering from continual high levels of dental decay. Despite improvements in this area the level of dental decay remains 2 to 3 times higher than that experienced by those in the rest of Canada. Specific comparisons show that for 6-11 year olds, 93 percent of those living in the Inuit Nunangat (Inuit homeland) have experienced decay compared to 53 percent for those living in a southern community. Not only do these children have a higher prevalence but their severity of disease is higher. The average dmft/DMFT (6 to 11yrs) in the north is 7.08 compared to 2.48 in the rest of Canada. This trend continues into adulthood and has resulted in the creation of a 'menu of preventive programs' that can be used by various communities to reduce their levels of dental decay.

Dental caries or cavities, is a chronic condition that can be prevented. The Canadian Dental Association (CDA) defines caries as "an infectious, transmissible disease in which bacterial by-products dissolve the hard surfaces of teeth. Unchecked, the bacteria can penetrate the dissolved surface, attack the underlying dentin, and reach the soft pulp tissue. Dental caries can result in loss of tooth structure, pain, and tooth loss and can progress to acute systemic infection".¹ Through the various dental preventive programs laid out in this publication dental caries can be prevented and the caries process (if started) can be slowed.

The role of fluoride in caries prevention is both topical and systemic. Topically, fluoride is delivered via toothpastes, mouth rinses and professionally applied varnishes or gels.

¹ Centers for Disease Control and Prevention. Recommendations for using fluoride to prevent and control dental caries in the United States. MMWR 2001; 50(No. RR-14): 1-59.

Fluoride also accumulates in the dental plaque to prevent demineralization and promote remineralisation of tooth structure.¹ Systemically, through fluoridated water fluoride is ingested and incorporated into developing teeth to make them more resistant to decay.¹ Recent research has highlighted the importance of topical fluoride in further decreasing caries levels.¹

Note

It should be noted that prior to the implementation of any dental preventive program the background sources of fluoride within a community must be determined. Specific to this is the level of fluoride in the community water source (testing of fluoride levels is required in each distinct season e.g. wet and dry seasons; spring thaw and winter freeze) and the use of other fluoridated products. This **must** be completed prior to program commencement to minimize the risk of enamel fluorosis.

The dental preventive programs listed in this menu should not be considered exclusive of each other. A multi-faceted approach that includes a combination of these programs as well as other community based health promotion activities will ensure long-term success in the prevention of dental decay. The common-risk factor approach (where oral health programs are integrated into existing or emerging population health programs) with the involvement of other health services will allow for the development of health awareness and encourage cross-sector co-operation.

1. Community Water Fluoridation (CWF)

Community water fluoridation is the process of adding fluoride to the communal water source to the optimal level (0.7 ppm) for caries prevention as determined by the Federal, Provincial, Territorial Committee on Drinking Water. Continual monitoring of the fluoride levels ensures it remains within the acceptable range to allow maximum dental decay benefits and reducing the chances of dental fluorosis.

CWF is globally accepted as a safe and equitable method of preventing dental caries and has been recognized by the Centers for Disease Control and Prevention (CDC) as one of the ten great public health achievements of the 20th century.² Fluoride works to reduce dental caries in two ways systemically and topically. The systemic effect of fluoride is pre-eruptive (during tooth formation) and must be ingested to be incorporated within the tooth to strengthen the enamel and tooth surface which is more resistant to dental caries. The fluoride ions enter the crystal structure of enamel whereby hydroxyapatite becomes fluorapatite.³ Systemic fluoride is incorporated into the developing tooth enamel to strengthen the tooth structure and create an enamel surface which is more resistant to decay.⁴ Water fluoridation benefits the entire community regardless of age or socioeconomic status. Everyone who consumes the water, or consumes foods and beverages prepared with the water automatically receives the benefits. Benefits do not depend on the availability of professional dental services or the ability to afford them.

The second and more predominant affect of fluoride is topical. Fluoride, through the use of toothpastes, mouthrinses, professionally applied gels and varnish makes teeth more resistant to dental caries and reduces the effect of an acid attack.³ Despite the availability of topical fluorides, CWF is still effective in reducing decay, especially in communities with high dental caries risk.⁵ Community water fluoridation is a valuable public health measure due to the following reasons:

- Accessible to entire population irrespective of education, socioeconomic status, and income
- Behaviour change is not required to receive the benefit
- Cost-effective when compared to other forms of fluoride treatments (at a population level)

Pros

- Effective, safe and equitable way to improve community oral health
- Cost-effective
- Results still seen with the use of topical fluorides
- Well established public health measure

² Riley JC, Lennon MA, Ellwood RP. The effect of water fluoridation and social inequalities on dental caries in 5-year-old children. *Int J of Epidemiol* 1999; 28: 300-305.

³ Newbrun E. *Fluorides and Dental Caries* (Vol 3). Springfield IL: Charles C. Thomas (1986)

⁴ Newbrun E. Systematic Benefits of Fluoride and Fluoridation. *J Pub Health Dent* 2004; 64: 35-39.

⁵ Hawkins RJ. Fluoridation works: let your voice be heard. *J Can Dent Assoc* 2009; 75: 413

Cons

- Contentious issue (opposition to implementation and maintenance)
- Requires robust capital investments (equipment, monitoring, training, personnel)

Human Resources

- Trained and accredited water treatment professional for monitoring and addition of fluoride

2. Toothbrushing with fluoridated toothpaste Program

Fluoridated toothpaste is the most widely accepted form of fluoride globally, due in large part to mass marketing.⁶ Commercially available toothpastes typically contain 1000 ppm fluoride but can range from 500 to 1500 ppm or higher. Marinho *et al* (2003) reported that with the use of fluoridated toothpaste the pooled prevented fraction was 24 percent (24 percent caries reduction seen with using fluoridated toothpaste at least once daily).⁶ While the majority of studies in the review looked at permanent (adult) teeth, a single study reported on deciduous (baby) teeth and found 37 percent caries reduction.⁶

Walsh *et al* (2010) examined different fluoride concentrations in toothpaste and their effectiveness in reducing caries. The authors found that toothpastes with at least 1000 ppm fluoride conferred the greatest preventive benefits.⁷ Such that as the fluoride concentration increases within toothpastes so does the prevented fraction (dose-response relationship). This does not hold for toothpastes with 440 to 550 ppm fluoride (children's formulations) which did not show any statistically significant difference from the placebo.⁷ It is important to realize that the use of toothpastes with higher fluoride concentrations in children must be weighed against the risk of enamel fluorosis and is dependent on background fluoride consumption.⁷

A recent Jordanian study looking at the role of intense oral hygiene instructions with supervised toothbrushing compared to oral hygiene, found that after a 4-year follow-up period those in the control group (oral hygiene instruction only) were 6.4 times more likely to develop decay (for 6-year olds).⁸ Similarly, an earlier study from China looked at the role of supervised daily brushing and oral health instruction versus a control (no intervention) in kindergarten children.⁹ After a 3-year follow-up the authors found that the progression of new carious lesions was slowed and that the net caries increment (all new and reactivated caries lesions minus the number of arrested caries and examiner reversals) in the treatment group was 43 percent lower than in the control group.⁹ It is worth noting that in this study no water fluoridation was available and the oral health instruction was completed by teachers without formal dental training.⁹

⁶ Marinho VCC, Higgins JPT, Logan S, Sheiham A. Fluoride toothpastes for preventing dental caries in children and adolescents. Cochrane Database of Systematic Reviews. 2003, Issue 1. Art No.: CD002278.DOI: 10.1002/14641858.CD002278.

⁷ Walsh T, Worthington HV, Glenny AM, Marinho VCC, Shi X. Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. Cochrane Database of Systematic Reviews. 2010, Issue 1. Art No.: CD007868.DOI: 10.1002/14651858.CD007868.pub2.

⁸ Al-Jundi SH, Hammad M, Alwaeli H. The efficacy of a school-based caries preventive program: a 4-year study. *Int J Dent Hygiene* 2006; 4: 30-34.

⁹ Schwarz E, Lo ECM, Wong MCM. Prevention of early childhood caries-Results of a fluoride toothpaste demonstration trial on Chinese preschool children after three years. *J Public Health Dent* 1998; 58(1): 12-18.

In Scotland a two year trial was undertaken to see if a school-based supervised toothbrushing program targeted to high-risk children would be effective in reducing their caries levels.¹⁰ The intervention group received daily toothbrushing with 1000 ppm fluoridated toothpaste and toothpaste and toothbrushes for home use compared to a no treatment control group.¹⁰ All trial participants received six monthly dental examinations.¹⁰ The authors found that at the completion of the study those in the intervention group had 36 percent less D₁ lesions and 56 percent less D₃ lesions in their first permanent molars.¹⁰ A subsequent study by Pine *et al* (2007) followed-up the participants of the aforementioned trial to determine if the observed caries reductions were still present four years after the program ended.¹¹ When comparing baseline data to that collected at the 84-month follow-up exam there was still a 33 percent reduction at the D₁ level and a 40 percent reduction at the D₃ level for the intervention group.¹¹ The authors continue to state that when the original trial began many of the children had not developed the habit of brushing twice daily. The continued oral health benefits can be attributed to either a behaviour change (habit of twice daily brushing) or the possible increased resistance of first molars to decay.¹¹ To explore this further a second follow-up study has been proposed.¹¹

In the Philippines the *Fit for School* initiative aims to link resources for health, nutrition, and education in a single venue. Schools act as a second home for children and ideal for familiarizing children with habits that benefit their health.¹² The program includes daily hand washing with soap, daily toothbrushing with fluoridated toothpaste, and biannual deworming.¹² The program has been successful and cost effective and can be implemented in underserved areas.¹²

An interesting study by Davies *et al* (2001) looked at the impact of free fluoridated toothpaste on caries for low socioeconomic status children in England.¹³ Fluoridated toothpaste (1450 ppm and 440 ppm) was mailed to participating children every 12 weeks from 12 months to 5.5 years of age. Included in the mail-outs were dental health tips (twice daily brushing with a pea-sized amount of toothpaste) and a new toothbrush was provided yearly.¹³ At the conclusion of the trial, a statistically significant caries reduction (16 percent reduction) was seen for those using 1450 ppm fluoridated toothpaste but not for those using the 440 ppm toothpaste.¹³ The results show that by providing free fluoridated toothpaste (1450 ppm), caries levels in 5-year olds can be affected in high caries risk communities.

¹⁰ Curnow MMT, Pine CM, Burnside G, Nicholson JA, Chesters RK. A randomised controlled trial of the efficacy of supervised toothbrushing in high-caries-risk children. *Caries Res* 2002; 36: 294-300

¹¹ Pine CM, Curnow MMT, Burnside G, Nicholson JA, Roberts AJ. Caries prevalence four years after the end of a randomized controlled trial. *Caries Res* 2007; 41: 431-436

¹² Fit For School website. <http://www.fitforschool.ph/>. Last accessed 9/8/2011

¹³ Davies GM, Worthington HV, Ellwood RP, Bentley EM, Blinkhorn AS, Taylor GO, Davies RM. A randomised controlled trial of the effectiveness of providing free fluoride toothpaste from the age of 12 months on reducing caries in 5-6-year old children. *Community Dental Health* 2002; 19: 131-136.

Pros

- Teaches young children the importance of daily oral hygiene practices
- Does not require dental providers to oversee the program
- Easily integrated into existing school curriculum on nutrition and personal hygiene

Cons

- Teachers/auxiliary staff/community volunteer must manage the program
- Requires dedicated time within the school day

Human Resources

- Teacher/auxiliary staff/volunteer
- Regional dental provider to provide support

3. Fluoride Varnish Program

The use of topical fluorides such as professionally applied fluoride varnish, which are at concentrations of approximately 22000 ppm, allows for prolonged contact between the tooth's surface and the varnish.¹⁴ Developed in the 1960s varnishes have been widely used throughout Europe, Scandinavia and Canada.¹⁴ They are principally used for at-risk patients with moderate to high caries risk.¹⁴ Despite the high fluoride concentration (Colgate®Duraphat® 22600 ppm) the application is safe for use in young children. This is due to the small application amount and even if ingested the level of fluoride ingested remains well below the toxic levels.¹⁴ Marinho *et al* (2002) reported a 46 percent reduction in DMFS and a 33 percent reduction in d(e/m)fs following the use of fluoride varnish in their systematic review.¹⁴

When considering high risk, special needs populations Weintraub (2003) found that the ease of application and fast setting nature of fluoride varnish resulted in greater patient and provider acceptance.¹⁵ Comparisons of varnish to other fluoride modalities showed that bi-annual applications of fluoride varnish were preferred over mouthrinsing programs due to lack of compliance. It resulted in a lower caries increment versus fluoride gel and has an additive effect in optimally fluoridated communities.¹⁵ These findings can easily be transferred to other high risk populations.

When looking at the efficacy of fluoride varnish in preventing early childhood caries Weintraub *et al* (2006) found that, "findings support the use of fluoride varnish to prevent early childhood caries and reduce caries increment in very young children".¹⁶ The authors continue to state that "although more frequent fluoride varnish applications were more beneficial one application was preferable to none".¹⁶ This is highly relevant to underserved communities.

Beltrán-Aguilar and Goldstein (2000) examined the safety of fluoride varnish and reported that plasma levels peak two hours post application and are comparable to brushing with fluoridated toothpaste. Also, fluoride varnish exhibited ingestion amounts considerably lower than levels associated with fluoride gel ingestion.¹⁷ Further they state that, "the caries-preventive efficacy of fluoride varnishes is equal to that of other topical fluoride vehicles in school-aged children".¹⁷

¹⁴ Marinho VCC, Higgins JPT, Logan S, Sheiham A. Fluoride varnishes for preventing dental caries in children and adolescents. Cochrane Database of Systematic Reviews. 2002, Issue 1. Art No.: CD00279.DOI: 10.1002/14641858.CD00279.

¹⁵ Weintraub JA. Fluoride varnish for caries prevention: comparison with other preventive agents and recommendations for a community-based protocol. *Spec Care Dentist* 2003; 23(5): 180-186.

¹⁶ Weintraub JA *et al*. Fluoride varnish efficacy in preventing early childhood caries. *J Dent Res* 2006; 85(2): 172-176.

¹⁷ Beltrán-Aguilar ED, Goldstein JW. Fluoride Varnishes: A review of their clinical use, cariostatic mechanism, efficacy and safety. *JADA* 2000; 131: 589-596.

Azarpazhooh and Main (2008) provided a clinical protocol for the application of fluoride varnish which recommends varnish application every six months and the use of single dose products for young children.¹⁸ Further, they recommend that fluoride varnish programs be complimentary to sealant application, toothbrushing programs, oral hygiene instruction and nutrition counselling.¹⁸

Within First Nations communities Lawrence *et al* (2008) compared fluoride varnish application and caregiver counselling to counselling alone and found that those in the fluoride varnish group had a 24.5 percent reduction in early childhood caries levels (included all children in the intention to treat analysis).¹⁹ These results are consistent with an Australian study which reported a 24 to 36 percent (dependent on the caries increment) caries reduction among rural Indigenous children.²⁰ In both studies, only one child reported an adverse reaction to the fluoride varnish.^{19,20}

Often a concern in rural and remote regions is the lack of dental personnel available to deliver these services such that medical staff are considered for this role. Slade *et al* (2007) looked at the role of different education methods on the provision of dental preventive services (varnish application) being delivered at well-baby visits.²¹ The authors found that the varying methods of delivering education did not influence the provision of these services.²¹ The medical offices involved provided dental services to 10 percent of Medicaid eligible children.²¹

Pros

- Targets high risk children and adults
- Well tolerated by young children
- Possible to be delivered by trained personnel
- Complementary to other services (sealants, education, nutrition)

Cons

- Co-operation of very young children can be a challenge
- Requires applications every 6 months(problem if understaffed)

Human Resources

- Dental provider or trained medical/auxiliary staff

¹⁸ Azarpazhooh A, Main PA. Fluoride varnish in the prevention of dental caries in children and adolescents: A systematic review. *JCDA* 2008; 74(1): 73-79j.

¹⁹ Lawrence *et al*. A 2-year community-randomized controlled trial of fluoride varnish to prevent early childhood caries in Aboriginal children. *Community Dent Oral Epidemiol* 2008; 36: 503-516.

²⁰ Slade GD *et al*. Effect of health promotion and fluoride varnish on dental caries among Australian Aboriginal children: results from a community-randomized controlled trial. *Community Dent Oral Epidemiol* 2011; 39: 29-43.

²¹ Slade GD *et al*. Training pediatric health care providers in prevention of dental decay: results from a randomized controlled trial. *BMC Health Services Research* 2007; 7: 176

4. School Sealant Program

Introduced in the 1960s dental sealants are placed over the chewing (occlusal) surfaces of the posterior teeth to prevent bacterial attack.²² The material used is either resin-based or a glass ionomer cement. Both materials can be placed atraumatically by auxiliary staff (dental therapist, dental hygienist). As one of the recommended strategies for preventing caries by the *Task Force on Community Preventive Services* (2001) school-based or -linked programs can be completed in both public and private clinic settings.²³ By targeting children with high caries risk, who often have limited access to dental care, it could be provided with a preventive service at a critical age.²³ This is important because about 90 percent of the decay (by 1987) in permanent teeth of children occurred in the pits and fissures.²⁴ The Task Force reported a median decrease in occlusal caries for children 6 to 17 years old of 60 percent.²³

Ahovuo-Saloranta *et al* (2008) reported in their systematic review that after 9 years after sealant placement, only 27 percent of sealed teeth had decayed compared to 77 percent of teeth that did not receive sealants.²² The authors also report conflicting findings pertaining to the superiority of either resin-based or glass ionomer cement sealants.²²

Yengopal *et al* (2009) completed a meta-analysis of the evidence to determine if either glass ionomer or resin-based materials were superior in their caries prevention.²⁵ The authors reported that there was no evidence that either material was superior to the other in the prevention of caries.²⁵ A later update of this paper confirmed these findings.²⁶

In their literature review, Gooch *et al* (2009) reported that only 20 percent of children (aged 6 to 11 years) in low income families had received sealants, far less than the 40 percent of high income children with sealants.²⁷ Their findings include the recommendation to seal sound and non-cavitated occlusal surfaces. They also state that sealants should be placed irrespective of follow-up.²⁷

²² Ahovuo-Saloranta A, Hiiri A, Nordbald A, Mäkelä M, Worthington HV. Pit and fissure sealants for preventing dental decay in the permanent teeth of children and adolescents. *Cochrane Database of Systematic Reviews* 2008, Issue 4. Art No.: CD001830.DOI: 1002/14651858.CD001830.pub3

²³ Guide to Community preventive Services. Preventing dental caries: dental school-based or-linked sealant delivery programs. [www.communityguide.org/oral/schoolsealants.html\(schoolsealants.html\)](http://www.communityguide.org/oral/schoolsealants.html(schoolsealants.html)). Last accessed 5/4/2011

²⁴ Truman BI *et al*. Reviews of Evidence on Interventions to Prevent Dental Caries, Oral and Pharyngeal cancers, and Sports-related Craniofacial Injuries. *Am J Prev Med* 2002; 23: (1S)

²⁵ Yengopal V *et al*. Caries-preventive effect of glass ionomer and resin-based fissure sealants on permanent teeth: a meta analysis. *J Oral Sci* 2009; 51(93): 373-382

²⁶ Mickenautsch S, Yengopal V. Caries-preventive effect of glass ionomer and resin-based fissure sealants on permanent teeth: An update of systematic review evidence. *BMC Research Notes* 2011; 4: 22

²⁷ Gooch BF *et al*. Preventing dental caries through school-based sealant programs. Updated recommendations and reviews of evidence. *JADA* 2009; 140: 13561363

When being compared to another preventive program, such as fluoride varnish, pit and fissure sealants are superior in the reduction of occlusal decay. Hiiri *et al* (2010) state that the 23-month effectiveness of sealants is statistically superior to 6-month varnish applications for the reduction of occlusal decay.²⁸

Successful school based sealant programs often have a follow-on effect where schools, teachers and parents are more open towards other school based programs (immunization, nutrition), thus increasing population directed programs.²⁴

Pros

- Protects high risk tooth surfaces (occlusal surfaces of molars)
- Glass ionomer cement and resin-based sealants are equally effective
- Can be done in concert with fluoride varnish/gel application
- Can be well integrated into community level nutrition/health programs
- Can be done within a school setting or a private clinic

Cons

- Retention rates are variable (depends on application technique and material choice)
- Needs to be done with population based and other targeted measures (varnish/gel)

Human Resources

- Dental team (dental assistant, dental therapist/dental hygienist/dentist)
- Administrative personnel for record keeping

²⁸ Hiiri A *et al*. Pit and fissure sealants versus fluoride varnishes for preventing dental decay in children and adolescents. Cochrane Database of Systematic Reviews 2010, Issue 3. Art No.: CD003067.DOI: 10.1002/14651858.CD003067.pub3.

5. Fluoride Gel Program

Fluoride gels are characterized as having a high fluoride concentration, approximately 12000 ppm, a long contact time (4 minutes), professional application with long intervals between applications.²⁹ Fluoride gels have been widely used within dental practices however current recommendations are for use within high risk populations only.³⁰ A large concern with the use of gels is its ingestion. Typically a single dose is 5 ml however the probable toxic dose of 100 mg would be reached in a dose of 8 ml (for a 5 to 6 year old or 20 kg child).³⁰

The Marinho *et al* (2002) systematic review reported a 21 percent reduction in the DMFS following the use of fluoride gels such that communities with a caries increment of 2.2 DMFS per year the number needed to treat (NNT) to prevent one DMFS is 2.³⁰ The authors noted that as the frequency and intensity of gel application increased, so did the treatment effect.³⁰

Several reports have commented on the protocols for application of gels and consistent in recommending the following:

- Application for 4 minutes (despite manufacturer's instructions)
- Use should be limited to high risk children only
- Sealants are best for preventing occlusal decay but gel can be used if sealants are refused
- No pre-application prophylaxis is required
- Strict protocol to be followed to minimize the risk of ingestion
- Professionally applied gel (4500 ppm) for children with low caries risk is not clinically relevant³¹
- 6-month applications are sufficient³²

A single study looked at the prevalence of dental fluorosis in children receiving at minimum 6-month gel applications (starting at age six) and resided in low fluoride areas. The authors reported that semi-annual gel application did not increase the prevalence of fluorosis on incisors, canines, pre-molars, and second molars and this finding was true even with up to 5 applications per year (starting at age seven).³³

²⁹ Poulsen S. Fluoride-containing gels, mouth rinses and varnishes: An update of evidence of efficacy. *European Archives of Paediatric Dentistry* 2009; 10(3): 157-161

³⁰ Marinho VCC, Higgins JPT, Logan S, Sheiham A. Fluoride gels for preventing dental caries in children and adolescents. *Cochran Database of Systematic Reviews* 2002 Issue1. Art No.: CD002280.DOI: 10.1002/14651858.CD002280.

³¹ Truin GJ, van't Hof MA. Professionally applied fluoride gel in low-caries 10.5-year-olds. *J Dent Res* 2005; 84: 418-421

³² Hawkins R, Locker D, Noble J. Prevention Part 7: Professionally applied topical fluorides for caries prevention. *British Dental Journal* 2003; 195(6): 313-317

³³ Joost Larsen M, Kirkegård E, Fejerskov O, Poulsen S. Prevalence of dental fluorosis after fluoride-gel treatments in a low-fluoride area. *J Dent Res* 1985; 64: 1076-1079

Pros

- Prolonged contact with high level of fluoride
- Targets high risk children

Cons

- Patient compliance required (taste, gagging, time)
- Must be done in dental setting by a dental provider
- Side effects not well discussed within the literature
- Limited by Human Resources and clinic capabilities

Human Resources

- Dental provider (dental assistant/dental hygienist/dental therapist)
- Administrative personnel for record keeping

6. Fluoride Rinsing Program

Since the 1970s, school fluoride rinsing programs have been used extensively for the prevention of childhood decay, especially in schools with a high-risk population.³⁴ This has been complemented by the increasing popularity of commercial rinses which potentially could have a wider population segment exposed to the benefits of topical fluoride.³⁴ Fluoride rinsing programs typically begin in grade one (children older than 6 years) to ensure that the participants can comprehend the process of swishing and spitting, and can continue until the completion of secondary school. In their review, Marinho *et al* (2009) looked at over 14,600 children (16 or younger) participating in supervised rinsing programs. An average caries reduction of 26 percent was found with varying concentrations of fluoride mouthrinses.³⁴ The authors reported that these reductions occur with the use of both fluoridated toothpaste and drinking fluoridated water.³²

In their analysis, Disney *et al* (1989) reported that fluoride mouthrinses had little beneficial effect in both low- and high-caries forming children of non-fluoridated communities. The authors continue to state that these programs cannot be recommended in optimally fluoridated communities and public programs are better directed towards larger results in high risk children than marginal results in low risk children.³⁵

A Japanese study looked at the impact of school mouthrinse programs in adulthood. The authors reported that when looking at new mothers (20 years or older), those who had been exposed to long-term rinsing programs had lower DMFT scores than those who had not participated in school programs. The study does not account for the role of diet, access to care, background fluoride exposure or socioeconomic status and the results cannot be used.³⁶

Pros

- Can be done in a school setting
- Exposes high risk children to high dose fluoride at regular intervals
- Improves children's knowledge about oral health

Cons

- Time commitment (from teachers and volunteers)
- Risk of ingestion (side effects)

³⁴ Marinho VCC, Higgins JPT, Logan S, Sheiham A. Fluoride mouthrinses for preventing dental caries in children and adolescents. Cochrane Database of Systematic Reviews 2003, Issue 3. Art No.: CD002284.DOI: 10.1002/14651858.CD002284

³⁵ Disney JA *et al*. Comparative effects of a 4-year fluoride mouthrinse program on high and low caries forming grade 1 children. Community Dent Oral Epidemiol 1989; 17: 139-143

³⁶ Neko-Uwagawa Y, Yoshihara A, Miyazaki H. Long-term Caries preventive effects of a school-based fluoride mouth rinse program in adulthood. The Open Dentistry Journal 2011; 5:24-28

- Need support from education system and school administrators to mandate its use
- Caries reduction not consistently observed
- Can only start when child capable of rinsing (over 6 years) therefore not effective for early childhood caries (ECC)

Human Resources

- Community volunteer and teacher
- Local dental provider/dental office representative for implementation, training and support

7. Salt Fluoridation

Beginning in Switzerland (1955), salt fluoridation provides a viable alternative to community water fluoridation. The use of fluoridated salt is popular in Europe and several countries in the Americas. Results from some of the first countries to use this method of fluoridation (Switzerland, Hungary, Colombia) showed the decreasing prevalence of caries in successive community cohorts.³⁷ The wider introduction of fluoridated salt has produced caries reductions ranging from 13.3 to 89.5 percent. The interpretation of the results should be with the understanding that these countries had varying initial DMFT rates, salt exposure and concentration.³⁷ Specifically, Costa Rica reported a DMFT prior to salt fluoridation (1984) of 9.1. Salt fluoridation commenced in 1987 and by 1992 their DMFT was 4.8 and by 1999 their reported DMFT was 2.5.³⁷ For Jamaica (where all forms of salt are fluoridated) their DMFT prior to implementation was 6.7 (1987) and in 1995 the DMFT had been lowered to 1.1.³⁷

In their systematic review, Gillespie *et al* (2007) report that the advantages of salt fluoridation include that, as salt is an essential component of the diet it can reach all sectors of the population. Also, introduction seems less contentious, it's not limited by treatment plant distribution and fluoridation is compatible with iodisation.³⁸ Fluoridated salt at levels of 250 mg/kg along with consumption of table (domestic) salt ranging between 1 to 4 g/day, a person would consume 1 mg of fluoride daily (optimal dose).³⁸

When the majority of salt consumed by a community is fluoridated, its effectiveness approximates that seen with water fluoridation.³⁹ This makes it an important public health measure. Opposition to salt fluoridation centers on the belief that the promotion of the dental benefits of fluoridated salt would be unacceptable and contradictory to other public health measures that encourage the reduction of consumption of salt and thus decrease the risk of hypertension.³⁹ However, where salt is fluoridated these "populations are not encouraged to consume more salt to improve their dental health; rather, the automatic or passive effect of fluoridated salt is accepted [and where there is a reduction in salt consumption], the concentration of fluoride [in salt] could simply be increased appropriately".³⁹

Pros

- Population based approach
- Exposes people to fluoride passively
- Good results in other countries

³⁷ Pan American Health Organization. Promoting oral health: the use of salt fluoridation to prevent dental caries. Washington D.C: PAHO, 2005

³⁸ Gillespie G *et al*. Salt fluoridation for preventing dental caries. Cochrane Database of Systematic Reviews 2007, Issue 4. Art No.: CD006846.DOI: 10.1002/14651858.CD006846

³⁹ Jones S, Burt BA, Petersen PE, Lennon MA. The effective use of fluorides in public health. Bulletin of the World Health Organization 2005; 83(9): 670-676

- Fluoride level can be adjusted if salt consumption decreases
- Allows for choice (can still purchase non-fluoridated salt)
- Results are at least equivalent to water fluoridation

Cons

- People may increase salt intake if they think it helps their teeth (risk of increased systemic diseases)
- Cannot be implemented in communities with high levels of natural water fluoridation (background fluoride levels needed)
- Multiple manufacturing and production tracks (especially in areas that are naturally fluoridated)

Human Resources

- None required for ongoing fluoridation
- Monitored by salt producers
- Co-operation of salt producers needed

8. Milk Fluoridation

The use of fluoridated milk for caries prevention was first discussed in the 1950s when in Japan, fluoride tablets were added to school meals.⁴⁰ Subsequently, milk fluoridation programs were initiated in Louisiana, Switzerland, Bulgaria, China and Scotland.⁴⁰ The World Health Organization (WHO) conducted a systematic review and found that the use of fluoridated milk should start before 4 years and continue until the first molars have erupted.⁴⁰ There have been no studies conducted on the effectiveness of milk fluoridation on adults.⁴⁰

Yeung *et al* (2008) reported that, based on their systematic review there were insufficient studies with good quality evidence examining the effects of fluoridated milk in preventing dental caries.⁴¹

In their review of the NHANES data Sohn, Burt and Sowers (2006) discovered that children who had diets with a 'high regular milk' content experienced less decay than those who had diets high in 'carbonated soft drinks'. They continue to state that the 'high milk' children had similar caries levels as the 'high water' children.⁴²

In Chile, fluoride was included in the National Complimentary Feeding Programme (PNAC), which covers 90 percent of Chilean children. Under this program powdered fluoridated milk/milk derivatives are provided to children until their sixth birthday at no cost. Percentage reductions in the mean dmfs scores ranged from 41 percent in 4 year olds to 78 percent in 5 year olds.⁴⁰ A follow-up study (after the cessation of the milk program) reported an increase in caries experience but found no statistical difference between the former control and test communities at that point in time.⁴⁰

Pros

- Milk is integral to children's diets
- Can be placed in all forms of milk (fresh, ultra heat treated (UHT), powdered)
- Can be integrated into existing school milk/lunch programs

Cons

- Production and distribution could be difficult
- Need consistent exposure to be effective

Human Resources

- Community volunteer
- Milk producers add and monitor the fluoride levels

⁴⁰ Bánóczy J, Petersen PE, Rugg-Gunn AJ (Editors). Milk fluoridation for the prevention of dental caries. World Health Organization 2009

⁴¹ Yeung *et al*. Fluoridated milk for preventing dental caries. Cochrane Database of Systematic Reviews 2005, Issue 3. Art No.: CD003876.DOI: 10.1002/14651858.CD003876.pub2.

⁴² Sohn W, Burt BA, Sowers MR. Carbonated soft drinks and dental caries in the primary dentition. J Dent Res 2006; 85(3): 262-266

9. School Water Fluoridation

Initially proposed as an alternative to community water fluoridation, fluoridating school water supplies was first tested in the Virgin Islands (1954).⁴³ The school water was fluoridated to a level of 2.3 ppm to account for water consumption being limited to school hours.⁴³ This program was run from 1954 to 1962 and resulted in a DMFT reduction of 21.9 percent and led to similar programs in various U.S. states.⁴³ All programs reported caries reductions with varying fluoride concentrations (2.3 to 6.3 ppm).⁴³

School water fluoridation programs have been phased out and are not seen as a satisfactory alternative to community water fluoridation.⁴⁴

Pros

- Provides alternative if community water fluoridation is not viable

Cons

- Requires separate water system for schools
- Equipment costs
- Requires capital investment and maintenance
- Background water fluoride level needed

Human Resources

- Trained and accredited water treatment professional for monitoring and addition of fluoride

⁴³ Avery KT, Shapiro S, Biggs JT. School Water Fluoridation. *The Journal of School Health* 1979; Oct: 463-465

⁴⁴ Calderone JJ (chairman). Community and school water fluoridation: Summary and recommendations. *J Public Health Dentistry* 1984; 44(1): 43-46

10. Xylitol Program

Xylitol is a sugar substitute within the polyol family and is commonly referred to as a 'sugar alcohol'.⁴⁵ These reduced-calorie substances are used to sweeten products like chewing gum. The use of xylitol is associated with the remineralizing of artificial and genuine carious lesions.⁴⁶ Xylitol can be incorporated into chewing gum, children's candies and syrup.

An isolated trial was conducted in the Marshall Islands to determine if the use of xylitol syrup would be effective in preventing early childhood caries (ECC).⁴⁷ The study compared infants (9 to 15 months of age) who received either 8 g of xylitol syrup in two or three daily divided doses versus a control group receiving a single dose of 2.67 g of xylitol syrup. The lack of a placebo control group was due to government insistence; however no evidence supports any dental benefit from a single dose.⁴⁷ During the trial period all families received oral health education and health care.⁴⁷ The results show that a total dose of 8 g of xylitol (delivered twice daily) could prevent up to 70 percent of decayed primary teeth.⁴⁷ The authors go on to state that three daily doses did not increase the effectiveness of the treatment.⁴⁷ Of the 84 infants that completed the study 11.3 percent experienced side effects (loose stools and diarrhea) and this was similar to results during the lead-up and follow-up periods of the study.⁴⁷

Milgrom and Tut (2009) completed an evaluation of the preventive strategies in the Marshall Islands (conducted one year after program implementation).⁴⁸ The program encompassed varnish applications three times per school year, varnish with twice daily toothbrushing and varnish, toothbrushing and consumption of xylitol gummy bear snacks (3 times per day) with home visits.⁴⁸ The authors found that children who received varnish with either the toothbrushing or xylitol were half as likely to develop cavities compared to those receiving varnish only.⁴⁸ The results also show that paraprofessional assistants and teachers can deliver effective intervention programs.⁴⁸ It should be noted that the Marshall Islands does not have water fluoridation or any private dentists (only a hospital based public clinic).

Kandleman and Gagnon (1990) in their trial among low socioeconomic Montreal children compared the use of 65 % xylitol chewing gum to 15 % xylitol with 50 % sorbitol

⁴⁵ Burt BA. The use of sorbitol-and xylitol-sweetened chewing gum in caries control. *JADA* 2006; 137: 190-196

⁴⁶ Mäkinen KK. Sugar alcohols, caries incidence, and remineralisation of caries lesions: A literature review. *International Journal of Dentistry* 2010; Article ID 981072 DOI:10.1155/2010/981072

⁴⁷ Milgrom P *et al.* Xylitol pediatric topical syrup to prevent dental caries: a double blind, randomized clinical trial of efficacy. *Arch pediatr Adolesc med* 2009; 163(7): 601-607

⁴⁸ Milrom P, Tut O. Evaluation of Pacific Islands early childhood caries prevention project: republic of the Marshall Islands. *J Public Health Dent* 2009; 69(3): 201-203

chewing gum versus a no chewing control.⁴⁹ Study participants also received oral hygiene instruction, weekly fluoride rinsing, screening and referral for necessary dental treatment during the study.⁴⁹ The authors reported an additional 62 percent caries reduction within the gum chewing groups.⁴⁹

In terms of acceptability of a school-based xylitol program involving chewing gum, Autio and Courts (2000) found that while the children readily accepted the program, the teachers expressed concerns over increased workload and class disruption.⁵⁰

Pros

- Accepted by children
- Low incidence of side effects in past studies
- Complimentary program to traditional topical fluoride programs

Cons

- Needs to be culturally accepted practice (chewing gum)
- Limited acceptance by teachers

Human Resources

- Community volunteer/teacher

⁴⁹ Kandelman D, Gagnon G. A 24-month clinical study of the incidence and progression of dental caries in relation to consumption of chewing gum containing xylitol in school preventive programs. *J Dent Res* 1990; 69(11): 1771-1775

⁵⁰ Autio JT, Courts FJ. Acceptance of the xylitol chewing gum regime by preschool children and teachers in a Head Start program: a pilot study. *Pediatric Dentistry* 2001; 23(1): 71-74

11. Casein Derivatives

Casein is the name given to bovine milk phosphoprotein (CPP-ACP) and has shown promise in the remineralisation of white spot and subsurface lesions.⁵¹ Limited research has been produced but it is emerging within the dental field. Under the global brand of Recaldent™, North American products include Trident Xtra Care™, MI Paste and MI Paste Plus (GC America).

Developed in Australia at the University of Melbourne it is commercially available in North America as MI Paste and MI Paste Plus (GC America). The MI Paste Plus contains 900 ppm of fluoride and is not recommended for children under the age of 6; however the original formulation can be used on infants.⁵² This product can be used in all patients except those with milk protein sensitivities and those on dialysis (it can be used on people with lactose intolerance).⁵³

A systematic review of the literature showed that there is insufficient clinical trial evidence (in quantity or quality) to make a recommendation regarding the long-term effectiveness of casein derivatives.⁵⁴

Pros

- Shows promise in remineralizing early lesions
- Milk based and can be used if lactose intolerant
- Can be used on infants

Cons

- No high level supporting evidence currently available (randomised control trial)
- Patient compliance required

Human Resources

- Parental supervision for young children

⁵¹ Reynolds EC. The prevention of sub-surface demineralization of bovine enamel and change in plaque composition by casein in an intra-oral model. *J Dent Res* 1987; 66(6): 1120-1127

⁵² MI Paste™ website. <http://www.mi-paste.com/faq.php>. last accessed 14/7/2011

⁵³ Recaldent™ website. http://www.recaldent.com/p_what_is.asp. Last accessed 14/7/2011

⁵⁴ Azarpazhooh A, Limeback H. Clinical efficacy of casein derivatives: A systematic review of the literature. *J Am Dent Assoc* 2008; 139: 915-924

Combined Fluoride Therapies

While the individual benefits of the fluoride programs have been presented earlier, it is important to put forward the evidence for their use in combination. In their systematic review, Marinho *et al* (2009) looked at various combinations of topical fluorides versus toothpaste alone.⁵⁵ The review showed that for the following combinations a non-significant effect in favour of the combinations exists:

- Fluoride toothpaste plus mouthrinse versus toothpaste alone
- Fluoride toothpaste plus gel versus toothpaste alone
- Fluoride mouthrinse plus toothpaste versus mouthrinse alone
- Fluoride gel plus toothpaste versus gel alone

Significant effects in favour of the combined therapy were seen for fluoride toothpaste plus varnish versus toothpaste alone; fluoride gel plus mouthrinse versus gel alone; fluoride varnish plus toothpaste versus varnish alone.⁵⁵

An Irish review of the evidence showed that the most promising combination program involved sealants and fluoride varnish.⁵⁶ The authors went on to state the considerable benefit to high-risk patients from the use of combined fluoride therapies.⁵⁶ Similarly Newbrun (2001) reported that for the treatment of non-cavitated lesions sealants are the most appropriate preventive therapy.⁵⁷

⁵⁵ Marinho VCC, Higgins JPT, Sheiham A, Logan S. Combinations of topical fluoride (toothpastes, mouthrinses, gels, varnishes) versus single topical fluoride for preventing dental caries in children and adolescents. Cochrane Database of Systematic Reviews 2004, Issue. Art No.: CD002781. DOI: 10.1002/14651858.CD002781.pub2.

⁵⁶ Whelton H, O'Mullane D. The use of combinations of caries preventive procedures. J Dent Educ 2001; 65(10): 1110-1113

⁵⁷ Newbrun E. Topical fluoride in caries prevention and management: A North American perspective. J Dent Educ 2001; 65(10): 1078-108

Overall Ranking of Programs

Program	Range of Caries Reduction	Overall Ranking
Community water fluoridation	29.1-50.7% ⁵⁸	1
Sealant program	5-93% (median 60%) ²⁴	2
Toothbrushing	24-56% ^{6,10}	3
Fluoride varnish	24-46% ^{14,20}	4
Fluoride gel	18-43% ³⁰	5
Fluoride mouthrinses	0-26% ³⁴	6
Salt fluoridation	13.3-89.5% ³⁷	7
Milk fluoridation	35.5-78.4% ^{41,a}	Cannot be ranked
School water fluoridation	21.9-38.9% ^{43,b}	Cannot be ranked
Xylitol	62-70% ^{47,49,c}	Cannot be ranked
Casein derivatives	Not available	Cannot be ranked

^a Only two trials were identified and therefore a ranking cannot be produced due to the variability in values

^b No longer in widespread use and not a viable population-based approach to decrease caries

^c Due to the isolated nature of the trials and potential problems with acceptability a ranking cannot be given

⁵⁸ Guide to Community Preventive Services. Preventing dental caries: community water fluoridation. www.thecommunityguide.org/oral/fluoridation.html. Last accessed 22/1/12.

Costs of Programs

The values presented here represent the annual cost per person attributed to various oral health preventive programs. For the toothbrushing and fluoride rinsing programs the cost provided does not include any estimates for the costs of shipment and storage of supplies, training and staff remuneration (including travel). These will be specific to each community and thus must be incorporated into their individual program planning costs.

Community Water Fluoridation ^a

Cost per person= 0.77¢-\$4.00

Sealant Program ^b

Cost per person=\$20.00-\$36.00

Toothbrushing Program ^d

Cost per person=\$6.74

Fluoride Varnish Program ^c

Cost per person=\$24.00-\$51.00

Topical Fluoride (Gel Fluoride) Application by Public Health Services ^e

Cost per person= \$44.50

Topical Fluoride (Gel Fluoride) Application by Private Dentists ^e

Cost per person= \$96.12

Fluoride Rinsing Program

Cost per person=\$2.24

^a costs were presented by the Toronto Medical Officer of Health and were based on the City of Hamilton's values for 2 applications per year

^b costs reflect NIHB fees for initial sealant per quadrant, subsequent sealants are charged a step-down fee

^c costs reflect the 2011 ODA fee guide

^d cost assumes an 8 month school year in which each participant receives 3 toothbrushes and 2 tubes of toothpaste

^e costs represent 2 applications per year and were based on the City of Hamilton's values

Summary of Programs

Program	Pros	Cons	Human Resources	Ranking	Cost per person
Community Water Fluoridation	Well established, safe and cost-effective	Capital investment	Trained and accredited water treatment personnel	1	0.77¢-\$4.00
Sealant Program	Protects high risk tooth surfaces, can be combined with other programs	Application by dental personnel	Dental Provider	2	\$20.00-\$36.00 (NIHB costs for first sealant per quadrant with step-down fee for additional sealants)
Toothbrushing	Teaches good oral hygiene habits, does not need dental personnel supervision	Teachers or auxiliary staff involvement, allotted time within school	Teacher/auxiliary staff	3	\$6.74
Fluoride Varnish	Targets high risk children	Application at regular intervals by dental or trained personnel	Dental provider or trained personnel	4	\$24.00-\$51.00 ^a (2011 ODA fee guide)
Fluoride Gel	Targets high risk children	Must be done in a dental setting, compliance	Dental provider	5	\$22.25 ^a (applied by public health personnel) \$48.06 ^a (applied by private dentists) \$13.30-\$31.91 ^a (NIHB costs)
Fluoride Rinsing Program	Done in school setting, improve knowledge about oral health	Risk of ingestion, time commitment (from teachers/auxiliary staff)	Teacher/auxiliary staff	6	\$2.24

^a Represent cost per application of the topical fluoride

Health Human Resources

This section provides an overview of strategies for the recruitment of dental providers to rural and remote regions. The options listed here are not exhaustive but represent a starting point in the conversation.

Oral Health Provider Database

Provides a dedicated location where providers, clinics and communities can get in contact with each other, with the aim of increasing access to care in rural and remote regions. Located within the Federal, Provincial, Territorial website all rural and remote regions can access this list and select the provider that best suits their community's needs. It is up to the interested parties to contact each other and arrange the locum details. The process to create this database is currently underway, and once approval from legal is obtained a mock- up will be generated.

Residency Program

There is potential for the various governments to initiate a dental internship program. This scheme has just been announced in Australia where the Federal Government pledged 53.1 million dollars over 3 (some reports say 4) years to fund 50 placements per year. The goal is that these placements will be in underserved areas and address the access issues faced by segments of the Australian population. This could be feasible in northern Canada with the help of the major governmental agencies. A one-year contract to service northern and remote communities would address some concerns facing these communities.

Operation Nanook (Dental Outreach Initiative)

The Department of National Defence operation occurred in August of 2011. The operation included a Canadian Forces dental team who delivered care to both the military personnel and the local community. Dental care was provided to the residents of Resolute Bay via the local community centre clinic. Despite the operation's early suspension (due to a fatal air crash), the collaborative relationship between Health Canada, the Department of National Defence and the Government of Nunavut was strengthened. This model for delivery of services can be revisited in the future.

Note: There are other options also including but not limited to student placements, salaried dentists, rurally bonded dentists, rural incentive programs, continued training of dental therapists (all of which could be explored to increase access)

Glossary

Caries Increment – The number of new caries developing over either a two or three year period. This is determined from longitudinal studies, which document the change in caries levels from baseline to endpoint on the same group of individuals.

D₁ Caries Threshold – Represents all visible cavitated and non-cavitated lesions in enamel and dentine. This includes the D₃ caries threshold.

D₃ Caries Threshold – Represents all visible cavitated and non-cavitated lesions in dentine.

DMFT – Decayed, Missing, or Filled Teeth index. Provides an estimation of how much of the individual's dentition has been affected by caries until the day of the examination. The use of upper case letters indicates permanent teeth. It can be calculated for 28 permanent teeth (excludes the 18, 28, 38 and 48 known as the wisdom teeth) or it can be calculated including them, thus making the index out of 32 teeth. The score is the sum of each component. It describes the prevalence of dental caries in an individual or population sub-group.

DMFS – Decayed, Missing, or Filled Surfaces index. Provides an estimation of how much of the individual's dentition has been affected by caries until the day of the examination. This index represents a more detailed version of Decayed, Missing, Filled Teeth index. Molars and premolars have 5 surfaces; canines and incisors have 4 surfaces. The maximum value is then 128 (not including the wisdom teeth). It describes the prevalence of dental caries in an individual or population sub-group.

deft – decayed, extracted, filled teeth. Provides an estimation of how much of the child's dentition has been affected by caries until the day of the examination. This use of lower case letters indicates the use of this index for deciduous teeth. The maximum value is 20 and the 'e' represents 'extracted teeth'.

Early Childhood Caries (ECC) – Represents 1 or more decayed (cavitated or non-cavitated), missing (due to caries) or filled tooth surfaces in a primary tooth of a child 71 months or younger. For children younger than 36 months any smooth surface decay indicated severe early childhood caries (S-ECC).

Number Needed to Treat (NNT) – Number of patients that must be treated to prevent one additional bad outcome. For example, with the use of fluoridated toothpaste the NNT=1.6 such that 1.6 children must brush with fluoridated toothpaste to prevent 1 DMFS in a community with a caries increment of 2.6 DMFS per year.

Prevented or Preventive Fraction – The proportion of disease occurrence that is averted due to a protective risk factor or public health intervention.

Topical Fluoride – The application of fluoride, at elevated concentrations to the exposed tooth surfaces thus conferring a local protective effect, these products are not intended for ingestion.