



**CORE**

Public Health Functions for BC

**Evidence Review:**  
**Dental Health**

**Population and Public Health  
BC Ministry of Health**

March 2014 (update from September 2006)

*This is a review of evidence and best practice that should be seen as a guide to understanding the scientific and community-based research, rather than as a formula for achieving success. This review does not necessarily represent ministry policy, and may include practices that are not currently implemented throughout the public health system in BC. This is to be expected as the purpose of the Core Public Health Functions process—consistent with the quality improvement approach widely adopted in private and public sector organizations across Canada—is to put in place a performance improvement process to move the public health system in BC towards evidence-based best practice.*

*This Evidence Review should be read in conjunction with the accompanying Model Core Program Paper.*

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## **Core Public Health Functions for BC: Evidence Review**

### **Dental Health**

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## **EXECUTIVE SUMMARY**

### **Introduction**

In March 2005, the Ministry of Health released *A Framework for Core Functions in Public Health* (Core Functions Framework), which clearly defined the core functions of the public health system and identified a comprehensive set of core public health programs intended to improve health and well-being, and/or reduce disease, disability and injury. This policy work formed the foundation of *Promote, Protect, Prevent: Our Health Begins Here. BC's Guiding Framework for Public Health* (Guiding Framework)—the 10-year directional document for the public health system released in March 2013. The Guiding Framework reinforces Core Functions as the framework for public health program and service delivery in the province, provides a strong foundation for all current public health efforts, and builds on the critical elements necessary to consider when identifying future priorities.

Dental health is a core public health program, which is aligned with the Maternal, Child & Family Health goal in the Guiding Framework. Each core public health program is supported by an evidence review and model core program paper, quality improvement tools that help the Ministry of Health and health authorities ensure that public health policies, programs and services are based on evidence and best practice.

This evidence review is an update of the dental health evidence review completed in 2006. This updated evidence review provides findings regarding new priorities, presents evidence on emerging issues that were not covered (or not covered in sufficient depth) in the previous evidence review, and identifies recent studies on effective dental health programs. The document also provides information of continuing relevance from the earlier evidence review. The updated evidence review could be used to ensure that the dental core public health program continues to reflect the most up-to-date research.

Good dental health<sup>a</sup> is important for people to eat, speak, and relate to each other without embarrassment. Dental diseases (including caries and periodontal diseases<sup>b</sup>) are progressive, infectious diseases with multiple risk factors. Pain and infection from dental disease can affect people's ability to function as full members of society. In addition, there is increasing understanding of the contribution of poor dental health to the incidence of preterm and low birth weight infants and the effect on other conditions such as diabetes.

Although population health principles aim to improve the health of the entire population, there is a particular focus in dental health on the early childhood period. This priority includes

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<sup>a</sup> The term “dental health” refers to the health of the teeth and gums. The term “oral health” refers to the health of the whole mouth (including the health of the teeth, gums, tongue, palate, lips and throat), which can be affected by disease, developmental abnormalities or injury.

<sup>b</sup> Periodontal diseases are infections of the gums and bone that surround and support the teeth. Toxins from bacterial accumulations infect the tissue surrounding the tooth causing inflammation. In the early stage (called gingivitis), the gums become swollen and red, and may bleed. In a more serious form (called periodontitis), the gums can pull away from the tooth, bone can be lost, and the tooth may loosen or fall out (Centers for Disease Control, 2013).

pregnant women and new mothers. Prevention strategies are especially important in the early years to promote healthy development and establish a foundation for dental health throughout one's life. Strategies to address dental health disparities in vulnerable<sup>c</sup> populations who are susceptible to poor dental health at any stage of life are also a key dental health priority. The social, economic, physical and environmental determinants of health and their implications for public policy and preventive interventions are fundamental in planning dental health programs.

### **Overview of Oral and Dental Health in BC and Canada**

Information on oral and dental health status is not routinely collected by provincial/territorial or federal health departments as part of their vital statistics or disease surveillance processes. As a result, information needs to be collected by surveys designed specifically for this purpose.

For kindergarten children, the most recent British Columbia statistics are based on the 2012/2013 Dental Survey. The findings indicate an increase in the number of caries free<sup>d</sup> children with all BC health authorities showing an overall improvement in dental health for children in kindergarten.

National findings on dental health for children (6- to 11-year-olds) and adolescents (12- to 19-year-olds), based on a 2007-2009 survey, indicated that across all age groups, approximately 58 per cent of children and adolescents had dental caries, but the prevalence and severity has declined substantially over the past three to four decades.

The most recent BC survey of adult dental health was conducted in 2006. The findings indicated that, although dental health has generally improved over the past 20 years, periodontal health has not.

With respect to the economic costs of dental diseases, the literature indicates the following:

- Dental disease can be costly in terms of time lost from work, school and normal activities.
- Water fluoridation is one of the most cost effective and safest methods of reducing dental decay.
- Dental sealants are a low cost and effective method for reducing caries particularly when compared to the cost of dental treatments and fillings.
- In Canada, over 95 per cent of dental care is privately funded (2009 numbers).<sup>15</sup>
- Dental treatment can be costly and prohibitively expensive for low-income families and some may turn to hospital emergency departments for urgent dental treatment.
- In Canada, the public cost of hospital care related to day surgeries for early childhood caries is estimated to be \$21.2 million per year.

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<sup>c</sup> The term "vulnerable" is used in this document to refer to people who are susceptible to developing oral and/or dental health problems because of socio-demographic characteristics (such as income, age, and location).

<sup>d</sup> It is difficult to determine if someone is truly caries free. The term is used in this document to indicate that there was no visible decay or broken enamel.

- The average hospital cost per day surgery for early childhood caries in BC is estimated to be \$1,515 (which is about the average cost for the other provinces and territories combined).

### **Promotion of Dental Health**

With respect to the promotion of dental health, a number of professional groups and researchers have recommended the following:

- Collaborating with a wide variety of health and education professionals to integrate and promote dental health education into mainstream health services.
- Building partnerships with organizations for community outreach, education and advocacy for dental health.

### **Prevention of Dental Diseases**

With respect to the prevention of dental diseases, several strategies have been identified. Those with the highest level of evidence (*Evidence for Dissemination*) include the use of fluoride and dental sealants. For example:

- Fluoridation of community water has been shown to be a safe and effective public health measure that significantly reduces the rate of dental decay.
- Fluoride toothpaste over 1000 ppm has been shown to have a significant caries preventive effect. However, for children under the age of six, the risk of developing caries should be balanced against the risk of mild fluorosis.<sup>e</sup>
- Mouth rinses with fluoride have been shown to be effective in reducing dental caries (although they are not recommended for young children who may swallow them).
- The use of fluoride rinses in school based programs in high-risk areas appears to be cost effective. However, the cost effectiveness of such programs in schools with low caries prevalence has been questioned.
- The application of fluoride varnish applied two to four times a year is highly effective in preventing dental caries in both primary and permanent teeth.
- Additional caries reduction has been shown to result from the use of a variety of topical fluoride therapies (such as mouth rinses, gels and varnishes) when combined with fluoride toothpaste. A variety of fluoride therapies are appropriate for people considered to be very susceptible to developing caries.
- Dental sealants are highly effective in preventing caries. Based on the research, it has been recommended that they be placed on the primary molars of children who are susceptible to caries and on permanent molars without cavitation.

Strategies with sufficient evidence to demonstrate positive outcomes (*Evidence for Outcome Effectiveness*) include the following:

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<sup>e</sup> Fluorosis refers to mild dental cosmetic effects resulting from excessive intake of fluoride.

- Fluoride supplements have been shown to be effective in preventing dental caries in permanent teeth, but mixed results have been obtained regarding their effectiveness for primary teeth. Supplements may be prescribed for vulnerable individuals where there is little access to other forms of fluoride. Caution must be taken to minimize the risk of fluorosis (particularly in young children).
- The use of xylitol and/or sorbitol chewing gum has been shown to be effective as part of oral hygiene, particularly for those at moderate to high risk of developing dental caries.
- Xylitol and/or sorbitol chewing gums may also reduce the level of *S. mutans* in new mothers, thus reducing the transfer of these bacteria to their infants.
- Some benefits may result from individual instruction in hygiene, although it may have limited value unless it is combined with other strategies. Oral health instruction is more effective when it is repeated.

Strategies with sufficient *Evidence for Implementation* include the following:

- High and frequent sugar intake and consumption of carbohydrates is a moderate risk factor for caries where there is adequate exposure to fluoride. Lower and less frequent sugar consumption can reduce the risk of dental caries.
- Integrated preventive strategies to address periodontal disease have been shown to be effective.
- Education and behavioural interventions designed to reduce plaque levels and gingival bleeding have shown significant short-term improvements, although there is no current evidence that indicates the short-term benefits are sustained in the long term.

### **Dental Health for Pregnant Women and New Mothers**

The highest level of evidence with respect to dental health for pregnant women and new mothers (*Evidence for Dissemination*) supports the following:

- Dental treatment for pregnant women is important to safeguard the mother's dental health, suppress maternal *S. mutans* reservoirs, and reduce the possibility of transferring *S. mutans* to the infant. The second trimester is the most optimal time to perform dental treatment, although it can be safely accomplished any time during pregnancy.

The next level of evidence (*Evidence for Outcome Effectiveness*) includes the following:

- Education and guidance on good dental hygiene practices for pregnant women and new mothers is considered to be critical. Pregnancy provides an opportunity to develop good lifetime dental and nutrition behaviours in both mothers and infants.
- Preventive interventions for pregnant women involving multiple strategies have been shown to be effective.
- Maternal salivary levels of *S. mutans* are significantly related to dental caries in their children. Preventive measures to suppress maternal *S. mutans* include dietary counselling, reducing the frequency of simple carbohydrate intake, applying topical

fluoride (through mouth rinses, etc.), removing and restoring active caries, and chewing gum containing xylitol.

*Evidence for Implementation* includes the following:

- A linkage between periodontal disease and gestational diabetes appears to be supported by relatively strong evidence.
- There is considerable and significant evidence linking periodontal disease with preterm births. However, the research has been inconsistent.

An intervention that *warrants further research* is the use of amalgam during pregnancy. Although evidence has shown that amalgam may be used as a restorative material in pregnant women (as no adverse effects have been demonstrated in extensive research) some respected Canadian organizations suggest it should be avoided as a cautionary measure.

### **Dental Health in Early Childhood and in School-aged Children and Adolescents**

The highest level of evidence for successful prevention of early childhood dental disease (*Evidence for Dissemination*) indicates the following:

- Fluoride toothpastes and varnishes as well as water fluoridation can successfully reduce early childhood caries.

The next highest level of evidence (*Evidence for Outcome Effectiveness*) indicates the following:

- Human breast milk is the best nutrition for infants and does not have any harmful impact on dental caries. However, mouth cleaning or tooth brushing should be part of the daily routine for all infants, including those who are breastfed.
- National dental organizations stress the importance of the first dental visit by year one to ensure access to dental assessment, education and early intervention for early childhood caries.
- A dental home<sup>f</sup> can provide a comprehensive family centred approach with continually accessible care thus increasing the likelihood that children will receive appropriate dental care.

Further, there is *Evidence for Implementation* that

- Caries risk assessment tools may be an effective way to estimate children's risk for dental caries as they cover a range of risk and protective factors; however, research information is insufficient to enable quantitative caries risk assessment analyses.

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<sup>f</sup> A dental home addresses all aspects of oral health that result from the interaction of patients, parents, dentists, dental professionals and non-dental professionals (American Academy of Pediatric Dentistry, Council on Clinical Affairs, 2009). It enables oral health care to be delivered in a comprehensive, continuously accessible, coordinated and family-centered way.

- Nutritional counselling for new mothers may be successful in reducing early childhood caries when the counselling is combined with fluoride use.

There is mixed evidence regarding the effectiveness of school based interventions (including the use of fluoride) in improving dental health in school-aged children and adolescents. This is an area that *Warrants Further Research*.

### **Oral and Dental Health in Individuals with Chronic Conditions**

There is moderate evidence (*Evidence for Implementation*) that oral and/or dental health can be affected by several chronic conditions, including oral and pharyngeal cancers, diabetes, and respiratory disease:

- Human papilloma virus (HPV) is emerging as a strong risk factor for both oral and pharyngeal cancers. Early diagnosis is important for reducing the physical, social and economic burden of these cancers.
- There is increasing evidence of a bi-directional link between diabetes and periodontal health.
- Although evidence of an association between poor oral hygiene, periodontal disease and respiratory disease is unclear, intervention studies support providing preventive oral health care as the risk of developing respiratory disease can have major implications for population health.

There is limited evidence that oral and/or dental health can be affected by several chronic conditions, such as HIV/AIDS, eating disorders, and osteoporosis; all of these areas *warrant further research*.

In addition, the American Heart Association recently stated that there is no convincing evidence that periodontal disease increases the risk of heart disease or that treating periodontal disease reduces the risk of heart disease or stroke. An association between the two diseases had previously been suggested by researchers. This is also an area that *warrants further research*.

### **Oral and Dental Health in Aboriginal Populations**

Oral health disparities exist between Aboriginal people living on and off reserve as well as between Aboriginal and non-Aboriginal people. Aboriginal people may face barriers to good oral health. Barriers can exist at the individual, community and broader systemic levels and may include: lack of knowledge regarding oral health care and the importance of oral health; anxiety regarding, or fear of, dental procedures; previous negative experiences or a mistrust of health services; lack of transportation to access services; limited ability to access healthy foods; and lack of financial resources to pay for healthy food and/or for dental services.

There is *Evidence for Outcome Effectiveness* for the following:

- Cultural safety training, which may result in long-term changes to clinical practices and the provision of more sensitive and effective services. It may also increase practitioners' ability to comfortably liaise with Aboriginal communities.
- Oral and dental health strategies, which are consistent with those used in non-Aboriginal populations, but which are embedded in health promotion frameworks that respect traditional cultures and practices and are empowering.
- Community based promotion initiatives such as changing diets through education and improved selection of foods; emphasizing the importance of oral health for pregnant women, preschool and school-aged children; and using culturally appropriate intervention strategies to improve oral hygiene.

There is some evidence (*Evidence for Implementation*) that the Children's Oral Health Initiative, which targets Aboriginal children and their parents/caregivers, has resulted in increased knowledge about oral health as well as a decrease in caries.

### **Dental Health in Other Vulnerable Populations**

Low socio-economic status is one of the most important risk factors for developing caries. While addressing financial barriers is critical, there is also a need to increase the availability of dental services for low-income populations and ensure services are appropriately delivered. Scotland's *Childsmile* program has shown clear and positive outcomes with significant reductions in dental caries for low-income children (*Evidence for Outcome Effectiveness*).

Individuals living in rural areas experience a number of factors that may affect their ability to access dental care. Improving oral health in rural populations requires practical and flexible approaches (*Evidence for Implementation*). Proposed solutions include using mass prevention/public health interventions (such as increased water fluoridation, timely oral health education and caries risk assessment and referral); encouraging more providers (in various health sectors) to work in rural areas; increasing the flexibility and capacity of the oral health workforce in rural areas; and overcoming distance barriers through the use of mobile clinics and telehealth technology.

Seniors are retaining more teeth but are also experiencing increased periodontal problems. It has been suggested that oral health promotion and disease prevention based on a common risk factors approach is effective in improving dental health for older adults (*Evidence for Implementation*).

There is growing recognition that individuals with developmental disabilities may have insufficient access to dental care and less than optimal dental outcomes because of complex health care needs. Although there is a need for additional research in this area, the literature provides several suggestions for improving access and care for those with developmental disabilities (*Evidence for Implementation*). These include improved education for

parents/caregivers and practitioners; having up-to-date medical histories for dentists; use of a dental home and/or dental passport; and use of developmentally appropriate communications.

There is some suggestion (*Limited Investigation*) that the use of a common risk factors approach and integrated health services may improve both the general and dental health of immigrants/refugees and assist them in accessing and navigating the system.

**Summary**

The following table provides a summary of those areas that have been rated as having the highest level of evidence (i.e., *Evidence for Dissemination*).

Subject Area	Strategy
Prevention of Dental Diseases	<ul style="list-style-type: none"><li>• Fluoridation of community water</li><li>• Use of fluoride toothpaste over 1000 ppm (except for children under the age of 6)</li><li>• Mouth rinses with fluoride (except for young children)</li><li>• Use of fluoride rinses in school based programs in high-risk areas</li><li>• Application of fluoride varnish applied two to four times a year on both primary and permanent teeth</li><li>• Use of a variety of topical fluoride therapies (e.g., mouth rinses, gels and varnishes) in combination with fluoride toothpaste</li><li>• Use of dental sealants on primary molars of children who are susceptible to caries and on permanent molars without cavitation</li></ul>
Dental Health for Pregnant Women and New Mothers	<ul style="list-style-type: none"><li>• Dental treatment for pregnant women to safeguard the mother’s dental health, suppress maternal <i>S. mutans</i> reservoirs and reduce the possibility of transferring <i>S. mutans</i> to the infant.</li></ul>
Dental Health in Early Childhood and in School-aged Children and Adolescents	<ul style="list-style-type: none"><li>• Use of fluoride toothpastes and varnishes as well as water fluoridation to prevent early childhood dental disease</li></ul>

As with the 2006 evidence review, the current literature continues to provide support for the following:

- The negative impact periodontal disease can have on pregnancy, delivery, and the health of both mothers and their children (particularly in the early years, but also into the school years and adolescence).
- The role diet (particularly the frequent ingestion of fermentable carbohydrates) plays in dental health.
- The use of fluoride and dental sealants in preventing caries.
- The use of a common risk factors approach to manage dental health care.
- The importance of dental health education in general (particularly for parents and other caregivers) and when used with other interventions.
- The importance of a collaborative approach that involves multiple health care sectors and community programs.

The current literature also indicates the following:

- There is a greater emphasis on education regarding good dental hygiene practices and dental treatment for pregnant and new mothers and their importance in reducing caries risk in young children.
- There is evidence that xylitol gum may have a beneficial effect on oral health (this is a change from the 2006 evidence review).
- There is a (potential) relationship between oral/dental health and various chronic conditions.
- There has been more interest in the economic costs associated with dental diseases and various interventions, but accurate costs continue to be difficult to obtain as most dental care remains privately funded.

In addition, the current literature on dental health indicates that access to appropriate oral and dental health care may be problematic for several populations, including those with lower incomes, Aboriginal people, immigrants/refugees, seniors, people living in rural areas, and individuals with development disabilities. Further, oral and dental health care may be more costly for these populations when they do access it. This may mean that dental health services are accessed less frequently than by other populations (e.g., because of a lack of dental insurance) and/or the cost of providing service is more expensive because it is sought at later stages of disease and in a more costly setting. The use of dental homes may increase accessibility.

## 1.0 OVERVIEW/ SETTING THE CONTEXT

### 1.1 The Core Functions Framework

In March 2005, the Ministry of Health released *A Framework for Core Functions in Public Health* (Core Functions Framework) that clearly defined the core functions of the public health system and identified a comprehensive set of public health services, based on the best available evidence and best practices. This policy work formed the foundation of *Promote, Protect, Prevent: Our Health Begins Here. BC’s Guiding Framework for Public Health* (Guiding Framework)—the 10-year directional document for the public health system released in March 2013.<sup>1</sup> The Guiding Framework reinforces Core Functions as the framework for public health program and service delivery in the province, provides a strong foundation for all current public health efforts, and builds on the critical elements necessary to consider when identifying future priorities (See Figure 1).

The original Core Functions Framework has been revised to reflect the alignment with the Guiding Framework. It outlines the 20 core public health programs within the seven goal areas that health authorities provide as they seek to improve the overall health of their populations. Four strategies (health promotion; health protection; preventive interventions; and health assessment and disease surveillance) are used to guide implementation.

Dental health is a core public health program, and it is aligned with the Maternal, Child & Family Health goal (Goal 2) within the Guiding Framework.

**Figure 1: Core Functions Framework**



Each core public health program is supported by quality improvement tools that help the Ministry of Health and health authorities ensure that public health policies, programs and services are based on evidence and best practice.

- An *evidence review*, which identifies and ranks the evidence of effective public health interventions related to the core public health program.
- A *model core program paper*, which identifies the core elements of a comprehensive program, including goals and objectives, principles, key components, best practices, and indicators and potential performance measures. The information in the evidence review provides the foundation for the main components and best practices outlined in the model core program paper.

Health authorities are expected to use these quality improvement tools to inform planning, policy development and delivery, and support ongoing quality improvement. Specifically to

- Ensure programs and services are evidence-based and address health inequities.
- Develop and implement new public health priorities, as identified by the Guiding Framework and other public health directional documents.
- Educate and inform internal and external stakeholders of the evidence and support them in implementing evidence-based practices.

## **1.2 Introduction to the Core Public Health Program of Dental Health**

This document is an update of the evidence review on dental health completed in September 2006. This evidence review describes findings regarding new priorities, presents evidence on emerging issues that were not covered (or not covered in sufficient depth) in the previous evidence review, and identifies recent studies on effective dental health programs. The document also provides information of continuing relevance from the earlier evidence review. The updated evidence review could be used to ensure that the dental core public health program continues to reflect the most up-to-date research.

### **1.2.1 Linkages with Other Core Public Health Programs**

Because of the links to chronic health conditions, a number of health concerns related to dental health are also addressed in the core evidence reviews on Prevention of Chronic Diseases (e.g., cancer, chronic respiratory disease, diabetes, etc.), Healthy Living (e.g., common risk factors such as unhealthy eating and tobacco use), and Early Childhood Development (e.g., strategies to support parents in developing healthy lifestyles and behaviours for children). Dental health may also be addressed to some extent in several other core evidence reviews, such as Unintentional Injury Prevention and Prevention of Disease, Disability and Injury. Previous reports on the dental health of British Columbians are listed in Appendix A.

### 1.2.2 Background on Dental Health

The promotion of good oral health and the prevention of dental diseases is a core function of public health. In referring to oral health and dental health in this report, the following definitions are used.

- **Oral health** – pertains to the health of the whole mouth (including the health of the teeth, gums, tongue, palate, lips and throat), which can be affected by disease, developmental abnormalities or injury.
- **Dental health** – pertains to the health of the teeth and gums. This report focuses on dental health.

Good dental health is important for people to eat, speak, and relate to each other without embarrassment. Dental diseases, which include caries and periodontal diseases,<sup>6,2</sup> are progressive, infectious diseases with multiple risk factors. Pain and infection from dental disease can affect people's ability to function as full members of society. If people cannot attend school to learn, obtain employment or attend their workplace to earn income because of dental disease, they, their families, and communities in general become less well off. In the extreme, dental disease can cause severe disability. In addition, there is increasing understanding of the contribution of poor dental health on the incidence of preterm and low birth weight infants and the effect on other conditions such as diabetes.

While population health principles aim to improve the health of the entire population, there is a particular focus in dental health on the early childhood period. This priority includes pregnant women and new mothers. Prevention strategies are especially important in the early years to promote healthy development and establish a foundation for dental health throughout one's life.

Strategies to address dental health disparities in vulnerable populations who are susceptible to poor dental health at any stage of life are also a key dental health priority. The social, economic, physical and environmental determinants of health and their implications for public policy and preventive interventions are fundamental in planning dental health programs.

Strategies articulated in the *Ottawa Charter for Health Promotion* provide an important planning and implementation framework, particularly for collaborating with other sectors to strengthen dental health promotion, preventive services and referrals.<sup>3</sup> These strategies include the following:

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<sup>6</sup> Periodontal diseases are infections of the gums and bone that surround and support the teeth. Toxins from bacterial accumulations infect the tissue surrounding the tooth causing inflammation. In the early stage (called gingivitis), the gums become swollen and red, and may bleed. In a more serious form (called periodontitis), the gums can pull away from the tooth, bone can be lost, and the tooth may loosen or fall out (Centers for Disease Control, 2013).

- Building healthy public policy.
- Creating supportive environments.
- Strengthening community actions.
- Developing personal skills.
- Reorienting health services.

### 1.2.3 Organization of this Report

In BC, the primary focus of dental health is on the period from birth to 6 years of age. Thus, this document emphasizes dental health in pregnant women, new mothers, and children in the early childhood period. For completeness, the document also examines evidence related to dental health in school-aged children and adolescents, and in various population groups (such as individuals with chronic conditions and those in vulnerable populations).

This report is organized as follows:

- Chapter 2 presents a brief overview of the methodology used in developing the updated evidence review on dental health.
- Chapter 3 provides an overview of dental health in BC and Canada.
- Chapter 4 presents findings related to the promotion of dental health.
- Chapter 5 presents findings related to the prevention of dental diseases.
- Chapters 6 to 10 present findings related to specific populations (pregnant women and new mothers; young children, school-aged children and adolescents; individuals with chronic conditions; Aboriginal populations; and other vulnerable<sup>h</sup> populations).
- Chapter 11 presents a summary of the current research on dental health.

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<sup>h</sup> The term “vulnerable” is used in this document to refer to people who are susceptible to developing oral and/or dental health problems because of socio-demographic characteristics (such as income, age, and location).

## **2.0 METHODOLOGY**

High quality evidence has been used to develop this updated evidence review on dental health. The information in the current document is based primarily on systematic reviews and academic studies where these were available on specific topics. Observational studies, case studies and program evaluations were included when these were the only evidence resources available on a specific issue.<sup>i</sup> Documents from Canada, the United States (US) and other countries were included in the review.<sup>j</sup>

The primary sources of information were the Medline electronic database from the US National Library of Medicine and the many health science databases provided through EBSCO Information Services (including Dentistry and Oral Sciences Source, BioMedical Abstracts, Health Policy Reference Center, Nursing and Allied Health Collection, etc.). The search strategy is included in Appendix B.

In addition, an expert group of officials from the Ministry of Health and the health authorities provided important reference sources and advice during the development of the document.

### **2.1 Strength of Evidence**

Although randomized control trials (RCTs) are commonly considered the gold standard in evaluating health-related practices, many experts in the field acknowledge that RCT designs may not lend themselves to evaluation of the effectiveness of many complex public health interventions.

Aside from achieving random allocation in practice, there are situations in public health in which the use of a randomized control design would be unethical. In other cases, the cost of such a design may be prohibitive. In these cases, a non-randomized design may be more appropriate.<sup>4</sup> As a result, public health initiatives tend to be evaluated using quasi-experimental designs and qualitative methods to assess community capacity, the impact of social determinants of health and/or the impact on structural change.

The BC Core Programs Steering Committee supports the evidence scale presented in Table 1. This scale considers both theoretical and empirical studies as well as other factors of relevance in population level health interventions. The scale was used to rate the level of evidence available for the various topics covered in the current document.<sup>k</sup>

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<sup>i</sup> As some studies are based on small numbers, their findings should be interpreted with caution. This also applies to some extent, when considering the findings from systematic reviews, depending on the number of studies (and the number of individuals), as well as the strengths and limitations of the studies included in the reviews.

<sup>j</sup> The purpose of this evidence review was to update findings related to dental health. It is noted that not all programs included in the review may be applicable to the Canadian or British Columbian context.

<sup>k</sup> The symbols presented in Table 1 are provided for completeness only. They were not used in presenting the level of evidence in this document.

**Core Public Health Functions for BC: Evidence Review**  
**Dental Health**

**Table 1: Evidence Scale**

Symbol	Evidence Rating	Definition
0	Limited investigation	No relevant effectiveness studies were located and there were no empirical or theoretical grounds suggesting the intervention might potentially impact the outcome. The evidence may also be inconsistent or contradictory.
☒	Evidence is contra-indicative	The evidence for the use of the strategy to prevent the targeted outcome is contra-indicated; consistent null or negative findings were obtained in well-controlled evaluation studies.
Ⓜ	Warrants further research	Strategies appeared theoretically sound or have some promising evidence for their implementation or outcome, but the operational specifics of the delivery format are not clearly resolved or have been investigated only in small scale or inadequately controlled studies. Policies and programs utilizing these strategies might be priority targets for future research funding.
★	Evidence for implementation	<p>Published studies reported a sound theoretical rationale, a clearly specified service delivery format, acceptance within service delivery organizations, target population recruitment on a scale sufficient to usefully contribute to population health impacts, and adequate consumer approval measured using indicators such as program retention. The proportion of positive demonstrations of impacts on risk factors, protective factors or outcome behaviours was reported.</p> <p>Although this rating requires a clear service delivery format, in some cases, not all other criteria are satisfied. Policies and programs utilizing these strategies might be supported for implementation where there are few costs and obvious benefits. In other cases, wider implementation may await rigorously controlled outcome evaluation to better establish benefits.</p>
★★	Evidence for outcome effectiveness	Positive outcomes were consistently published in well controlled interventions. Interventions were required to be of sufficient scale to ensure outcomes within the constraints imposed by large-scale population health frameworks. Policies and programs utilizing these strategies might be carefully monitored for their impacts while being supported for wide-scale dissemination.
★★★	Evidence for dissemination	Published reports of impacts where programs were delivered on a large scale, not by research teams, but rather by government auspice bodies or other service delivery agents. Evidence for dissemination was only sought for strategies demonstrating evidence for outcomes. Policies and programs utilizing these strategies might be accorded some priority for dissemination. Initial Canadian dissemination trials should monitor for impacts. Where possible, cost-effectiveness has been considered for programs using these strategies.

## **3.0 AN OVERVIEW OF DENTAL HEALTH**

This chapter presents an overview of data collection methods related to oral and dental health as well as dental health statistics for both children and adults. Findings related to the economic costs of dental diseases are also discussed.

### **3.1 Data Collection Methods**

#### 3.1.1 National Surveys

Information on oral and dental health status is not routinely collected by provincial/territorial or federal health departments as part of their vital statistics or disease surveillance processes. As a result, information on dental health has to be collected by surveys dedicated in whole, or in part, to this purpose.<sup>5</sup> Several national surveys, which have included questions on one or more areas relative to dental health behaviours, dental care utilization, or dental status, have been conducted. These have included the 1981 and 1986 Canada Health Survey, the 1990 Health Promotion Survey, the biennial National Population Health Surveys from 1994/1995 to 2006/2007, the 1999 Health of Canadians Survey, and the 2007 Canadian Community Health Survey. As these surveys have not used consistent methods relative to the target population or included similar dental health questions, it is difficult to make comparisons among them.

#### 3.1.2 Epidemiologic/Examination Surveys

Detailed surveys involving dental examinations have been conducted on an irregular basis. The WHO developed standards for epidemiologic surveys of teeth based on the number of decayed/missing or filled teeth or tooth surfaces. This type of information gathering requires a clinical dental setting and is the basis of epidemiologic dental surveys.

Although dental surveys have been carried out in a number of provinces, the only extensive national examination survey was conducted between 1970 and 1972 as part of the Nutrition Canada National Survey. Over 14,000 people between 3 and 60 years of age were examined both dentally and medically as part of this survey. Even though it was a huge undertaking, sample sizes for some age groups were too small to provide reliable provincial estimates.<sup>5</sup>

In 1990, the National Health Research and Development Program of Health Canada funded the Canadian Dental Association (CDA) to develop an examination system that included revised interview questions, updated examination standards, and a survey instrument. Upon completion, the CDA sought research funding to conduct the examinations but funds were never approved as the cost would have consumed almost the entire budget available for dental research in Canada (Health Canada, 2010). More recently, Health Canada conducted a national survey on dental health as part of the omnibus Canadian Health Measures Survey, 2007-2009.<sup>5</sup>

Although the survey was based on interviews and clinical examination of over 5,500 individuals, it was not large enough to provide valid provincial level data.<sup>1</sup>

An approach previously used by the British Columbia Dental Association (BCDA) has recently been suggested as the model for a national survey.<sup>5</sup> In conjunction with the BC Ministry of Health, the BCDA conducted an adult dental health survey every five years between 1981 and 2006. A convenience sample of adults aged 16 and over who presented at a dental office on a specified day were included in the survey. Data were collected by private dentists who performed a clinical examination and completed special examination records on their patients on the specific day. The records were returned to the BCDA for analysis and report generation. The data have been used to analyze shifts in population dental health status over time.<sup>m</sup> The BCDA is currently exploring options for continuing to implement the survey.

### 3.1.3 Basic Surveillance/Screening Surveys

Basic surveillance/screening surveys provide a quicker and more cost-effective way to gather data than epidemiologic surveys and are considered adequate for surveillance purposes.<sup>6</sup> The surveys do not need to be conducted by dentists or in a clinical setting.

In BC, a basic screening survey has been used every three years since 1990 to assess oral health status in kindergarten children in school settings.<sup>7</sup> Using a standardized public health dental screening process, health authority dental professionals check the children for

- Evidence of no visible dental decay (caries free).<sup>n</sup>
- Evidence of existing restorations, but no visible decay.
- Evidence of pain or infection at the time of screening.
- Evidence of visible dental decay (caries) in one or more teeth.
- The location of decay by quadrant.

The check does not replace a regular dental exam. Rather, its purpose is to determine the prevalence of obvious or visible dental decay, to identify trends in dental health, and where possible, to obtain a measure of the effectiveness of early childhood dental health initiatives. In some regions, the survey has also been used to identify cases for referral and to facilitate access to treatment (when required).

In the United States, a basic screening survey is conducted to assess the oral health status of the population and establish preventive programs. Although there is little research on the

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<sup>1</sup> The questions from the Canadian Health Measures Survey could be used at a provincial level to enable comparisons with the national data.

<sup>m</sup> It is likely that many of the individuals who were included in the survey had dental plans and/or experienced few barriers to oral health care.

<sup>n</sup> It is difficult to determine if someone is truly caries free. The term is used in this document to indicate that there was no visible decay or broken enamel.

validity and reliability of the screening survey, a 1994 study of 632 elementary schools in Georgia found high validity for caries and treatment needs (> 90 per cent sensitivity, specificity, and predictive values in a sample having 30 to 40 per cent prevalence.<sup>8</sup>

In Scotland, the mouths of children in primary levels 1 and 7 are assessed and each child is assigned to one of three categories based on their dental health. The data are used to monitor the impact of local and national oral health improvement programs and to assist in the development of local dental services. In addition, a representative sample of primary level 1 children undergoes a detailed inspection every two years to enable comparisons between different areas of Scotland.<sup>9</sup>

## **3.2 Dental Health Statistics**

### **3.2.1 Children's Dental Health**

#### **3.2.1.1 BC Kindergarten Children**

The most recent British Columbia statistics are based on the 2012/2013 school year, from the dental survey of kindergarten-aged children.<sup>10</sup> Preliminary data indicate that 91.8 per cent of all children enrolled in provincial kindergarten programs (40,318 children) participated in the survey. In brief, the 2012/2013 Dental Survey findings indicate an increase in the number of caries free children with all BC health authorities showing an overall improvement in dental health for children in kindergarten. More specifically, preliminary findings from the 2012/2013 survey indicate that:

- 67.3 per cent of kindergarten children had no visible decay and no existing restorations compared to 63.3 per cent in 2009/2010 and 61.1 per cent in 2006/2007.<sup>o,11</sup>
- 18.1 per cent had restorations present with no visible decay, compared to 19.7 per cent in 2009/2010 and 21.7 per cent in 2006/2007.
- 14.6 per cent had evidence of visible decay in one or more teeth, compared to 17.0 per cent in 2009/2010 and 17.3 per cent in 2006/2007.
- 12.9 per cent of children were referred for non-urgent treatment, while 2.1 per cent were referred for urgent treatment (compared to 14.7 per cent and 2.0 per cent, respectively in 2009/2010).

#### **3.2.1.2 Canadian Children and Young People 6 to 19 Years Old**

National findings on dental health from the Canadian Health Measures Survey 2007-2009<sup>5</sup> indicated that for children 6 to 11 years old:

- 53 per cent of 6-year-olds were caries free and 47 per cent had evidence of decay.
- Across the age groups, 56 per cent of children had dental caries.
- The prevalence of dental caries on permanent teeth had declined since 1970/1972.

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<sup>o</sup> The Federal, Provincial and Territorial Dental Directors suggest that 60 per cent of children age 5 to 6 years should be caries free (Williamson, 2006).

Caries affected less than 25 per cent of children in 2007/2009 (compared to 74 per cent of children in 1970/72). Furthermore, the conditions decreased in severity as the mean count of decayed, missing, or filled permanent teeth was 0.49 teeth in 2007/2009 compared to 3 to 6 permanent teeth in 1970/1972. However, those with one or more teeth affected had, on average, 2.1 decayed, missing, or filled permanent teeth in 2007/2009.

- 31.6 per cent of children had one or more dental sealants in 2007/2009, with a mean of 2.9 teeth sealed.
- So few children had moderate or severe fluorosis that the data could not be reported.

The findings from the Canadian Health Measures Survey 2007-2009<sup>5</sup> indicated that for adolescents 12 to 19 years old:

- 58.8 per cent had one or more teeth affected by dental caries.
- The mean count of decayed, missing or filled permanent teeth was 2.5 with 0.4 (14.4 per cent) decayed.
- Both the prevalence and severity of dental caries had declined substantially since the 1970/1972 survey.
- 50.6 per cent of Canadian adolescents had received dental sealants in 2007/2009.

### 3.2.2 Adult Dental Health

#### *3.2.2.1 British Columbia Adult Dental Health*

The most recent survey conducted by the BCDA involved 1,618 adults who visited participating dental offices in BC on December 6, 2006.<sup>12</sup> The major findings were as follows:

- The average number of decayed, missing and filled teeth was 15.8 in 2006 (compared to 16.1 in 2001). This was a reduction of close to 12 per cent over the previous 20 years.
- There was a reduction in the rate of decayed, missing and filled teeth in young adults (aged 16 to 25 years) between 1986 and 1996. Since then, the rates have stabilized at about 7.0. The rates for those aged 26 to 35 years and 36 to 45 years have declined by more than 20 per cent since 1986.
- The percentage of adult patients with untreated tooth decay was 20 per cent in 2006 (compared to 30 per cent in 1986).

The survey indicated that although the number of decayed, missing and filled teeth has been improving, periodontal health has not.

- Moderate or deep pockets occurred in close to 54 per cent of all dental patients (compared to 46 per cent in 1996 and 31 per cent in 1986).
- The 16 to 25 age group had the best periodontal status with 74 per cent having healthy, or reversible to healthy, periodontal conditions. The highest prevalence of serious

periodontal conditions occurred in the middle age groups with close to one in five patients aged 46 to 75 years having deep pockets.

- Although seniors are retaining more teeth, they are experiencing increased periodontal problems. Compared with 20 years ago, there were 60 to 70 per cent fewer seniors with one or more sextants having no teeth, while the percentage with moderate or deep pockets had more than doubled.
- However, the percentage of seniors with healthy gums has also increased. For patients aged 66 to 75, 11.6 per cent had healthy gums in 2006 compared to 3.4 per cent in 1996. For those 76 to 85 years of age, 17.2 per cent had healthy gums in 2006, compared to 2.2 per cent in 1986.

Finally, the survey found that the percentage of patients with dental insurance coverage was 76 per cent<sup>p</sup> (compared to 78 per cent in 2001, 71 per cent in 1991 and 68 per cent in 1986).

### *3.2.2.2 Canadian Adult Dental Health*

Findings for adults (20 to 79 years old) from the Canadian Health Measures Survey 2007-2009<sup>5</sup> indicated that

- 6.4 per cent of adults 19 years of age and older in 2007/2009 had lost all their natural teeth compared to 23.6 per cent in 1970/1972.
- 95.9 per cent of those with at least one natural tooth in 2007/2009 experienced coronal (visible) caries. The mean number of decayed, missing or filled teeth was 10.7 in 2007/2009 (compared to 17.5 in 1970/1972).
- Compared to the US and Australia, Canadian adults appear to have better periodontal health.

## **3.3 Risk Factors Affecting Oral and Dental Health**

The four most prominent non-communicable diseases (cardiovascular diseases, diabetes, cancer and chronic obstructive pulmonary diseases) share common risk factors with oral disease.<sup>13</sup> The risk factors for oral health are preventable and related to lifestyle. They include diet, lack of exposure to fluoride, the presence of oral bacteria that affect the progression of dental diseases and tobacco use.<sup>13</sup> In addition, several general disease conditions have oral manifestations that can increase the risk of oral disease. The relationship between oral/dental health and several chronic conditions is discussed further in Chapter 8.

One of the most important risk factors for developing oral disease (especially caries) is lower socio-economic status. An evaluation of early childhood dental programs in BC<sup>14</sup> found that

- For children in low socio-economic neighbourhoods, approximately 50 per cent experience dental decay.

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<sup>p</sup> Based on patients who visited a dentist during the 2006 survey.

- For those in moderate level neighbourhoods (which reflect the majority of BC neighbourhoods), at least 33 per cent experience dental decay.
- For children in high socio-economic neighbourhoods, approximately 30 per cent experience dental decay.

Findings from the Canadian Health Measures Survey 2007-2009<sup>5</sup> related to socio-economic status indicated the following:

- The rates of annual visiting and receiving care are greatly influenced by income and insurance. Overall, 17.3 per cent of participants reported avoiding dental visits and 16.5 per cent reported declining recommended care because of cost.
- Lower income families and those with no insurance reported not obtaining care three to four times more frequently than families with higher incomes.
- Canadians from lower income families are twice as likely to have unfavourable dental health outcomes as Canadians from higher income families. The outcome measures included: self-reported fair or poor dental health; number of decayed, missing or filled permanent teeth among adolescents; loss of all natural teeth; and untreated caries.
- Approximately 46.6 per cent of lower income Canadians with at least one natural tooth need one or more types of treatment compared to 25.6 per cent of those with higher incomes.

The effect of socio-economic status on the oral/dental health of various vulnerable groups is discussed further in Chapters 9 and 10.

## **3.4 The Economic Costs of Dental Diseases**

### **3.4.1 Direct and Indirect Costs**

In Canada, expenditures for dental services account for 7 per cent of total health expenditures.<sup>15</sup> In 2009, total expenditures on dental services were estimated at almost \$13 billion, an increase of 5.6 per cent over the previous year. Of this, \$12.2 billion (95 per cent) were private sector expenditures and \$608 million (5 per cent) were public sector expenditures.<sup>15</sup> Per capita spending on dental services was \$380.83. In 2009, federal spending on public dental programs was between \$250 million and \$275 million; provincial and municipal public sector expenditures accounted for the remainder.<sup>15</sup>

The Canadian Health Measures Survey 2007-2009<sup>5</sup> found that high levels of dental visits and dental sick days were associated with indirect costs of time lost from work, school or normal activities.<sup>5</sup> Some 39.1 per cent of Canadians experience such a time loss annually. At five hours per school day for children and adolescents and seven hours per working day for adults, an estimated 2.26 million school days and 4.15 million working days are lost annually due to dental visits or dental sick days.<sup>5</sup>

In BC, the publicly funded Healthy Kids Program helps low-income families with costs associated with basic dental care.<sup>q</sup> Dependent children under 19 years of age are automatically registered with the Healthy Kids Program if they are in families approved for MSP premium assistance.<sup>r</sup> Children are eligible for \$1400 of basic dental services every two years.<sup>s,t</sup> In fiscal 2011/2012, 59,002 children received dental treatment. The cost of the program for this same time period was \$18,718,285.<sup>16</sup>

### 3.4.2 Cost-Effectiveness of Specific Interventions

Several studies have examined the cost-effectiveness of specific interventions such as community water fluoridation, dental sealants and various forms of delivery (e.g., dentist's office, community or school).

- Water fluoridation is considered one of the most cost effective and safest methods of introducing fluoride. A systematic review attributed a 14 per cent reduction in caries to this method, with the impact being even greater in communities where rates of caries are high. The annual per person cost saved ranged from \$15.95 for communities of less than 5000 to \$18.62 for larger communities.<sup>17</sup>
- Dental sealants have been extensively researched. A Cochrane review in 2004 found a reduction in caries of between 57 per cent and 86 per cent, depending on the rate of caries in the population. Further, the Pew Report<sup>18</sup> suggests that dental sealants are a third of the cost of a filling. Application of a sealant at \$35 is a better investment than a filling (which can grow progressively worse and require a root canal or a crown for \$2,000 to \$3,000).<sup>17</sup>
- The affordability of the workforce and the infrastructure that is best suited to provide a range of promotion and preventive services has been debated. For example, in 2008, the mean annual wage for a dentist was \$154,270 (US) while the average annual salary for a dental hygienist was \$66,950 (US). Such a difference could affect the ability of a program to demonstrate cost-effectiveness. Some services may be more cost effective if performed by hygienists or delivered in non-clinical settings (such as a community centre or school).<sup>17</sup>

### 3.4.3 Hospital Dental Programs

Hospital dental programs meet the needs of special patient populations who face barriers to accessing oral health care in the private dental office setting, including medically compromised individuals and mentally or physically disabled individuals. Such programs enable dentists to

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<sup>q</sup> The program also helps low-income families with costs associated with prescription glasses.

<sup>r</sup> Approval for Medical Services Plan (MSP) premium assistance is provided through the Ministry of Health. The current income threshold for MSP premium assistance is \$30,000 net adjusted income.

<sup>s</sup> Basic dental services include: exams; x-rays; fillings; cleanings; and extractions.

<sup>t</sup> Although the Healthy Kids Program is publicly funded, the amount available under the program does not meet current fee guides. Some dentists balance bill which may be an access barrier for some families.

treat clients safely.<sup>u</sup> However, these programs also tend to serve as a community safety net, providing emergency dental care<sup>v</sup> to individuals who face financial barriers to accessing care in the private practice sector. This can be a more costly and less effective approach to the provision of particular dental services.

In the US (as in Canada), people may seek dental care in hospital emergency rooms for preventable dental conditions.<sup>18</sup> Wall and Nasseh<sup>19</sup> noted that most dental emergency department visits are for non-traumatic dental conditions and in most cases, prescriptions are provided for pain or infections.

For many low-income children, emergency rooms are the first and last resort because their families struggle with the costs of private dental care. Emergency room treatments add to the financial burden of hospitals; particularly high costs result when severe decay related problems require hospitals to use general anesthesia.

Dental treatment and care from hospitals is unlikely to provide lasting relief. In general, hospitals are unable to treat toothaches and dental abscesses effectively as most emergency rooms are not staffed with dentists, and physicians and other health care providers are not trained to treat underlying dental health problems. A study of low-income patients with toothaches found that among those who went to an emergency room, 80 per cent needed subsequent care from a dentist. These patients had a high rate of repeat visits.

A review by the Pew Centre in the US noted the high costs of hospital dental care.<sup>18</sup> For example:

- In Florida, more than 115,000 hospital emergency room visits for dental problems resulted in costs exceeding \$88 million in 2010.
- In New York State, costs for treating young children for decay related ailments in emergency rooms or ambulatory surgery centres rose from \$18.5 million in 2004 to more than \$31 million in 2008.
- In Georgia, about 60,000 emergency room visits for non-traumatic dental problems cost more than \$23 million in 2007.

The Canadian Institute for Health Information<sup>20</sup> reported that 19,000 day surgeries are performed annually to treat early childhood caries (i.e., to fill or treat cavities and extract teeth) in children under the age of 6. The vast majority (99 per cent) of the surgeries involved general anesthesia. The public cost of hospital care related to the day surgeries was estimated to be

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<sup>u</sup> There are no hospital-based dental programs in BC which provide restorative services. The dental department at BC Women's and Children's Hospital in Vancouver offers a referral based program for children with complex dental issues (M. Williamson, personal communication, 2013).

<sup>v</sup> The College of Dental Surgeons of British Columbia (no date) has stated that a dental emergency exists if professional judgment determines that a person requires immediate attention as a result of uncontrolled bleeding, uncontrolled swelling, traumatic injury or uncontrolled severe pain.

\$21.2 million per year for children 1 year of age to less than 5 years of age.<sup>20</sup> The estimate did not include costs associated with care providers (such as dental surgeons and anesthesiologists) or travel. As shown in Table 2, the average hospital cost per day surgery varied across Canada, from a low of \$1,271 in New Brunswick to a high of \$1,963 in Alberta. Anesthesia costs were available for the four western provinces (see Table 2). For 22.3 per cent of the day surgeries, families travelled two or more hours for care.<sup>w,20</sup>

**Table 2: Hospital and Anesthesia Costs of Day Surgery for Early Childhood Caries**

Province/Territory	Average Hospital Cost Per Day Surgery	Average Anesthesia Cost Per Day Surgery
BC	\$1,515	\$267
Alberta	\$1,963	\$329
Saskatchewan	\$1,699	\$361
Manitoba	\$1,643	\$240
Ontario	\$1,408	Data not available
New Brunswick	\$1,271	
Nova Scotia	\$1,657	
Prince Edward Island	\$1,441	
Newfoundland & Labrador	\$1,734	
Yukon	\$1,912	
Northwest Territories	\$1,379	
Nunavut	\$1,454	

### 3.4.4 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health also examined economic costs. The following findings were reported.

In 2004, the total cost for dental services in Canada was estimated to be \$9.3 billion. Public expenditures were estimated to be less than 5 per cent of overall dental services spending outside of hospitals.<sup>21</sup> There is no accurate record of the total dental care costs as most Canadian dental care is privately funded.

Most provinces and territories in Canada provide some dental coverage for children and social assistance recipients.<sup>21</sup> Access to care is a concern. The Canadian Association of Public Health Dentistry<sup>22</sup> position statement on access to oral health care states “All Canadians should have access to preventive and restorative oral health care regardless of their employment, health, gender, race, marital status, place of residence, age, or socio-economic status.” In BC, less than 40 per cent of people of all ages who were eligible for government support for dental treatment accessed treatment in 2004/2005. However, the total number of eligible individuals includes those whose coverage is only for treatment for an emergency.

Although most children in BC receive treatment in a private dental clinic, costs of dental treatment services for children who required treatment with a general anesthetic were

<sup>w</sup> Additional information regarding this study is presented in Section 7.4.1.

included in the BC Dental Association Task Force Report.<sup>23</sup> The children needed general anesthesia because they had severe dental caries or were very young. As shown in Table 3, the cost of treating children under four years of age in hospital was about 25 per cent higher than treating children (of all ages) in a private facility.

**Table 3: Children Requiring a General Anesthetic**

	<b>Number Treated</b>	<b>Estimated Cost/Child</b>	<b>Total Cost</b>
Children treated in publicly funded hospitals (< 4 years)	2641	\$2,090	\$5,519,690
Children treated in private facilities (all ages)	3173	\$1,650	\$5,235,450
<b>Total</b>			<b>\$10,755,140</b>

The Children's Dental Health Project in the United States reported in the *Cost Effectiveness of Preventive Dental Service*<sup>24</sup> that

- Low-income children who have their first preventive dental visit by age one are less likely to have subsequent restorative or emergency room visits compared to children who have their first visit after age one. In addition, their average dental-related costs are almost 40 per cent lower over a five-year period.
- A three-year aggregate comparison of Medicaid reimbursement for inpatient emergency department treatment versus preventive treatment revealed that, on average, the cost to manage symptoms related to dental caries on an inpatient basis is approximately 10 times more than to provide dental care in a dental office.
- Parents of children covered by Medicaid are three-and-a-half times less likely to report that their child has an unmet dental need than parents of uninsured children.<sup>25</sup>
- Further estimates reveal a savings of 7.3 per cent from regular screening and early intervention.

### **3.5 Summary**

As information on oral and dental health status is not routinely collected by provincial/territorial or federal health departments as part of their vital statistics or disease surveillance processes, information needs to be collected by surveys dedicated in whole, or in part, to this purpose.

For kindergarten children, the most recent British Columbia statistics are based on the 2012/2013 school year. The 2012/2013 Dental Survey findings indicate an increase in the number of caries free children with all BC health authorities showing an overall improvement in dental health for children in kindergarten.

National findings on dental health for children 6 to 11 years old (based on the 2007-2009 Canadian Health Measures Survey) indicated that across all age groups, 56 per cent of children had experienced dental caries, although the prevalence of dental caries on permanent teeth had declined substantially over the previous 37 years. For adolescents (12 to 19 years of age),

approximately 59 per cent had experienced dental caries, but the prevalence and severity had declined substantially over the previous 37 years.

The most recent BC survey of adult dental health was conducted in 2006. The findings indicated that, in general, dental health (assessed by the number of decayed, missing and filled teeth) has generally improved over the past 20 years. However, periodontal health has not; moderate or deep pockets occurred in over half of all adult dental patients.

With respect to the economic costs of dental diseases, the literature indicates that

- Dental disease can be costly in terms of time lost from work, school and normal activities.
- Water fluoridation is one of the most cost effective and safest methods of reducing dental decay.
- Dental sealants are a low cost and effective method for reducing caries particularly when compared to the cost of dental treatments and fillings.
- In Canada, over 95 per cent of dental care is privately funded (Canadian Dental Association, 2010, 2009 numbers).
- Dental treatment can be costly and prohibitively expensive for low-income families and some may turn to hospital emergency departments for urgent dental treatment.
- In Canada, the public cost of hospital care related to day surgeries for early childhood caries is estimated to be \$21.2 million per year.
- The average hospital cost per day surgery for early childhood caries in BC is estimated to be \$1,515 (which is about the average cost for the other provinces and territories combined).

## **4.0 THE PROMOTION OF DENTAL HEALTH**

This chapter discusses general approaches to dental health promotion. General strategies for preventing caries and periodontal diseases are discussed in Chapter 5. Health promotion and disease prevention strategies for specific groups are discussed in Chapters 6 to 10.

The World Health Organization Global Policy for Improvement of Oral Health acknowledges that dental (and oral) disease is still a major public health problem in high income countries.<sup>26</sup> The strategy proposed that the promotion of dental health and dental disease prevention needs to be integrated with general health promotion and chronic disease prevention as the risks to health are linked.

The Canadian Oral Health Strategy<sup>27</sup> noted that Canadians need to be informed of the impact dental health has on general health and their overall quality of life. It also noted that dental health will improve through individuals practicing overall healthy lifestyles. The Federal, Provincial and Territorial Dental Directors stated: “Health promotion needs collaborative efforts from all health providers, governments, and community leaders, with the dental health professionals playing a leading and integrating role for dental health.” The Canadian Oral Health Strategy recommends population-based dental health promotion, education and awareness; awareness and education programs in schools, health units, community health centres and long-term care facilities; and targeted dental health promotion, education and awareness for vulnerable populations.

### **4.1 Integrated Collaborative Approaches**

A number of professional groups and researchers have recommended the need to work collaboratively with a wide variety of health and education professionals to effectively promote dental health:

- In the US, the Surgeon General endorsed partnerships as a way to improve dental outcomes.<sup>28</sup>
- An evaluation of the early childhood dental program in BC suggested that healthy dental practices can most effectively be developed through strategies involving community outreach, partnership-building, and integration with existing public health programs to support families in accessing dental care.<sup>14</sup>
- The Commonwealth Dental Association noted that

a change in attitude is needed so that the whole community health team regards oral health as an integral part of general health. As well as monitoring pregnant women and young families, there are three key messages to get across for caries prevention: brushing with fluoride toothpaste as soon as the first tooth erupts, keeping sugary foods to mealtimes, and establishing a pattern of regular visits to the dentist.<sup>29</sup>

- Coordinated care involving primary care providers has been shown to facilitate referrals, prevention of dental disease and health promotion and early identification of dental disease.<sup>30</sup>
- The Canadian Oral Health Strategy<sup>27</sup> noted that dental health professionals should be seeking opportunities for collaborative partnerships with agencies offering health promotion activities (such as diabetes programs, the Canadian Heart and Stroke Foundation, child development programs, smoking cessation programs, community development programs, etc.) and other professional groups (such as physicians, nurses, dietitians, child caregivers, etc.).

Collaboration can be particularly helpful to address strategies related to nutrition and healthy eating. The American Dietetic Association notes that scientific and epidemiological data suggest a lifelong synergy between nutrition and the integrity of the oral cavity in health and disease. Collaboration between dietetics and dental professionals is recommended for dental health promotion and disease prevention and intervention. Oral infectious diseases, as well as acute, chronic, and terminal systemic diseases with oral manifestations, impact the functional ability to eat as well as diet and nutritional status. The Association has a policy position on nutrition as an integral component of dental health and supports the integration of oral health with nutrition services, education and research. Both dietetic and dental professionals must provide screening and baseline education and refer to each other as part of comprehensive client/patient care.<sup>31</sup>

Evidence reviews for the core programs of Healthy Living, Food Security and Chronic Disease Prevention provide more specific information on nutrition and healthy eating with respect to evidence and strategies to reduce consumption of sugary drinks; improve school-based food environments; improve nutrition education; and enhance access to, and the availability of, healthy food.

## **4.2 Community Outreach and Advocacy**

The Canadian Oral Health Strategy 2005-2010<sup>27</sup> noted that the greatest improvements in the oral health of Canadians will be achieved through health promotion, education, and awareness activities involving the public, health professionals and policy makers. They suggested the key to good oral health is to enable and empower citizens to take control of, and responsibility for, their own oral health. To do this, they need to have the personal skills, knowledge and desire to practice good oral health behaviour as well as easy access to professional care when required. To support this approach, social policy is necessary to create healthy supportive environments and to strengthen community action.

Because the accepted determinants of health are common to both general and oral health, multidisciplinary initiatives addressing the determinants are likely to be the most effective in improving the oral health of Canadians. Initiatives should address issues such as maternal health, child development, nutrition and smoking cessation.<sup>27,32</sup>

There is a growing consensus that public health interventions need to combine both population based and high-risk approaches.<sup>33,34</sup> The Marmot Review<sup>33</sup> recommended a policy of proportionate universality in which “actions must be universal, but with a scale and intensity that is proportionate to the levels of disadvantage.” It is possible, for example, that a multi-pronged coordinated approach that involves a combination of individual and community level interventions may be well suited for the most socio-economically disadvantaged areas (with high rates of dental decay, where it is expected that families encounter multiple, pervasive barriers to accessing services). However, interventions that solely target vulnerable individuals are not sufficient to address the social gradient in dental health, nor do they address the majority of new lesions that occur in mid socio-economic levels.<sup>33,34,35</sup>

Community outreach was highlighted as an effective strategy in the evaluation of early childhood dental programs in BC.<sup>14</sup> By building partnerships with community organizations, public health dental programs can efficiently expand their program coverage to include the families that the community partners already work with. The types of community partners included drop-in programs; health fairs; community events; support groups; infant programs; parenting groups; early childhood development networks; preschools; school districts; and individual community champions.

In addition, community programs can improve the links between families and dental health care through referrals and networks as their staff are well positioned to identify children who are vulnerable to caries at an early age. Children involved with community initiatives, programs or organizations have an increased likelihood of dental visitation as “community programs can serve as a vehicle to increase access to the oral health care system.”<sup>28</sup>

The Canadian Oral Health Strategy<sup>27</sup> suggested continuing education on dental health service provision for special populations that exhibit low dental service utilization rates; an increase in the delivery of dental health care by community health centres; and advocacy to increase awareness of the need for universal access to dental care.

### **4.3 Comparisons with the 2006 Evidence Review: Dental Public Health**

The 2006 evidence review on dental health found that a health promotion approach that includes multiple strategies and targets vulnerable groups is effective in improving oral health. It also reflects the increasing interest in collaboration and integration with other health professionals and community based strategies.

In the United States, non-dental health and child care providers have been trained to engage in oral health promotion and disease prevention strategies. Pierce, Rozier and Vann<sup>36</sup> reviewed a training program for primary care physicians who were able to “achieve an adequate level of accuracy in identifying children with cavitated carious lesions” after a two-hour training session. The Connecticut Department of Public Health has trained more than 2,000 non-dental health

and human service providers who work with young children in the Openwide program, since its inception in 2002.<sup>37</sup>

The evidence paper on oral health developed in Australia for the State of Victoria examined evidence in relation to dental health in five key areas.<sup>38</sup>

- Building healthy public policy – Expert opinion suggests that advocacy at a variety of levels can raise community awareness and is likely to be beneficial.
- Creating supportive environments – Water fluoridation and the use of fluoride toothpaste have good systematic reviews to support their benefit in controlling caries. Access to timely clinical examinations and tailored health promotion in specific settings are likely to be beneficial.
- Strengthening community action – Well-designed studies demonstrate that education interventions targeting parents/caregivers of preschool children and vulnerable groups are beneficial, and expert advice suggests community development is likely to be beneficial in addressing specific oral health issues.
- Developing personal skills – Flossing, tooth brushing, using self-applied fluoride, oral hygiene instruction and smoking cessation advice all have at least one good systematic review and evidence of a beneficial health gain.
- Reorienting health services – professionally applied fluorides and dental sealants have good systematic reviews to support their benefit, with targeted approaches to vulnerable individuals/groups showing greater cost-effectiveness.

Examples of projects that have employed multiple community wide health promotion strategies are described below:

- Margolis et al.<sup>39</sup> evaluated the effectiveness of a community-wide intervention delivered at multiple levels. Low-income pregnant mothers and their infants, primary care practices, and departments of health and mental health participated. Interventions were directed toward major risk factors (e.g., poverty and effective care systems for preventive care) and involved community-, practice- and family-level interventions. Margolis et al. observed a number of positive effects at all three levels of intervention over the three-year study period, including improved service delivery in many areas, positive outcomes at the family level, and policy level changes that expanded to other communities.
- The Oral Health Action Teams in an area of Glasgow adopted the principles of health promotion to target families in an area that had some of the highest levels of caries in Europe.<sup>40</sup> Working with community volunteers, lay representatives, agencies, charities, and local businesses, they “identified lifestyle issues they believed held prospects for local modification and were appropriate in light of scientifically accepted literature.” Examples of specific interventions included breakfast clubs; fruit distribution; milk tokens; food-tasting sessions; free fluoride toothpaste distribution; promotion of sugar-free medicines; development of snack and meal policies; and tooth brushing programs

at preschool and arts and crafts activities. Positive indications from epidemiological studies in the pilot area became evident after two years and it was considered unethical to withhold further intervention in the control area.

Health education may result in increased knowledge related to health, but knowledge does not always translate into positive health behaviours and lifestyles. Similarly, having access to universal dental care from birth did not eliminate the disparities in caries experienced by six and seven year olds in Nova Scotia.<sup>41</sup> The significant limitation of many clinical and educational interventions is that they fail to achieve sustainable improvements in oral health and largely ignore the underlying factors that create poor oral health.<sup>42,43</sup> The WHO states that the problems are not unique to dentistry, and that reviews of the evidence base for a wide range of topics areas have highlighted the limitations of the clinical preventive approach to improve health.<sup>43</sup>

#### **4.4 Summary**

There is a growing consensus that public health interventions need to combine both population-based and targeted approaches. A policy of proportionate universality, in which actions are universal, but are at a level and intensity that is proportionate to the level of disadvantage, has been recommended.

With respect to the promotion of dental health, a number of professional groups and researchers have recommended the following:

- Collaborating with a wide variety of health and education professionals to integrate and promote dental health education into mainstream health services; and
- Building partnerships with organizations for community outreach, education and advocacy for dental health.

While dental health education may result in increased knowledge, sustainable improvements in oral health may not be obtained unless the underlying factors that create poor oral health are addressed.

## **5.0 THE PREVENTION OF DENTAL DISEASES**

This chapter examines the impact of fluoride, dental sealants, and non-sugar sweetened chewing gum on the development of caries. It also discusses control and treatment of periodontal diseases.

### **5.1 Fluoridation of Water**

#### 5.1.1 Current Evidence

The Chief Public Health Officer for Canada<sup>44</sup> noted that numerous scientific studies have shown that water fluoridation reduces tooth decay. Four systematic reviews of the benefits of water fluoridation have been published since 2000.<sup>45,46,47,48</sup> Taken together, the findings from these reviews indicate that individuals who live in areas with water fluoridation experience 27 per cent to 50 per cent fewer decayed, missing and filled teeth compared to individuals who live in areas without water fluoridation.

In 2007, an expert panel of researchers provided Health Canada with advice and recommendations regarding water fluoridation. They supported the position that water fluoridation is a safe and effective public health measure that substantially reduces the rate of dental decay in all segments of the Canadian population. They noted that Canadians appear to be concerned about dental fluorosis<sup>x</sup> but have no reason to worry. Canadian and international studies agree that water that is fluoridated at optimum levels provides important benefits and does not cause adverse health effects.

More recently, a review of the literature on water fluoridation was prepared for the Public Health Agency of Canada.<sup>49</sup> It confirmed the positive impact of fluoridation on dental health and found no evidence of harmful health effects. The review also explored arguments against fluoridation. It concluded that although the majority of Canadians are in favour of, or at least not opposed to, fluoridation, it appears that those who are anti-fluoridation are more vocal and over represented among those who vote on this issue.

In Canada, the fluoridation of drinking water is a decision that is made by each municipality, in collaboration with the appropriate provincial or territorial authority. In 2007, the Office of the Chief Dental Officer conducted a scan of the areas in Canada that have fluoridated water. The information was collected from Provincial or Territorial Environment Ministries and verified by the Dental Directors of each province and territory. Between 2005 and 2007, the number of people who had access to fluoridated water in Canada increased from 42.6 per cent to 45.1 per cent.<sup>50</sup>

The latest review of provincial/territorial estimates of coverage for community water fluoridation was published in 2007.<sup>51</sup> Table 4 shows the percentage of the population with

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<sup>x</sup> Fluorosis refers to mild dental cosmetic effects resulting from excessive intake of fluoride.

fluoridated water in each of the provinces and territories. Data from November 2012 indicated that the following communities in British Columbia had fluoridated drinking water: Cranbrook, Fort St. John, Prince George, Sparwood, and Terrace.<sup>52</sup> By comparison, more than 72 per cent of the US population that have community water systems benefit from water fluoridation; 27 states provide fluoridated water to more than 75 per cent of their residents on public water systems.<sup>53</sup>

**Table 4: Percentage of the Population with Fluoridated Water (2007)**

Province/Territory	Percentage of Population
Alberta	74.7
British Columbia	3.7*
Manitoba	69.9
Ontario	75.9
New Brunswick	25.9
Newfoundland & Labrador	1.5
Northwest Territories	56.4
Nova Scotia	56.8
Nunavut	0.0
Prince Edward Island	23.7
Quebec	6.4
Saskatchewan	36.8
Yukon	0.0

\* Statistics from November 2012 indicate that 3.0 per cent of the 2009 BC population have fluoridated water Source: Springinotic C. Personal communication; 2014 Mar 10.

The cost of water fluoridation has been estimated to be \$0.60 to \$1.00 per person per year.<sup>51</sup>

### 5.1.2 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health noted the following:

- Research strongly supports the appropriate use of fluoride for dental caries prevention as it re-mineralizes and strengthens the tooth structure. Fluoride has been added to water, salt, milk and toothpaste with highly effective results for caries control.<sup>54,55</sup> In Canada, fluoride is added to toothpaste and water (in some communities).
- Watt<sup>43</sup> estimated a 14 per cent reduction in caries through fluoridation of water, with the effect tending to be greater in primary teeth. In regions of high caries rates, the impact of water fluoridation may be greater.
- A study from the Centers for Disease Control and Prevention on the cost-effectiveness of fluoridation assessed “the local cost savings resulting from community water fluoridation, given current exposure levels to other fluoride (and) compared the annual per person cost of fluoridation with the cost of averted disease and productivity losses.” They reported “the annual per person cost savings resulting from fluoridation ranged from \$15.95 in very small communities (< 5000) to \$18.62 in large communities (>20,000)”.<sup>56</sup>

- In BC, high concentrations of natural fluoride occur along the southeast coast of Vancouver Island, including the islands from Saltspring to Gabriola, and in the Okanagan from Okanagan Falls to Salmon Arm.<sup>57</sup>
- The water drinking practices of people influence the intake of fluoride. Studies on the fluoride concentration of bottled waters suggest increased consumption of bottled water, in preference to fluoridated tap water, would lead to a marked decrease in caries protection.<sup>58</sup> Studies from Mexico and Greece show that bottled drinking waters contain differing concentrations of fluoride.<sup>59,60</sup> In Canada, manufacturers are not required to indicate the fluoride level. In the US, the concentration of fluoride is regulated but does not have to be stated on the label unless the bottler adds fluoride during processing.<sup>25</sup>

**Level of Evidence:** *Evidence for Dissemination*

Research has clearly demonstrated that fluoridation of community water is a safe and effective public health measure that significantly reduces the rate of dental decay.

## **5.2 Fluoride Toothpastes**

### **5.2.1 Current Evidence**

A recent Cochrane review confirmed the benefits of using fluoride toothpaste (when compared with a placebo), in preventing caries in children and adolescents, but only significantly for fluoride concentrations of 1,000 ppm and above.<sup>61</sup> The preventive effects increase with higher fluoride concentrations. However, there is weak, unreliable evidence that the use of fluoride toothpaste in children under 12 months may be associated with an increased risk of fluorosis. Researchers concluded that the decision of what fluoride levels to use for children under six years of age should be balanced between the risk of developing dental caries and the risk of mild fluorosis.

The Canadian Dental Association<sup>62</sup> has stated that, between birth and three years of age, children should have their teeth and gums brushed by an adult. Fluoridated toothpaste should only be used for children in this age group if they are considered to be at risk of developing tooth decay (as determined by a health professional). Children between three and six years of age should be assisted by an adult to brush their teeth. A small amount of fluoridated toothpaste (i.e., a portion the size of a green pea) should be used.

### **5.2.2 Comparisons with the 2006 Evidence Review: Dental Public Health**

The 2006 evidence review on dental health stated the following:

- Fluoride's predominant effect is topical, which occurs mainly through re-mineralization of early caries lesions and a reduction in the de-mineralization of sound tooth enamel.<sup>63</sup>
- Fluoride toothpaste is highly effective for caries prevention as it provides the topical fluoride necessary for re-mineralization of incipient lesions and can slow the progress of

cavitated lesions. In Watt's<sup>43</sup> summary of the Cochrane reviews, the estimated overall benefit of fluoride toothpaste was 24 per cent.

- In Canada, most toothpastes contain 1,000 to 1,200 ppm fluoride. There are also toothpastes with 5,000 ppm (which are about four times more expensive to purchase than regular toothpastes), toothpastes with 500 ppm and toothpastes with no fluoride.
- The effectiveness of fluoride toothpaste appears to be dose related. A study in Glasgow showed better caries prevention for three to five year old children with a 1,000 ppm fluoride toothpaste than with a 500 ppm fluoride toothpaste.<sup>40</sup>

**Level of Evidence:** *Evidence for Dissemination*

There is strong evidence that fluoride toothpaste over 1,000 ppm has a significant caries preventive effect. However, for children under the age of six, the risk of developing caries should be balanced against the risk of mild fluorosis.

## **5.3 Fluoride Supplements**

### **5.3.1 Current Evidence**

A 2008 systematic review commissioned by the American Dental Association examined evidence regarding the effectiveness of fluoride supplements in preventing caries and their association to dental fluorosis.<sup>64</sup> The review, which examined studies that evaluated dosage schedules similar to those recommended by the American Dental Association, found the following:

- One study of primary teeth in children during the first three years of life reported a 47.2 per cent reduction in dental caries.
- One trial involving three to six year old children found a 43.0 per cent difference, while another trial of children in this age group did not find a significant benefit.
- Researchers in several studies involving older children detected a significant reduction in caries increments in permanent teeth with the use of fluoride supplements.
- There was weak and inconsistent evidence that the use of fluoride supplements prevents dental caries in primary teeth. However, there is evidence that fluoride supplements prevent caries in permanent teeth. Mild to moderate fluorosis is a significant side effect.

The Canadian Dental Association does not recommend fluoride supplements in the form of chewable tablets, lozenges or drops for the majority of Canadians. However, they suggest health professionals may wish to prescribe fluoride supplements to vulnerable individuals in non-fluoridated communities where individuals are not able to obtain fluoride in any other form (e.g., toothpaste) and after they have completed a thorough analysis of the patient's fluoride intake. The use of fluoride supplements for young children should not exceed a total daily fluoride intake of 0.05 to 0.07 mg fluoride per kg body weight in order to minimize the risk of fluorosis.<sup>53,62</sup>

### 5.3.2 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health noted the following:

- The Canadian Dental Association<sup>65</sup> stated that fluoride supplementation only needs to be considered for people at high risk of dental caries, may be unnecessary for people receiving adequate fluoride from other sources, and is generally not recommended before the eruption of the first permanent tooth.
- Recommendations regarding the use of fluoride supplements are inconsistent across the world and vary amongst health professionals within Canada. This results in a mixed message for the Canadian consumer.

**Level of Evidence:** *Evidence for Outcome Effectiveness*

Research indicates that fluoride supplements are effective in preventing dental caries in permanent teeth but the results are mixed regarding their effectiveness for primary teeth. Supplements may be prescribed by health professionals for vulnerable individuals where there is little access to other forms of fluoride. Caution must be taken, especially with young children, to minimize the risk of fluorosis.

## **5.4 Fluoride Mouth Rinses**

### 5.4.1 Current Evidence

The Centers for Disease Control and Prevention<sup>25</sup> in the US recommended that fluoride mouth rinses should be considered for individuals who are at high risk of dental caries at the population level (e.g., those with low socio-economic status, with limited access to dental services and/or with low use of dental care services). Fluoride mouth rinses are also appropriate for those with active dental caries.<sup>25</sup> However, fluoride mouth rinses should not be used with very young children who have not matured enough developmentally to be able to swish and spit without swallowing the rinse.<sup>6</sup>

School-based fluoride mouth rinse programs appear to be popular in several jurisdictions in Canada, the US and elsewhere. Weekly rinsing is more practical and less costly than daily rinsing, and the impact on caries reductions are similar.<sup>66</sup> Based on a meta-analysis of 34 studies involving 14,600 children, Marinho et al.<sup>63</sup> reported a 26 per cent reduction in decayed, missing and filled surfaces as a result of mouth rinsing programs.

Several experts have recommended that fluoride mouth rinses be targeted to groups and individuals at high risk of developing caries. Several states, such as New York, have targeted fluoride rinse programs to vulnerable school-aged children in non-fluoridated areas.<sup>67</sup>

### 5.4.2 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health noted the following:

- Several different formulations of mouth rinses are available, differing in the active ingredient, concentration, and suggested frequency of use. For safety reasons, mouth rinses are not recommended for children under the age of six in Canada.
- Studies of school-based fluoride mouth rinse programs are primarily from the 1970s and early 1980s and show high caries reduction. However, Watt's<sup>43</sup> summary of the Cochrane review suggests a 26 per cent reduction in caries rates from fluoride mouth rinses.
- The National Preventive Dentistry Demonstration Program in the United States documented a limited reduction in dental caries attributable to fluoride mouth rinses, especially when children were also exposed to fluoridated water.<sup>25</sup>
- A review of fluoride mouth rinses by the International Dental Federation suggested they are effective in caries reduction and would be useful for individuals at high risk for caries, but questioned the efficiency of large scale mouth rinsing.<sup>68</sup>
- Marinho, Higgins, Sheiham, and Logan<sup>69</sup> noted that "the intensive use of fluoride mouth rinsing in school programs has been discontinued in many developed countries because of doubts regarding its cost effectiveness at schools with a low prevalence of dental caries...[it is] being replaced by selective fluoride therapy directed to vulnerable children."
- In a Vancouver study, Wyatt and MacEntee<sup>70</sup> used a randomized control trial to evaluate the effectiveness of a fluoride solution and a chlorhexidine solution as a daily mouth rinse for controlling caries in seniors in long-term care facilities over a two year period. They concluded that the use of a fluoride mouth rinse every day reduced the incidence of caries.

**Level of Evidence:** *Evidence for Dissemination*

Mouth rinses with fluoride have been shown to be effective in reducing dental caries. The use of fluoride rinses in school based programs in high-risk areas appears to be cost effective. However, the cost effectiveness of such programs in schools with low caries prevalence is questioned.

## **5.5 Fluoride Varnishes**

### 5.5.1 Current Evidence

Fluoride varnishes have been used extensively for over three decades to prevent caries.<sup>71</sup> A recent Cochrane review of randomized or quasi-randomized control trials comparing topically-applied fluoride varnish with either a placebo or no treatment found that the use of fluoride varnish resulted in a 43 per cent reduction of dental caries in permanent teeth, and a 37 per cent reduction in primary teeth.<sup>71</sup> However, the evidence was assessed as being of

moderate quality, as there was considerable heterogeneity among the studies. There was also little information regarding the acceptability of treatment or possible side effects.

Azarpazhooh et al.<sup>72</sup> also conducted a systematic review of the research on the use of fluoride varnish for the prevention of dental caries. They reviewed a total of 105 articles and identified 7 original research studies. They found a number of evidence-based reports with clear outcomes. They found that fluoride varnish can substantially reduce tooth decay in both primary and permanent teeth and concluded that “fluoride varnishes applied professionally two to four times a year [can] substantially reduce tooth decay in children.”

Fluoride varnish is ideally suited for topical application to the teeth of preschool children because of its ease of use, its acceptability to young children, and the reduced risk of over ingestion of fluoride.<sup>73</sup> Its efficacy in reducing cavities in primary teeth has been shown in a number of studies.<sup>74</sup> Based on the evidence, the American Dental Association’s 2006 topical fluoride guidelines recommend that fluoride varnish be applied every six months for preschool children at moderate risk of caries and every three to six months for children at high risk.<sup>75</sup>

A 2009 randomized control trial examined whether children with high caries prevalence could receive sufficient caries prevention with an intensive annual application of fluoride varnish (three applications over two weeks) that would be equivalent to, or more effective than, the standard six month application.<sup>76</sup> The intensive application group failed to demonstrate any clear difference in efficacy compared to the standard treatment group. In fact, there was a 36 per cent greater rate of caries in the intensive application group indicating that equivalence of the treatments could not be concluded.

### 5.5.2 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health noted the following:

- A Cochrane review found that “fluoride toothpastes in comparison to mouth rinses or gels appear to have a similar degree of effectiveness for the prevention of dental caries in children. There is no clear suggestion that fluoride varnish is more effective than mouth rinses and the evidence for the comparative effectiveness of fluoride varnishes and gels and mouth rinses and gels is inconclusive.”<sup>69</sup>
- Fluoride varnish application in combination with caregiver counseling is efficacious in reducing early childhood caries incidence.<sup>74</sup>

**Level of Evidence:** *Evidence for Dissemination*

Research has demonstrated that the application of fluoride varnish applied two to four times a year is highly effective in preventing dental caries in both primary and permanent teeth.

## **5.6 Combined Fluoride Therapies**

### 5.6.1 Current Evidence

A Cochrane systematic review of randomized control trials involving a variety of fluoride therapies confirmed a clear and similar effectiveness for topical fluoride toothpastes, mouth rinses, gels and varnishes in preventing caries.<sup>77</sup> It also showed that additional caries reduction can be expected when a topical fluoride is combined with fluoride toothpaste. Evidence is insufficient to confirm the effectiveness of slow release fluoride devices and fluoridated milk. The review concluded that the benefits of topical fluorides are firmly established based on a sizeable body of evidence from randomized control trials. The amount of caries reduction in both primary and permanent teeth emphasizes the importance of including topical fluoride delivered through toothpastes, rinses, gels or varnishes in any caries preventive programs. The review also noted that trials to discern potential adverse effects of fluoride are required.

### 5.6.2 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health reported the following:

- The Canadian Dental Association<sup>65</sup> stated that fluoride supplementation may be unnecessary for patients receiving adequate fluoride from other sources. In Canada, fluoridated toothpaste is widely used and provides adequate fluoride to prevent caries if used appropriately.
- Fluoride supplements, varnishes, mouth rinses, or other fluoride products are adjunct therapies for people who are susceptible for developing caries.

**Level of Evidence:** *Evidence for Dissemination*

Additional caries reduction has been shown to result from the use of a variety of topical fluoride therapies such as mouth rinses, gels and varnishes when combined with fluoride toothpaste. A variety of fluoride therapies are appropriate for people at high risk for caries.

## **5.7 Dental Sealants**

### 5.7.1 Current Evidence

In a systematic review, Azarpazhoooh and Main<sup>72</sup> found 38 original research studies that confirmed that there is strong evidence for the efficacy of dental sealants in preventing dental caries in both primary and permanent teeth. The evidence indicated that placing sealant material over arrested caries or incipient lesions does not increase the risk of further development of caries under the sealant.

The researchers recommended the following:<sup>72</sup>

- Dental sealants should be placed as part of an overall prevention strategy based on assessment of caries risk.

- Dental sealants should not be placed on partially erupted teeth or teeth with cavitation or caries of the dentin.
- Dental sealants should be placed on the primary molars of children who are susceptible to caries (i.e., those with a history of caries).
- Dental sealants should be placed on permanent molar teeth without cavitation as soon after eruption as isolation can be achieved.
- Dental sealants should be placed on first and second permanent molar teeth within four years after eruption.

A study on factors related to the low use of dental sealants by dentists<sup>78</sup> found that dentists: have an orientation toward restorations rather than prevention; a distrust in sealant treatment; a lack of confidence in caries risk assessment; and concern about sealing over caries. The study concluded that best practices for community-based dental education requires acquisition of knowledge and necessary skills; a cost benefit approach to sealant placement; meticulous sealant placement procedures; and a recall procedure to evaluate sealant retention.

### 5.7.2 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health found the following:

- Dental sealants prevent decay in the chewing surfaces of molars as they seal the pits and fissures from bacterial invasion. They are most effective when placed shortly after eruption when the tooth has only had short exposure to the oral environment. Application requires a clinical setting to adequately dry the tooth surface, as technique is critical to the longevity of the sealant. The 6- and 12-year molars are most frequently targeted for dental sealants.
- Ahovuo-Saloranta et al.<sup>79</sup> found that, in the short term (i.e., at 12 months) dental sealants can reduce caries incidence by up to 86 per cent depending on the baseline caries rate; the four-year caries reduction in the permanent molars of children aged 5 to 10 years was 57 per cent.

**Level of Evidence:** *Evidence for Dissemination*

Research studies have demonstrated that dental sealants are highly effective in caries prevention. Based on the evidence, researchers recommend they be placed on primary molars of children who are susceptible to caries and on permanent molars without cavitation within four years of eruption.

## **5.8 Nutrition and Diet**

### 5.8.1 Current Evidence

Research evidence supports a lifelong relationship between nutrition and oral health.<sup>80</sup> A balanced and nutritious diet is important for both general and dental health. Without the

right nutrients, teeth and gums can be negatively affected.<sup>81</sup> In addition, acute, chronic, and terminal systemic diseases with oral manifestations can affect an individual’s ability to eat as well as his/her nutritional health.<sup>y</sup>

Table 5 presents dietary factors and eating patterns that are associated with caries risk.<sup>z,80</sup>

**Table 5: Dietary Factors and Eating Patterns Associated with Caries Risk**

	<b>Increased Risk of Caries</b>	<b>Decreased Risk of Caries</b>
Dietary Factors	<ul style="list-style-type: none"> <li>• Sugar-sweetened liquids (e.g., fruit drinks)</li> <li>• Sticky foods (e.g., raisins)</li> <li>• Slowly dissolving candies</li> <li>• Sugary starchy snacks (e.g., cookies)</li> <li>• Simple sugars (e.g., honey)</li> </ul>	<ul style="list-style-type: none"> <li>• Sugar-free chewing gum, mints, and candies</li> <li>• Fresh fruits and vegetables</li> <li>• High-quality protein foods (e.g., eggs, fish and beans)</li> <li>• Whole-grain, low-sugar breads and cereals</li> </ul>
Eating Patterns	<ul style="list-style-type: none"> <li>• Frequent and prolonged intake of foods rich in simple sugar</li> <li>• Eating sticky foods alone</li> <li>• Sipping sugar-sweetened liquids for prolonged periods</li> </ul>	<ul style="list-style-type: none"> <li>• Space frequency of food and beverage intake out</li> <li>• Select fresh, whole, unprocessed food to stimulate salivary output</li> <li>• Chew sugarless gum for a brief period immediately after a meal or snack</li> </ul>

Harris et al.<sup>82</sup> conducted a systematic review of randomized control trials designed to assess the effectiveness of one-to-one dietary interventions carried out in a dental care setting. Five studies met the study criteria for inclusion. In two studies, the dietary intervention was one component of a larger prevention program. One study focused specifically on dental caries prevention and the other two focused on general health outcomes. None of the studies focused on dietary changes aimed at preventing tooth erosion. A substantial change in dietary behaviour was found for at least one of the outcome variables in four of the studies. The authors concluded that “There is some evidence that one-to-one dietary interventions in the dental setting can change behaviour, although the evidence is greater for interventions aiming to change fruit/vegetable and alcohol consumption than for those aiming to change dietary sugar consumption.”<sup>82</sup>

A diet rich in fruits and vegetables has been shown to reduce the risk of oral cancer. High levels of vitamin C or carotene consumption may also reduce the risk of oral cancer.<sup>aa,83</sup>

There is a need for additional research examining the relationship between nutrition/diet and oral/dental health.

<sup>y</sup> The impact of nutrition and diet on periodontal disease is discussed in Section 5.10. The relationship between chronic conditions and oral/dental health is discussed in Chapter 9.

<sup>z</sup> Section 5.9 discusses evidence related to the use of chewing gums with non-sugar sweeteners.

<sup>aa</sup> Oral cancer is discussed in more detail in Chapter 9.

### 5.8.2 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health noted that diet plays a key role in the acquisition of decay causing bacteria, the accumulation of bacteria to pathological levels, and the development of dental caries. “Nearly all carbohydrates have caries promoting properties...The physical consistency, frequency of consumption, and the order foods are eaten in affect cariogenicity.”<sup>84</sup>

A WHO technical report on diet, nutrition and the prevention of chronic diseases noted an association between caries and both high and frequent sugar intake.<sup>85</sup> The report indicated that where there is adequate exposure to fluoride, sugar consumption is a moderate risk factor for caries. Although the evidence is not strong, the report indicated that the level of caries is lower in countries with lower consumption of sugars and that consumption of hard cheese probably decreases risk for caries.<sup>85</sup>

**Level of Evidence:** *Evidence for Implementation*

Research indicates that high and frequent sugar intake and consumption of carbohydrates is associated with decay causing bacteria and is a moderate risk factor for caries where there is adequate exposure to fluoride. Lower and less frequent sugar consumption can reduce the risk of dental caries.

## **5.9 Chewing Gums with Non-Sugar Sweeteners**

### 5.9.1 Current Evidence

A systematic review of original research studies on the impact of non-sugar sweetened chewing gum on dental caries identified 19 peer-reviewed articles including Cochrane reviews.<sup>86</sup> The studies compared use of non-sugar sweetened chewing gum with no chewing gum. The results showed that the use of xylitol gum resulted in 58.7 per cent fewer caries, the use of xylitol-sorbitol gum resulted in 52.8 per cent fewer caries, and the use of sorbitol gum resulted in 20.1 per cent fewer caries. The clinical conclusion was that although research gaps exist, particularly regarding optimal dosing and relative efficacy, research evidence supports use of these chewing gums as part of normal oral hygiene to prevent dental caries.

Based on a review of the evidence, the American Academy of Pediatric Dentistry<sup>87</sup> noted that clinicians should consider recommending xylitol use to patients with a moderate or high risk of developing caries. Those recommending xylitol should be familiar with product labeling and recommend age appropriate products. They should also routinely reassess (at least once every six months) a patient for changes in caries risk status and adjust recommendations accordingly. Mints and hard candies containing xylitol have been shown to be as effective as xylitol chewing gum. The American Academy of Pediatric Dentistry does not recommend the use of chewing gum, mints or hard candy by children less than four years of age due to the risk of choking.

### 5.9.2 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health noted the following:

- A review of clinical studies on the caries preventive and therapeutic effects of sugar alcohol<sup>bb</sup> concludes that

chewing sugar free gum three or more times daily for prolonged periods of time may reduce caries incidence irrespective of the type of sugar alcohol used. The caries preventive effects...seem to be based on stimulation of the salivary flow, although an anti-microbial effect cannot be excluded.<sup>88</sup>

- Several studies have found chewing xylitol gum significantly reduces the levels of *S. mutans*.<sup>89,90,91</sup> However, there may also be an effect related to behavioural change and reduced intake or frequency of sugar. In a review of the research literature on the effect of dietary measures on dental caries, Stillman-Lowe<sup>92</sup> noted

no study could be found that had evaluated the effect of information designed to reduce sugar intake/frequency as a single preventive measure. It is suggested that the evidence for the use of sorbitol or xylitol in chewing gum, or for the use of invert sugar, is inconclusive.<sup>92</sup>

**Level of Evidence:** *Evidence for Outcome Effectiveness*

Research indicates that the use of xylitol and/or sorbitol chewing gum is effective as part of oral hygiene, particularly for individuals at moderate to high risk of dental caries (although chewing gum, mints or hard candies should not be used by children less than four years of age due to the risk of choking).

## **5.10 Periodontal Diseases**

An international classification of periodontal diseases established in 1999 continues to provide standard descriptions.<sup>93,94</sup> It includes eight categories, the four most common being gingival diseases, chronic periodontitis, aggressive periodontitis and periodontitis as a manifestation of systemic disease. Gingival diseases are reversible and do not inevitably progress to periodontitis. They are classified as plaque induced and non-plaque induced based on etiology.<sup>95</sup>

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<sup>bb</sup> A sugar alcohol is a naturally occurring water-soluble carbohydrate that resembles both sugar and alcohol in terms of chemical structure. Sugar alcohols, which include maltitol, sorbitol and xylitol, are widely used in the food industry as sweeteners and thickeners.

### 5.10.1 Risk Factors

Risk factors for periodontal disease include poor oral hygiene; presence of specific bacteria; fillings that have become defective; bridges that do not fit properly; crooked teeth; any change in the way teeth fit together; diet; diabetes; underlying immune-deficiencies; taking medications that cause dry mouth; gender; genetics; socio-economic status; stress; and smoking.<sup>2,80,96</sup>

Table 6 presents dietary factors associated with periodontal disease.<sup>80</sup> Oral soft tissues are among the first tissues in the body to be affected by both nutritional deficiencies and excesses.<sup>80</sup>

**Table 6: Dietary Factors Associated with Periodontal Disease**

<b>Dietary Factor</b>	<b>Impact of Inadequate Intake on Risk of Periodontal Disease</b>
Protein	<ul style="list-style-type: none"> <li>• Compromised or impaired response to infection and wound healing of oral soft tissues</li> <li>• Compromised antibacterial properties of saliva</li> </ul>
n-3 Fatty acids Vitamins A, C, and E Copper, iron, zinc Non-nutrient antioxidants	<ul style="list-style-type: none"> <li>• Depressed anti-inflammatory and immune response of oral soft tissue</li> </ul>
Vitamins D and K Calcium, boron	<ul style="list-style-type: none"> <li>• Inadequate jaw bone density and strength to anchor tooth structure</li> </ul>

Poor nutritional status may occur as a result of tooth loss and replacement with dentures (either full or partial) as eating abilities with dentures are not the same as with natural teeth. For example, chewing capacity with regular dentures is about 20 to 25 per cent of that with natural teeth. This may be particularly problematic for seniors.<sup>cc,80</sup>

### 5.10.2 Prevention and Control

An overview by Armitage and Robertson<sup>97</sup> demonstrated that gingivitis and periodontitis are biofilm induced infections caused by components of the indigenous oral microbiota and that host inflammatory immunologic responses to these microbial challenges are responsible for most of the observed tissue damage. Researchers have found that biofilms that cause gingivitis and periodontitis are complex and resistant to anti-microbial agents. An increased understanding of natural inflammation resolving mechanisms suggests that control of inflammation is at least as important as anti-microbial therapy in the treatment of periodontal infections.

Periodontal diseases can be control by monitoring risk factors and receiving treatment from dental professionals. Gingivitis can be treated with good oral hygiene and regular professional cleaning. More severe forms of periodontal disease can also be treated successfully but may require more extensive treatment. Such treatment might include deep cleaning of the tooth

<sup>cc</sup> Seniors represent the largest group of denture wearers (Touger-Decker & Mobley, 2013).

surfaces below the gums, medications taken by mouth or placed directly under the gums, and/or corrective surgery.<sup>98</sup> Data from randomized control clinical trials have shown that most conventional forms of periodontal therapy are effective as long as patients comply with post-treatment maintenance programs.<sup>97</sup>

Advances by researchers in the fields of molecular biology, human genetics and stem cell biology are expected to pave the way for future development of procedures needed for the regeneration of periodontal tissues.<sup>97</sup>

### 5.10.3 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review and dental health noted that

- Epidemiological studies of periodontal diseases are difficult to interpret due to the diversity of measures used to describe and quantify disease, and the absence of a uniform definition and classification over the years.<sup>95,99,100</sup> As with caries, “there is a conspicuous lack of uniformity in the definition of periodontitis used in epidemiological studies.”<sup>100</sup>
- Signs of periodontal disease include gingival bleeding, periodontal pocketing and loss of attachment. Other than gingival bleeding, which can occur in both gingival diseases and periodontitis, the other indicators of periodontal disease require assessment in a clinical dental setting. The findings from the WHO global Oral Health Data Bank indicate that gingival bleeding is very prevalent among adult populations in all regions of the world. Advanced disease with deep periodontal pockets (> 6 mm) affects approximately 10 per cent to 15 per cent of adults worldwide.<sup>99</sup> This is consistent with the findings of the 2001 BC Adult Dental Health Survey, where 15.4 per cent of adults aged 16 and older had deep periodontal pockets.<sup>101</sup> The BC survey involved a subpopulation of adults who attended a private dental clinic. As people in low socio-economic situations are likely to experience more periodontitis and attend a dentist less often, the data must be interpreted with caution. Clinical expression of plaque-induced diseases can be affected by systemic factors (such as perturbations in the endocrine system), medications, and malnutrition.<sup>100</sup>
- While the role of bacteria in the initiation of periodontitis is primary, a range of factors influence the onset, clinical presentation and rate of progression of the disease. An individual’s response, the modifying effect of various risk factors, and the bacterial attack from dental plaque accounts for a variety of disease patterns, both between individuals and between different sites in the mouth within the same individual.
- The WHO recommends integrated preventive strategies to address periodontal disease (based on the common risk factors approach for public health practice) and suggests integration of oral disease prevention within the prevention of non-communicable chronic diseases.<sup>102</sup>
- A Cochrane review of 13 studies on educational and behavioural interventions to reduce plaque levels and/or gingival bleeding shows that “interventions had significant short-term improvements but were not effective in the long term. Reductions in plaque and

gingival bleeding were seen in the short term in the majority of studies reviewed. However, future studies need longer follow-up periods to assess whether short-term beneficial changes are sustained. Other forms of oral health promotion require better quality evaluation if they are to be used to improve periodontal health.<sup>103</sup> Five of the trials were set in schools, four focused on adults in a clinical or workplace setting, three targeted older people and one targeted parents of infants. None of the studies produced a negative effect.<sup>103</sup>

**Level of Evidence:** *Evidence for Implementation*

Integrated preventive strategies to address periodontal disease have been shown to be effective. Education and behavioural interventions to reduce plaque levels and gingival bleeding have shown significant short-term improvements. There is no current evidence that indicates that short-term benefits are sustained in the long term.

## **5.11 Oral Hygiene Instruction**

### **5.11.1 Current Evidence**

Almost 50 years of experimental research and clinical trials in various geographical and social settings have confirmed that the effective removal of dental plaque is essential for dental and periodontal health. Oral hygiene acts as a non-specific suppressor of plaque mass and reduces the injurious load on the inflamed tissues adjacent to bacterial deposits. Primary prevention of periodontal disease includes educational interventions as well as regular, self-performed plaque removal and professional mechanical removal of plaque and calculus.<sup>104</sup>

Although brushing twice daily with fluoride toothpaste is an integral part of most people's daily hygiene routine in Western societies, most individuals are unable to achieve total plaque control at each cleaning. A systematic review of the literature summarized the evidence regarding various aspects of oral hygiene.<sup>104</sup> It found that

- A single oral hygiene instruction has a small positive effect that will last six months or more.
- Tooth brushing using a manual toothbrush is effective to the extent that it results in a reduction of the plaque scores by approximately half compared to no tooth brushing. An oscillating/rotating toothbrush provides additional efficacy with studies demonstrating an additional 7 per cent increase in plaque reduction and a 17 per cent increase in gingivitis reduction.<sup>dd</sup>
- Research on dental flossing indicates that few individuals floss correctly and thus are unable to remove plaque efficiently. Dental flossing is only effective in reducing the risk of inter-proximal caries when conducted by a dental professional.

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<sup>dd</sup> Oscillating/rotating toothbrushes may be too large for some age groups.

### 5.11.2 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health noted that

- Conscious and repeated efforts are required to prevent decay through daily personal hygiene. The biofilm on the teeth must be removed daily through mechanical action and fluoride applied for caries prevention.
- Alterations in knowledge, attitudes and beliefs do not necessarily result in changes in behaviour or health. Complex and technical education methods add little benefit, and simple provision of information is often sufficient to increase knowledge levels. Repeated sessions are of more value than single instruction sessions.<sup>38,54</sup>
- A review of evidence from Australia found education is most effective if given one-to-one and individualized to meet the person's needs and address their motivational and environmental influences.<sup>38</sup> They found good systematic reviews of the development of personal skills including tooth brushing and flossing, with good evidence to recommend flossing as an adjunct to tooth brushing and benefits of brushing with fluoride toothpaste.

**Level of Evidence:** *Evidence for Outcome Effectiveness*

Research has shown that some benefits result from individual instruction in hygiene, although it may have limited value unless combined with other strategies. Oral health instruction is more effective when it is repeated.

## **5.12 Summary**

With respect to the prevention of dental diseases, several strategies have been identified. Those with the highest level of evidence (*Evidence for Effective Dissemination*) include the use of fluoride and dental sealants. For example:

- Fluoridation of community water has been shown to be a safe and effective public health measure that significantly reduces the rate of dental decay.
- Fluoride toothpaste over 1000 ppm has been shown to have a significant caries preventive effect. However, for children under the age of six, the risk of developing caries should be balanced against the risk of mild fluorosis.
- Mouth rinses with fluoride have been shown to be effective in reducing dental caries.
- The use of fluoride rinses in school based programs in high-risk areas appears to be cost effective. However, the cost effectiveness of such programs in schools with low caries prevalence has been questioned.
- The application of fluoride varnish applied two to four times a year is highly effective in preventing dental caries in both primary and permanent teeth.
- Additional caries reduction has been shown to result from the use of a variety of topical fluoride therapies (such as mouth rinses, gels and varnishes) when combined with

fluoride toothpaste. A variety of fluoride therapies are appropriate for people considered to be very susceptible to developing caries.

- Dental sealants are highly effective in caries prevention. Based on the research, it has been recommended that they be placed on the primary molars of children who are susceptible to caries and on permanent molars without cavitation.

Strategies with sufficient evidence to demonstrate positive outcomes (*Evidence for Outcome Effectiveness*) include the following:

- Fluoride supplements have been shown to be effective in preventing dental caries in permanent teeth, but mixed results have been obtained regarding their effectiveness for primary teeth. Supplements may be prescribed for vulnerable individuals where there is little access to other forms of fluoride. Caution must be taken to minimize the risk of fluorosis (particularly in young children).
- The use of xylitol and/or sorbitol chewing gum has been shown to be effective as part of oral hygiene, particularly for those at moderate to high risk of developing dental caries.
- Xylitol and/or sorbitol chewing gums may also reduce the level of *S. mutans* in new mothers, thus reducing the transfer of these bacteria to their infants.
- Some benefits may result from individual instruction in hygiene, although it may have limited value unless it is combined with other strategies. Oral health instruction is more effective when it is repeated.

Strategies with sufficient *Evidence for Implementation* include the following:

- High and frequent sugar intake and consumption of carbohydrates is a moderate risk factor for caries where there is adequate exposure to fluoride. Lower and less frequent sugar consumption can reduce the risk of dental caries.
- Integrated preventive strategies to address periodontal disease have been shown to be effective.
- Education and behavioural interventions designed to reduce plaque levels and gingival bleeding have shown significant short-term improvements, although there is no current evidence that indicates the short-term benefits are sustained in the long term.

## **6.0 DENTAL HEALTH FOR PREGNANT WOMEN AND NEW MOTHERS**

Dental health plays a crucial role in the overall health and well-being of pregnant women.<sup>105</sup> It is also essential for the health and well-being of their newborn children. Many expectant mothers are unaware of the implications of poor oral health for themselves, their pregnancy, and/or their unborn child. Furthermore, mothers with poor oral health and high levels of cariogenic oral bacteria are more likely to infect their children with the bacteria and increase their children's caries risk at an early age.<sup>106</sup>

### **6.1 The Effect of Maternal Periodontal Disease on Pregnancy**

#### **6.1.1 Preeclampsia**

Periodontal disease has been associated preeclampsia. For example:

- Boggess<sup>107</sup> found that a common oral bacterial marker, *Micromonas micros*, was prevalent in a group of women with early onset preeclampsia. It was suggested that oral pathogens from periodontal disease travel to the uteroplacental areas causing placental inflammation or oxidative stress, which leads to placental damage and potential preeclampsia.
- Ruma et al.<sup>108</sup> found that women with periodontal disease (defined as having a serum C-reactive protein level at the 75th percentile) had a five-fold greater risk of developing preeclampsia during pregnancy.
- Conde-Agudelo et al.<sup>109</sup> have suggested that pre-existing preeclampsia may be further aggravated by periodontal disease.

A meta-analysis of 15 studies (3 cohort and 12 case control studies) was conducted by Sgolastra et al.<sup>110</sup> A positive association was found between periodontal disease and preeclampsia. The authors noted, however, that there were important differences among the studies with respect to definitions and diagnoses as well as a lack of good methodological quality. They concluded that additional research needs to be conducted.

#### **6.1.2 Gestational Diabetes**

Gestational diabetes mellitus occurs in approximately 7 to 18 per cent of pregnant women.<sup>111</sup> Half of those who develop gestational diabetes mellitus will develop Type 2 diabetes mellitus within three to five years postpartum.<sup>112</sup>

Dasanayake et al.<sup>113</sup> found that pregnant women with periodontal disease are more likely to develop gestational diabetes mellitus than pregnant women with healthy gums. In a study of 256 pregnant women, 8.3 per cent developed gestational diabetes. These women had significantly higher levels of periodontal disease and inflammation than others in the study.

A more recent, but much smaller case control study confirmed these findings.<sup>114</sup> In this study, 50 females diagnosed with gestational diabetes were compared with 50 age-matched females.

Half of the women with gestational diabetes had periodontitis compared to 26 per cent of the women in the control group.

Another recent study found a high prevalence of periodontitis in pregnant women with and without gestational diabetes.<sup>115</sup> This case control study of 360 women found that 40 per cent of those with gestational diabetes and 46.3 per cent of those in the control group had periodontitis. The researchers concluded that the findings suggested “the need for implementation of health policies directed to the periodontal care of pregnant women.”<sup>115</sup>

Gestational diabetes can have a long-term effect on women. Bellamy et al.<sup>116</sup> conducted a comprehensive systematic review and meta-analysis to assess the strength of association between these two factors. Studies that included over 650,000 women were examined and it was concluded that women with gestational diabetes are seven times more likely to develop Type 2 diabetes than women with normoglycaemic pregnancies.

### 6.1.3 Preterm/Low Birth Weight Births

Preterm/low birth weight births are a significant public health issue. They are a major cause of neonatal death, long-term neuro-developmental conditions, and other long-term health problems.

Emerging evidence supports the theory that periodontal disease triggers an increased inflammatory response that can induce labour. There is moderate to strong evidence that the presence of the bacterium *Porphyromonas gingivalis* in amniotic fluid is associated with preterm/low birth weight births. Additional studies suggest that women with periodontal infection experience preterm deliveries more often than women without infection.<sup>117</sup>

### 6.1.4 Pregnancy Outcomes

Periodontal disease has been associated with adverse pregnancy outcomes such as: preterm/low birth weight; low birth weight by gestational age; miscarriage or pregnancy loss; and preeclampsia. However, inconsistent findings have been also been obtained. For example:

- A 2006 prospective study compared periodontal health and related obstetrical outcomes for over 1,000 women.<sup>118</sup> Antepartum and postpartum periodontal examinations were conducted. The relative risk for spontaneous preterm birth at less than 37 weeks of gestation was significantly elevated for women with moderate to severe periodontal infection (the relative risk was 2 per cent, adjusted for maternal age, race, parity, previous preterm birth, tobacco use and socio-economic status). In addition, periodontal disease progression was found to be an independent risk factor for delivery at less than 32 weeks.
- Xiong et al.<sup>119</sup> performed a systematic review of 25 studies (13 case control, 9 cohort, and 3 controlled trials). Of these, 18 suggested an association between periodontal

disease and an increased risk of an adverse pregnancy outcome and 7 found no evidence of an association.

- a 2006 systematic review found that of 44 studies identified, 29 suggested an increased risk of adverse pregnancy outcomes with periodontal disease while 15 studies showed no association.<sup>120</sup>
- Dasanayake et al.<sup>121</sup> examined 55 papers published between 1966 and 2007 that presented original data. Of these, 31 indicated a positive association between periodontal disease and adverse pregnancy outcomes, 13 failed to find an association and 11 reported mixed results. In addition, of the 31 studies showing a positive association, there was considerable variation in the methods used to evaluate clinical periodontal status.
- A 2009 meta-analysis of worldwide studies on the relationship between periodontal disease and adverse pregnancy outcomes found that 50 studies reported a significant association while 24 failed to find an association.<sup>122</sup>

Some of the authors noted that failure to find an association between periodontal disease and adverse pregnancy outcomes may be due to small sample sizes, inadequate measures of disease status, and population-specific factors.<sup>121</sup> Different definition criteria for periodontal disease were also found to influence the outcome of studies that tested the association between pregnancy outcomes and periodontal disease.<sup>123</sup>

#### 6.1.5 Comparisons with the Dental Public Health Evidence Update 2006-2009 and the 2006 Evidence Review: Dental Public Health

The Dental Public Health Evidence Update: 2006-2009 (prepared for the Vancouver Coastal Health Authority by Hollander Analytical Services)<sup>124</sup> noted the following:

- Novak, et al.<sup>112</sup> analyzed data from the Third National Health and Nutrition Examination Survey (NHANES III). The treatment group consisted of women between 20 and 59 years of age who reported having had at least one pregnancy and a diagnosis of gestational diabetes mellitus; the control group consisted of women in the same age range without a history of gestational diabetes mellitus when the NHANES III was conducted. The researchers found that women with a history of gestational diabetes mellitus are likely to have more severe periodontal disease than women with a history of pregnancies without gestational diabetes mellitus.

The 2006 evidence review on dental health indicated the following:

- Between 30 per cent and 50 per cent of preterm births are thought to be due to maternal infections.<sup>125</sup>
- Mothers with severe periodontal disease have up to a seven-fold increase in the risk of delivering a preterm low birth weight baby.<sup>126</sup>

The 2006 evidence review also suggested that a child born prematurely and with low birth weight may have tooth and palate distortions and a higher prevalence of enamel hypoplasia in the primary teeth, and thus a predisposition to caries.<sup>127</sup> However, the research is inconsistent. For example, in a review of 13 published studies, O’Neill<sup>128</sup> found “contradictory results and a dearth of longitudinal studies” regarding a link between premature birth and altered oral development. Shulman<sup>129</sup> analyzed the National Health and Nutrition Examination Survey data and found it did not support an association between low birth weight and caries in primary teeth (see also Burt & Pai<sup>130</sup>).

**Level of Evidence:** *Evidence for Implementation*

A linkage between periodontal disease and gestational diabetes appears to be supported by relatively strong evidence.

There is considerable and significant research linking periodontal disease with preterm births. However, researchers have not found consistent results in their analysis.

## **6.2 Education and Promotion**

### **6.2.1 Introduction**

Pregnancy offers an opportunity to educate women regarding dental health by providing a ‘teachable moment’ in self-care and future child care. Based on an extensive review of the research literature, the American Academy of Pediatric Dentistry Council on Clinical Affairs<sup>131</sup> recommends:

- Education for health providers – As physicians, nurses and other health care professionals are far more likely than dentists to see expectant or new mothers and their infants, it is essential that they be educated about the infectious etiology and associated risk factors for dental caries and early childhood caries so they can make appropriate decisions regarding timely and effective interventions for pregnant women.
- Oral health education – Counselling during the perinatal period from all health care providers (including physicians, dentists and nurses) is essential to ensure good oral health for the mother and infant.
- Diet – Important components of the mother’s diet need to be discussed fully. A healthy diet is necessary to provide adequate amounts of nutrients for the mother-to-be and the unborn child. Food cravings may lead to the consumption of foods that increase the mother’s risk of caries. The caries potential of the mother’s diet (e.g., cariogenicity of certain foods, beverages and medicines) as well as its effect on the child should be addressed. The frequency of consumption of cariogenic substances and resulting demineralization/re-mineralization process are also important discussion topics.

### 6.2.2 Education for Health Providers

An online education program for midwives to assist them in improving perinatal oral health in pregnant women has been developed in Australia.<sup>132</sup> It recognizes that poor maternal oral health may affect pregnancy outcomes and the general health of women and their babies, and that midwives are well placed to provide dental health advice and referral. The education program is designed to: improve midwives' dental health knowledge; prepare them to assess the dental health of women and make referrals when required; and provide appropriate dental education to women and their families.

### 6.2.3 Oral Health Education

A landmark Swedish study has demonstrated strong evidence for effective strategies focused on women during pregnancy and mothers of young children to reduce the long-term risk of dental caries in children and adolescents. The prenatal dental disease prevention program for pregnant women was introduced in Sweden in 1978. All phases of the program included education about dental health, examination and treatment based on the concept of early dental health promotion. Longitudinal studies on the program have provided significant evidence of successful strategies.

- Phase I of the program, conducted between 1979 and 1991 was limited to the period of pregnancy. Findings indicated a drop in caries incidence and prevalence by 75 per cent to 90 per cent among pregnant women and delayed colonization of toddlers and young children with caries pathogens.<sup>133</sup>
- Phase II of the study comprised the preventive care of mothers and their children until the age of three. It found the delay in colonization of the children's oral activities with caries pathogens was extended for a longer period of time as no children in the prevention group showed detectable *S. mutans* levels at the age of three and were caries free with no fillings.
- Phase III of the project continued preventive care for mothers and children until the age of six. The study found that after age six, 75 per cent of participants in the prevention group were caries free compared to 50 per cent of participants in the control group.
- Phase IV examined the longer term impact on participants in the prevention group at ages 13 and 14. The positive effects of an early oral health care program started during pregnancy were clearly documented. Some 89.7 per cent of the teenagers in the prevention group in Phase IV were caries free (65.5 per cent were totally caries free, and 24.2 per cent were caries free with fillings). By comparison, 56.7 per cent of the teenagers in the control group were caries free (30.0 per cent were totally caries free and 26.7 per cent were caries free with restorations). However, the study also found a pronounced polarization or concentration of caries in low-income families in the control group, which pointed to the significance of treatment needs among vulnerable individuals in this group.<sup>133</sup>

The American Academy of Pediatric Dentistry Council on Clinical Affairs<sup>131</sup> suggests that health professionals provide guidance on dental hygiene to pregnant women regarding the following:

- The importance of tooth brushing with fluoridated toothpaste and flossing to help reduce bacterial plaque levels.
- Rinsing with a cup of water containing a teaspoon of baking soda and waiting an hour before brushing to help minimize dental erosion that may otherwise result when a pregnant woman experiences frequent vomiting.
- Chewing sugarless gum or gum containing xylitol and eating small amounts of nutritious food throughout the day to help minimize the risk of caries.
- Rinsing with an alcohol free, over the counter mouth rinse twice a day to reduce plaque levels and help promote enamel re-mineralization.

Because of the strong association between periodontal diseases and pregnancy outcomes, Dasanayake et al.<sup>121</sup> suggest that nurses do the following:

- Teach their pregnant patients that dental health can be related to fetal health and that the bacteria in their mouths can make a difference in their babies' health.
- Assess maternal dentition as a routine prenatal practice and provide advice on proper brushing and flossing techniques.
- Encourage all women to visit their oral health care professional if their last visit was more than six months ago.
- Be proactive in referring pregnant women for dental care.
- Stress that dental care is both safe and effective during pregnancy.

An adolescent pregnancy program, the Rochester Adolescent Maternity Program, integrated an evidence-based dental health care model into its group prenatal practice.<sup>134</sup> Evidence-based guidelines were adopted to focus on tracking dental health services, screening and triaging prenatal patients and providing patients and staff with the education needed to decrease dental health risks for the mother, fetus and baby. An evaluation of the model found very good to excellent levels of patient satisfaction and high satisfaction with service delivery.

#### 6.2.4 Diet

Several studies on maternal nutritional habits have shown an association with a lower risk of dental caries in infants and children.

- A Japanese study examined 315 children of women who completed surveys regarding their dietary habits during pregnancy. The researchers found that a high intake of dairy products during pregnancy was associated with a lower risk of dental caries in the children. It was suggested that the calcium in the dairy products made the tooth enamel more resistant to acid.<sup>135</sup>

- Vitamin D levels during pregnancy may affect primary tooth calcification (vitamin D is essential in helping the body absorb calcium, a critical component of healthy bones and teeth). University of Manitoba researchers conducted a study to determine the relationship of prenatal vitamin D status of pregnant women with the incidence of enamel defects and early childhood tooth decay among their infants.<sup>136</sup> Some 206 pregnant women in their second trimester participated. Only 21 women (10.5 per cent) were found to have adequate vitamin D levels. Mothers of children with enamel defects had lower, but not significantly different, mean vitamin D concentrations during pregnancy compared to mothers of children without defects. However, mothers of children with early childhood tooth decay had significantly lower vitamin D levels than mothers of children who were cavity free. Infants with enamel defects were significantly more likely to have early childhood tooth decay.
- Schroth et al.<sup>137</sup> concluded that vitamin D deficiency is of concern and that supplementation may be necessary for many women during pregnancy, especially those in northern regions.

**Level of Evidence:** *Evidence for Outcome Effectiveness*

Education and guidance on good dental hygiene practices for pregnant women and new mothers is considered by leading organizations and experts in the field to be crucial. Pregnancy provides an opportunity to develop good lifetime dental and nutrition behaviours in both mothers and infants.

## **6.3 Prevention and Control of Dental Disease in Pregnant Women**

### **6.3.1 Introduction**

The American Academy of Family Physicians recommends that every pregnant woman be screened for oral risks, counselled on proper oral hygiene, and referred for dental treatment when necessary.<sup>138</sup> The American Academy of Pediatric Dentistry Council on Clinical Affairs<sup>131</sup> supports this position, noting that routine professional dental care for pregnant women can help optimize their dental health and avoid the risks that can result from periodontal disease and cariogenic oral bacteria. Unfortunately, many women do not seek dental care during their pregnancy and those that do often confront dentists who are unwilling to provide care.<sup>139,140</sup>

Removal of active caries with subsequent restoration of the remaining tooth structure is important to suppress maternal *S. mutans* reservoirs and has the potential to minimize the transfer of *S. mutans* to the infant, thereby decreasing the infant's risk of developing early childhood caries.<sup>141</sup> Treatment options include: the use of antibiotics and analgesics to treat infection and control pain; the use of diagnostic x-rays; dental prophylaxis and periodontal treatment; and restorations.<sup>131,141,142,143,144,145</sup>

### 6.3.2 Treatment for Infection and Pain

Acute conditions, such as pain and swelling should be treated as soon as possible. A delay in necessary treatment could result in a significant risk to the mother and an indirect risk to the unborn child.<sup>144</sup> The American Academy of Pediatric Dentistry Council on Clinical Affairs<sup>131</sup> has indicated that the consequences of not treating an active infection during pregnancy outweigh the possible risks presented by most of the medication required for dental treatment.

### 6.3.3 Use of X-rays

With respect to the use of diagnostic x-rays, the Canadian Dental Association<sup>146</sup> recommends that pregnant patients requiring essential and/or emergency treatment receive the minimum number of radiographs needed for diagnostic purposes.

### 6.3.4 Periodontal Treatment

Some research shows that scaling and root planing during pregnancy can reduce the likelihood of preterm deliveries and low birth weight babies.

- A study by Mitchell-Lewis et al.<sup>147</sup> compared 74 teenagers who received periodontal treatment during pregnancy with 90 teenagers who did not receive treatment during pregnancy. The rate of preterm/low birth weight delivery was 13.5 per cent in the group that received treatment and 18.9 per cent in the control group.
- In a study conducted by López et al.<sup>148</sup>, pregnant women with gingivitis were randomized to receive periodontal treatment prior to 28 weeks gestation (early treatment) or after birth (delayed treatment). The incidence of preterm/low birth weight infants among women treated during pregnancy was 1.8 per cent compared to 10.1 per cent for women who were not treated during pregnancy (i.e., the delayed treatment group).
- Three of the clinical trials reviewed by Xiong et al.<sup>119</sup> suggested that oral prophylaxis and periodontal treatment can lead to a 50 per cent reduction in preterm births and a 57 per cent reduction in preterm/low birth weight births.
- A meta-analysis of randomized control trials of treatment of gingivitis and periodontitis via scaling and root planing was undertaken by Polyzos et al.<sup>149</sup> Results were determined for overall outcome and stratified by severity of periodontal disease, preterm birth or low birth weight birth and education level. There was strong evidence that periodontal treatment reduced the rate of preterm birth, borderline statistical support that it reduced low birth weight and no support that treatment reduces fetal loss. A subgroup analysis indicated that the absence of previous preterm birth and less severe periodontal disease resulted in significantly fewer preterm births. There was no correlation with education level or presence of severe periodontal disease.

Other research does not show an association between periodontal treatment and prevention of preterm birth, fetal growth restriction or preeclampsia (e.g., Michalowicz et al.<sup>150</sup>).

Recognizing the lack of clear evidence, the American Academy of Pediatric Dentistry Council on Clinical Affairs<sup>131</sup> states that regardless of the potential to improve pregnancy outcomes, the data on the relationship between maternal and child experience with dental caries is well established. Therefore, comprehensive dental services for pregnant women should be available to safeguard their own oral and general health and reduce their children's risk of caries.<sup>131,151</sup>

### 6.3.5 Restorations

Statements regarding the use of amalgams during pregnancy are inconsistent. According to a number of experts, there is no evidence that mercury released from the mother's existing restorations causes any adverse effects on the unborn child.<sup>131,143,141,145</sup> As mercury vapour released during removal and placement of an amalgam restoration may be absorbed into the blood stream and cross the placental barrier, the use of a rubber dam and high speed evaluation are recommended.

Health Canada has stated that amalgams should not, if possible be placed or removed during pregnancy. Wrzosek and Einarson<sup>152</sup> note that

this might be a rather conservative approach as studies and case reports of amalgam exposure during pregnancy have not documented any toxicity, including birth defects, neurologic sequelae, spontaneous abortions or a reduction in fertility. In one study there was no association of cumulative amalgam exposure in 1,062 births categorized as having complications of pregnancy and childbirth. A case control study of 1,117 low birth weight infants found no association between low birth weight and placement of amalgam during pregnancy.

In addition, the Canadian Dental Association<sup>81</sup> noted that a stakeholder committee convened by Health Canada concluded that while "the research evidence did not support excluding children, pregnant or lactating women...from receiving amalgam fillings...common sense dictates that pregnant women should avoid any elective medical or dental intervention until after delivery."

The optimal time to perform dental treatment during pregnancy is in the second trimester.<sup>138,151,141</sup> The risk of pregnancy loss is lower in the second trimester compared to that in the first trimester and organogenesis is complete. Due to patient positions, comfort is a consideration for treatment during the third trimester and elective treatment is sometimes best deferred until after delivery.<sup>131</sup> Even though the second trimester is usually optimal, dental treatment can be accomplished safely at any time during pregnancy.<sup>131,144</sup>

### 6.3.6 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health noted that randomized control trials on early interventions and the effect of periodontal therapy suggest that treatment reduces the risk of preterm/low birth weight births.<sup>126,153</sup> For example, in a study in Chile of 870 pregnant women

with gingivitis, the treatment group received oral hygiene instruction, scaling and daily rinsing with 0.12 per cent chlorhexidine every two to three weeks until delivery. The incidence of preterm/low birth weight births was 2.1 per cent in the treatment group and 6.7 per cent in the control group.<sup>153</sup>

**Level of Evidence:** *Evidence for Dissemination*

During pregnancy, treatment for dental conditions is important to safeguard the mother's dental health and suppress maternal *S. mutans* reservoirs as well as reduce the possibility of transferring *S. mutans* to the infant.

The second trimester is the most optimal time to perform dental treatment, although it can be safely accomplished any time during pregnancy.

**Level of Evidence:** *Evidence for Outcome Effectiveness*

Preventive interventions for pregnant women involving multiple strategies have been shown to be effective.

Periodontal treatment for pregnant women should be available to safeguard their own health and reduce the risk of having a preterm/low birth weight baby.

**Level of Evidence:** *Warrants Further Research*

Although amalgam may be used as a restorative material in pregnant women (evidence has shown there are no adverse effects), some respected Canadian organizations suggest it should be avoided as a cautionary measure.

## **6.4 Dental Health for New Mothers**

### **6.4.1 Reduction of Maternal Reservoir *S. mutans***

It has been shown that maternal salivary levels of *S. mutans* are significantly related to *S. mutans* colonization in their plaque and dental caries in their children.<sup>154,155</sup> DNA fingerprinting studies show genotype matches between mothers and infants in over 70 per cent of cases.<sup>156</sup> Mothers who have experienced extensive tooth decay are most likely to harbour high levels of *S. mutans* and will thus put their young children at elevated risk for early childhood caries.<sup>151,157</sup>

The American Academy of Pediatric Dentistry's Guideline B<sup>131</sup> addresses the importance of delaying the onset and reducing the impact of *S. mutans* colonization of the infant. Modification of the mother's oral hygiene and diet and other preventive practices can have a significant effect on *S. mutans* levels and correspondingly, the infant's caries rate. Preventive measures to suppress maternal *S. mutans* reservoirs can include: dietary counselling; reducing the frequency of simple carbohydrate intake; applying topical fluoride and/or chlorhexidine;

removing and restoring active caries; and chewing gum containing xylitol.<sup>131,144,158</sup> The American Academy of Pediatric Dentistry<sup>159</sup> also recommends educating parents about the importance of avoiding saliva-sharing behaviours (e.g., cleaning a dropped pacifier or toy with their mouth, sharing spoons or other utensils, and sharing cups) to prevent *S. mutans* colonization in infants.

#### 6.4.2 Use of Fluoride and/or Chlorhexidine

In a study by Brambilla et al.,<sup>160</sup> a fluoride and chlorhexidine regime used over a 30-month period reduced the salivary *S. mutans* levels in mothers by approximately six times over those in the control group. The significant reductions in the level of caries causing bacteria resulted in delayed colonization of the bacteria among offspring.

#### 6.4.3 Removing Active Decay

Brambilla et al.<sup>160</sup> also reported that reducing high levels of *S. mutans* by removing active decay and improving the mother's oral hygiene before her baby is born prevents or delays infection in her infant. At 30 months, 48 per cent of the children in the experimental group, and 83 per cent of the children in the control group were infected.

#### 6.4.4 Use of Xylitol

A review by the New York Langone Medical Centre<sup>161</sup> discussed current evidence that regular use of xylitol by a mother of a newborn may prevent the growth of the *S. mutans* bacteria and provide long lasting protection to the child.

#### 6.4.5 Education Programs

A public health dental program, a component of Healthiest Babies Possible, was evaluated in Vancouver BC in 2006. The program had been providing dental health education and limited clinical services for over 20 years to low-income women assessed to be at high risk of preterm or low weight births. A before-and-after evaluation was conducted over a one year period with 61 women. Outcomes were assessed based on questionnaires used during two clinic visits and one post-natal visit. Results indicated that clinical indices of gingival health improved significantly over the time of the evaluation. Improvements in teeth cleaning were demonstrated by a significant decrease in plaque. The mothers' oral health knowledge improved and they pursued infant dental care and sought professional dental visits for their children.<sup>162</sup>

The US Nurse-Family Partnership Program is an intensive home-visiting program that is available to pregnant women and new mothers (up until the child's second birthday). A 15-year follow up of a randomized control trial indicated that the program not only influenced the children's development in a positive way but also caused a long-term improvement in health (including dental health) in mothers and their offspring. Researchers concluded that intense care with early preventive treatment may result in long-term improvement of oral and general health, particularly in children.<sup>160,163</sup>

#### 6.4.6 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health noted the following:

- Chewing gum may help prevent caries by stimulating saliva flow, replacing fermentable sugars in the diet or reducing the ability of *S. mutans* to adhere to the tooth surface. Sugar free gums generally contain sorbitol as the sweetener and act by stimulating saliva flow and possibly replacing fermentable sugars in the diet. Short-term use of gum containing xylitol is associated with decreased *S. mutans* levels in saliva and plaque.<sup>164</sup>
- In another study, mothers with high *S. mutans* counts chewed xylitol gum three times daily from the time their child was six months old until it was 18 months old. The results showed that “maternal consumption of xylitol and chlorhexidine/xylitol containing chewing gums significantly reduced the mother-child transmission of salivary *S. mutans*.”<sup>165</sup> The amount of xylitol needed to reduce *S. mutans* levels is unclear as a follow-up study noted that

lower but non-significant levels of salivary *S. mutans* and dental decay were observed in three year old children of mothers who used high content xylitol gums compared with those who used lower amounts of xylitol. The efficiency of this type of targeted intervention in a low caries community may be questioned.<sup>91,166</sup>

- In a longer study, Soderling et al.<sup>167</sup> looked at *S. mutans* levels after maternal xylitol consumption had been discontinued (in this study, the mothers started when their child was three months old and continued until their child was 24 months old). They found that at age three, 27.6 per cent of the children of mothers who used xylitol were colonized with *S. mutans*, compared to 64.5 per cent in the group whose mothers had received fluoride varnish at 6, 12 and 18 months, and 37.0 per cent in the group whose mothers had received chlorhexidine varnish at 6, 12 and 18 months. At six years of age, 51.6 per cent of the xylitol, 83.9 per cent of the fluoride varnish and 86.4 per cent of chlorhexidine groups showed detectable levels of *S. mutans* in their saliva.

**Level of Evidence: Evidence for Outcome Effectiveness**

Maternal salivary levels of *S. mutans* are significantly related to dental caries in their children. Preventive measures to suppress maternal *S. mutans* reservoirs can include dietary counselling, reducing the frequency of simple carbohydrate intake, applying topical fluoride (through mouth rinses, etc.), removing and restoring active caries, and chewing gum containing xylitol. It is also important that parents avoid saliva-sharing behaviours (e.g., sharing spoons with their children).

## 6.5 Summary

The highest level of evidence with respect to dental health for pregnant women and new mothers (Evidence for Effective Dissemination) supports the following:

- Dental treatment for pregnant women is important to safeguard the mother's dental health, suppress maternal *S. mutans* reservoirs, and reduce the possibility of transferring *S. mutans* to the infant.
- The second trimester is the most optimal time to perform dental treatment although it can be safely accomplished any time during pregnancy.

The next level of evidence (Evidence for Outcome Effectiveness) indicates the following:

- Education and guidance on good dental hygiene practices for pregnant women and new mothers is considered to be critical. Pregnancy provides an opportunity to develop good lifetime dental behaviours in both mothers and infants.
- Preventive interventions for pregnant women involving multiple strategies have been shown to be effective.
- Maternal salivary levels of *S. mutans* are significantly related to dental caries in their children. Preventive measures to suppress maternal *S. mutans* include dietary counselling, reducing the frequency of simple carbohydrate intake, applying topical fluoride (through mouth rinses, etc.), removing and restoring active caries, and chewing gum containing xylitol. It is also important that parents avoid saliva-sharing behaviours (e.g., sharing spoons with their children).

Evidence for Implementation includes the following:

- A linkage between periodontal disease and gestational diabetes appears to be supported by relatively strong evidence.
- There is considerable and significant evidence linking periodontal disease with preterm births. However, the research has been inconsistent.

An intervention that *warrants further research* is the use of amalgam during pregnancy. Although evidence has shown that amalgam may be used as a restorative material in pregnant women (as no adverse effects have been demonstrated in extensive research) some respected Canadian organizations suggest it should be avoided as a cautionary measure.

## **7.0 DENTAL HEALTH IN EARLY CHILDHOOD AND IN SCHOOL-AGED CHILDREN AND ADOLESCENTS**

Children's oral health impacts their social functioning and economic productivity later in life.<sup>28</sup> In studies of children under the age of six, dental decay or early childhood caries has been linked to embarrassment, increased irritability, and fewer social interactions.<sup>168</sup> Dental decay is also related to a child's subsequent health and emotional development. Among children aged 4 to 15, caries has been significantly associated with adverse effects on smiling, self-confidence and emotional well-being.<sup>14,169</sup>

It is important for parents and caregivers to understand the oral health needs of children at each stage of development. The Association of State and Territorial Dental Directors<sup>170</sup> suggests that effective communication methods are required to inform parents/caregivers at an individual level and the public at large about the nature of tooth decay in early childhood, its risk factors, and disease process.

This chapter examines evidence related to dental health in children and adolescents. Sections 7.1 to 7.6 focus on early childhood dental health, especially the impact and treatment of early childhood caries. Section 7.7 focuses on dental health in school-aged children and adolescents.

### **7.1 Definition of Early Childhood Caries**

Early childhood caries is an infectious disease that involves social, behavioural, microbiologic, environmental and clinical factors. It is defined by the American Academy of Pediatric Dentistry Council on Clinical Affairs<sup>171</sup> as the presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child 71 months of age or younger. In children younger than three years of age, any sign of smooth surface caries is indicative of severe early childhood caries. From ages three through five, one or more cavitated, missing or filled smooth surfaces in primary maxillary anterior teeth or a decayed, missing or filled score of > 4 (age 3), > 5 (age 4), or > 6 (age 5) surfaces constitutes severe early childhood caries.<sup>171</sup>

### **7.2 Risk Factors for Early Childhood Caries**

Several risk factors for early childhood caries have been identified. These include: developmental defects in enamel; microbiologic factors; presence of visible plaque; history of dental caries; dietary factors; socio-economic status; psychosocial factors; and social support (Association for State and Territorial Dental Directors, 2011.<sup>62,170</sup>

#### **7.2.1 Enamel Developmental Defects**

Lack of enamel maturation or the presence of developmental structural defects in enamel may increase the caries risk in preschool children. Such defects increase *S. mutans* colonization and enhance plaque retention.

### 7.2.2 Microbiologic Factors

Preschool children with high colonization levels of *S. mutans* have greater caries prevalence and a much greater risk of new lesions than children with low levels of *S. mutans*.

Early infection with *S. mutans* is a significant risk factor for future development of cavities.<sup>160,172</sup> Bacterial studies show that in children with early childhood caries, *S. mutans* exceeds 30 per cent of the plaque flora compared to less than 0.1 per cent in children with negligible to no caries activity. These studies also show that the frequency of infant infection increases when the mother has high levels of *S. mutans*.<sup>172</sup> Further, studies suggest transmission of *S. mutans* can occur not only between mother and child but also horizontally between siblings and in day care settings (e.g., through saliva-sharing behaviours).<sup>172</sup> The Canadian Dental Association<sup>173</sup> recommends cleaning a child's mouth (with a clean damp washcloth or soft baby brush) even before he/she has teeth.

### 7.2.3 Visible Plaque

Studies demonstrate a correlation between visible plaque on primary teeth and caries. One study found that 91 per cent of children are correctly classified as to caries risk solely on the basis of the presence or absence of visible plaque.

### 7.2.4 Previous Caries Experience

Children under the age of five with a history of dental caries should automatically be classified as being at high risk for future decay. The absence of caries is not a useful caries risk predictor for infants and toddlers because even if these children are at high risk, there may not have been enough time for carious lesion development. White spot lesions are precursors to cavitated lesions and will be apparent before cavitations. Thus, white spot lesions as well as staining of pits and fissures should be considered equivalent to caries when determining caries risk.

### 7.2.5 Dietary Factors

There is abundant epidemiological evidence that dietary sugars affect dental caries prevalence and progression. A young child's exposure to excess sugary liquid during bottle feeding and habits such as dipping a pacifier in honey or corn syrup can increase the risk of tooth decay. Also, allowing a child to use a bottle continuously throughout the day or to sleep with a bottle can lead to decay.<sup>170</sup>

The intensity of caries in preschool children may be due to frequent sugar consumption. High frequency of sugar consumption enables repetitive acid production by cariogenic bacteria that adhere to teeth. Four cohort studies of preschool children from the age of one to five years found that daily consumption of drinks containing sugar, especially during the night, and daily intake of sugar were independent risk factors in the development of early childhood caries.

The American Academy of Pediatric Dentistry Council on Clinical Affairs<sup>131</sup> has indicated that while there is no question that fermentable carbohydrates are a necessary link in the causal chain for dental caries, a systematic study of sugar consumption and caries risk has concluded that the relationship between sugar consumption and caries is weaker in the modern age of fluoride exposure than previously thought.

#### 7.2.6 Socio-economic Status

The evaluation of early childhood dental programs in BC noted that low socio-economic status is a key factor in potential early childhood caries.<sup>14</sup> As noted previously, children from low-income families are more likely to have caries than children from high-income families. Although prevalence levels are lower for children from high-income families, when they develop caries, the severity of the disease is similar to that of low-income children.

The relationship between low socio-economic status and early childhood caries appears to be consistent across multiple measures of socio-economic status that relate to community characteristics (such as unemployment, home ownership, households with children under five years of age, single-parent families and first-generation citizens). The relationship between socio-economic status and dental health also holds across measures such as educational attainment, ethnicity, and household income.<sup>14</sup>

#### 7.2.7 Psychosocial Factors

Some psychosocial and environmental factors appear related to caries development but are not well understood. These include parenting stress, social support, caregiver perceived self-efficacy and neighbourhood issues. The association between stress and chronic disease is well established in the research literature, but not clearly in the relationship with dental caries as studies of caregiver stress and caries risk among young children have shown varying results.

#### 7.2.8 Social Support

Social support and social integration have received considerable attention in the general health literature. They have been shown to reduce the adverse effects of many health conditions and to contribute to positive well-being, improved quality of life and greater longevity. Social support has received less attention in the oral health literature. However, a longitudinal study of low-income African-American children and their caregivers has consistently demonstrated the importance of individual and neighbourhood level social support in reducing caries risk and in predicting caries progression among young children.

#### 7.2.9 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health noted the following:

- Frequent ingestion of fermentable carbohydrates through daytime snacking or inappropriate use of nursing bottles and sippy cups can enhance exposure to sugars. Frequent feeding during sleep intensifies the risk of caries due to a decrease in the rate of oral clearance and salivary flow.<sup>172</sup> The nutritional content of food as well as the frequency and consistency of food impact the development of caries.<sup>174</sup> Further, the morphology of the tooth and the consistency and flow rate of the saliva impact caries development.
- A study in the United States of eating patterns of children aged one to five years found that higher snack eating events increased caries risk, as did higher exposures to 100 per cent juice and soda pop at snack and meal times.<sup>174</sup>

## **7.3 Impact of Early Childhood Caries**

### **7.3.1 Current Evidence**

A 2009 review of the impact of early childhood caries<sup>175</sup> on affected children and their families indicated that the consequences can be substantial. It noted the following:

- Early childhood caries and its treatment can lead to serious disability and even death.
- Some studies found that early childhood caries significantly impacts child development (e.g., 19 per cent of children with early childhood caries experienced interference with play, 32 per cent with school, 50 per cent with sleeping and 86 per cent with eating).
- One study reported failure to thrive (a condition of poor growth in young children) in a cohort of low-income children. Body measurements and blood tests indicative of malnourishment are significantly associated with severe early childhood caries and suggest iron deficiency anemia.
- Although studies on the impact of early childhood caries on the development of children in physical, emotional and intellectual terms is fragmented, episodic pain from dental caries is well established as a constant finding, even from an early age, affecting up to 20 per cent of preschoolers.
- The effect of early childhood caries related pain on distraction from learning and school performance, while not generally measured, is significant. One cross-sectional study reported that more than one in ten school children experience tooth pain and another identified an association between poor general and oral health and poor school performance. A study in Michigan documented loss of sleep, inability to concentrate in school and absences from school all caused by dental caries related pain.
- Some studies concluded that a dysfunctional family or social situation (often with emotional outbursts and the threat of, or actual violence) can lead to a recurrence of early childhood caries. The relationship between early childhood caries and neglect is well established, but only recently have child maltreatment experts included dental caries in children as a possible marker for maltreatment.

The Canadian Institute for Health Information (CIHI)<sup>20</sup> has noted that dental problems may result in communication and socialization problems as well as poor self-esteem. Extraction of

primary teeth may affect the alignment of permanent teeth and increase the risk of dental problems later in life.

CIHI<sup>20</sup> reported that between 2010 and 2012, approximately 1 per cent of children one to five years of age in Canada underwent day surgery to fill or treat cavities and remove teeth due to early childhood caries. Day surgery for early childhood caries was the leading cause of day surgery for children in this age group. Day surgery rates were: 8.6 times higher for children from neighbourhoods with high Aboriginal populations (compared to those with low populations); 3.9 times higher for children in the least affluent neighbourhoods (compared to those in the most affluent neighbourhoods) and 3.1 times higher for children in rural neighbourhoods (compared to those in urban neighbourhoods). Table 7 shows the number of day surgeries and rate per 1,000 by health service delivery areas in BC.<sup>20</sup>

**Table 7: Number and Rate of Day Surgeries for Early Childhood Caries for Health Authorities in BC**

Health Authority	Health Service Delivery Area	Number	Rate per 1,000
Northern	Northwest	377	51.6
	Northern Interior	282	20.6
	Northeast	140	17.0
	<i>Total</i>	799	29.7*
Interior	Thompson/Cariboo	349	19.7
	Okanagan	247	9.5
	Kootenay-Boundary	113	19.6
	East Kootenay	58	8.3
	<i>Total</i>	767	14.3
Fraser	Fraser North	540	11.1
	Fraser South	824	12.5
	Fraser East	193	6.9
	<i>Total</i>	1557	10.2
Vancouver Coastal	North Shore/Coast Garibaldi	173	8.5
	Vancouver	470	10.5
	Richmond	123	8.4
	<i>Total</i>	766	9.1
Island	North Vancouver Island	191	20.4
	Central Vancouver Island	553	29.4
	South Vancouver Island	347	13.8
	<i>Total</i>	1091	21.2

\* Total rates are averages.

**Note:** The data are for children one to five years of age, for 2010-2011 and 2011-2012 combined. The data underestimate the prevalence of early childhood caries as they do not include children who were on wait lists for day surgery or treated for early childhood caries in community based settings.

**Source:** Canadian Institute for Health Information, 2013.<sup>20</sup>

The financial impact of the day surgeries is substantial, especially since early childhood caries is preventable. CIHI<sup>20</sup> estimated that for Canada the public cost of hospital care was \$21.2 million per year (not including costs for dental surgeons and anesthesiologists). For BC, the estimated public cost of hospital care was \$3.5 million per year, with an average cost of \$1,515 per day surgery.

### 7.3.2 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health also reported research findings related to the effect of caries on children's growth and ability to thrive. A 1999 report of a study at the Montreal Children's Hospital revealed that young children with caries had to wait six to eight months before treatment. During this wait time, 48 per cent of the children were in pain, 43 per cent had difficulty eating and 35 per cent had difficulty sleeping. After dental treatment, only 3 per cent had difficulty eating and 16 per cent had difficulty sleeping.<sup>23</sup>

## **7.4 Education and Promotion of Early Childhood Dental Health**

### 7.4.1 Current Evidence

It is commonly understood that beliefs, behaviours and attitudes towards health are shaped during the formative years. With this in mind, the importance of improving oral health care at the earliest possible age should not be underestimated.

Oral health promotion/education can be most effective when it is targeted at parents of newborns.<sup>176</sup> Evidence indicates that good oral health behaviours attained in the early years will translate to good oral health behaviours and good oral health outcomes in adult life.<sup>177</sup>

Health care practitioners are in an ideal position to provide oral health care and hygiene counselling during multiple well child health supervision visits in the first six years of life. Primary care health practitioners can play a significant role in the prevention of early childhood caries as they are uniquely positioned to provide assessment, intervention, education and referrals. To support this role, they should be encouraged to seek out and complete certification courses in early childhood caries prevention, management and anticipatory guidance.<sup>ee,178</sup>

### 7.4.2 Comparisons with the Dental Public Health Evidence Update 2006-2009 and the 2006 Evidence Review: Dental Public Health

The findings noted above are consistent with findings presented in two documents: the 2006 evidence review on dental health, and the Dental Public Health Evidence Update: 2006-2009.<sup>124</sup>

- Multiple intervention health promotion programs incorporating dental health education with other interventions are effective in reducing caries in young children and promoting other supportive health behaviours. The additional interventions within these programs include the tailoring of information to individual parents, home based delivery of interventions, multiple sessions and the inclusion of oral health promotion as part of a child health program.<sup>179,180</sup> For example, intensive education and support for

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<sup>ee</sup> Anticipatory guidance is the process of providing parents/caregivers with practical, developmentally appropriate information about children's health related to significant physical, emotional and psychological milestones. With respect to oral and dental health, discussion topics should include the causes and process of tooth decay, dietary and oral habits, and recognizing early signs of tooth decay.

mothers of young children in low socio-economic areas is effective in reducing childhood caries by 30 per cent to 50 per cent.<sup>23,179</sup> Reinforcing or repeating educational sessions were shown to be more effective if given one-to-one and individualized to meet the parent's needs.<sup>180</sup> Also, motivational interviewing techniques have proven to be effective strategies for influencing and supporting positive oral health practices and behaviours.<sup>181</sup> The Public Health Division of the Department of Human Services in Victoria Australia reported that, based on the evidence, it can be concluded that there will be a beneficial health gain from dental programs directed toward preschool children and their parents.<sup>38</sup>

- The timing of oral health promotion programs is important. A number of studies with effective outcomes were carried out with children under the age of three. Oral health promotion programs for parents initiated at the prenatal stage and continued post-natally were more effective in reducing childhood caries, plaque levels and maternal and child salivary *S. mutans*.<sup>182</sup>

## **7.5 Caries Risk Assessment**

### **7.5.1 Current Evidence**

Caries risk assessment models involve a combination of factors based on a child's age, biological factors, protective factors and clinical findings to determine the likelihood of the incidence of caries during a certain time period or the likelihood that there will be a change in the size or activity of lesions already present. The risk indicators are variables that are thought to cause the disease directly (e.g., microflora) or have been shown to be useful in predicting it (e.g., socio-economic status). They should be a routine component of new and periodic examinations by oral health and medical providers.<sup>131</sup>

There is not enough research information to establish quantitative caries risk assessment analyses.<sup>131</sup> Nevertheless, estimating children at low, moderate, and high caries risk by a preponderance of risk and protective factors will enable a more evidence-based approach to medical provider referrals. It will also establish the periodicity and intensity of diagnostic, preventive and restorative services.<sup>131</sup> The research also notes that the field of caries risk assessment is relatively new and that there are multiple population factors to consider in program planning, including socio-economic status, language diversity, etc.

The evaluation of early childhood dental programs in BC found that a variety of health authority staff administer dental health risk assessments.<sup>14</sup> The evaluators suggested that a standardized caries risk assessment tool could be used by public health dental personnel as well as by non-dental public health staff. It was suggested that, where feasible, dental staff should administer the risk assessment since they can provide follow up immediately. If no dental staff are available, non-dental public health staff (e.g., clerical staff or volunteers) could administer the questionnaire and submit the completed forms to dental staff for follow up.

The evaluators also suggested that the Ministry of Health consider developing standardized guidelines and follow up procedures for a provincial caries risk assessment guideline.<sup>14</sup> The tools do not need to be exactly the same for each health authority but consistent standard risk classification, data collection procedures, and resources should be used along with standardized messaging and consistent communication. The evaluators also recognized and encouraged health authorities to use/develop additional and supplementary tools that uniquely reflect their individual regions.

The Scottish National Clinic Guideline for the Prevention and Management of Tooth Decay in the Preschool Child states that caries risk assessment would be appropriate for use by both dental and non-dental personnel, and would be appropriate in a primary care setting. It recommends that “specialist community public health nurses and child health care professionals could consider carrying out a caries risk assessment of children in their first year as a part of the child’s overall health assessment” (Scottish Intercollegiate Guidelines Network, 2005).<sup>183</sup>

### 7.5.2 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health included the following findings:

- “The common risk approach provides a valuable opportunity to incorporate oral health promotion into general health promotion.”<sup>13</sup> Modification of risk factors at an early stage, before there is a need for treatment, decreases the impact of the disease. Recognizing the multiple risk factors for oral diseases and the inequalities in oral health patterns, several studies have looked at tools to identify individuals or groups who may be vulnerable to dental caries or periodontal diseases.
- The American Academy of Pediatric Dentistry<sup>184</sup> developed a caries risk assessment tool for infants, children and adolescents. The tool is designed for both dental and non-dental health care providers to assess levels of risk for disease, not to diagnose disease. Clinical conditions, environmental characteristics, and general health conditions are used to categorize a child as being at low, moderate or high risk for developing caries. The assessment enables determination of risk at a point in time so interventions can be planned that support families to prevent caries. The tool should be applied periodically to assess changes in risk status.<sup>43,185,186</sup>
- Studies have looked at the use of risk assessments by dental professionals, other health personnel and lay people. Both risk indicators and risk factors have been examined. Risk indicators have been defined as factors associated with the disease experience that may play a causal role in the disease process. Risk factors are not causally related to the disease process but aid in identifying vulnerable groups. Verification of risk indicators and risk factors requires longitudinal studies.<sup>187</sup>
- A number of online courses have been developed in the US to support health professionals to develop knowledge and skills in using a caries risk assessment tool. The American Academy of Pediatric Dentistry recognizes that an evaluation of the caries risk assessment is required.<sup>186</sup>

- Use of a risk assessment and subsequent follow up with parents of 12-month-olds has been effective in changing family behaviours.<sup>188</sup> Horowitz<sup>42</sup> supports the need for dental health interventions and says, “Community interventions hold the greatest promise of preventing early childhood caries because [they] can reach larger numbers of people.”
- Crall<sup>189</sup> offers a conceptual model for oral health services targeting preschool-aged children, which involves the use of a periodic risk assessment and dividing children into four categories based upon caries risk and level of disease. The model includes examples of strategies that could be incorporated into risk and/or disease management.

**Level of Evidence:** *Evidence for Implementation*

Caries risk assessment tools are considered by researchers to be an effective way to estimate children’s risk for dental caries (at a specific moment in time) as they cover a range of risk and protective factors. It is recognized, however, that research information is insufficient to enable quantitative caries risk assessment analyses.

## **7.6 Prevention and Control**

### **7.6.1 Introduction**

Although childhood tooth decay is common, it is also preventable. As noted above, the disease is multi-factorial in nature. However, the extent of the disease and the number of teeth affected can be influenced by preventive measures.

The American Public Health Association<sup>190</sup> has established a policy stating that the prevention of early childhood dental diseases requires an interdisciplinary approach, given the present low rate of dental attendance in early childhood, and that such prevention should commence in the health care networks that already serve children.

Early intervention programs are an important element of dental public health services as they seek to not only address inequities in access to regular prevention and restorative dental care, but also to increase the potential for all children to remain disease free.<sup>14</sup> Several strategies identified in the research literature are discussed below.

### **7.6.2 Healthy Eating**

#### ***7.6.2.1 Breast Milk***

Studies of human breast milk have shown that it is the best possible nutrition for infants. A very large, rigorous research study examined the effects of prolonged and exclusive breastfeeding on dental caries.<sup>191</sup> The researchers followed children participating in the Promotion of Breastfeeding Intervention Trial, a cluster-randomized trial of a breastfeeding promotion intervention based on the WHO/UNICEF Baby Friendly Hospital Initiative. A total of 17,046 healthy, mother-infant breastfeeding pairs were enrolled from 31 Belarusian maternity hospitals and affiliated polyclinics; 13,889 (81.5 per cent) were followed up at 6.5 years. At

follow up, polyclinic pediatricians transcribed and recorded the reports of a standard dental examination performed by public health dentists in the medical charts of the children at age six. The breastfeeding intervention led to a large increase in exclusive breastfeeding at three months (43.3 per cent vs. 6.4 per cent for the control group) and a significantly higher prevalence of any breastfeeding at all ages up to and including 12 months. No significant intervention effects were observed on dental caries. The results, based on the largest randomized trial ever conducted in the area of human lactation, provided no evidence of beneficial or harmful effects of prolonged and exclusive breastfeeding on dental caries at early school age.<sup>191</sup>

An earlier systematic review of epidemiological studies found inconsistent evidence of an association between breastfeeding beyond one year and the development of early childhood caries.<sup>192</sup> The reviewers concluded that the apparent observed association between breastfeeding and caries beyond one year is likely explained by dietary factors not accounted for in the design of the studies.

The Canadian Dental Association<sup>193</sup> has indicated support for breastfeeding as a nutritional benefit for infants and an effective preventive health measure. The Association also notes that "... breastfeeding is one of many risk factors that may contribute to the development of dental caries. Therefore, it is vital that mouth cleaning or tooth brushing be part of the daily routine for all infants, including those who are breastfed."<sup>193</sup>

**Level of Evidence:** *Evidence for Outcome Effectiveness*

There is strong evidence indicating that human breast milk is the best nutrition for infants and that it does not have any harmful impact on dental caries. However, mouth cleaning or tooth brushing should be part of the daily routine for all infants, including those who are breastfed.

**7.6.2.2 Nutritional Counselling**

Nutritional counselling for the purpose of reducing caries incidence in children is aimed primarily at teaching parents the importance of reducing frequent exposure to sugar. Two Swedish studies tested the effect of preventive education for new mothers on the subsequent caries experience of their children.<sup>194,195</sup>

One study provided diet and oral hygiene counselling to mothers of children in the test group at 6, 12 and 24 months of age as well as fluoride supplements. This study observed a 65 per cent lower caries rate in the four year old children of mothers in the treatment group compared to children of mothers in the control group.<sup>195</sup>

Another study with a similar program found a 42 per cent decrease in caries prevalence after four years.<sup>194</sup> This second study used a randomized control trial to provide nutritional counselling and oral health instruction to new mothers. It found that at four years of age, children of mothers in the treatment group had fewer between meal snacks, reduced sugar and

soft drinks intake, and increased consumption of fluoride tablets compared to children of mothers in the control group.

**Level of Evidence:** *Evidence for Implementation*

Studies on nutritional counselling for new mothers have demonstrated significant success in reducing early childhood caries when the counselling is combined with fluoride use (the studies do not indicate the relative success of nutritional counselling compared to fluoride use).

**7.6.3 First Dental Visit**

The Canadian Dental Association,<sup>196</sup> the American Association of Public Health Dentistry,<sup>197</sup> and the American Academy of Pediatric Dentistry<sup>159</sup> all recommend that children receive a dental health assessment within six months after the eruption of the first primary tooth, but no later than one year of age. This evaluation is intended to assess and check for dental problems and educate parents/caregivers.

The first dental visit should include the following:<sup>170</sup>

- Completion of medical/dental histories for the mother, primary caregiver and infant.
- An oral examination and development of a plan for comprehensive care in accordance with accepted guidelines and periodicity schedules for pediatric oral health.
- An assessment of the infant's risk of developing caries and determination of an appropriate prevention plan and interval for periodic re-evaluation.
- Guidance regarding dental and oral development, fluoride status, non-nutritive sucking habits, teething, injury prevention, oral hygiene instruction, and the effects of diet on dentition.
- Referral to appropriate health professionals if intervention is necessary.

A number of organizations (e.g., American Public Health Association,<sup>190</sup> American Association of Public Health Dentistry<sup>197</sup>) recommend that government agencies include the promotion of oral health of infants and children as an integral component of general health assessment and health promotion. They provide specific information, training and technical assistance on oral health assessment procedures and anticipatory guidance messages. State and local health departments and community health centres are encouraged to incorporate dental health in interdisciplinary programs for infants and children.

**Level of Evidence:** *Evidence for Outcome Effectiveness*

National dental organizations in Canada and the US highlight the importance of the first dental visit by year one to ensure access to dental assessment, education, and early intervention for early childhood caries.

#### 7.6.4 Fluoride

Fluoride exposure maximizes caries preventive effects both pre and post eruption of young children's teeth for those residing in non-fluoridated communities.

Studies have shown a consistent reduction in caries with the use of fluoridated toothpaste. A 2008 literature review reinforced the role of fluoride toothpaste as the most cost effective home care measure.<sup>198</sup> The use of fluoridated toothpaste in children under three years of age should be based on the child's level of risk of developing dental caries; parents should consult a health professional to determine if their child is at risk.<sup>62</sup> Children who are not at risk for developing tooth decay should have their teeth brushed by an adult using a toothbrush moistened only with water while those who are at risk should have their teeth brushed using a minimal amount of fluoridated toothpaste.<sup>62</sup> Children three to six years of age should be assisted during brushing and only a small amount of fluoridated toothpaste should be used.<sup>62</sup>

Topical fluoride applied professionally semi-annually also reduces caries. Fluoride varnishes are generally similar to other topical fluoride methods. The use of semi-annual fluoride varnish applications was identified as the best professional method for infants.<sup>198</sup>

The use of fluoride supplements is associated with a significant reduction in caries in both primary and permanent teeth.<sup>131</sup>

A child's caries risk should be considered in determining the use of professionally applied topical fluoride and fluoride supplements. Limited use of fluoride is recommended for children at low risk of developing caries, but significantly more intensive fluoride regimes are recommended for those who are more likely to develop caries.<sup>195</sup> For example, children under age six living in a community with fluoridated water and using fluoride toothpaste may have adequate caries prevention without professionally applied topical fluoride; those with lower exposure to fluoride may need the added benefits of a fluoride varnish applied at three-or six-month intervals.<sup>75</sup>

**Level of Evidence:** *Evidence for Dissemination*

Strong research evidence demonstrates successful results in the use of fluoride to reduce early childhood caries. This includes the use of fluoride toothpastes and varnishes (as well as water fluoridation).

#### 7.6.5 Dental Home

Organizations such as the American Academy of Pediatric Dentistry,<sup>159</sup> the American Academy of Pediatrics<sup>199</sup> and the Children's Dental Health Project support the concept of a "dental home", which brings together the interaction of the child, parents, non-dental professionals and dental professionals to deliver oral health care in a comprehensive, continuously accessible, coordinated, and family centred way.<sup>200</sup>

A dental home should emphasize prevention and disease management, as well as tailor care to meet individual needs for better health outcomes at lower costs. A dental home should also provide parental education and counselling (including anticipatory guidance), and make necessary referrals to dental specialists.<sup>200</sup> The first dental visit can be the initial step in establishing a dental home.

Public policy makers have long recognized the need to facilitate access to dental services for children, particularly children from low-income households.<sup>84</sup> Studies have shown that children who have a dental home are more likely to receive early preventive and appropriate dental health care.<sup>199</sup> Several state dental health programs assist families in establishing dental homes for vulnerable children or those with unmet dental needs.

The National Oral Health Policy Centre analyzed a number of factors related to the widespread adoption and implementation of the concept of the dental home.<sup>201</sup> They concluded that

- The potential impact of the dental home concept is greatest for the youngest children.
- The dental home will particularly benefit children whose risk for oral disease is exacerbated by social and/or medical vulnerabilities.
- Oral health promotion from an early age in a dental home will require extensive improvements in public awareness and professional engagement and systems-level improvements in care coordination between medicine and dentistry.
- Current dental system capacity cannot support wholesale implementation of the dental home unless the dental home's functions are shared by other agencies that interact with children where they live, learn and play.

The concept of a dental home is evolving. For example, Iowa's definition of a dental home is a network of individualized care based on risk assessment, which includes oral health education, dental screenings, preventive services, diagnostic services, restorative treatment services and emergency services. This 'virtual dental home' is one solution to the insufficient number of dentists in the US.<sup>170</sup>

In addition, medical and dental homes have led to the concept of a "health home" to coordinate all health care needs. At the 2009 Institute of Medicine workshop *Sufficiency of the US Oral Health Workforce in the Coming Decade*, presenters discussed moving toward better integration of dental care within the medical home model by creating a health home. An example of this integration is a trained pediatrician or qualified medical professional conducting an oral risk assessment on a child, providing basic oral health education to the parent, delivering appropriate prevention services, and making any necessary dental referrals. The establishment of such a health home would further integrate oral health into the overall health care system.<sup>170</sup>

**Level of Evidence:** *Evidence for Outcome Effectiveness*

Evidence has shown that a dental home can provide a comprehensive family centred approach with continually accessible care. The likelihood that children will receive appropriate dental care is improved.

## **7.7 Dental Health in School-aged Children and Adolescents**

### **7.7.1 Caries**

Petersen et al.<sup>13</sup> estimated that dental caries is a significant health problem for 60 per cent to 90 per cent of school-aged children in most developed countries. Dental caries has declined in most developed countries over the past three decades as a result of effective use of fluoride and improved self-care practices.<sup>13</sup> Nevertheless, Petersen et al.<sup>13</sup> stated “it must be emphasized that dental caries as a disease of children has not been eradicated, but only controlled to a certain degree.”

Although dental caries can have serious health effects throughout life, it may be particularly challenging for school-aged children and adolescents as it can contribute to failure to thrive, may result in oral pain that can interfere with one’s ability and desire to eat, and can contribute to substantial loss of school and work days.<sup>53</sup>

### **7.7.2 Education and Promotion**

It is generally known that tooth brushing by children under the age of 10 is inefficient, which can be explained by the lack of motivation and poor manual dexterity normal to this age group. In view of this, there is considerable evidence to support the provision of knowledge and teaching skills for children regarding oral hygiene.<sup>176</sup>

Studies in Holland indicated that during an intervention in a school setting, there was a significant increase in the frequency of tooth brushing.<sup>177</sup> However, the effects were not maintained in a one-year follow-up, indicating the simple tooth brushing instruction was not sufficient to change behaviour. By comparison, an intervention for school-aged children in Scotland included both a school and home based strategy involving supervised tooth brushing on school days with fluoride toothpaste for two years with home based incentives to promote twice daily brushing. The results indicated that children who took part in the intervention had 64 per cent fewer caries than children in the control group (who brushed once a day or less).<sup>176</sup>

Cooper et al.<sup>202</sup> conducted a systematic review of primary school-based interventions designed to change behaviour related to tooth brushing and the frequency of consumption of cariogenic foods and beverages in 4- to 12-year-olds. Four studies were included. Of these, three were at high risk of bias, and one was at unclear risk of bias. As the studies used a variety of interventions and outcome measures, it was difficult to make statistical comparisons. The authors concluded that “there is insufficient evidence for the efficacy of primary school-based behavioural interventions for reducing caries. There is limited evidence for the effectiveness of

these interventions on plaque outcomes and on children’s oral health knowledge acquisition.”<sup>202</sup>

There is a need for further research in this area.

### 7.7.3 Prevention and Treatment

Palmer and Gilbert<sup>53</sup> noted that “the use of fluoride varnishes in school based oral health programs for children as well as in private practice is increasing, as fluoride varnish is an effective and easily applied method for providing topical fluoride therapy.” Palmer and Gilbert<sup>53</sup> note that children who are at low caries risk will not likely benefit from professional topical fluoride applications. However, children and adolescents with moderate caries risk should have fluoride varnish or gel applied professionally twice a year at the discretion of the dentist and patient. Those with high caries risk should have fluoride varnish applied professionally two to four times a year or fluoride gel applied twice a year at the discretion of the dentist and patient. There is some evidence that more frequent applications may be more effective.<sup>53</sup>

The American Academy of Pediatric Dentistry<sup>87</sup> has noted that a total dose of five grams of xylitol per day consumed by children at about age ten in gum or lozenges resulted in 35 per cent to 60 per cent reductions in tooth decay, with no differences between the delivery methods. Gummy bears, other confections and milk containing xylitol have all been studied, but they are neither well established scientifically nor commercially available at present.<sup>87</sup>

### 7.7.4 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review of dental health noted the following:

- The results of a series of papers published between 1982 and 1994 found that dental health education interventions have a small, positive, but temporary effect on plaque accumulation, no discernible effect on caries increment and a consistent positive effect on knowledge levels.<sup>54</sup> “There is no convincing evidence that school-based education programs had any effect on plaque levels, even when brushing at school was part of the program, but educating parents about plaque control in their children was effective.”<sup>54</sup>
- The Task Force on Community Preventive Services in the US found strong evidence that school based sealant delivery programs were effective interventions.<sup>25</sup>
- The report from the Children’s Dental Health Project noted that “Sealants....reduce associated treatment costs, especially among vulnerable children, where sealants applied to permanent molars have been shown to avert tooth decay over an average of five to seven years.”<sup>24</sup>

**Level of Evidence:** *Warrants Further Research*

There is mixed evidence regarding the effectiveness of school-based interventions (including the use of fluoride) in improving dental health in school-aged children and adolescents.

## **7.8 Summary**

The highest level of evidence for successful prevention of early childhood dental disease (*Evidence for Effective Dissemination*) indicates that

- Fluoride toothpastes and varnishes as well as water fluoridation can successfully reduce early childhood caries.

The next highest level of evidence (*Evidence for Outcome Effectiveness*) indicates that

- Human breast milk is the best nutrition for infants and does not have any harmful impact on dental caries. However, mouth cleaning or tooth brushing should be part of the daily routine for all infants, including those who are breastfed.
- National dental organizations stress the importance of the first dental visit by year one to ensure access to dental assessment, education and early intervention for early childhood caries.
- A dental home can provide a comprehensive family centred approach with continually accessible care thus increasing the likelihood that children will receive appropriate dental care.

There is *Evidence for Implementation* that

- Caries risk assessment tools may be an effective way to estimate children's risk for dental caries as they cover a range of risk and protective factors; however, research information is insufficient to enable quantitative caries risk assessment analyses.
- Nutritional counselling for new mothers may be successful in reducing early childhood caries when the counselling is combined with fluoride use.

There is mixed evidence regarding the effectiveness of school-based interventions (including the use of fluoride) in improving dental health in school-aged children and adolescents (*Warrants Further Research*).

## **8.0 ORAL AND DENTAL HEALTH IN INDIVIDUALS WITH CHRONIC CONDITIONS**

This chapter examines evidence regarding the relationship between dental health and chronic conditions such as oral cancers, eating disorders, diabetes, heart disease, respiratory disease and osteoporosis. Much of the research in this area is still emerging.

### **8.1 Oral and Pharyngeal Cancers**

Although most studies of oral cancer do not distinguish between specific subsites within the oral cavity, it is important to distinguish between oral and oropharynx sites.<sup>203</sup> The most common oral sites are the lip, anterior third of the tongue, hard palate, floor of the mouth, gingiva and buccal mucosa. The oropharynx includes the soft palate, the base of the tongue, the tonsillar region and the posterior pharynx.

In Canada, oral cancer is the 13th most common type of cancer.<sup>204</sup> In 2009, it was estimated that the number of new cases and death due to oral cancer would be two times higher than for liver cancer and three times higher than for cervical cancer.<sup>204</sup> The prognosis for the disease is relatively poor; the five-year survival rate is estimated to be 63 per cent.<sup>204</sup> In the US, oropharyngeal cancers occur more frequently and are among the eight most common types of cancer. The survival rate for oropharyngeal cancers is about 50 per cent to 60 per cent.<sup>80,205</sup> Oropharyngeal cancer is more common in developing countries than in developed ones.<sup>13,206</sup> The prevalence of oral cancer is higher in males than females.<sup>13,207,208</sup>

Petersen<sup>206</sup> noted that tobacco use and excessive alcohol consumption are estimated to account for about 90 per cent of oral cancers. However, having human papilloma virus (HPV) is emerging as a strong risk factor for both oral and pharyngeal cancers.<sup>83</sup> Of the more than 120 types of HPV, two (HPV-16 and HPV-18) are considered high risk for head and neck cancers.<sup>83,203</sup> Over 87 per cent of HPV-positive oropharyngeal cancers and 68 per cent of HPV-positive oral cancers have been associated with HPV-16.<sup>83,208</sup>

Ryerson and colleagues<sup>208</sup> examined over 44,000 cases of potentially HPV associated oral and oropharyngeal cancers and found that approximately 44 per cent affected the tonsils and an additional 38 per cent affected the base of the tongue (see also McGorray et al.<sup>207</sup>). It is noted, however, that detection of HPV infection does not prove that the virus is involved in the pathogenesis of the tumour.<sup>203,207</sup> However, recognizing that HPV plays any role in oral and oropharyngeal cancers has important implications for cancer prevention.<sup>208</sup>

Increased morbidity and mortality are associated with advanced stage oral and pharyngeal cancers.<sup>205</sup> Treatment of advanced stage cancers may result in disfigurement and/or impairment of basic functions (such as breathing, eating, talking and swallowing). The median one year cost of treating individuals with advanced stage oral and pharyngeal cancers was 22 per cent higher

than for those with early stage cancers.<sup>205</sup> Thus, early diagnosis is important for reducing the physical, social and economic burden of oral and pharyngeal cancer.

Langevin et al.<sup>205</sup> found that, compared to individuals without dental insurance, those with insurance were likely to report going to the dentist more frequently (at least annually). In addition, they found that oral cancer was more likely to be identified among individuals who went to the dentist more frequently than among those who went less frequently; no consistent relationship was observed for pharyngeal cancer. Further, when oral or pharyngeal cancer was present, those who went to a dentist more frequently were more likely to have early stage cancer compared to those who went less often. The authors concluded that “the public health burden of oral and pharyngeal cancer [may be reduced through] earlier detection of the disease.”

Various tools have been developed for detecting and diagnosing oral cancer and precancer. Tran and Severn<sup>209,ff</sup> noted that

No technique or technology to date has provided definitive evidence to suggest that it improves the sensitivity and specificity of oral cancer screening beyond the conventional oral examination...Toluidine blue staining, direct fluorescent visualization and brush cytology may be used as adjunctive visual tools to determine which lesions are needed for scalpel biopsy (the gold standard) to establish a definitive diagnosis.<sup>209</sup>

**Level of Evidence:** *Evidence for Implementation*

The presence of HPV is emerging as a strong risk factor for both oral and pharyngeal cancers. Early diagnosis is important for reducing the physical, social and economic burden of these cancers.

## **8.2 HIV/AIDS**

Approximately 40 per cent to 50 per cent of individuals with HIV/AIDS experience oral disease caused by viral, bacterial or fungal infections; the infections often occur early in the course of the disease.<sup>13</sup> Dry mouth may occur as a result of decreased salivary flow, and may increase the risk of developing dental caries. Dry mouth may also lead to difficulties with chewing, swallowing and tasting foods.<sup>13</sup>

**Level of Evidence:** *Warrants Further Research*

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<sup>ff</sup> Tran and Severn (2008) noted that two systematic reviews found that “there was insufficient evidence to recommend the inclusion or exclusion of visual examination as a screening tool for oral cancer and precancerous lesions.”

## **8.3 Eating Disorders**

Eating disorders, such as bulimia nervosa and anorexia nervosa, are most common among adolescents and young adults.<sup>210</sup> Women are four times more likely than men to report an eating disorder.<sup>210</sup> Although some individuals with bulimia or anorexia may recover after a single episode, others may have a fluctuating pattern of health and relapse and still others may experience issues throughout their lives.<sup>210</sup>

With respect to oral and dental health, loss of enamel, caries, altered salivary function and dental sensitivity may occur as a result of eating disorders.<sup>80</sup> For those experiencing bulimia, frequent consumption of fermentable carbohydrates followed by vomiting exposes the mouth to acid from food, fluid, vomit or all three.<sup>80</sup> As a result, individuals with bulimia are more likely to experience tooth erosion and decay than those without such behaviours.<sup>80</sup> Individuals with anorexia are susceptible to developing dry mouth due to medications (such as antidepressants and diuretics).<sup>80</sup>

<b>Level of Evidence:</b> <i>Warrants Further Research</i>
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## **8.4 Diabetes**

### **8.4.1 Current Evidence**

There is increasing evidence of a bidirectional link between diabetes and periodontal health. For example:

- Individuals with diabetes are more likely to have periodontal disease than those without diabetes.<sup>122</sup>
- Simpson et al.<sup>211</sup> have suggested that the chronic inflammation and infection that results from periodontal disease can have an adverse effect on glycemic control (see also Scannapieco et al.<sup>122</sup>). They noted that people with severe periodontitis were up to six times more likely to have poor glycemic control at a two- to four-year follow-up.
- The extent and severity of periodontal disease increases in patients with Type 2 diabetes according to a study of pregnant diabetic women, as they demonstrated a higher degree of periodontal inflammation and destruction compared to non-pregnant diabetics and healthy non-pregnant patients.<sup>212</sup>

A systematic review of epidemiologic observational evidence on the effect of periodontal disease on diabetes found that “a small body of evidence supports significant, adverse effects of periodontal disease on glycemic control, diabetes complications, and development of Type 2 (and possible gestational) diabetes.”<sup>213</sup> The authors stated that additional studies should be conducted.

#### 8.4.2 Comparisons with Dental Public Health Evidence Update: 2006-2009

The evidence noted above is consistent with a study cited in Dental Public Health Evidence Update: 2006-2009.<sup>124</sup>

- Simpson<sup>214</sup> suggested a bi-directional relationship between glycemic levels and periodontal disease. Chronic inflammation and infection from periodontal disease could have an adverse effect on glycemic control in people with diabetes.

**Level of Evidence:** *Evidence for Implementation*

There is increasing evidence of a bi-directional link between diabetes and periodontal health.

## **8.5 Heart Disease**

### 8.5.1 Current Evidence

An American Heart Association committee, which included cardiologists, dentists and infectious disease specialists, found no conclusive scientific evidence that periodontal disease causes or increases the rate of cardiovascular diseases.<sup>215</sup> Although several studies appeared to show a strong relationship between periodontal disease and cardiovascular diseases, the researchers did not account for common risk factors (including smoking, age and diabetes). Lockhart et al.<sup>215</sup> also noted that current research does not indicate whether regular brushing and flossing or treatment of gum disease can reduce the incidence of atherosclerosis, or the narrowing of the arteries that can cause heart attacks and strokes.

### 8.5.2 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health reflected the view of researchers at the time that there may be an association between heart disease and periodontal disease. However, it noted that the evidence was not conclusive. The review also noted that, since the mid-1990s, there has been a proliferation of research on the link between cardiovascular diseases and periodontal disease and tooth loss, specifically focusing on coronary heart disease, cerebrovascular ischemia, fatal cardiovascular disease, stroke, myocardial infarction, cerebrovascular accident and the preclinical signs of cardiovascular disease. Several theories exist about the biological pathways linking oral infections and cardiovascular disease but there is insufficient evidence to show a definitive causal relationship between periodontal disease and tooth loss and cardiovascular disease. The balance of the evidence suggests that periodontal disease and tooth loss may be independent risk factors for cardiovascular disease.

**Level of Evidence:** *Warrants Further Research*

The American Heart Association recently stated that there is no convincing evidence that periodontal disease increases the risk of heart disease or that treating periodontal disease reduces the risk of heart disease or stroke. An association between the two diseases had previously been suggested by researchers.

## **8.6 Respiratory Disease**

### **8.6.1 Current Evidence**

A recent review of the literature<sup>216</sup> on the role of oral bacteria in respiratory disease noted that the association between poor oral hygiene, periodontal disease and respiratory disease has been increasingly debated in recent years. A considerable number of hypotheses have sought to explain the possible role of oral bacteria in the pathogenesis of respiratory disease and some clinical and epidemiological studies have found results favouring such an association. The review concluded that while there is no consensus regarding the association, a number of theories have been put forward. These include the following:

- Oral bacteria that colonize the oropharynx may be aspirated through the lower respiratory tract, particularly in individuals at high risk of infection, such as hospitalized patients.
- Salivary enzymes associated with periodontal disease may modify the mucosal surfaces along the respiratory tract, thus facilitating colonization by pathogens.
- Hydrolytic enzymes that result from periodontal disease may destroy salivary films and make bacteria elimination difficult, thus promoting the possibility of aspiration of these pathogens into the lungs.

A 2006 systematic review<sup>217</sup> examined the association between oral health and pneumonia and other respiratory diseases. Nineteen studies met the research criteria. Five studies found that the presence of carcinogenic and periodontal pathogens, dental decay and poor oral hygiene were potential risk factors for pneumonia (fair evidence quality). A weak association between periodontal disease and chronic obstructive pulmonary disease (COPD) was identified in four studies of poor quality. Ten studies provided evidence that interventions aimed at improving oral health reduced the progression or occurrence of pneumonia. The review concluded that there is good evidence that improved oral hygiene and frequent professional oral health care reduces the progression or occurrence of respiratory diseases in individuals in intensive care units and vulnerable elderly adults living in nursing homes.

### **8.6.2 Comparisons with the 2006 Evidence Review: Dental Public Health**

The 2006 evidence review on dental health found the following:

- Microbes found frequently in the mouth have been associated with pulmonary infections in elderly people. A review of the research literature found a moderate

association between oral health/periodontal disease and respiratory diseases. When routine tooth brushing is not performed in people who are susceptible to developing respiratory diseases, bacteria from the mouth may be aspirated into the lower respiratory tract. Infection sets in when the bacteria multiply resulting in aspiration pneumonia. Although the risk is considered moderate, due to the prevalence of respiratory disease, even a moderate risk can have major implications for population health. Intervention studies support providing preventive oral health care to the elderly, especially those in institutional settings who are at high risk of developing respiratory diseases.<sup>218</sup>

- A search of published studies on the relationship between oral hygiene intervention and rate of pneumonia in institutionalized patients found that several studies demonstrate a potential association between periodontal disease and COPD. Of the initial 1,688 studies identified, 36 were included in the analysis. A variety of oral interventions aimed at improving oral hygiene through mechanical and/or topical chemical disinfection and the use of antibiotics reduced the incidence of nosocomial pneumonia by an average of 40 per cent.<sup>218</sup>

**Level of Evidence:** *Evidence for Implementation*

Although evidence of an association between poor oral hygiene, periodontal disease and respiratory disease is unclear, intervention studies support providing preventive oral health care as the risk of developing respiratory disease can have major implications for population health.

## **8.7 Osteoporosis**

A systematic review of studies on the association between osteoporosis and periodontitis concluded that the majority of studies suggest a relationship between these diseases.<sup>219</sup> As both diseases affect bone mass and share common risk factors, they may be related. Twelve of 13 studies demonstrated a positive association and similar risk factors. The need for further studies to assess the relationship between the two diseases was identified.

**Level of Evidence:** *Warrants Further Research*

## **8.8 Summary**

There is moderate evidence (*Evidence for Implementation*) that oral and/or dental health can be affected by several chronic conditions including oral and pharyngeal cancers, diabetes, and respiratory disease.

- Human papilloma virus (HPV) is emerging as a strong risk factor for both oral and pharyngeal cancers. Early diagnosis is important for reducing the physical, social and economic burden of these cancers.

- There is increasing evidence of a bi-directional link between diabetes and periodontal health.
- Although evidence of an association between poor oral hygiene, periodontal disease and respiratory disease is unclear, intervention studies support providing preventive oral health care as the risk of developing respiratory disease can have major implications for population health.

There is limited evidence that oral and/or dental health can be affected by several chronic conditions, such as HIV/AIDS, eating disorders, and osteoporosis; all of these areas *warrant further research*.

In addition, the American Heart Association recently stated that there is no convincing evidence that periodontal disease increases the risk of heart disease or that treating periodontal disease reduces the risk of heart disease or stroke. An association between the two diseases had previously been suggested by researchers. This is also an area that *warrants further research*.

## 9.0 ORAL AND DENTAL HEALTH IN ABORIGINAL POPULATIONS

This chapter examines oral and dental health in Aboriginal populations both in Canada and internationally.<sup>88,220</sup>

### 9.1 The Impact of Socio-Demographic Variables on Dental Health

#### 9.1.1 Aboriginal Identity

UNICEF Canada<sup>221</sup> has stated that “nowhere is the health disparity between Aboriginal and non-Aboriginal children more evident than in dental health.” In BC, Aboriginal identity is considered a significant predictor of developing early childhood dental decay.<sup>14</sup> Table 8 presents the percentage of Aboriginal and non-Aboriginal kindergarten children in BC in 2012-2013 who were caries free, had restorations, and had visible decay.

**Table 8: Percentage of Aboriginal and non-Aboriginal Kindergarten Children Who Were Caries Free, or Had Restorations or Visible Decay in 2012-2013**

	Aboriginal Kindergarten Children	non-Aboriginal Kindergarten Children
Caries Free	43.3	69.5
Had Restorations	31.9	16.8
Had Visible Decay	24.8	13.7

**Source:** Preliminary data, BC Ministry of Health, 2014.

#### 9.1.2 Location

Various studies have reported very high rates of early childhood caries in remote and isolated First Nations and Inuit communities in Canada. For example, the prevalence of early childhood caries ranged from 66 per cent in the Inuvik Region in the Northwest Territories to 78 per cent in the Manitoulin District in southern Ontario to 98 per cent in a northern First Nations community in Manitoba.<sup>222,223,224</sup>

Oral health disparities exist between Aboriginal people living on and off reserve as well as between Aboriginal and non-Aboriginal people. For example, in 2005, the mean number of decayed, missing and filled teeth in Aboriginal four-year-olds living on reserve in the Sioux Lookout area in northwest Ontario was 11.9; by comparison, the mean number of decayed, missing and filled teeth in Aboriginal four year olds living in neighbouring Thunder Bay was 5.9.<sup>225</sup>

<sup>88</sup> In Canada, the term “Aboriginal Peoples” refers to First Nations, Inuit and Métis (National Aboriginal Health Organization, 2013). The term “Indigenous” usually refers to Aboriginal people internationally (National Aboriginal Health Organization, 2013). The term “Aboriginal populations” is used in this document to refer to both Aboriginal Peoples in Canada and Indigenous people in the United States and elsewhere.

### 9.1.3 Barriers to Access

Aboriginal people may face barriers to good oral health at the individual, community and broader systemic levels. Barriers may include: lack of knowledge regarding oral health care and the importance of oral health; anxiety regarding, or fear of, dental procedures; previous negative experiences or a mistrust of health services; lack of transportation to access services; limited ability to access healthy foods; and lack of financial resources to pay for healthy food and/or for dental services.<sup>17,221</sup>

Researchers noted that understanding and appreciating these barriers to access can help public health dental staff better reach Aboriginal families and communities regarding oral health care. Focus group discussions regarding dismantling barriers to care identified the need for: cultural safety training for dental staff; community outreach initiatives; community partnerships; and mitigation of extraneous stressors such as transportation.<sup>221</sup>

## **9.2 Cultural Safety Training**

As a result of the historical impacts of colonization, some Aboriginal people may experience distrust towards public health initiatives. A precursor to earning the trust of Aboriginal families may be implementation of cultural safety training for staff. Cultural safety training differs from cultural sensitivity in that it shifts the focus from individual interactions to societal/structural level inequities for minority groups.<sup>226</sup> It helps participants to think critically about their own social position by being “mindful of their own socio-cultural, economic and historical locations.”<sup>227</sup> Societal level power imbalances become salient in cultural safety training resulting in the provision of more sensitive and effective services.<sup>228</sup>

In Australia, as part of advocating for culturally appropriate health delivery systems that improve health outcomes for Aboriginal and Torres Strait Islander people, the Royal Australian College of General Practitioners (RACGP) has developed a set of educational criteria for both cultural awareness education and cultural safety training.<sup>229</sup> The RACGP National Faculty of Aboriginal and Torres Strait Islander Health<sup>229</sup> has stated that “any cultural awareness education or cultural safety training should be based on genuine partnership with Aboriginal and Torres Strait Islander people and involvement with local communities in its planning, delivery and evaluation.” This is a fundamental component in the cultural safety training standards and assessment process developed by the National Aboriginal Community Controlled Health.<sup>230</sup> Mandatory content for the RACGP’s cultural safety training includes

identification of barriers to cultural safety and examples of culturally safe processes; strategies for developing an ongoing relationship with local Aboriginal and Torres Strait Islander community or representative groups; and strategies for implementing a culturally safe health service, including access...interpersonal relationships, communication and culturally appropriate procedures for assessment, referral, treatment and continued care.<sup>229</sup>

**Level of Evidence:** *Evidence for Outcome Effectiveness*

Cultural safety training may result in long-term changes to clinical practices and the provision of more sensitive and effective services. It may also increase practitioners' ability to comfortably liaise with Aboriginal communities.

### 9.3 Recommendations for Improving Oral Health

Evidence-based oral health recommendations for Aboriginal communities were issued jointly by the Canadian Paediatric Society and the American Academy of Pediatrics in 2011.<sup>231,232</sup> The recommendations, which are described in Table 9, are supported by clinical care recommendations and community-based promotion initiatives.

**Table 9: Oral Health Recommendations for Aboriginal Communities**

Recommendation	Canadian Task Force on Preventive Health Care		US Preventive Services Task Force	
	Grade	Level of Evidence	Grade	Level of Certainty
Women should be provided with preconception and prenatal screening for oral health, anticipatory guidance for oral health and hygiene, and referral for dental care if required.	B	I	B	Moderate
Community health nurses, family physicians, or pediatricians should perform oral health screening during child health assessments and make referrals to dental health providers as needed.	B	II-3	B	Moderate
Motivational interviewing and anticipatory guidance regarding oral hygiene and diet should be used with parents and caregivers of infants and children.	B	II-3	B	Moderate
The supervised use of fluoridated toothpaste in all Aboriginal children should be promoted once the first tooth has erupted.*	A	I	A	High
All Aboriginal children should have access to: a) a series of fluoride varnishes; and b) an assessment to determine the need for sealant placement on deep grooves and fissures.	A	II-1	A	Moderate
	A	I	A	High

\* A rice grain sized portion of toothpaste should be used for infants and a green pea sized portion should be used for children.

**Note:** Grade, Level of Evidence and Level of Certainty are defined in Appendix C.

Clinical care recommendations include the following:<sup>232</sup>

- Early childhood caries should be considered an infectious disease that is influenced by a variety of factors including socio-economic conditions, parenting practices, and maternal and infant nutrition.
- Oral health should be included as part of overall childhood health and well-being.

- Motivational interviewing and anticipatory guidance regarding oral hygiene and diet should be used with pregnant women and parents and caregivers of infants and children. Referrals for dental care should be made if required.
- Primary care providers should be aware of the level of fluoride in the drinking water for the various Aboriginal communities in their service area.

In addition, it has been suggested that community-based promotion initiatives include the following:<sup>232</sup>

- Individuals in Aboriginal communities should be encouraged to alter practices of frequent consumption of sugary drinks and snacks through education and improved selection of foods.
- Community based activities should be used to emphasize the importance of oral health for pregnant women and their infants.

A group of University of Waterloo Public Health Masters students<sup>17</sup> conducted a literature review and recommended that solutions for improving oral health should

- Honour and respect the traditional cultures and practices of First Nations and be community owned and based.
- Support First Nations leaders to make evidence-based decisions.
- Include oral health as part of the role of primary health care providers.
- Embed oral health strategies in health promotion frameworks that are empowering, participatory, holistic, inter-sectoral, equitable, evidence-based, sustainable, multi-strategic, and inclusive of evaluation.

**Level of Evidence:** *Evidence for Outcome Effectiveness*

Strategies for improving oral and dental health (e.g., the use of fluoride), which were discussed in previous chapters, have also been recommended for Aboriginal populations. In addition, it is recommended that the strategies be embedded in health promotion frameworks that respect traditional cultures and practices and are empowering.

## **9.4 Children's Oral Health Initiative**

The Children's Oral Health Initiative (COHI) is an early childhood caries prevention program that targets Aboriginal children from birth to 7 years of age, their parents/caregivers, and pregnant moms.<sup>233</sup> The COHI program is delivered by Health Canada's First Nations and Inuit Health Branch, except in BC where it is delivered by the First Nations Health Authority.<sup>hh</sup> As of September 2013, there were 79 COHI communities in BC.<sup>ii</sup>

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<sup>hh</sup> Responsibility for the COHI program was transferred to the BC First Nations Health Authority on January 21, 2014.

<sup>ii</sup> There were 320 COHI communities across Canada as of September 2013.

COHI services include an annual dental screening and a caries risk assessment. Based on the results from the screening and caries risk assessment, a fluoride varnish regimen (of two or four varnishes) is provided, beginning as soon as the first teeth erupt. In addition, temporary fillings are provided, and sealants are placed on the first permanent molars. Services for pregnant women include optional screening, oral hygiene instructions and support to obtain necessary dental treatment. Oral health education and the provision of resources are also available.

The development of community capacity is considered critical for the program. The health director in each community is included in the planning and delivery of the program. In addition, partnerships are established with other health providers, school staff, day care staff and those working with various children's programs. Further, funding is provided for each community to hire a COHI Aide, a community member who provides an essential link between the community and the dental provider.

COHI is delivered by a team of professionals. The dental "lead" in each community is either a dental therapist or a dental hygienist. The COHI Aide is trained to provide oral hygiene education and motivational interviewing as well to apply fluoride varnish.

Resources include Parent Kits, which are provided to pregnant moms and to parents when children are newborn, 6 months old, 12 months old, preschool age, and school age. The kits are only provided when accompanied by a discussion with a parent or caregiver. All needed oral hygiene supplies (including toothbrushes, toothpaste and floss) are provided regularly. In addition, communities are provided with tooth models, age-appropriate teaching tools, teaching DVDs, presentation materials, posters, and newsletters.

A formal evaluation of the national program has not been conducted. However, individual communities have reported a substantial decrease in caries, a decrease in the need for treatment under general anesthetic, and an increase in knowledge about oral health in children and adults.

**Level of Evidence:** *Evidence for Implementation*

There is some evidence that the Children's Oral Health Initiative has resulted in increased knowledge about oral health in children and adults as well as a decrease in caries. Community capacity is a key component of the program.

## **9.5 Other Interventions for Improving Oral Health**

Aboriginal preschool children in the Sioux Lookout area in Ontario participated in a program that targeted improved nutrition and oral health.<sup>234</sup> Prenatal women, new mothers and care providers were targeted. A media campaign, educational material, and oral hygiene instruction were used and healthy foods, toothbrushes and other supplies were readily available in the

community. Partnerships included the First Nations Health Authority, Head Start Program, Women and Child Community Nutrition Program, community lay health workers, Ontario Public Health, and the University of Toronto. The results showed a reduction in the number of decayed tooth surfaces and in the number of children needing emergency care for abscessed teeth. A reduction in the risk for obesity in Aboriginal preschoolers was also noted.<sup>234</sup>

Several intervention strategies have reported successful outcomes for Aboriginal children in Australia. For example, the Top Tips for Teeth program targets preschool and primary school children. An after-lunch brushing program is held prior to commencing afternoon classes. The initiative is supported by four culturally appropriate education sessions focusing on oral health, skill enhancement and brushing technique. Culturally sensitive educational resources (e.g., fridge magnets, newsletters and information sheets) are provided to students. An evaluation of the program revealed improved plaque scores indicating that children in the program had significantly improved their brushing techniques.<sup>176</sup>

Another Australian intervention focused on improving oral health by encouraging Aboriginal children to drink water in between meals and to ‘swig-swish-swallow’ after meals and snacks. The intervention included a teachers’ resource, oral health policies, a storybook video, songs, water bottles, stickers, and a poster for use in early childhood centres. It was reported to be ‘particularly successful’ and has been rolled out state wide in New South Wales by the Oral Health Branch. In addition, the Secretariat of National Aboriginal and Islander Child Care and the National Aboriginal Community Controlled Health Organization have endorsed the program for nation-wide release. While the intervention has a culturally specific flavour, it can also be used with non-Aboriginal children.

**Level of Evidence:** *Evidence for Outcome Effectiveness*

Several community-based promotion initiatives have been shown to improve overall oral and dental health in Aboriginal populations. These include changing diets through education and improved selection of food; emphasizing the importance of oral health for pregnant women, preschool and school-aged children; and using culturally appropriate intervention strategies to improve oral hygiene.

## **9.6 Summary**

Oral health disparities exist between Aboriginal people living on and off reserve as well as between Aboriginal and non-Aboriginal people.

Aboriginal people may face barriers to good oral health at the individual, community and broader systemic levels. Barriers may include: lack of knowledge regarding oral health care and the importance of oral health; anxiety regarding, or fear of, dental procedures; previous negative experiences or a mistrust of health services; lack of transportation to access services;

limited ability to access healthy foods; and lack of financial resources to pay for healthy food and/or for dental services.

There is *Evidence for Outcome Effectiveness* for the following:

- Cultural safety training, which may result in long-term changes to clinical practices and the provision of more sensitive and effective services. It may also increase practitioners' ability to comfortably liaise with Aboriginal communities.
- Oral and dental health strategies that are consistent with those used in non-Aboriginal populations, but that are embedded in health promotion frameworks that respect traditional cultures and practices and are empowering.
- Community-based promotion initiatives such as changing diets through education and improved selection of foods; emphasizing the importance of oral health for pregnant women, preschool and school-aged children; and using culturally appropriate intervention strategies to improve oral hygiene.

There is some evidence (*Evidence for Implementation*) that the Children's Oral Health Initiative (COHI), which targets Aboriginal children and their parents/caregivers, has resulted in increased knowledge about oral health as well as a decrease in caries. Community capacity is a key component of the program.

## **10.0 DENTAL HEALTH IN OTHER VULNERABLE POPULATIONS**

This chapter examines dental health in several vulnerable populations, including: individuals with low incomes; immigrants and refugees; seniors; individuals living in rural areas; and individuals with developmental disabilities. Access to services is often a barrier for these individuals.<sup>jj</sup>

### **10.1 Lower Socio-Economic Status**

#### **10.1.1 BC Study**

As noted previously (in Chapter 3), low socio-economic status is one of the most important risk factors for developing caries for a variety of reasons (including a lack of dental insurance and poor diets). In addition, the majority of dental care in Canada is privately funded, making it difficult for those with low incomes to pay for dental services. As noted in other sections in this report, several vulnerable populations (including Aboriginal people, seniors, and individuals with developmental disabilities) may have low incomes and thus be at high risk for developing caries.

A BC study explored the perceived needs of, barriers for, and suggestions from, low-income people living in the northern part of Vancouver Island where unmet dental needs are common.<sup>235</sup> Information was gathered from three groups of respondents: people who had experienced difficulty accessing dental care because of financial circumstances; dentists; and local health and social service providers. A total of 60 interviews were conducted.

More than half (56 per cent) of the low-income respondents reported experiencing dental pain often or sometimes. Most (78 per cent) visited the dentist for emergency care only, almost half (46 per cent) had accessed the medical system because of dental pain, and over a quarter (27 per cent) had visited the emergency department because of dental pain. The interviews generated ideas regarding increased accessibility including improved public dental benefits; coordinated dental volunteerism; dental access assistance; and community dental clinics.

The researchers concluded that while addressing financial barriers is paramount, there is also a need to simultaneously increase the availability of dental services for low-income populations and ensure services are appropriately delivered.

#### **10.1.2 Childsmile**

Childsmile is one of the largest programs designed to combat oral health inequalities in the United Kingdom.<sup>236</sup> It is a comprehensive health promotion intervention that includes building

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<sup>jj</sup> The National Oral Health Action Plan (NOHAP) is a priority project for the Canadian Dental Association. As part of its inaugural symposium on February 27, 2014, NOHAP will begin discussions on the challenges of oral health care delivery.

healthy public policy, creating supportive environments, strengthening community action, developing personal skills, and reorienting health services.<sup>236</sup>

The program includes three major components:<sup>236</sup>

- Monitoring children (and parents) from socio-economically deprived areas. Parents of newborn children who are assessed as being susceptible to developing tooth decay are monitored by a public health nurse. For those with the greatest need, additional support is offered via a dental health support worker who facilitates regular attendance at a local dental practice, provides dental health advice and information in the family home, and links families with other community health improvement initiatives. As the child grows older, additional preventive care such as fluoride varnish and dental sealants are provided.
- Provision of fluoride varnish twice a year to children in the most deprived 20 per cent of nurseries and schools in each health board area. The varnish is applied by Childsmile teams who also provide oral health promotion advice to parents and caregivers and referral to dental services for those who have not yet accessed them.
- A country-wide toothbrushing program, which includes the distribution of free fluoride toothpaste and toothbrushes to every child on at least six occasions during their first five years and the offer of free daily tooth brushing for every three- and four-year-old child attending a nursery in Scotland. The tooth brushing program is also available to primary 1 and 2 classes of schools located in disadvantaged areas across the country.

Scottish studies have demonstrated that it is possible to impact the prevalence and morbidity of dental decay across the socio-economic spectrum in a population. Dental inspections of 10,000 children over four years of age found considerable improvements during the initial years of the Childsmile interventions.<sup>237</sup> During the last 10 years there has been a substantial reduction in the number of Scottish children with dental decay as the various programs have been tested and implemented. At the beginning of the last decade, nearly 60 per cent of 5- and 11-year-olds had experienced dental decay; by 2012, 40 per cent of Scottish children in these age groups were affected.<sup>238</sup>

A systematic review of 54 studies on the daily use of fluoride toothpaste by children and adolescents found strong evidence for a caries preventive effect compared with placebo in the young permanent dentitions.<sup>239</sup> There was also strong evidence for higher caries reductions with supervised tooth brushing compared to unsupervised brushing.

**Level of Evidence:** *Evidence for Outcome Effectiveness*

Low socio-economic status is one of the most important risk factors for developing caries. While addressing financial barriers is critical there is also a need to increase the availability of dental services for low-income populations and ensure services are appropriately delivered. Scotland's Childsmile program has shown clear and positive outcomes with significant reductions in dental caries for low-income children across the country.

## **10.2 Immigrants/Refugees**

A BC study on the oral health needs of government assisted refugees living in the Lower Mainland examined access issues related to dental health practices, dental care, utilization of dental services, and self-report and professional assessment of treatment needs and oral health outcomes.<sup>240</sup> Results indicated that government assisted refugees have high debris, calculus, gingivitis scores, and decayed, missing or filled teeth scores. All suggest a significant unmet oral health need and a lack of access to dental services. The study concluded that the needs of government assisted refugees are greater and more complex than the needs of the general Canadian population or Aboriginal populations.

With limited dental insurance available through federal health programs, the findings suggest that an inequality in oral health needs exists for these groups and should be considered an important public health issue. The researchers suggest that, rather than expanding the interim federal health dental program (a 12-month program),

comprehensive dental care services [should] be provided at New Canadian Health Clinics, where refugees receive their general health care upon arrival in Canada. Integrating health services and utilizing a common risk factor approach will not only improve oral health but will also improve the general health of this group. The integration will also provide an efficient one stop shop for health service delivery and reduce the systemic barriers for government assisted refugees trying to navigate the system.<sup>240</sup>

**Level of Evidence:** *Limited Investigation*

Experts suggest the use of a common risk factors approach and integrated health services to improve both the general and dental health of immigrants/refugees and to assist them in accessing and navigating the system.

## **10.3 Seniors**

### **10.3.1 Current Evidence**

Seniors are vulnerable to the development of decay, particularly root caries. Touger-Decker and Mobley<sup>80</sup> estimated that in the United States, approximately 33 per cent of seniors have

untreated dental caries. Approximately 25 per cent of individuals 65 years of age or older have no natural teeth and those living in poverty are twice as likely to be toothless compared to individuals with higher incomes.<sup>80</sup> Chronic health conditions, increased use of medications, and physical and cognitive difficulties can impact seniors' oral health as well as their ability to support basic daily mouth care needs.<sup>241</sup> The Centers for Disease Prevention and Control<sup>242</sup> in the US noted that older Americans with the poorest oral health are those who are economically disadvantaged, lack insurance and are members of racial and ethnic minorities.

As noted previously (in Section 3.2.2.1), a BC survey has shown that although seniors are retaining more teeth, they are experiencing increased periodontal problems. Touger-Decker and Mobley<sup>80</sup> estimated that 40 per cent of individuals over the age of 65 have periodontal disease. The US Centers for Disease Prevention and Control<sup>242</sup> noted that the severity of periodontal disease increases with age and estimated that 23 per cent of 64- to 74-year-olds have severe disease.

Many older individuals take both prescription and over-the-counter drugs. Individuals in long-term care facilities (which account for about 5 per cent of the seniors' population) take an average of eight drugs a day. Over 400 commonly used medications can be the cause of a dry mouth. A reduction in the flow of saliva increases the risk of dental disease, since saliva contains anti-microbial components as well as minerals that help rebuild tooth enamel attacked by decay causing bacteria.

Neurological conditions associated with age (such as Parkinson's disease, Alzheimer's disease, Huntington's disease, and stroke) can affect oral sensory and motor functions as well as limit an individual's ability to care for himself/herself.<sup>242</sup> In addition, painful conditions that affect the facial nerves are more common among the elderly and can be severely debilitating. These conditions can affect mood, sleep, and oral-motor functions such as chewing and swallowing.

The World Health Organization (WHO) noted that globally, poor oral health amongst older people has resulted in high levels of dental caries and tooth loss as well as high prevalence rates for periodontal disease, xerostomia (dry mouth) and oral precancer/cancer.<sup>13</sup> The negative impact of poor oral conditions on the quality of life of older adults is an important public health issue that should be addressed by policy makers. The WHO recommended that countries improve the oral health of older adults by adopting strategies that incorporate oral health promotion and disease prevention based on a common risk factors approach. In addition, the WHO suggested that control of oral disease and illness in older adults should be strengthened through the organization of affordable dental health services that meet their needs.

### 10.3.2 Comparisons with the 2006 Evidence Review: Dental Public Health

The 2006 evidence review on dental health noted the following:

- As the population ages and more older adults keep their teeth, the prevention and control of periodontal disease become more important for public health.

- The British Columbia Residential Care Regulation under the *Community Care and Assisted Living Act* states that “A licensee must encourage persons in care to be examined by a dental health care professional at least once every year” and “if a person in care is admitted to the community care facility for a period of more than 30 days, a licensee must ensure that a care plan for the person in care...(includes) an oral health care plan.”<sup>243</sup>
- Chalmers and Pearson<sup>244</sup> reviewed the research on programs to improve oral health in adult residential care and suggested that a regular system of oral assessments along with oral hygiene care and dental treatment were needed. They stated that “expert opinion indicates that oral assessment screening by staff and a dentist would be ideal at admission and regularly thereafter.”
- Nicol et al.<sup>245</sup> looked at the effectiveness of health care worker training on the oral health of older adults in nursing homes. The education program was effective in changing oral health care procedures in the facilities with measurable improvements in the oral health of the residents.
- Chalmers et al.<sup>246</sup> evaluated the Oral Health Assessment Tool (OHAT) as a component of the Best Practice Oral Health Model for Australian Residential Care study. They also investigated the development of dental policies and procedures and the use of an oral hygiene care plan. The assessment tool includes evaluation of eight categories: oral cleanliness; dental pain; the lips; teeth; dentures; tongue; gums; and saliva. The researchers found that the OHAT was a reliable and valid screening assessment tool for use in residential care facilities by non-dental care staff.<sup>246</sup>
- An Australian review noted that

very little evidence exists around health promoting interventions for the elderly, other than clinical interventions, and those that address health education through group processes demonstrate much the same levels of effectiveness as for other age groups.... Specific oral health programs without clinical intervention have not demonstrated moderate to long-term effectiveness.<sup>38</sup>

**Level of Evidence:** *Evidence for Implementation*

Seniors are retaining more teeth but are also experiencing increased periodontal problems. It has been suggested that oral health promotion and disease prevention based on a common risk factors approach is effective in improving dental health for older adults.

## **10.4 People Living in Rural Areas**

Compared to urban populations, rural populations in the United States tend to have: less water fluoridation; higher rates of dental caries; higher rates of poverty; lower rates of insurance; lower dental care utilization; fewer dentists per population; and greater distances to travel to

access care.<sup>247</sup> It is expected that many of these factors also apply to people living in rural areas of Canada.

Skillman et al.<sup>247</sup> noted that improving oral health for rural populations requires practical and flexible approaches to expand and better distribute the rural oral health workforce. This includes approaches tailored to remote areas. Proposed solutions include the following:

- Using mass prevention/public health interventions including: increased water fluoridation; preventive services; behavioural interventions (such as smoking and tobacco cessation programs); provision of timely oral health education; and caries risk assessment and referral.
- Focusing prevention needs at the front line of rural dental health care with systematic approaches that cross health professions and health sectors.
- Encouraging more providers to work in rural areas by, for example, recruiting students from rural areas, training students in rural locations, and providing loan repayment and scholarship programs.
- Increasing the flexibility and capacity of the oral health workforce in rural areas by creating new roles for, and new types of, providers.
- Overcoming distance barriers through the use of mobile clinics and telehealth technology.

**Level of Evidence:** *Evidence for Implementation*

Individuals living in rural areas experience a number of factors that may affect their ability to access dental care. Improving oral health in rural populations requires practical and flexible approaches.

## **10.5 Individuals with Development Disabilities**

In the 2006 evidence review on dental health, there was no specific review of the literature related to dental care for individuals with developmental disabilities.<sup>kk</sup> There is now a growing recognition that this is a vulnerable group that may have insufficient access to dental care and less than optimal dental outcomes because of complex health care needs.

A review of the literature (including the “grey” literature) was conducted and it is clear further research needs to be conducted in this area. Much of the existing literature is based on studies related to children with special health care needs, including children with physical and congenital disabilities. Research related specifically to children with developmental disabilities is limited and tends to be from the United States, the United Kingdom, and Australia; relatively little is available from Canada. However, the literature provides a good starting point. Some

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<sup>kk</sup> It is recognized that both children and adults with acquired disabilities may require assistance with oral and dental health. However, the assistance required may vary considerably depending on the nature of the disability. This topic is not addressed further.

common themes emerged and there was consistency around some of the steps that need to be taken to better address the oral health needs of children with developmental disabilities.

There also appears to be very little literature on oral or dental health in adults with developmental disabilities. However, much of the literature regarding children with developmental disabilities likely applies to adults with developmental disabilities as well.<sup>248</sup>

### 10.5.1 Overview

“The number of people with intellectual/developmental disabilities is increasing because of population growth, better reporting, increased longevity, and the aging of the population, along with more accurate and sensitive methods of detection and diagnosis.”<sup>249</sup> The Centers for Disease Control and Prevention in the United States<sup>250</sup> estimated that, amongst children 3 to 17 years of age, 13.9 per cent (or about one in six children) have some developmental disability. In addition, over the last 12 years, the prevalence of developmental disabilities has increased by 17.1 per cent. Amongst this group, the prevalence of autism increased by 289.5 per cent and the prevalence of Attention Deficit Hyperactivity Disorder (ADHD) increased by 33.0 per cent. Compared to females, males were twice as likely to have developmental disabilities, particularly ADHD, autism, and learning disabilities. In addition, children from families with incomes below the federal poverty level had a higher prevalence of developmental disabilities.

Children with developmental disabilities often have unmet complex health care needs as well as significant physical and cognitive limitations. Children with more severe conditions and from low-income families are particularly at risk with high dental needs and poor access to care. In addition children with developmental disabilities are living longer, requiring continued oral health care.<sup>251</sup>

Dental health appears to be related to the severity of intellectual disability. Children with physical disabilities have better oral hygiene relative to children with intellectual disabilities, suggesting that reduced cognition may impair dental hygiene.<sup>252</sup>

Sullivan et al.<sup>253</sup> noted that dental disease is common in adults with developmental disabilities because of challenges related to maintaining oral hygiene routines and accessing dental care. A Massachusetts study used clinical and demographic information from a network of dental clinics designed specifically to provide comprehensive oral health care to adults (20 to 98 years of age with special needs).<sup>248</sup> The study found that even with access to comprehensive care, adults with intellectual and developmental disabilities have substantial challenges with oral and dental health. Approximately 11 per cent of the sample had no teeth. For those that had teeth: the mean number of teeth was 21.4 and the mean number of decayed, missing and filled teeth was 13.9; 87.8 per cent of the adults had caries experience, and 32.2 per cent had untreated caries at the time of the study; and the prevalence of gingivitis (without periodontitis) was 18.0 per cent while the prevalence of periodontitis was 80.3 per cent.<sup>248</sup>

### 10.5.2 Dental Care

Lewis<sup>254</sup> noted that dental care is the most frequently cited unmet health need for children with special health care needs. A US study found that between 11 per cent and 17 per cent of children with ADHD, cerebral palsy, developmental disabilities, and Down Syndrome had unmet dental care needs. Stein et al.<sup>255</sup> concluded that “children with Autism Spectrum Disorders experience greater difficulties and barriers to care both in the home and in dental office settings than their typically developing peers.”

A number of studies conducted in the US and the UK found that children with developmental disabilities had

- Less access to restorative care than children in the general population, although access to preventive care was comparable.
- Less access to dental care than children with physical disabilities.
- Similar access to dental care as children in the general population for children under five years of age.
- Less access to care (particularly restorative care) than 12- to 18-year-olds in the general population.<sup>256</sup>

US studies indicate that with reduced access to dental care, children with developmental disabilities run the risk of greater oral disease over their lifetimes.<sup>84,254,257</sup> Sullivan et al.<sup>253</sup> recommended that adults with developmental disabilities be provided with regular oral hygiene treatment and other preventive measures (e.g., fluoride application).

As with the general population, socio-economic status is a significant factor affecting access to dental care; those with lower incomes have less access. Newacheck and Kim<sup>258</sup> concluded that the overall cost of dental care is greater for children with developmental disabilities, suggesting that access may also be challenging for those with moderate incomes. In addition, access to care decreases with an increase in the severity of the disability. Further, access to dental care is influenced by the level of parental education, and, in particular, maternal education levels. US studies also indicate that minority groups with children who have special health care needs have lower access to dental care. Access can also be influenced by whether a child/family has a dental home and, in the US, whether they have dental insurance. At least one study found that caregiver burden affects access to dental care; significant caregiver burden may result in fewer visits.<sup>259</sup>

In addition to access issues, there are a number of challenges related to providing dental care to individuals with developmental disabilities:

- They may not have the fine motor skills required to carry out certain techniques such as brushing and flossing and may therefore have decreased oral hygiene.<sup>260</sup>
- They may not have the cognitive skills to carry out instructions from practitioners.

- They may have a reduced ability to cooperate with treatment needs.
- They may have high dental anxiety levels and behaviour management problems when receiving dental care and may need sedation more frequently.
- They may need to have care provided in a hospital setting more frequently.

Morgan et al.<sup>248</sup> found that, even with dental health professionals trained in the special oral health needs of people with intellectual and developmental disabilities, approximately 25 per cent of the adults in their study were unable to accept any dental intervention without the use of advanced behaviour management techniques, and an additional 40 per cent required some form of behavioural assistance to receive dental treatment.

The literature provides several suggestions related to improving access and care for children with developmental disabilities. These include the following:

- Providing improved parental/caregiver education on performing oral care.
- Providing training for practitioners providing care for individuals with developmental disabilities.
- Encouraging access to, and use of, a dental home.
- Having accurate, up-to-date medical histories for dentists.
- Using developmentally appropriate communications.
- Using dental passports for individuals with developmental disabilities.<sup>261</sup>

There is a need for further research in this area to better guide programs.

**Level of Evidence:** *Evidence for Implementation*

There is growing recognition that individuals with developmental disabilities may have insufficient access to dental care and less than optimal dental outcomes because of complex health care needs. Although there is clearly a need for additional research in this area, the literature provides several suggestions for improving access and care for those with developmental disabilities.

## **10.6 Summary**

### **10.6.1 Low Socio-economic Groups**

Low socio-economic status is one of the most important risk factors for developing caries. While addressing financial barriers is critical, there is also a need to increase the availability of dental services for low-income populations and ensure services are appropriately delivered. Scotland's Childsmile program has shown clear and positive outcomes with significant reductions in dental caries for low-income children across the country (*Evidence for Outcome Effectiveness*). The program includes the following components:

- Facilitation by dental health support workers to regularly attend a local National Health Services dental practice, provide dental health advice and information in the family home, and link families with other community health improvement initiatives.
- Distribution of fluoride toothpaste and toothbrushes to every child on at least six occasions during their first five years and free daily tooth brushing for every three and four year old child attending nursery school.
- Provision of additional preventive care by a dental practice team as the child gets older (including the use of fluoride varnishes and dental sealants).

#### 10.6.2 Immigrants/Refugees

Experts suggest the use of a common risk factors approach and integrated health services to improve both the general and dental health of immigrants/refugees and to assist them in accessing and navigating the system (*Limited Investigation*).

#### 10.6.3 Seniors

Seniors are retaining more teeth but are also experiencing increased periodontal problems. It has been suggested that oral health promotion and disease prevention based on a common risk factors approach is effective in improving dental health for older adults (*Evidence for Implementation*).

#### 10.6.4 People Living in Rural Areas

Individuals living in rural areas experience a number of factors that may affect their ability to access dental care. Improving oral health in rural populations requires practical and flexible approaches (*Evidence for Implementation*). Proposed solutions include: using mass prevention/public health interventions (such as increased water fluoridation, timely oral health education and caries risk assessment and referral); encouraging more providers (in various health sectors) to work in rural areas; increasing the flexibility and capacity of the oral health workforce in rural areas; and overcoming distance barriers through the use of mobile clinics and telehealth technology.

#### 10.6.5 Individuals with Developmental Disabilities

There is growing recognition that individuals with developmental disabilities may have insufficient access to dental care and less than optimal dental outcomes because of complex health care needs. Although there is clearly a need for additional research in this area, the literature provides several suggestions for improving access and care for those with developmental disabilities (*Evidence for Implementation*). These include: improved education for parents/caregivers and practitioners; having up-to-date medical histories for dentists; use of a dental home and/or dental passport; and use of developmentally appropriate communications.

## **11.0 SUMMARY**

This document provides an update of the evidence related to dental health since the 2006 evidence review on dental health. As with the 2006 evidence review, the current literature continues to provide support for the following:

- The negative impact periodontal disease can have on pregnancy, delivery, and the health of both mothers and their children (particularly in the early years, but also into school years and adolescence).
- The role diet (particularly the frequent ingestion of fermentable carbohydrates) plays in dental health.
- The use of fluoride and dental sealants in preventing caries.
- The use of a common risk factors approach to manage dental health care.
- The importance of dental health education in general (particularly for parents and other caregivers) and when used with other interventions.
- The importance of a collaborative approach that involves multiple health care sectors and community programs.

The current literature also indicates that

- There is a greater emphasis on education regarding good dental hygiene practices and dental treatment for pregnant and new mothers and their importance in reducing caries risk in young children.
- There is evidence that xylitol gum may have a beneficial effect on oral health (this is a change from the 2006 evidence review).
- There has been more interest in the economic costs associated with dental diseases and various interventions, but accurate costs continue to be difficult to obtain as most dental care remains privately funded.

In terms of the relationship between oral/dental health and various chronic conditions, the current literature indicates that

- There is evidence that some oral and oropharyngeal cancers are associated with some types of the HPV virus (particularly HPV-16). Treatment of these cancers can have an impact on oral health.
- A substantial proportion of individuals with HIV/AIDS experience oral disease.
- Loss of enamel, caries, altered salivary function and dental sensitivity may all occur as a result of eating disorders.
- There appears to be an association between periodontal disease and osteoporosis.
- There is no clear evidence that periodontal disease causes heart disease or stroke (this is a change from the 2006 evidence review).

- There is mixed evidence regarding an association between poor oral hygiene, periodontal disease and respiratory conditions (this is a change from the 2006 evidence review).

Further, the current literature indicates that access to appropriate oral and dental health care may be problematic for several populations, including those with lower incomes, Aboriginal people, immigrants/refugees, seniors, people living in rural areas, and individuals with development disabilities. In addition, oral and dental health care may be more costly for these populations when they do access it. This may mean that dental health services are accessed less frequently than by other populations (e.g., because of a lack of dental insurance) and/or the cost of providing service is more expensive because it is sought at later stages of disease and in a more costly setting. The use of dental homes may increase accessibility.

## **APPENDIX A: PREVIOUS BC DENTAL HEALTH REPORTS**

Previous reports on the dental health of British Columbians include the following:

- *Assessing Risk for Early Childhood Caries in Infants. Projects in British Columbia as of July 1999* (Bassett, McDonald, and Woods 1999).
- *A Summary of Services Provided by Community Health Dental Staff to Clients in Residential Care Facilities & Seniors Living in the Community*, November 1999.
- *Strategies to Enhance the Oral Health of British Columbians, specifically Aboriginal Peoples, Tobacco-Users, and Those of Low Socio-economic Background*, May 2001.
- *Children's Dentistry Task Force Report* (Harrison 2001).
- *BC Adult Dental Health Survey(s) – 1981, 1986, 1991, 1996, 2001* (British Columbia Dental Association).
- *British Columbia School Screening Dental Program. A Regional and Provincial Analysis* (Kashaninia, 2003).
- *Core Functions in Public Health; the Evidence Base for Dental Health*, May 2004.
- *An Overview of Dental Public Health Promotion and Disease Prevention Programs for Early Childhood*, March 2006.
- *Evidence Review: Dental Public Health*, BC Ministry of Health, 2006.
- *Evaluation of BC Early Childhood Dental Programs: Final Report* (Human Early Learning Partnership, Early Childhood Screening Research and Evaluation Unit, University of British Columbia, 2011).

## **APPENDIX B: SEARCH STRATEGY**

The search strategy used to identify research studies for this evidence review included the following:

1. [Systematic review] OR [systematic analysis] OR [meta analysis] OR [randomized controlled trials]

AND

2. [dental public health] OR [oral public health]

AND

3. [perinatal oral health] OR [prenatal oral health] OR [pregnancy and oral health] OR [pregnancy and dental] OR [maternal oral health] OR [periodontal disease and preterm birth] OR [periodontal disease and pregnancy] OR [periodontal infection and pregnancy]

OR

[Aboriginal and oral health] OR [Aboriginal and dental] OR [First Nations and dental]

OR

[socio-economic status and oral health] OR [socio-economic status and dental] OR [immigrant and oral health] OR [immigrant and dental]

OR

[efficacy and dental screening tools] OR [DEMFT and screening] OR [decayed, missing, filled teeth and screening] OR [visual screening for decay]

4. #1 AND #3 without #2 (depending on results in some categories).

## **APPENDIX C: ORAL HEALTH RECOMMENDATIONS FOR ABORIGINAL COMMUNITIES**

The following is an explanation of the grades, levels of evidence and levels of certainty referred to in Table 9: Oral Health Recommendations for Aboriginal Communities.

**Table C1: Grades of Recommendations**

<b>Grade</b>	<b>US Preventive Services Task Force</b>	<b>Canadian Task Force on Preventive Health Care</b>
A	High certainty that the net benefit is substantial.	Good evidence to recommend.
B	High certainty that the net benefit is moderate or there is moderate certainty that the net benefit is moderate to substantial.	Fair evidence to recommend.
C	Recommends against routinely providing the service. There may be considerations that support providing the service in an individual patient. At least moderate certainty that the net benefit is small.	Existing evidence is conflicting and does not allow one to make a recommendation for or against; however, other factors may influence decision-making.
D	Recommends against the service. Moderate or high certainty that the service has no net benefit or that the harms outweigh the benefits.	Fair evidence to recommend against the action.
I	Current evidence is insufficient to assess the balance of benefits and harms. Balance of benefits and harms cannot be determined.	Insufficient evidence (in quantity or quality) to make a recommendation; however, other factors may influence decision-making.

**Table C2: Level of Evidence or Certainty Regarding the Net Benefit**

<b>US Preventive Services Task Force</b>		<b>Canadian Task Force on Preventive Health Care</b>	
<b>Level of Certainty</b>	<b>Description</b>	<b>Level of Evidence</b>	<b>Description</b>
High	Evidence usually includes consistent results from well designed, well conducted studies in representative primary care populations. These studies assess the effects on health outcomes. This conclusion is therefore unlikely to be strongly affected by the results of future studies.	I	Evidence obtained from at least one properly randomized trial.
		II-1	Evidence obtained from well-designed controlled trial without randomization.
Moderate	The evidence is sufficient to determine the effects of the service on health outcomes but confidence in the estimate is constrained by factors such as: the number, size, or quality of studies; inconsistency of findings across studies; limited generalizability of findings; and lack of coherence in the chain of evidence.  As more information becomes available, the magnitude or direction of the observed effect could change and this change may be large enough to alter the conclusion.	II-2	Evidence obtained from well-designed cohort or case controlled analytic studies, preferably from more than one centre or research group.
		II-3	Evidence obtained from comparisons between times and places, with or without the intervention. Dramatic results in uncontrolled experiments could also be included in this category.

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US Preventive Services Task Force		Canadian Task Force on Preventive Health Care	
Level of Certainty	Description	Level of Evidence	Description
Low	<p>The available evidence is insufficient to assess effects on health outcomes. Evidence is insufficient because of the following: limited number or size of studies; important flaws in study design/methods; inconsistency of findings across studies; gaps in the chain of evidence; findings not generalizable; and lack of information on important health outcomes.</p> <p>More information may allow estimation of effects of health outcomes.</p>	III	Opinions of respected authorities based on clinical experience, descriptive studies or reports of expert committees.

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