

November 7, 2014

Notice to the reader

Re: A Review of Water Fluoridation, October 1, 2010 report

This report is a compilation of existing resources, materials and research that highlight key aspects of the water fluoridation debate. It was developed as a support to assist Medical Officers of Health in Alberta in dealing with queries on fluoridation. While not written for the public, this report is now widely available to help anyone interested to better understand the issue and to provide answers to questions about fluoridation.

The reader must be aware that this report is not drafted as a scientific review article for publication although references are made to previous systematic reviews and their findings. It is also important to note that specific references for quoted material are given in the text at the time they are used.

Office of the Chief Medical Officer of Health, Alberta Health

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A Review of Water Fluoridation

SUBMITTED: OCTOBER 1, 2010

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Executive Summary

This report has been prepared as a **compilation of existing resources that highlight key aspects of the water fluoridation debate**. Specific references for quoted material are given in the text at the time they are used. This report is not a systematic review of the literature although **references are made to previous systematic reviews** and their findings.

Oral health is an important part of overall health and dental caries and other oral diseases continue to affect many within Alberta and Canada. As dentistry is most often paid for through private insurance or out-of-pocket income there are many who find it difficult to access dental care and prevention.

To prevent wide-spread, chronic diseases, a population approach needs to be considered in terms of how it can impact on disease rates and minimize risk to those who are most vulnerable. Controlled community water fluoridation has been in place for over 60 years in parts of North America. 45% of Canadians and **75% of Albertans have access to fluoridated public water supplies**. Recent studies show that a majority (almost two-thirds) of Canadians know about water fluoridation, support its efficacy and believe it to be safe.

Debate against the practice of community water fluoridation has been around since the inception of this preventive activity many decades ago. Strong emotion and argument questions the effectiveness, the safety and the ethical underpinnings of such a practice. Anti-fluoride groups are often well-organized, financially supported and passionate in forcing the debate, often utilizing techniques that do not allow for clear and unbiased review of the scientific evidence. Care has to be taken to ensure that those who support fluoridation do not also use these same techniques.

Decisions such as whether or not to fluoridate water systems **demand a rigorous adherence to the principles of scientific inquiry and review**. It is important to search extensively, to evaluate quality and appropriateness of the information being published and use the concepts of quantity and quality of evidence to base our decisions. There is a hierarchy of evidence and it is important to adhere to the highest quality when making important public impact decisions.

We know that **fluoride works** to reduce the initiation and progress of dental caries, especially as it is **delivered topically in low doses on a regular basis**. A number of fluoride therapies, including water fluoridation exist that will deliver fluoride in this way. One of the major considerations in terms of **risk or side-effect is the link to dental fluorosis**. Higher levels of fluoride ingestion during the development of teeth can lead to dental fluorosis. Moderate to severe levels of dental fluorosis are rarely seen and do not appear to have changed much over the years. More individuals do demonstrate fluorosis, but primarily of a very mild to mild presentation.

Evidence from rigorous systematic reviews over the last decade have been reviewed as part of the literature review for this report. Additionally a literature review from the past three years (not a systematic review) was also undertaken.

Three key questions are considered:

- 1) Does water fluoridation work? What are the benefits?
- 2) Does water fluoridation cause harm? What are the risks?
- 3) Is it ethical to fluoridate water supplies? What other options are there?

Extensive review of the published and peer-reviewed quality literature continues to demonstrate that there is a difference in percentages of children with dental caries between communities with controlled or natural fluoridation and those without and that similarly there is a difference in the average number of decayed, missing and filled teeth.

Other than dental fluorosis, there is no clear and extensive evidence that supports water fluoridation as a harmful agent at the levels recommended.

Accepting the benefit that fluoridation brings to many of the population and that it is an element used in a public health intervention and not as a medication prescribed for the masses, **principles of beneficence and meeting the public good will balance the challenges against personal autonomy** for those opposed to adding fluoride to the public water supply.

Significant support continues for water fluoridation as a sound and ethical practice designed to use an evidence-based public health intervention to decrease the morbidity and mortality associated with increased dental disease.

The following recommendations are proposed for Alberta to ensure that water fluoridation is practiced according to the best science and allows for the maximal benefit to Albertans:

- 1) **Continue to support water fluoridation** as a means of providing an effective and safe preventive modality for dental caries to the majority of the Albertan population (the data when considered in terms of quality and quantity still supports the use of water fluoridation).
- 2) **Maintain, support and monitor existing water treatment facilities** in providing water fluoridation correctly, efficiently and safely.
- 3) **Consider the dental health of communities over 1,000 population without water fluoridation** and work collaboratively to determine how best to provide fluoride for residents of those communities.
- 4) A mechanism should be developed for **AHW/Chief Medical Officer/Provincial Dental Public Health Officer to be consulted and provide information** on the health implications related to all municipal/water system administrative decisions to either add or remove fluoride out of public water supplies.

- 5) **Develop a Community Water Fluoridation program** similar to Manitoba (<http://www.gov.mb.ca/health/publichealth/environmentalhealth/dental.html>) with collaboration between Health & Environment Ministries. This could include:
 - a. grants for communities wishing to install fluoridation systems,
 - b. initial training in equipment operation/maintenance, testing procedures, safety standards and monitoring,
 - c. education for municipal decision-makers/water commissions on the science behind fluoridation and the decision-making process in supporting this practice,
 - d. a province-wide fluoride level monitoring and reporting program,
 - e. expert, scientific & public health groups responsible for both regular review of the relevant science and policy and creation of appropriate health promotion messaging related to supporting water fluoridation.
- 6) **Develop a province-wide fluoride level monitoring and reporting program** with annual reports of data collection provided to key stakeholders, including the Chief Medical Officer of Health and the Provincial Dental Public Health Officer (see 5.d.).
- 7) **Convene various groups** under the direction of Alberta Health & Wellness to formally accomplish the following tasks (see 5.e.):
 - a. Expert Panel to routinely review the best available scientific evidence about water fluoridation, and to recommend policy for Alberta.
 - b. Coalition of health professionals and elected municipal and appointed officials (water commissions) to proactively advocate for and support water fluoridation.
 - c. Public Health advisory group to generate health promotion information and messages that support the scientific evidence for water fluoridation.
- 8) **Collaboratively create and implement broad public policy/promotion activities** regarding healthy eating, labelling of foods, hidden sugars, education of youth/parents, personal behaviours, lifestyle, access to basic dental care and prevention, appropriate use of preventive agents, etc. all designed to minimize dental disease in Alberta.
- 9) In collaboration with provincial dental public health programs, regularly **complete surveillance activities** to determine dental caries disease rates, trends and patterns of dental disease, dental fluorosis rates, location of sub-groups with high risk/high disease rates, water consumption rates (including bottled & tap water) all with the aim to best determine mechanisms for preventing disease and evaluating effectiveness of current prevention activities.
- 10) Consult with Provincial Dental Public Health Officer with respect to publicly delivered fluoride varnish programs and **prepare to be responsive to change in rates of fluoridation** through planned expansion of dental public health fluoride programs.

Introduction/Background

Importance of oral health

A common message heard today from experts in the field of oral health is that evidence exists that highlights the importance of good oral health in contributing to overall general health. Health Canada's website describes how "the Office of the Chief Dental Officer (OCDO) is the focal point within Health Canada for oral health issues. The mandate of the office is to increase awareness of good oral habits and to improve the oral health of Canadians. As there is a link between oral health and general health, an improvement in oral health may lead to an improvement in overall general health." (<http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/life-vie/dent-eng.php>)

Further evidence of this support is highlighted on Health Canada webpages. "Poor oral health can affect more than just your mouth; it can affect other areas of your body as well. In fact there is now research that shows the connection between poor oral health and systemic disease such as diabetes in people of all ages and respiratory diseases particularly among elderly people. Also there is new research now pointing to possible connections between oral health and other systemic conditions such as heart disease and premature, low birth weight babies. It is important to maintain the health of your mouth and teeth throughout your lifetime." (<http://www.hc-sc.gc.ca/hl-vs/oral-bucco/index-eng.php>)

"Gum disease is an inflammation of the gums, which may also affect the bone supporting the teeth. Plaque is a sticky colourless film of bacteria that constantly builds up, thickens and hardens on the teeth. If it is not removed by daily brushing and flossing, this plaque can harden into tartar and may contribute to infections in the gums. Left untreated, gum disease can lead to the loss of teeth and an increased risk of more serious diseases, such as respiratory disease. The bacteria in plaque can travel from the mouth to the lungs, causing infection or aggravating existing lung conditions. There is also a link between diabetes and gum disease. People with diabetes are more susceptible to gum disease and it can put them at greater risk of diabetic complications. Studies are also examining whether pregnant women with poor oral health may be at a higher risk of delivering pre-term, low birth weight (PLBW) babies than women with good oral health. Babies who are pre-term or low birth weight have a higher risk of developmental complications, asthma, ear infections, birth abnormalities, behavioural difficulties and are at a higher risk of infant death. Even though this research is ongoing, it is still important for pregnant women to take care of their gums and teeth." (<http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/life-vie/dent-eng.php>)

The Surgeon General's report on oral health (May 2000) also contains the following emphasis on the importance of oral health and its contribution to overall health.

"The major message of this Surgeon General's report is that oral health is essential to the general health and well-being of all Americans *and* can be achieved by all Americans. However, *not all* Americans are achieving the same degree of oral health. In spite of the safe and effective means of maintaining oral health that have benefited the majority of Americans over the past half century, many among us still experience needless pain and suffering, complications that devastate overall health and well-being, and financial and social costs that diminish the quality of life and burden American society. What amounts to "a silent

epidemic” of oral diseases is affecting our most vulnerable citizens-- poor children, the elderly, and many members of racial and ethnic minority groups.

...oral health means much more than healthy teeth. It means being free of chronic oral-facial pain conditions, oral and pharyngeal (throat) cancers, oral soft tissue lesions, birth defects such as cleft lip and palate, and scores of other diseases and disorders that affect the oral, dental, and craniofacial tissues, collectively known as the *craniofacial complex*. These are tissues whose functions we often take for granted, yet they represent the very essence of our humanity. They allow us to speak and smile; sigh and kiss; smell, taste, touch, chew, and swallow; cry out in pain; and convey a world of feelings and emotions through facial expressions. They also provide protection against microbial infections and environmental insults.” (<http://www2.nidcr.nih.gov/sgr/execsumm.htm>)

Scope of Dental Disease in Alberta/Canada

Dental disease in Alberta

Over the past six years, oral health status data for children in grades two and six has been collected from at least seven of Alberta’s nine Regional Health Authorities (RHA’s). These surveys were consistent in the indicators measured, criteria for measurement, methodology and all examiners were calibrated by the three dental officers working within the regions.

The following table identifies the previous RHA’s, year of the school dental survey and whether or not a census (all schools) or a sample approach was utilized.

Dental Surveys (Alberta)

Regional Health Authority	Year of Survey (school year)	Sampling Approach
Aspen Health Region	2004-2005	Census (all schools)
Calgary Health Region	2004-2005	Sample
Chinook Health Region	2005-2006	Sample
David Thompson Health Region	2008-2009	Census (all schools)
Northern Lights Health Region	2008-2009	Census (all schools)
Palliser Health Region	2005-2006	Census (all schools)
Peace Country Health Region	2009-2010	Census (all schools)

The following key indicators highlight comparisons between these seven geographical surveys:

Dental Caries Grades 2 & 6

- Dental caries in the **primary** dentition is measured utilizing the “deft” index which represents the average sum of decayed (d), extracted (e), and filled (f) primary teeth (t). It is a cumulative measure of total past and current impact of dental caries on the primary dentition.
- Dental caries in the **permanent** dentition is measured utilizing the “DMFT” index which represents the average sum of decayed (D), missing (M), and filled (F) permanent teeth (t). It is a cumulative measure of total past and current impact of dental caries on the primary dentition.

Children with Caries Grades 2 & 6

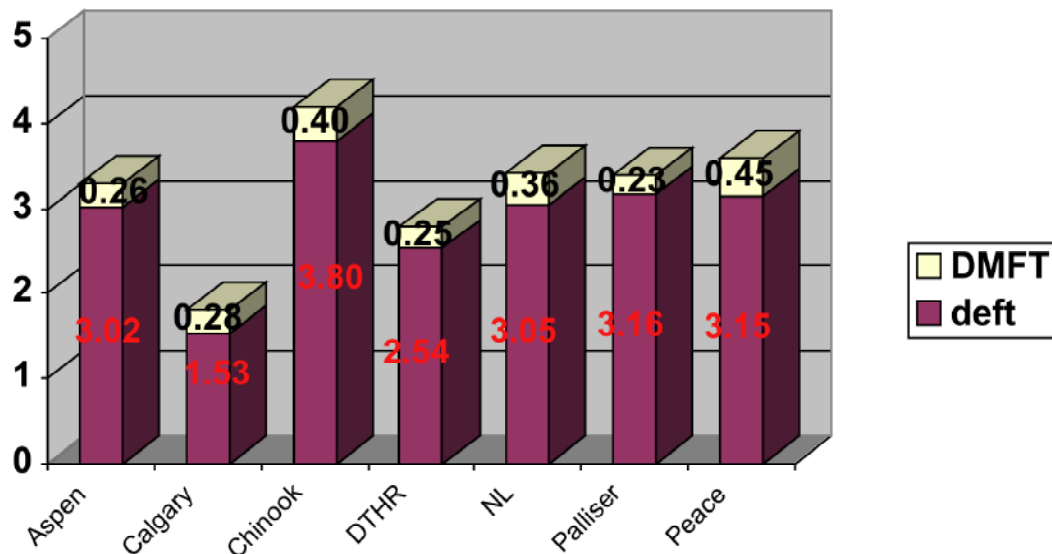
- Many children in Alberta have a deft or DMFT score of zero. This gives rise to an overall average deft or DMFT that includes all of the children with zero scores and demonstrates a lower population average.
- To ascertain the impact of dental caries on those children who actually have the disease, all children with zero deft or DMFT are taken out of the calculations.
- The resulting deft or DMFT describes the average decay experience for those children with disease.

Caries Experience Grades 2 & 6

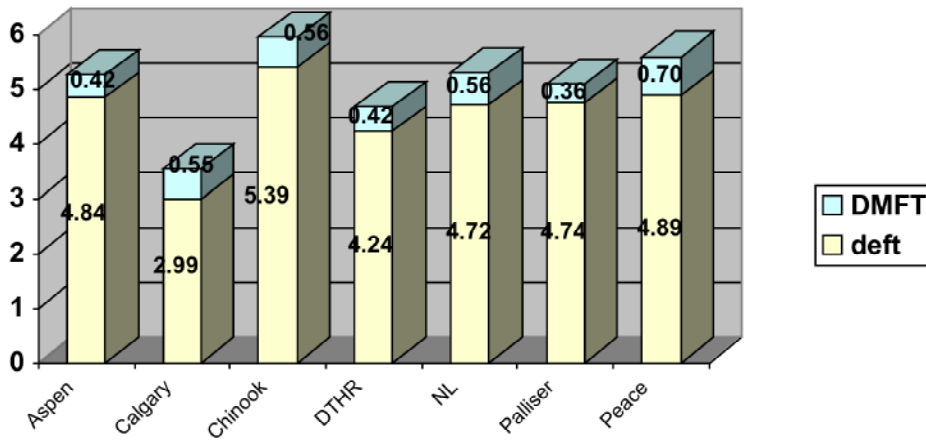
- Two indicators used here are percentage of children with no decay and percentage of children with untreated (or active) carious lesions present on teeth.
- The percentage of children with no decay highlights the extent of the absence and presence of disease within the age group.
- The percentage of children with untreated decay highlights the extent to which the disease has been treated.

Urgent Concerns Grades 2 & 6

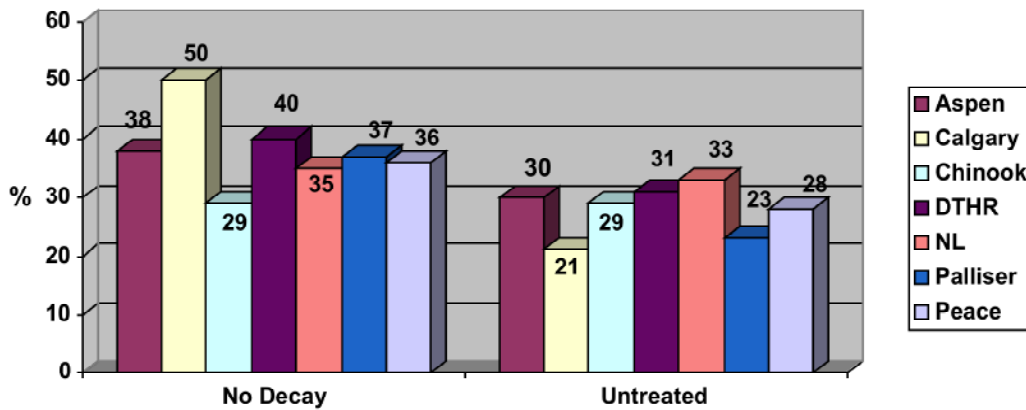
- The percentage of children demonstrating urgent dental problems such as pain, infection, broken-down teeth all sequelae of dental caries.

Dental Caries- Grade 2

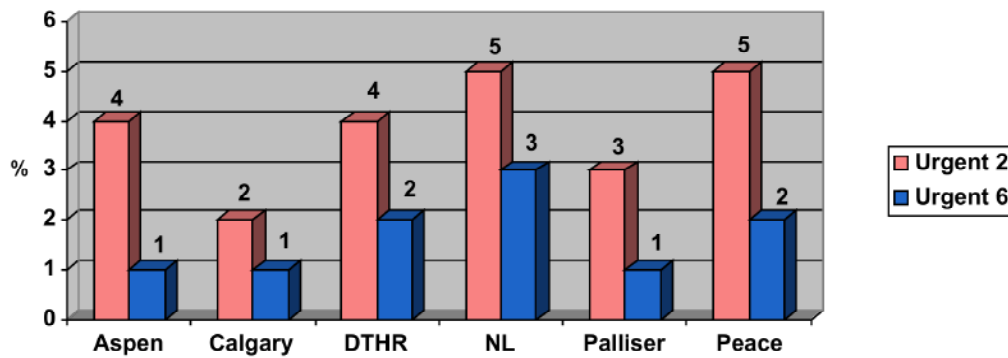
Children with Caries- Grade 2



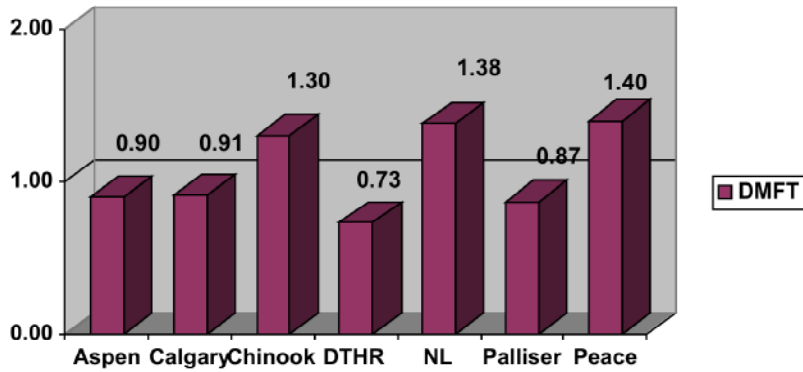
Caries Experience- Grade 2



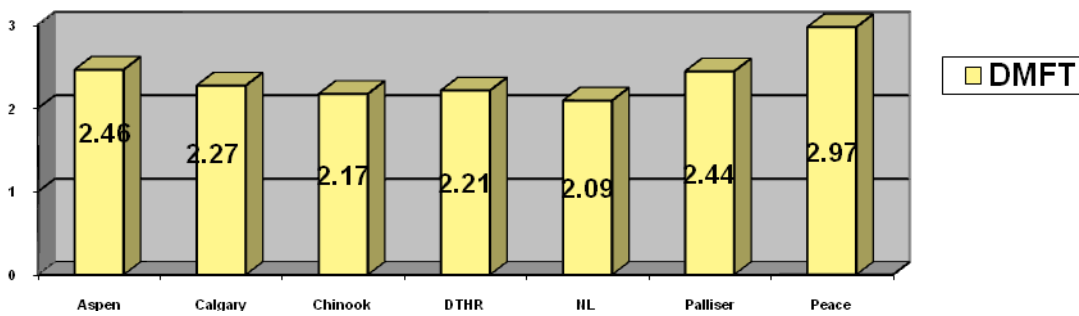
Urgent Dental Concerns- Grade 2 & 6



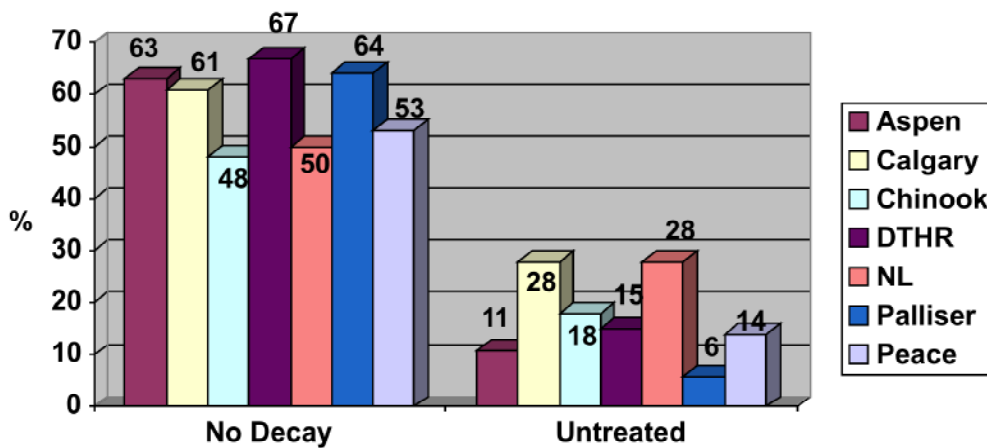
Dental Caries- Grade 6



Children with Caries- Grade 6



Caries Experience- Grade 6



Dental disease in Canada

“Statistics Canada collected data for the Canadian Health Measures Survey (CHMS) from about 6,000 people in 15 communities randomly selected across Canada between March 2007 and February 2009. The sample represents 97% of the Canadian population aged six to seventy-nine years old.

The Oral Health Module of the Canadian Health Measures Survey (CHMS) is a result of a collaborative partnership between three federal departments: Statistics Canada, Health Canada and the Department of National Defence.” (<http://www.hc-sc.gc.ca/hl-vs/pubs/oral-bucco/fact-fiche-oral-bucco-stat-eng.php>)

CHMS Key Findings:

<http://www.fptdvg.ca/assets/PDF/CHMS/CHMS-E-summ.pdf>

Impact on Productivity

An analysis of the results found that an estimated total of **40.36 million hours** are lost from school or work or normal activities in one year due to check-ups or problems with teeth. When we look at these results in terms of either a school-day or a work day this means that there are an estimated **2.26 million school-days and 4.15 million working-days** lost annually due to dental visits or dental sick-days.

Children (6–11 years of age)

Children who are between the ages of 6 and 11 have a mix of baby teeth and adult teeth in their mouth. As a result, dmft and DMFT scores were collected on both sets of teeth and then a combined deft + DMFT score was determined.

Primary (or baby) teeth

- The survey found that 48% of children aged 6–11 years of age have a deft count of at least 1.
- The average number of primary teeth that are decayed, missing, or filled is 1.99.

Permanent (or adult) teeth

Since children in this age group do not have all their adult teeth, the average count and the amount of disease present is lower.

- 24% of children aged 6–11 years of age have a DMFT count of at least 1.
- The average number of permanent teeth that are Decayed, Missing, or Filled is 0.49.

Combined primary and permanent teeth

- 57% of children aged 6–11 years of age have a combined deft + DMFT count of at least 1.
- The average number of teeth that have a deft + DMFT is 2.5 primary or permanent teeth.

Adolescent (12–19 years of age)

The Decayed Missing Filled Teeth (DMFT) scores for an adolescent are calculated on the permanent teeth.

- The survey found 59% of adolescents (12–19 years of age) have a DMFT count of at least 1.
- The average number of DMFT is 2.49 in adolescents.

Adults (20–79 years of age)

Adults can develop two different types of cavities. The first type is called a coronal cavity. A coronal cavity is a cavity that develops anywhere on the tooth – except on the root.

- 96% of adults (who have teeth) have a coronal DMFT of at least 1.
- The average number of coronal DMFT for adults is 10.67.

The second type of cavity that an adult can develop is called a root cavity. A root cavity is a cavity that is found along the root (or the part of the tooth that is usually hidden by the gums) of a tooth. A root cavity is difficult to find on the tooth and can be more difficult to treat as well.

- 20% of adults (20–79 years of age) have at least 1 decayed or filled root cavity.
- Canadian adults have an average of 0.66 Root, Decayed or Filled Teeth (RDFT).

Older adults (60-79 years of age)

- Older adults from 60–79 years of age have more root cavities (43%) than adults 20 to 39 years of age (6%).

Untreated coronal and root cavities

- 20% of adult Canadians (20–79 years of age) have on average 2.97 coronal cavities that need a filling.
- 7% of adult Canadians (20–79 years of age) have on average 2.81 root cavities that need a filling.

Economic factors

- Twice as many lower income Canadians have cavities that need a filling compared to Canadians from the higher income group.

Mechanism of Fluoride's Action

Benefits of Water Fluoridation (Fluoridation Facts, American Dental Association, pgs. 10-11, http://www.ada.org/sections/professionalResources/pdfs/fluoridation_facts.pdf)

“Fluoride protects teeth in two ways – systemically and topically. Systemic fluorides are those ingested into the body. During tooth formation, ingested fluorides become incorporated into tooth structures. Fluorides ingested regularly during the time when teeth are developing (preeruptively) are deposited throughout the entire tooth surface and provide longer-lasting protection than those applied topically. Systemic fluorides can also give topical protection because ingested fluoride is present in saliva, which continually bathes the teeth providing a reservoir of fluoride that can be incorporated into the tooth surface to prevent decay. Fluoride also becomes incorporated into dental plaque and facilitates further remineralization. Sources of systemic fluoride in the United States include fluoridated water, dietary fluoride supplements in the forms of tablets, drops or lozenges and fluoride present in food and beverages.

While it was originally believed that fluoride's action was exclusively systemic or preeruptive, by the mid-1950s, there was growing evidence of both systemic and topical benefits of fluoride exposure. Topical fluorides strengthen teeth already present in the mouth (posteruptively). In this method of delivery, fluoride is incorporated into the surface of teeth making them more decay-resistant.

Topically applied fluoride provides local protection on the tooth surface. Topical fluorides include toothpastes, mouthrinses and professionally applied fluoride foams, gels and varnishes. As mentioned previously, systemic fluorides also provide topical protection. Low levels of fluoride in saliva and plaque from sources such as optimally fluoridated water can prevent and reverse the process of dental decay. In clarifying the effectiveness of water fluoridation, John D.B. Featherstone, PhD, Professor and Chair, Department of Preventive and Restorative Dental Services, University of California San Francisco, noted: "...There is irrefutable evidence in numerous studies that fluoride in the drinking water works to reduce dental caries in populations. This is still the case."

The remineralization effect of fluoride is important. Fluoride ions in and at the enamel surface result in fortified enamel that is not only more resistant to decay (loss of minerals or demineralization), but enamel that can repair or remineralize early dental decay caused by acids from decay-causing bacteria. Fluoride ions necessary for remineralization are provided by fluoridated water as well as various fluoride products such as toothpaste. The maximum reduction in dental decay is achieved when fluoride is available preeruptively (systemically) for incorporation during all stages of tooth formation and posteruptively (topically) at the tooth surface. Water fluoridation provides both types of exposure."

Featherstone JDB. The science and practice of caries prevention. JADA 2000; 131 (7):887-899

In this article, Dr. John D.B. Featherstone, PhD, Professor and Chair, Department of Preventive and Restorative Dental Services, University of California San Francisco describes the three key mechanisms of fluoride as a caries-preventive agent.

"Bacterial plaque and acid production. The caries process is now well-understood; much of it has been described extensively in the dental literature. Some details of the caries process remain to be unraveled, but, in general, we understand the process well enough to initiate better-targeted methods of caries prevention and intervention.

The mechanism of dental caries formation is essentially straightforward. Plaque on the surface of the tooth consists of a bacterial film that produces acids as a byproduct of its metabolism. To be specific, certain bacteria within the plaque are acidogenic—that is, they produce acids when they metabolize fermentable carbohydrates. These acids can dissolve the calcium phosphate mineral of the tooth enamel or dentin in a process known as demineralization. If this process is not halted or reversed via remineralization—the redeposition of mineral via saliva—it eventually becomes a frank cavity.

Dental caries of the enamel typically is first observed clinically as a so-called "white-spot lesion." This is a small area of subsurface demineralization beneath the dental plaque. The body of the subsurface lesion may have lost as much as 50 percent of its original mineral content and often is covered by an "apparently intact surface layer." The surface layer forms by remineralization. The process of demineralization continues each time there is carbohydrate taken into the mouth that is metabolized by the bacteria. The saliva has numerous roles, including buffering (neutralizing) the acid and remineralization by providing minerals that can replace those dissolved from the tooth during demineralization.

The mutans streptococci and the lactobacilli, either separately or together, are the primary causative agents of dental caries.

Any fermentable carbohydrate (such as glucose, sucrose, fructose or cooked starch) can be metabolized by the acidogenic bacteria and create the aforementioned organic acids as byproducts. The acids diffuse through the plaque and into the porous subsurface enamel (or dentin, if exposed), dissociating to produce hydrogen ions as they travel. The hydrogen ions readily dissolve the mineral, freeing calcium and phosphate into solution, which can diffuse out of the tooth. Most importantly, lactic acid dissociates more readily than the other acids, producing hydrogen ions that rapidly lower the pH in the plaque. As the pH is lowered, acids diffuse rapidly into the underlying enamel or dentin.

The two most important groups of bacteria that predominantly produce lactic acid are the mutans streptococci and the lactobacilli. Each group contains several species, each of which is cariogenic. Mutans streptococci include *Streptococcus mutans* and *S. sobrinus*. The lactobacilli species also are prolific producers of lactic acid and appear in plaque before caries is clinically observed. These two groups of bacteria, either separately or together, are the primary causative agents of dental caries.

The ability of fluoride to prevent and arrest caries has been researched extensively. Fluoride has three principal topical mechanisms of action:

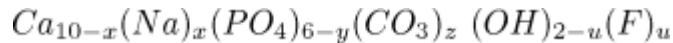
- inhibiting bacterial metabolism after diffusing into the bacteria as the hydrogen fluoride, or HF, molecule when the plaque is acidified;
- inhibiting demineralization when fluoride is present at the crystal surfaces during an acid challenge;
- enhancing remineralization and thereby forming a low-solubility veneer similar to the acid-resistant mineral fluorapatite, or FAP, on the remineralized crystals.

Inhibiting bacterial metabolism. Several investigators have studied the possible effects of fluoride on oral bacteria. The most significant finding reported is that the ionized form of fluoride, or F^- , cannot cross the cell wall and membrane but can rapidly travel into the cariogenic bacterial cells in the unchanged form as HF.

When the pH in the plaque falls as the bacteria produce acids, a portion of the fluoride present in the plaque fluid then combines with hydrogen ions to form HF and rapidly diffuses into the cell, effectively drawing more HF from the outside. Once inside the cell, the HF dissociates, acidifying the cell and releasing fluoride ions that interfere with enzyme activity in the bacterium. For example, fluoride inhibits enolase, an enzyme necessary for the bacteria to metabolize carbohydrates. As fluoride is trapped in the cell, the process becomes cumulative.

In summary, fluoride from topical sources is converted partially to HF by the acid that the bacteria produce and diffuses into the cell, thereby inhibiting essential enzyme activity.

Inhibiting demineralization. The mineral of our teeth (enamel, cementum, dentin) and bones is a carbonated hydroxyapatite that can be approximately represented by this simplified formula:



The substitutions in the hydroxyapatite crystal lattice (the arrangement of atoms and ions in the crystal) occur as the mineral is first laid down during tooth development, with the carbonate (CO_3) ion in particular causing major disturbances in the regular array of ions in the crystal lattice. During demineralization, the carbonate is lost, and during remineralization it is excluded from the newly formed mineral. The calcium-deficient, carbonate-rich regions of the crystal are especially susceptible to attack by the acid hydrogen ions during demineralization, as has been shown by several investigators. High-resolution lattice imaging, which images crystals almost to atomic resolution (viewed at about x2,000,000 magnification), was used to illustrate the appearance of hexagonal holes in the early stages of enamel crystal dissolution in dental caries, which coincided with the calcium-deficient, carbonate-substituted regions of the crystal.

The carbonated hydroxyapatite, or CAP, of our teeth is much more soluble in acid than hydroxyapatite, or HAP ($HAP = Ca_{10}(PO_4)_6(OH)_2$), and that in turn is much more soluble than fluorapatite, or FAP ($FAP = Ca_{10}(PO_4)_6F_2$), in which the OH^- ion in pure hydroxyapatite is completely replaced by an F^- ion. The resulting mineral FAP is highly resistant to dissolution by acid.

Fluoride inhibits demineralization. Sound enamel, except in its outer few micrometers, generally contains fluoride at levels of about 20 to 100 parts per million, or ppm, depending on the fluoride ingestion during tooth development. Teeth in children who lived in areas with fluoridated drinking water during tooth development have fluoride content toward the higher end of this range. The outer few micrometers of enamel can have fluoride levels of 1,000 to 2,000 ppm.

Fluoride in the solution surrounding CAP crystals has been shown to be much more effective in inhibiting demineralization than fluoride incorporated into the crystals at the levels found in enamel. Ten Cate, Nelson and colleagues and Featherstone and colleagues found no measurable reduction in the acid solubility of synthetic CAP (3 percent CO_3 by weight, comparable to that of dental enamel mineral) with about 1,000 ppm fluoride incorporated. Importantly, this means that fluoride incorporated during tooth mineral development at normal levels of 20 to 100 ppm (even in areas that have fluoridated drinking water or with the use of fluoride supplements) does not measurably alter the acid solubility of the mineral. Even when the outer enamel has higher fluoride levels, such as 1,000 ppm, it does not measurably withstand acid-induced dissolution any better than enamel with lower levels of fluoride. Only when fluoride is concentrated into a new crystal surface during remineralization is it sufficient to beneficially alter enamel solubility. The fluoride incorporated developmentally—that is, systemically into the normal tooth mineral—is insufficient to have a measurable effect on acid solubility.

In contrast to the lack of effect of fluoride incorporated into the CAP crystals of tooth mineral developmentally, as little as 1 ppm in the acid solution reduced the dissolution rate of CAP to a rate equivalent to that of HAP. Further increases in fluoride in the acid solution in contact with the CAP mineral surface decreased the solubility rate logarithmically. These results indicate that if fluoride is present in the aqueous solution surrounding the crystals, it is adsorbed strongly to the surface of CAP carbonated apatite (enamel mineral) crystals and thus acts as a potent protection mechanism

against acid dissolution of the crystal surface in the tooth's subsurface region. If fluoride is in the plaque fluid at the time that the bacteria generate acid, it will travel with the acid into the subsurface of the tooth and, therefore, adsorb to the crystal surface and protect it against being dissolved.

In summary, fluoride present in the water phase at low levels among the enamel or dentin crystals adsorbs to these crystal surfaces and can markedly inhibit dissolution of tooth mineral by acid. Fluoride that acts in this way comes from the plaque fluid via topical sources such as drinking water and fluoride products. Fluoride incorporated during tooth development is insufficient to play a significant role in caries protection. Fluoride is needed regularly throughout life to protect teeth against caries.

Enhancing remineralization. As the saliva flows over the plaque and its components neutralize the acid, raising the pH, demineralization is stopped and reversed. The saliva is supersaturated with calcium and phosphate, which can drive mineral back into the tooth. The partially demineralized crystal surfaces within the lesion act as "nucleators," and new surfaces grow on the crystals. These processes constitute remineralization—the replacement of mineral in the partially demineralized regions of the carious lesion of enamel or dentin (including the tooth root). Fluoride enhances remineralization by adsorbing to the crystal surface and attracting calcium ions, followed by phosphate ions, leading to new mineral formation. The newly formed "veneer" excludes carbonate and has a composition somewhere between HAP and FAP as described above. FAP contains approximately 30,000 ppm F and has a very low solubility in acid. The new remineralized crystal now will behave like low-solubility FAP rather than the highly soluble CAP of the original crystal surface.

In summary, fluoride in solution from topical sources enhances remineralization by speeding up the growth of a new surface on the partially demineralized subsurface crystals in the caries lesion. The new crystal surface veneer is FAP-like, with much lower solubility than the original CAP tooth mineral. Subsequent acid challenges must be quite strong and prolonged to dissolve the remineralized enamel.

Fluoride's three extensively studied and documented principal mechanisms of action rely on the presence of fluoride in saliva, in the plaque at the tooth surface and in the fluid among the crystals in the subsurface of the enamel or dentin. The clinical effects of fluoride, therefore, can be optimized by using delivery methods that bring fluoride to the surface of the tooth and into the plaque rather than incorporating fluoride into the tooth mineral crystals during tooth development. These topical delivery methods are equally applicable to adults and children and include fluoride in beverages and foods, dental products and drinking water. The benefits of continually providing low levels of fluoride in the saliva and plaque from the aforementioned topical sources are described more fully in a recent review article."

Featherstone, JDB. Prevention and reversal of dental caries: role of low level fluoride.

***Comm Dent Oral Epidemiology* 1999, Vol. 27 (1): 31-40.**

"Fluoride therefore must be considered as one of several protective factors. Obviously it is a key one and small adjustments can tip the caries balance one way or the other, leading to caries arrestment, reversal, or progression. The frequent delivery of fluoride to the surfaces of the teeth is a very important factor as described in detail above. The topical effects of fluoride are over-riding, and the systemic incorporation of fluoride in the tooth mineral is unfortunately not of major benefit. This

means that we must use this information to deal more effectively with caries in both adults and children. It is well established that fluoride in drinking water reduces dental caries, but does not eradicate it. Fluoride in the drinking water provides fluoride at levels in the mouth which can inhibit demineralization and enhance remineralization, and tip the caries balance towards protection, provided the challenge is not too great. Again, as described above, the concentration of fluoride in dental enamel and dentin provided by fluoridation of drinking water or by natural fluoride levels at about 1 ppm is insufficient to provide protection against caries. The mechanism of action of fluoride in the drinking water is therefore as a topical delivery system. The role of systemically incorporated fluoride is of very limited value. Fluoride-containing products such as dentifrice, mouthrinse and topically applied gels provide caries-preventive benefits via the topical mechanisms described above. The effects are all via the mechanisms of inhibition of demineralization, enhancement of remineralization and action on the bacteria. In the case of high bacterial challenge and/or xerostomia or salivary dysfunction, then even high levels of fluoride therapy may be insufficient to balance the effect of the pathological factors, and caries progresses. In each individual person there will be some level of challenge beyond which fluoride is insufficient to swing the balance. Fluoride products used frequently can maintain salivary fluoride levels in excess of 0.03 ppm, thereby providing marked caries protection. The biggest problem with the home-use products of course is the need for patient compliance on a daily basis.”

Dental Fluorosis

Safety of Water Fluoridation (Fluoridation Facts, American Dental Association, pgs. 28-30, http://www.ada.org/sections/professionalResources/pdfs/fluoridation_facts.pdf)

“Dental fluorosis is a change in the appearance of teeth and is caused when higher than optimal amounts of fluoride are ingested in early childhood while tooth enamel is forming. The risk of dental fluorosis can be greatly reduced by closely monitoring the proper use of fluoride products by young children. Dental fluorosis is caused by a disruption in enamel formation which occurs during tooth development in early childhood related to a higher than optimal intake of fluoride . Enamel formation of permanent teeth, other than third molars (wisdom teeth), occurs from about the time of birth until approximately five years of age. After tooth enamel is completely formed, dental fluorosis cannot develop even if excessive fluoride is ingested. Older children and adults are not at risk for the development of dental fluorosis. Dental fluorosis becomes apparent only after the teeth erupt. Because dental fluorosis occurs while teeth are forming under the gums, teeth that have erupted are not at risk for dental fluorosis. It should be noted that many other developmental changes that affect the appearance of tooth enamel are not related to fluoride intake.

Dental fluorosis has been classified in a number of ways. One of the most universally accepted classifications was developed by H. T. Dean in 1942; its descriptions can be easily visualized by the public. In using Dean’s Fluorosis Index, each tooth present in an individual’s mouth is rated according to the fluorosis index. The individual’s fluorosis score is based upon the severest form of fluorosis recorded for two or more teeth. Dean’s Index, which has been used for more than 60 years, remains popular for prevalence studies in large part due to its simplicity and the ability to make comparisons with findings from a number of earlier studies. Very mild to mild fluorosis has no effect on tooth function and may make the tooth enamel more resistant to decay. These types of fluorosis are not readily apparent to the affected individual or casual observer and often require a trained specialist to detect. In contrast, the moderate and severe forms of dental fluorosis,

characterized by esthetically (cosmetically) objectionable changes in tooth color and surface irregularities, are typically easy to detect. Most investigators regard even the more advanced forms of dental fluorosis as a cosmetic effect rather than a functional adverse effect. The U.S. Environmental Protection Agency, in a decision supported by the U.S. Surgeon General, has determined that objectionable dental fluorosis is a cosmetic effect with no known health effects. Little research on the psychological effects of dental fluorosis on children and adults has been conducted, perhaps because the majority of those who have the milder forms of dental fluorosis are unaware of this condition.

In a 1986-7 national survey of U.S. school children conducted by the National Institute of Dental Research (NIDR), dental fluorosis was present in 22.3% of the children examined using Dean's Index. These children were exposed to a variety of sources of fluoride (fluoridated water, food, beverages, fluoride dental products and dietary supplements). The prevalence of the types of dental fluorosis observed was:

- Very mild fluorosis 17.0%
- Mild fluorosis 4.0%
- fluorosis 1.0%
- Severe fluorosis 0.3%
- Total 22.3%

The incidence of moderate or severe fluorosis comprised a very small portion (6%) of the total amount of fluorosis. In other words, 94% of all dental fluorosis was the very mild to mild form of dental fluorosis. This survey conducted by NIDR remains the only source of national data regarding the prevalence of dental fluorosis. In a study that compared this data with data recorded by H. Trendley Dean in the 1930s, it was determined that the greatest increase in fluorosis from the 1930s to the 1980s appeared in the group with suboptimally fluoridated water. During the last ten years of this period, children were exposed to fluoride from multiple sources including water, infant formula, foods, foods and drinks prepared with fluoridated water as well as dietary supplements and the ingestion of fluoride toothpaste making it difficult to pinpoint the effect any one item had on the development of fluorosis. Using the same NIDR study, researchers looked at children aged 12-14 years who had never received dietary fluoride supplements and had only lived in one home. Through their analysis, they found that approximately 2% of U.S. school children may experience perceived esthetic problems which could be attributed to the currently recommended levels of fluoride in drinking water. They reported that dental fluorosis in the esthetically important front teeth occurs less often and is less severe than when looking at all teeth in an individual. While the researchers were not able to provide a cost estimate associated with the treatment of this fluorosis, they did note that such estimates are frequently an overestimation of the actual costs. Additionally, any change recommended to the current fluoridation policy would need to be weighed against fluoridation's lifetime benefits and the feasibility and associated costs of alternative solutions. As with other nutrients, fluoride is safe and effective when used and consumed properly. The recommended optimum water fluoride concentration of 0.7 to 1.2 ppm was established to maximize the decay preventive benefits of fluoride, and the same time minimize the likelihood of mild dental fluorosis.

In assessing the risks of dental fluorosis, scientific evidence indicates it is probable that approximately 10% of children consuming optimally fluoridated water, in the absence of fluoride from all other sources, will develop very mild dental fluorosis. Very mild fluorosis is characterized by small opaque, paper-white area covering less than 25% of the tooth surface. The risk of teeth forming with the very mildest form of fluorosis must be weighed against the benefit that the

individual's teeth will also have a lower level of dental decay thus saving dental treatment costs, patient discomfort and tooth loss. In addition, the risk of fluorosis may be viewed as an alternative to having dental decay, which is a disease that may cause cosmetic problems much greater than dental fluorosis. In 1994, a review of five recent studies indicated that the amount of dental fluorosis attributable to water fluoridation was approximately 13%. This represents the amount of fluorosis that might be eliminated if community water fluoridation was discontinued. In other words, the majority of dental fluorosis can be associated with other risk factors such as the inappropriate ingestion of fluoride products.

The type of fluorosis seen today remains largely limited to the very mild and mild categories; however, the prevalence of dental fluorosis in both fluoridated and nonfluoridated communities in the United States is higher than it was when the original epidemiological studies were conducted approximately 60 years ago.⁸⁴ The inappropriate use of fluoride-containing dental products is the largest risk factor for increased fluorosis as fluoride intake from food and beverages has remained constant over time. The risk of fluorosis can be greatly reduced by following label directions for the use of these fluoride products.”

Canadian Health Measures Survey (2007-2009)

<http://www.fptdwc.ca/assets/PDF/CHMS/CHMS-E-summ.pdf>

The results found that, according to the Dean's Index:

- 60% of the children (6–12 years of age) have teeth that are normal;
- 24% of children have enamel with white flecks or spots where the cause is questionable (*possibly as a result of the use of medications, fevers or fluoride exposure during younger years which have caused slight aberrations on the tooth enamel*); and
- 12% have one or more teeth with fluorosis classified as very mild and 4% with fluorosis classified as mild.

So few Canadian children have moderate or severe fluorosis that, even combined, the prevalence is too low to permit reporting. This finding provides validation that dental fluorosis remains an issue of low concern in this country.

Fluorosis Data from Albertan Regional Dental Surveys

Grade 6	Aspen 04-05	CHR 04-05	Capital 98-99	DTHR 08-09	Palliser 05-06	Peace 08-09	CHMS 07-09	AB 78	AB 85
None	60%	66%	64%	80%	64%	71%	60%	74%	
Very mild, mild	33%	19%	24%	14%	30%	27%	16%	16%	50%
Moderate, severe	7%	7%	12%	6%	7%	2%	0%	10%	

In comparing the fluorosis percentages from the 1978 Alberta Health Unit Survey and the survey results from Regional Dental Surveys, it can be noted that the percentage of moderate to severe fluorosis has not changed and remains around 10%. The very mild/mild category has increased, resulting in a corresponding decrease in the percentage of children with no fluorosis, however still approximately 2/3 of children in grade 6 do not demonstrate fluorosis.

Population vs. Individual High-Risk Approach to Disease Prevention

The following two excerpts highlight the concepts of population-based prevention and the importance of considering approaches that provide access to prevention for entire populations or cohorts. Water fluoridation is an example of a population-based preventive approach.

1) **Batchelor P, Sheiham A. The limitations of a 'high-risk' approach for the prevention of dental caries. *Community Dentistry Oral Epidemiology*. 2002, Volume 30 (4):302-312.** Rose divides strategy approaches into two distinct groups. Those aimed at the population and those in which certain sections of the population are identified, either as a group or as individuals, the risk approach. There are two kinds of risk approach. One is where individuals with the high levels of caries are identified; the 'high-risk' approach. The second, where groups with the higher rates of caries are identified, is a directed population approach. To decide whether to adopt a population or risk approach, Rose poses the fundamental question; would a small increase in risk in a large number of individuals generate more cases than a large increase in risk in a few individuals?

In general medical care options for varying strategy approaches have been suggested. Ritson examined differing strategies for alcohol-related problems, concluding that no single approach worked. Rose agreed, and said that no single approach should be adopted. Differing strategic approaches have been reported for coronary heart disease and hypertension. A finding common to all the approaches was that a strategy based on a 'high-risk' approach was inadequate. Indeed, Kottke et al. concluded that '... only a population approach can prevent the majority of deaths from cardiovascular disease in a community'. How do these principles apply to preventing dental caries?'

With increasing numbers of adults with low or no decay experience and a growing concern over the costs of dental care, the idea of targeting resources towards the high-risk group was postulated. The 'risk' approach suggests that, by screening susceptible individuals, prevention could be directed at those who would benefit most. That approach has been challenged by Sheiham and Joffe. They suggested that there was a choice of preventative strategies. For all, the population approach; for selected individuals, the 'high-risk' approach; or a combination, the directed population approach in which high-risk groups are targeted. In addition to the shortcomings of the high-risk strategy outlined, little attention is paid to the costs compared to benefits gained and most importantly, the fact that public health aspects of strategy development have not been sufficiently explored.

Sheiham argues that the recent decline in both caries and periodontal diseases has occurred through an uncoordinated population approach. Furthermore, he highlights a number of limitations in adopting the 'high-risk' approach. First, there is the implication that the problem belongs to someone else, the 'high-risk' group. The majority of the population is considered to be 'safe'. Second, the high-risk approach is both palliative and temporary in nature. It neither addresses the underlying cause(s) of the problem nor prevents new cases occurring. Finally, to be successful, the 'high-risk' approach requires individuals to adopt differing social norms compared to their peers.

A further criticism of the risk approach is that there are no reliable predictive markers for caries. Johnson and Newbrun and Leverett came to similar conclusions regarding markers of future caries, namely that no single marker is ever likely to be satisfactory. This view was reinforced by Hausen.

He highlighted the limitations of current dental screening methods. Because of the shortcomings, there are few efficiency arguments for adopting an individualised risk approach. Most importantly the unreliability of predicting caries casts doubt on the basis for a 'high-risk' strategy based on identifying individuals at higher risk.

The pivotal factor that should be used to determine the choice of preventive strategy is the distribution of the disease within the population. Here the fundamental axiom 'that a large number of people exposed to a small risk may generate many more cases than a small number of people exposed to a high risk', needs to be considered. The largest 'burden of ill health comes more from the many who are exposed to low inconspicuous risk than from the few who face an obvious problem'. This paper aims to investigate the application of Rose's concepts to caries preventive strategies. As stated earlier, the type of frequency distribution is an important factor in deciding upon the strategy. This study analyses the relationship between the mean caries score and the frequency distribution of caries.

2) **Watt Richard G. Strategies and approaches in oral disease prevention and health promotion. Bull World Health Organ [serial on the Internet]. 2005 Sep [cited 2010 Sep 04] ; 83(9): 711-718.** Available from:http://www.scielo.org/scielo.php?script=sci_arttext&pid=S0042-96862005000900018&lng=en "Geoffrey Rose in his seminal public health text, *The strategy of preventive medicine*, described two basic types of preventive approach, the high-risk and the population approach. The high-risk approach aims to focus attention on individuals at high risk who have been identified through screening tests. To be effective, the screening test must have an acceptable level of sensitivity, specificity and predictive power. Once identified, the high-risk individuals at the tail end of the disease distribution are then offered preventive support in an attempt to modify the course of the condition. This approach is very popular with many health professionals as it fits well with a clinical approach to prevention. However from a public health perspective the high-risk approach has certain recognized limitations. It is palliative in nature in that action is not directed at the underlying determinants of disease, new high-risk individuals will therefore constantly be emerging. The predictive power of available screening tests is limited and the approach ignores the majority of the population in whom most cases of disease occur. According to Beaglehole & Bonita "the high-risk approach to primary prevention has overshadowed the more important population approach".

In the population approach, public health measures are implemented to reduce the level of risk in the whole population, shifting the whole distribution to the left. This more radical approach aims to address the underlying causes of disease across the whole population. Another option, known as the targeted or directed population approach, involves focusing action on higher risk groups or subpopulations. Screening methods are not used to identify the higher risk groups. Instead epidemiological and/or sociodemographic data are used to define a particular subpopulation.

In the prevention of oral diseases the high-risk approach has been largely dominant. It is now increasingly acknowledged that a combination of the high-risk and directed population approaches is the best option.

Multiple strategies implemented in different settings

A key element of health promotion is the development and implementation of a range of complementary strategies to promote health. It is now widely recognized that clinical preventive and educational approaches alone can achieve only limited short-term effects, and may indeed widen health inequalities. Rather than relying solely on preventive and health education programmes targeted at high-risk individuals, a mix of complementary public health approaches is required which focus both on assisting individuals and communities to avoid disease and on the creation of supportive environments conducive to sustained good health. Policy development, organizational change, community action and legislation are all approaches that can be used to prevent oral diseases. In combination these strategies should address the broader social determinants of oral health.

Traditionally schools have been the main setting for oral health interventions, but a range of other settings can also be used. For example nurseries, youth centres, colleges, workplaces, places of worship and community centres may provide suitable settings in which to target defined population groups. In addition, rather than focusing solely upon influencing the general public, it may be more useful to target action at decision-makers and influential individuals in the local community. For example working with head teachers, local politicians or community representatives may lead to significant and sustainable change.

Future improvements in oral health and a reduction in inequalities in oral health are dependent upon the implementation of public health strategies focusing on the underlying determinants of oral diseases. A range of complementary actions delivered in partnership with relevant agencies and the local community are needed. Clinical prevention and health education alone will not achieve sustainable improvements in oral health. In addition these approaches are very costly and are dependent upon the availability of appropriately trained oral health personnel. In both developed and developing countries public health strategies based upon the common risk approach are more likely to be effective in achieving significant oral health gains.”

History of Water Fluoridation

Fluoride and Fluoridation (Fluoridation Facts, American Dental Association, pgs. 10-12, http://www.ada.org/sections/professionalResources/pdfs/fluoridation_facts.pdf)

“The fluoride ion comes from the element fluorine. Fluorine is an abundant element in the earth’s crust in the form of the fluoride ion. As a gas, it never occurs in its free state in nature, but exists only in combination with other elements as a fluoride compound. Fluoride compounds are components of minerals in rocks and soil. Water passes over rock formations and dissolves the fluoride compounds that are present, releasing fluoride ions. The result is that small amounts of fluoride are present in all water sources. Generally, surface water sources such as lakes, rivers and streams have very low levels of fluoride. For example, Lake Michigan’s fluoride level is 0.17 ppm. As water moves through the earth, it contacts fluoride-containing minerals and carries away fluoride ions. The concentration of fluoride in groundwater varies according to such factors as the depth at which the water is found and the quantity of fluoride bearing minerals in the area. In the United States, the natural level of fluoride in ground water varies from very low levels to over 4 ppm. The fluoride level of the oceans ranges from 1.2 to 1.4 ppm. Fluoride is naturally present to some extent in all foods and beverages, but the concentrations vary widely.

Water fluoridation is the adjustment of the natural fluoride concentration of fluoride-deficient water to the level recommended for optimal dental health. Based on extensive research, the United States Public Health Service (USPHS) established the optimum concentration for fluoride in the water in the United States in the range of 0.7 to 1.2 parts per million. This range effectively reduces dental decay while minimizing the occurrence of dental fluorosis. The optimum level is dependent on the annual average of the maximum daily air temperature in the geographic area. One milligram per liter (mg/L) of fluoride in water is identical to one part per million (ppm). At 1 ppm, one part of fluoride is diluted in a million parts of water.

The three basic additives used to fluoridate water in the United States are: 1) sodium fluoride which is a white, odorless material available either as a powder or crystals; 2) sodium fluorosilicate which is a white or yellow-white, odorless crystalline material and 3) fluorosilicic acid which is a white to straw-colored liquid. While fluoridation began in 1945 with the use of sodium fluoride, the use of silicofluorides began in 1946 and, by 1951, they were the most commonly used additives. First used in the late 1940s, fluorosilicic acid is currently the most commonly used additive to fluoridate communities in the U.S.

Fluoride is present in water as “ions” or electrically charged atoms. These ions are the same whether acquired by water as it seeps through rocks and sand or added to the water supply under carefully controlled conditions. When fluoride is added under controlled conditions to fluoride-deficient water, the dental benefits are the same as those obtained from naturally fluoridated water. Fluoridation is merely an increase of the level of the naturally occurring fluoride present in all drinking water sources. Some individuals use the term “artificial fluoridation” to imply that the process of water fluoridation is unnatural and that it delivers a foreign substance into a water supply when, in fact, all water sources contain some fluoride. A fluoridation study conducted in the Ontario, Canada, communities of Brantford (optimally fluoridated by adjustment), Stratford (optimally fluoridated naturally) and Sarnia (fluoride-deficient) revealed much lower decay rates in both Brantford and Stratford as compared to non-fluoridated Sarnia. There was no observable difference in decay-reducing effect between the naturally occurring fluoride and adjusted fluoride concentration water supplies, proving that dental benefits were similar regardless of the source of fluoride.”

History of Water Fluoridation (Fluoridation Facts, American Dental Association, pgs. 6-8, http://www.ada.org/sections/professionalResources/pdfs/fluoridation_facts.pdf)

“Research into the beneficial effects of fluoride began in the early 1900s. Frederick McKay, a young dentist, opened a dental practice in Colorado Springs, Colorado, and was surprised to discover that many local exhibited brown stains on their permanent teeth. Dr. McKay could find no documentation of the condition in the dental literature and eventually convinced Dr. G.V. Black, dean of the Northwestern University Dental School in Chicago, to join him in studying the condition. Through their research, Drs. Black and McKay determined that mottled enamel, as Dr. Black termed the condition, resulted from developmental imperfections in teeth. (Mottled enamel is a historical term. Today, this condition is called dental or enamel fluorosis.) Drs. Black and McKay wrote detailed descriptions of mottled enamel. In the 1920s, Dr. McKay, along with others, suspected that something either in or missing from the drinking water was causing the mottled enamel. Dr. McKay wrote to the Surgeon General in 1926 indicating that he had identified a number of regions in Colorado, New Mexico, Arizona, California, Idaho, South Dakota, Texas and

Virginia where mottled enamel existed. Also in the late 20s, Dr. McKay made another significant discovery – these stained teeth were surprisingly resistant to decay. Following additional studies completed in the early 1930s in St. David, Arizona and Bauxite, Arkansas, it was determined that high levels of naturally occurring fluoride in the drinking water were causing the mottled enamel. In Arizona, researchers scrutinized 250 residents in 39 local families and were able to rule out hereditary factors and environmental factors, except for one - fluoride in the water which occurred naturally at levels of 3.8 to 7.15 ppm. In Bauxite, H. V. Churchill, chief chemist with the Aluminum Company of America (later changed to ALCOA), was using a new method of spectrographic analysis in his laboratory to look at the possibility that the water from an abandoned deep well in the area might have high levels of aluminum-containing bauxite that was causing mottled teeth. What he found was that the water contained a high level of naturally occurring fluoride (13.7 ppm). When Dr. McKay learned of this new form of analysis and Dr. Churchill's findings, he forwarded samples of water from areas where mottled enamel was commonplace to Dr. Churchill. All of the samples were found to have high levels of fluoride when compared to waters tested from areas with no mottled enamel. During the 1930s, Dr. H. Trendley Dean, a dental officer of the U.S. Public Health Service, and his associates conducted classic epidemiological studies on the geographic distribution and severity of fluorosis in the United States. These early studies were aimed at evaluating how high the fluoride levels in water could be before visible, severe dental fluorosis occurred. By 1936, Dean and his staff had made the critical discovery fluoride levels of up to 1.0 part per million (ppm) in the drinking water did not cause the more severe forms of dental fluorosis. Dean additionally noted a correlation between fluoride levels in the water and reduced incidence of dental decay. In 1939, Dr. Gerald J. Cox and his associates at the Mellon Institute evaluated the epidemiological evidence and conducted independent laboratory studies. While the issue was being discussed in the dental research community at the time, they were the first to publish a paper that proposed adding fluoride to drinking water to prevent dental decay. In the 1940s, four classic, community-wide studies were carried out to evaluate the addition of sodium fluoride to fluoride-deficient water supplies. The first community water fluoridation program, under the direction of Dr. Dean, began in Grand Rapids, Michigan, in January 1945. The other three studies were conducted in Newburgh, New York (May 1945); Brantford, Ontario (June 1945) and Evanston, Illinois (February 1947.) The astounding success of these studies firmly established fluoridation as a practical and safe public health measure to prevent dental decay that would quickly be embraced by other communities. The history of water fluoridation is a classic example of a curious professional making exacting clinical observations which led to epidemiologic investigation and eventually to a safe and effective community-based public health intervention which even today remains the cornerstone of communities' efforts to prevent dental decay.”

Water Fluoridation as a Public Health Measure (Fluoridation Facts, American Dental Association, pgs. 8-

9, http://www.ada.org/sections/professionalResources/pdfs/fluoridation_facts.pdf

“Throughout decades of research and more than sixty years of practical experience, fluoridation of public water supplies has been responsible for dramatically improving the public's oral health. In 1994, the U.S. Department of Health and Human Services issued a report which reviewed public health achievements. Along with other successful public health measures such as the virtual eradication of polio and reductions in childhood blood lead levels, fluoridation was lauded as one of the most economical preventive interventions in the nation. A policy statement on water fluoridation reaffirmed in 1995 by the USPHS stated that water fluoridation is the most cost-

effective, practical and safe means for reducing the occurrence of dental decay in a community. In 1998, recognizing the ongoing need to improve health and well being, the USPHS revised national health objectives to be achieved by the year 2010. Included under oral health was an objective to significantly expand the fluoridation of public water supplies. Specifically, Objective 21-9 states that at least 75% of the U.S. population served by community water systems should be receiving the benefits of optimally fluoridated water by the year 2010. In 1999, the Centers for Disease Control and Prevention named fluoridation of drinking water one of ten great public health achievements of the 20th century noting that it is a major factor responsible for the decline in dental decay.”

Water fluoridation in Canada/Alberta (Rabb-Waytowich D. Water Fluoridation in Canada: past and present.] Can Dent Assoc 2009 Jul;75(6):451-4.) “Around the same time [as fluoridation began in the US], the cause was taken up in Canada by Dr. W.L. Hutton, medical officer of health for the Brant County Health Unit. In 1945, Brantford, Ontario, became the first Canadian city to add fluoride to its water. Brantford was paired with neighbouring Sarnia in an 11-year case study of the effects of water fluoridation. Over this period, Brantford children had a 63% reduction in the severity of caries and a 35% reduction in the prevalence of caries. Since the time of these early case studies, the rate of community water fluoridation in Canada has grown, with 45.1% of the total population now having access to fluoridated water.

The decision to fluoridate water supplies is made by local governments, with the federal, provincial and territorial governments setting the guidelines. Even though the decision to fluoridate water supplies falls upon the municipalities, there are significant trends among the provinces regarding community water fluoridation. Ontario, Alberta and Manitoba have the highest percentage of community water fluoridation with rates of 75.9%, 74.7% and 69.9% respectively. At the other end of the scale, the lowest rates of water fluoridation can be found in British Columbia (3.7%), Newfoundland and Labrador (1.5%) and Nunavut and the Yukon (0%). The latter 2 regions do not fluoridate their water at all.

Province/Territory	% of Population with Access to Fluoridated Water*
British Columbia	3.7%
Alberta	74.7%
Saskatchewan	36.8%
Manitoba	69.9%
Ontario	75.9%
Quebec	6.4%
New Brunswick	25.9%
Nova Scotia	56.8%
Prince Edward Island	23.7%
Newfoundland	1.5%
Nunavut	0.0%
Northwest Territories	56.4%
Yukon	0.0%
Canada	45.1%

*Provincial and Territorial Estimates for Community Water Fluoridation Coverage in 2007

This information was collected from Provincial or Territorial Environment Ministries and then verified by the Dental Directors of each province and territory. The Ministries of Environment provided detailed data on the community fluoridated, or the water plants well as population numbers.

Despite fluoride being introduced into Canadian communities over 60 years ago, the national average still currently sits at less than 50%. Clearly water fluoridation is not without its detractors, and over the years, the principal arguments for and against water fluoridation have changed very little. Those in favour of water fluoridation have supporters such as the WHO, the CDC, Health Canada, the Public Health Agency of Canada along with American and Canadian dental and allied health associations, such as CDA, the Canadian Association of Public Health Dentistry, the Canadian Dental Hygienists Association, the Royal College of Dental Surgeons of Ontario, the Canadian Pediatric Society and the Canadian Medical Association. These groups point to the proven benefits of water fluoridation in Canada. “Canada has one of the best systems in the world to ensure water quality. Health Canada supports water fluoridation as a public health measure to prevent dental decay. Dental disease is the number one chronic disease among children and adolescents in North America; fluoridation can therefore be an important public health measure,” says Dr. Peter Cooney, Health Canada’s Chief Dental Officer. “The big advantage of water fluoridation is that it benefits all residents in a community, regardless of age, socioeconomic status, education or employment.”

Research continues to show that water fluoridation is effective in reducing tooth decay by 20% to 40%. In 2009, analyzing data on a city-by-city basis is more challenging as populations are exposed to fluoride through a variety of sources such as toothpastes, fluoride treatments at the dental clinic, natural low-level fluoride in water and food manufactured in fluoridated regions being shipped to non-fluoridated communities. These factors can sometimes mask the true effects of water fluoridation. Certain cities in close proximity have been able to isolate rates of caries in their jurisdictions. For example, in the tricity area of Kitchener-Waterloo-Cambridge in Ontario, the rate of caries in children is 44% in Kitchener (0.1 parts per million [ppm] naturally occurring fluoride), 33% in Cambridge (0.3 ppm naturally occurring fluoride) and 32% in Waterloo (where water has been fluoridated since 1967). Even though Kitchener and Cambridge have naturally occurring fluoride in their water, these levels are well below the minimum rate of effectiveness of fluoridated water, which is considered to be 0.5 ppm.

In another study, the Simcoe Muskoka District Health Unit (which has largely non-fluoridated communities) compared its rate of decay in children 5 to 13 years of age against the rates of decay in 36 health units across Ontario. The study’s results showed that the children of Simcoe Muskoka had consistently higher rates of decay. Advocates against water fluoridation cite arguments relating to the cost of water fluoridation (estimated at \$0.60 to \$1.00 per person, per year), environmental pollution and alleged health risks such as dental and skeletal fluorosis, cancer, low IQ levels, bone fractures, immuno-toxicity, reproductive/developmental toxicity, genotoxicity and neurotoxicity. Others believe fluoridation is an infringement on human rights. The bottled water industry has even launched advertising campaigns picking up on this negative sentiment, offering its products as a fluoride-free alternative. Research supporting both sides of the fluoride debate exists, yet both camps accuse the other of “cherry picking” research to boost its argument. The reality, however, is that credible scientific research continues to support the conclusion that water fluoridation is safe at optimal levels and is an effective means of caries prevention.

In April 2008, Health Canada released its findings and recommendations from a Fluoride Expert Panel. This panel was brought together in January 2007 to provide expert advice and recommendations to Health Canada and the Federal-Provincial-Territorial Committee on Drinking Water regarding the optimal levels of fluoride in drinking water. Health Canada commissioned the panel to ensure exposure to fluoride remains below levels that could cause adverse effects (i.e., moderate and severe dental fluorosis), while achieving the public health benefit of preventing dental caries. The areas of study focused on total daily intake of fluoride, dental fluorosis, other health effects, risk assessment and the risks and benefits of drinking fluoridated water. The panel concluded that 0.7 mg/L ppm of fluoride in drinking water suitably protects against dental caries while minimizing the risk of dental fluorosis. This figure was reduced from the previous range of 0.8 to 1.0 mg/L ppm, to help prevent excessive intake of fluoride through multiple sources of exposure. The panel also concluded that the maximum allowable concentration should remain at 1.5 mg/L ppm. The panel found no health concerns with the prevalence of very mild and mild dental fluorosis. It considered moderate dental fluorosis to be the cosmetic end-point (as opposed to a toxicological end-point), and noted that the prevalence of moderate dental fluorosis is low in Canada and decreasing. The panel supports community drinking water fluoridation as an effective public health measure in reducing the prevalence of dental caries in Canada. It also recommended that the infant formula industry lower and standardize the fluoride concentration in formula as it was found to have the greatest variability. They found no evidence to link fluoride with an increased risk of cancer, bone fracture, immunotoxicity, reproductive/developmental toxicity, genotoxicity or neurotoxicity. Skeletal fluorosis is an adverse effect associated with excessive fluoride exposure, which is likely to occur if an individual ingests 10 mg of fluoride per day for 10 years or more. Currently, oral health data is being collected through the Canadian Health Measures Survey (CHMS). The CHMS is measuring key health information about Canadians through a household questionnaire followed by direct clinical measurements. These clinical measurements include a clinical oral examination phase, which will establish a national baseline level of the decayed, missing and filled teeth (DMFTs) for Canadians and a national level of fluorosis for children 6–11 years of age. However, the survey will not provide accurate comparisons on the effects of fluoride in different communities due to study design limitations. Public health units and dental practitioners across the country have made great strides in educating the public on the benefits of fluoridated water. The main advantage of water fluoridation is that it helps everyone in a community, especially those of lower socioeconomic status. Not everyone has the means or opportunity to go to the dentist on a regular basis or practise good oral health habits. Dentists are often on the front lines of the water fluoridation debate, answering tough questions from patients. CDA is working with Health Canada to compile a comprehensive list of resources, along with Question and Answer material for dentists, on water fluoridation. These online resources, which will be posted on the CDA website, will help dentists as they continue to promote the benefits of water fluoridation and dispel the myths of this scientifically proven, public health preventive measure.

Snapshot of water fluoridation in Canada (percentage of population with fluoridated water)

Ontario (75.9%)

Since 2008, the fluoridation debate in Ontario has been very active. At least 8 communities were challenged to discontinue community water fluoridation. Municipal councils voted to continue fluoridation in Hamilton, Tottenham and Atikokan. Dryden (by referendum) and Niagara (by regional council) voted not to restart its water fluoridation program. Halton and Norfolk councils voted to continue fluoridation while awaiting the final report of the Federal-Provincial-Territorial

Committee on Drinking Water. Thunder Bay, which is not fluoridated, has implemented a public education program on community water fluoridation. Waterloo's water supply is currently fluoridated, with a future plebiscite scheduled for the 2010 municipal elections. Other Ontario cities have decided to adjust their fluoride levels, with Toronto and Hamilton lowering their levels to 0.6 parts per million.

Quebec (6.4%)

In 2008, Quebec City voted to discontinue water fluoridation, while Dorval resumed fluoridation after a 5-year hiatus. Montreal's water supply remains non-fluoridated.

Nova Scotia (56.8%)

Fluoridation in Nova Scotia began in the 1970s. Currently, 57% of the population has access to fluoridated water. The province has a fluoride mouthrinse program offered in select schools for children 4–12 years of age. The Nova Scotia Department of Health Promotion and Protection supports the fluoridation of drinking water to help prevent caries.

Alberta (74.7%)

Calgary went through 5 plebiscites on fluoride up to 1998. A vote in 1989 received a majority, and water fluoridation started in 1991. A plebiscite held in 1998 resulted in a narrow victory for water fluoridation (55% voted yes). Edmonton has fluoridated its water since 1967.

British Columbia (3.7%)

Despite the British Columbia Ministry of Health Services supporting water fluoridation in the prevention of caries, less than 4% of B.C. community water is fluoridated.

Newfoundland/Labrador (1.5%)

Only 1.5% of the province's community water is fluoridated, down from 3.5% in 2005. Most private and community water sources in the province come from wells which may have natural sources of fluoride.

Prince Edward Island (23.7%)

A plebiscite on fluoridation was held in Charlottetown in 1967. Fluoridation began in 1968 in this city as well as the Canadian Forces Base in Summerside. Currently, P.E.I. is focusing on preventive dental programs for children and adolescents through schools, which include topical fluoride application for the partial prevention of tooth decay.

Attitudes of Canadians Towards Community Water Fluoridation (Quinonez C, Locker D. Public opinions on community water fluoridation. *Can J Public Health*. 2009 Mar-Apr;100(2):96-100.)

“Forty-five percent of this sample of Canadian adults had heard or read about CWF. They had heard or read about CWF predominantly from print and electronic media. Of those who knew about CWF, the great majority (79.5%) understood that it was used to prevent dental caries. Similarly, 63.0% believed that CWF was safe, and 59.7% believed that it was effective. Importantly, 62.4% of those who knew about CWF supported the idea of having fluoride added to their local drinking water. Of these, the great majority (89.6%) would continue to support the practice if governments had to spend money on new equipment and training. Finally, among the entire sample, 70.9% reported using fluoride-containing toothpaste, and 16.3% reported trying to avoid products or water that contained fluoride.

Bivariately, it appears that as age, income and education increase, so does an awareness of CWF. Conversely, when compared to urban areas, those who lived in rural areas were less aware of CWF, as were those families with the youngest children. Multivariately, income and education remain as the strongest predictors of having heard or read about CWF. It is also important to understand what

characterizes support for CWF. Bivariately, it appears that women, those with children, those who pay for dental care out-of-pocket, and those who avoid fluoride, were all less likely to support CWF; while those with greater incomes and those who visit the dentist more regularly were more likely to support CWF. Multivariately, income, having children, visiting frequency, and avoiding fluoride remain as predictors. A new relationship also appears relative to insurance, meaning that those who used public insurance were less likely to support CWF. Finally, it is also important to understand what characterizes the minority who avoid water or products that contain fluoride. Bivariately, those in rural areas and those with children under 6 years were more likely to avoid fluoride. Those with more income and education were less likely to avoid it. Multivariately, those with children under 6 years remains as the only predictor.

These data tell us that approximately one in two Canadians know about CWF. Of those who know about it, the majority think it is safe, support it, and do so even if new resource demands are made in terms of equipment and training. Yet irrespective of this support, CWF in Canada is arguably experiencing social challenges. For example, during the writing of this report, a municipal plebiscite in one Canadian community asked: Are you in favour of the fluoridation of the public water supply of this municipality? There was a 35% voter turnout, and the great majority (87%) voted that they were not in favour. Yet in a plebiscite only two years earlier in the same community, approximately 66% had been in favour of fluoridation. Stakeholders suggest that this turn in public opinion is largely the result of the well-organized efforts of anti-fluoride groups, specifically through their strong presence on the Internet. From the point of view of policy leaders, while there is ample evidence that CWF is an effective means to control dental caries, there now exists a very real challenge: How to maintain current levels of CWF while addressing what appears to be an increasing social resistance to the practice? First, it is necessary to not get caught up with the fervour of anti-fluoride sentiment. No amount of credible science will satiate such appetites. For the moment, policy leaders are well supported in their belief that the general public perceives CWF as a viable option, and this, in turn, is strongly reflected in the committed response produced by numerous federal agencies to the petition registered under the Auditor General Act. Second, if any action is taken to counter anti-fluoride sentiment, a social marketing approach under the purview of 'issues management' and 'communications' expertise in governments is a good direction. Importantly, these data can inform this direction, as they help characterize knowledge of CWF, support for CWF, and the tendency to avoid fluoride. As demonstrated, all of these outcomes are associated with patterns that are generally described as 'disparities' in the oral health arena, meaning that age, rural residence, income, education, the frequency of dental visits, and insurance coverage, all appear to play some role in determining these states. More importantly, these data also point to the potentially harmful aspects of anti-fluoride discourse. For example, it appears that gender and having children, in particular very young children, plays a role in perceiving CWF and fluoridation as a negative thing. This has important implications in terms of risk: if the strongest predictor of not supporting CWF is the active avoidance of fluoride-containing products (e.g., fluoridated toothpaste), it is conceivable that the anti-caries effect of fluoride is completely lost in certain households; again, potentially those households with the youngest children. This actually corresponds well with informal accounts by paediatric dentists suggesting that dental caries in very young children are appearing with greater frequency. While no data are available for Canada, recent evidence from the US, generally considered a good proxy, demonstrates that there has been an overall increase in dental caries among 2-5 year old children. This study's findings are also consistent with international evidence on public opinions of CWF, which dates back to the 1950s, with the most recent evidence published in 2008. This evidence suggests that knowledge about fluoridation varies across and within countries,

and is largely dependent on experience with CWF. In the US, for example, Beal noted that knowledge of CWF grew from approximately 50% in the 1950s to approximately 70% by the 1970s, likely as a result of its increasing prevalence. The most recent evidence from the US suggests that, by 1990, knowledge stood at approximately 62%. Studies also confirm the role of the media as the predominant source of knowledge for CWF. A general trend of diminishing support for CWF has also been noted internationally. There appears to be a general trend that those with high income or education are more likely to know and support CWF, as are those who visit the dentist with more frequency. The most recent evidence demonstrates gender as a predictor, meaning that women appear to be less supportive of CWF.”

Support for Water Fluoridation- Canadian & External Examples

Canadian Association of Public Health Dentistry

<http://www.caphd-acsdp.org/Position-Fluoridation.pdf>

The Canadian Association of Public Health Dentistry recognizes the benefits of community water fluoridation, and recommends it as a safe, effective and economical public health measure. It generates most difference in communities with a significant prevalence of dental caries. Continuing research into fluoridation is expected and recommended.

Canadian Dental Association

http://www.cda-adc.ca/files/position_statements/Fluorides-English-2010-06-08.pdf

CDA supports fluoridation of municipal drinking water (at minimum levels required for efficacy as recommended by the Federal-Provincial-Territorial Committee on Drinking Water) as a safe, effective and economical means of preventing dental caries in all age groups. Fluoride levels in the water supplies should be monitored and adjusted to ensure consistency in concentrations and avoid fluctuations. Communities considering water fluoridation are encouraged to review their individual circumstances carefully and in detail, giving attention to any available data on the dental health of community members, the size of the group not likely exposed to adequate fluoride from other sources, the minimum level of fluoride required to be beneficial, and any other information which would be helpful in making the required value judgment. CDA recognizes and supports the need for continued research to determine optimal water fluoridation levels that can continue to provide protection from dental caries while reducing potential to contribute to fluorosis.

Canadian Dental Hygienists Association

<http://www.cdha.ca/pdfs/Profession/Resources/ProbeFluoride.pdf>

Water fluoridation should be maintained and extended to additional communities where feasible. Infants past the age of 12 months should not consume formula made with fluoridated water. Fluoridation research is needed in:

- ✎ Developing an improved method for determining the optimal fluoride concentration in community drinking water, which takes into account other sources of fluoride from air, food, and dental products;
- ✎ High-quality water fluoridation efficacy studies;
- ✎ Developing recommendations for caries prevention and control using various combinations of fluoride modalities.

Canadian Medical Association

<http://www.cma.ca/policybase>)

Policy resolution GC77-27 - Fluoridation

Status:

Last Reviewed, 2004-Feb-28: Still relevant.

Approved, 1977-Jun-22.

Subject terms: [Drinking water](#); Fluoridation; [Public health](#); [Water supply](#) [Text of Policy resolution:](#)

That the Canadian Medical Association encourage programs to promote fluoridation of communal water supplies.

Canadian Paediatric Society

<http://www.cps.ca/english/statements/n/n02-01.htm>)

Fluoride should continue to be added to municipal water supplies where natural concentrations are less than 0.3 ppm. A suitable trade-off between dental caries and fluorosis occurs around 0.7 ppm.

Canadian Public

Quiñonez CR, Locker D. Public Public opinions on community water. *Canadian Journal of Public Health*, March/April 2009, Vol. 100, No. 2.

Results: Approximately 1 in 2 Canadian adults surveyed knew about CWF. Of these, 80% understood its intended use, approximately 60% believed that it was both safe and effective, and 62% supported the idea of having fluoride added to their local drinking water. Those with greater incomes [OR=1.4; p<0.001] and education [OR=1.6; p<0.001] were more likely to know about CWF. Those with greater incomes [OR=1.3; p<0.03] and those who visited the dentist more frequently [OR=1.8; p<0.002] were more likely to support CWF, and those with children [OR=0.5; p<0.02], those who accessed dental care using public insurance [OR=0.2; p<0.03], and those who avoided fluoride [OR=0.04; p<0.001] were less likely to support CWF. Conclusion: It appears that Canadians still support CWF. In moving forward, policy leaders will need to attend to two distinct challenges: the influence of anti-fluoride sentiment, and the potential risks created by avoiding fluoride.

Canadian Public Health Association

<http://cpa100.ca/12-great-achievements/fighting-good-fight-fluoridation-drinking-water>)

The fluoridation of drinking water is considered to be one of the great public health achievements. However, it is obvious that public health still needs to “fight the good fight” so that more Canadians have access to it for better oral health.

Centers for Disease Control

http://www.cdc.gov/fluoridation/guidelines/tooth_decay.htm)

Water fluoridation in the proper amounts (0.7-1.2 parts per million [ppm]) has been accepted as a safe, effective, and inexpensive method of preventing tooth decay. Adding fluoride to municipal drinking water also is an efficient strategy to reduce the inequalities in dental disease among Americans of all social strata. All persons should know whether or not their primary source of drinking water has an optimal level of fluoride. Approximately 100 million Americans currently do not receive the benefit of fluoridation.

A systematic review of published studies conducted by a team of experts on behalf of the independent, non-federal Task Force found that community water fluoridation was effective in reducing tooth decay among populations. Based on strong evidence of effectiveness, the Task Force recommends that community water fluoridation be included as part of a comprehensive strategy to prevent or control tooth decay in communities. Two publications provide information on the process, findings, and recommendations of the Task Force's review:

Full Report: Truman, BI, Gooch BF, Evans, Jr. CA (Guest Editors). Interventions to Prevent Dental Caries, Oral and Pharyngeal Cancers, and Sports-Related Craniofacial Injuries. *American Journal of Preventive Medicine* 2002; 23 (1 Sup.), July 2002: 1–82. See www.thecommunityguide.org/oral* for links to individual articles. This Web site includes fact sheets of key findings, the evidence tables, listings of studies used to determine effectiveness of community water fluoridation and on the studies reviewed, but not used, and a PowerPoint presentation on the Oral Health review. **Summary Report:** [Promoting Oral Health: Interventions for Preventing Dental Caries, Oral and Pharyngeal Cancers, and Sports-related Craniofacial Injuries: A Report on the Recommendations of the Task Force on Community Preventive Services](#). *MMWR*, November 30, 2001;50(RR21);1–13. <http://www.cdc.gov/fluoridation/guidelines/index.htm>

Chief Dental Officer Canada

(<http://www.hc-sc.gc.ca/ahc-asc/branch-dirgen/fnihb-dgspni/ocdo-bdc/project-eng.php#a6>)

As the Chief Dental Officer for Canada, I would like to highlight some of the many benefits of water fluoridation. Water fluoridation is the process of adjusting the level of fluoride in the water to provide dental health benefits. Many governments and health organizations, including Health Canada, the Canadian Public Health Association, the Canadian Dental Association, the Canadian Medical Association and the World Health Organization endorse the fluoridation of drinking water to prevent tooth decay. Community water fluoridation has been identified by U.S. Centers for Disease Control as one of 10 great public health achievements of the 20th century. Canada has one of the best systems in the world to ensure water quality. Health Canada supports water fluoridation as a public health measure to prevent dental decay. Dental disease is the number one chronic disease among children and adolescents in North America; fluoridation can therefore be an important public health measure. An expert panel was formed to provide Health Canada with advice and recommendations on the current state of relevant science with respect to the fluoridation of water. The report from the panel reinforces Health Canada's position that water fluoridation is important from a public health perspective and that our position on water fluoridation is sound. The report's recommendations are based on the latest science. In undertaking the study, we consulted with a number of experts including scientists from the Universities of British Columbia, Toronto, Iowa; scientists from many areas of Health Canada; and also received input from the Canadian Dental Association, the U.S. Environmental Protection Agency and public health experts from Canada and the U.S. The safety and efficacy of water fluoridation has been frequently studied and continues to be supported by current science. Canadian and international studies agree that water that was fluoridated at optimum levels does not cause adverse health effects. For example, an adult male would need to consume at least 15,000 litres of water that is fluoridated at optimum levels continuously in one sitting to get an acute toxic (lethal) dose of fluoride. There is also *no* evidence to suggest that children should avoid drinking fluoridated water at the accepted levels in Canadian drinking water supplies. The big advantage of water fluoridation is that it benefits all residents in a community, regardless of age, socioeconomic status, education, or employment.

Health Canada

(<http://www.hc-sc.gc.ca/ahc-asc/branch-dirgen/fnihb-dgspni/ocdo-bdc/project-eng.php#a6>)

(quoted by Dr. Peter Cooney- Chief Dental Officer- Canada)

Health Canada continues to support water fluoridation as a safe, cost effective public health measure, and encourages Canadians to review respected and credible sources of information to reach their own conclusions about water fluoridation.

Institut national de santé publique du Québec

(June 2007) Water Fluoridation: An Analysis of the Health Benefits and Risks

(<http://www.inspq.qc.ca/pdf/publications/705-WaterFluoriation.pdf>)

Water fluoridation is the safest, most effective and most economical public health measure for preventing and reducing dental caries. It benefits all citizens, regardless of their level of education, socio-economic status, age or ethnic background. Everyone can benefit from water fluoridation, especially the most vulnerable members of our society. Despite a lack of recent data on the prevalence of dental caries in Quebec children, the fact that the percentage of kindergarten children considered at risk for tooth decay has not declined in recent years suggests that current prevention methods are failing to reach the more vulnerable segments of the province's population. Public health professionals have a responsibility to inform the public about the health benefits of fluoridation, the potential risks associated with this practice, and the measures taken to minimize such risks. Clear and transparent communication is one important success factor. The Institute's recommendations are consistent with those of major groups of international experts who continue to view fluoridation as an important public-health measure. Still, Quebec lags far behind the rest of North America in the implementation of this public health measure, and would have to undertake fluoridation throughout the province to attain a fluoridation status comparable with most other states and provinces.

Media Release, August 7, 2008

(http://www.fptdwc.ca/assets/PDF/0808-joint_water_fluoridation_release_Aug7-08.pdf)

CANADIAN EXPERTS STAND UP FOR WATER FLUORIDATION

Ottawa/Toronto, Ontario – The Canadian Dental Association (CDA), Health Canada's Chief Dental Officer, the Ontario Dental Association (ODA), the Ontario Association of Public Health Dentistry (OAPHD), Toronto Public Health and the Royal College of Dental Surgeons of Ontario (RCDSO) are standing up for water fluoridation today, telling the country it's safe and urging people to get the facts about this important health-care issue.

"Canada has one of the best systems in the world to ensure water quality. Health Canada supports water fluoridation as a public health measure to prevent dental decay. Dental disease is the number one chronic disease among children and adolescents in North America; fluoridation can therefore be an important public health measure," said Health Canada's Chief Dental Officer, Dr. Peter Cooney.

"The big advantage of water fluoridation is that it benefits all residents in a community, regardless of age, socioeconomic status, education, or employment." The Canadian Dental Association couldn't agree more. "Water fluoridation is one of the greatest preventative measures we have in the war against dental decay," said CDA President Dr. Deborah Szymiest. "There is clear evidence that fluoride helps natural tooth enamel remineralize. Jurisdictions around the world support water fluoridation – as do we – and it is important that everyone understands the facts and the benefits of fluoride."

Some of the international experts who agree with Canadian experts on water fluoridation:

- Centre for Disease Control (CDC) in Atlanta, Georgia states:

“The CDC has recognized the fluoridation of drinking water to prevent dental decay as one of the 10 great public health achievements of the 20th century.”

- The U.S. Surgeon General states:

“Community water fluoridation continues to be the most cost-effective, equitable and safe means to provide protection from tooth decay in a community.”

- The World Health Organization (WHO) states:

“That universal access to fluoride for dental health is a part of the basic human right to life.”

At a symposium sponsored by the ODA entitled “Designing Dental Programs for High-Risk Children,” at the International Association of Dental Research held in Toronto recently, a panel of experts from around the world agreed that water fluoridation is essential in preventative care.

“Water fluoridation helps prevent tooth decay – it’s just that simple,” says Hamilton-based ODA President Dr. Larry Levin. “I see it in my office all the time – water fluoridation is something kids need from a very early age – adults need it too. It’s safe, preventative care that will help for life.”

Supportive Quotes:

Ontario Association of Public Health Dentistry’s Dr. Dick Ito:

“The Ontario Association of Public Health Dentistry supports the fluoridation of municipal drinking water. It recommends water fluoridation as a safe, effective and economical public health measure to prevent dental caries in all age groups.”

Toronto Public Health’s Dr. Hazel Stewart:

“Fluoridated water is the safest and most equitable way of improving oral health for Torontonians of all cultural and socioeconomic backgrounds.”

Royal College of Dental Surgeons of Ontario:

“Community water fluoridation at appropriate levels is the cornerstone of a critical dental public health program that benefits the whole continuum of our population, from children to the middle-aged and older adults too.”

Ontario Association of Public Health Dentistry

(http://www.oaphd.on.ca/PDF/0808_OAPHDFluoridationPolicy.pdf)

The Ontario Association of Public Health Dentistry (OAPHD) supports the fluoridation of municipal drinking water. It recommends water fluoridation as a safe, effective and economical public health measure to prevent dental caries in all age groups.

Ontario Chief Medical Officer of Health

Memo from Office of Chief Medical Officer of Health, Dr. Arlene King, May 31, 2010 to Medical & Associate Medical Officers of Health, Ontario

“...It is important to note that credible scientific organizations and associations continue to review the evidence and assess the benefits and potential risks of fluoridation. Their reports are publicly available and constitute the basis for the continuing support of water fluoridation. The most recent review has been conducted by Health Canada. In 2007, a Health Canada-appointed panel of experts concluded that there is no detrimental risk to the health of Canadians from fluoridation of community drinking water at the current recommended levels. The panel found that it remains an effective public health intervention to reduce the prevalence of dental caries.

The value of water fluoridation should not be underestimated. Tooth decay is the single most common chronic childhood disease, one that is highly preventable. According to sound research, fluoridated drinking water greatly reduces the number of cavities in children's teeth, which contributes to their healthy development. Therefore, we find no reason for Ontarians to avoid drinking fluoridated water at the recommended levels in Ontario's drinking water. Through Ontario's Child Health Program, boards of health are required to monitor the level of fluoride in water supplies where fluoride is added, and to notify the community when the level of fluoride falls outside the therapeutic level for an extended period of time. As you know, the decision to fluoridate local drinking water is made by each municipality in consultation with local residents. It is an effective public measure that reduces inequalities in health. It helps to contain the costs of health care in Ontario. It benefits all residents in a community, and for these reasons we fully expect that this important practice will continue for many years to come so that Ontarians can enjoy lasting health benefits. It is often difficult to communicate the information about this well-studied intervention amid misinformation and controversy generated by misinterpretation of data and study results...In my capacity as CMOH for the Province of Ontario and with the support of the Ministry of Health Promotion, my office will continue to monitor this issue and review the information as provided by the scientific reviews."

Ontario Dental Association

(http://www.fptdwc.ca/assets/PDF/0808-ODA_Fluoride_PressRelease-July23-08.pdf)

The Ontario Dental Association (ODA) is speaking out to communities and politicians who are considering removing fluoride from their water by urging them to get the facts from informed medical experts... "The ODA is saying to communities and to politicians that it's time to stand up for water fluoridation – it's important to your town, your city, your family and your dentist," says Dr. Levin. "It's essential to both your oral health and your overall health. If you have questions about water fluoridation, please speak to your dentist today."

Ontario Dental Hygienists' Association

(<http://www.fptdwc.ca/assets/PDF/0808-FluorideMediaRelease-ODHA.pdf>)

ODHA supports water fluoridation as the best way to provide fluoride protection to a large number of people at low cost, eliminating the barriers of individual income or access to routine dental care.

Public Health Agency- Canada

(<http://www.fptdwc.ca/assets/PDF/0808-press%20release%20caphd-phac-cdha.pdf>)

"Current science continues to support water fluoridation as a safe, cost effective public health measure." said Dr. David Butler-Jones, Canada's Chief Public Health Officer. "I encourage Canadians to review respected and credible sources of information to reach their own conclusions about water fluoridation. Community water fluoridation has been identified by the United States Centers for Disease Control as one of the 10 great public health achievements of the 20 century."

World Health Organization

Petersen PE, Lennon MA. Effective use of fluorides for the prevention of dental caries in the 21st century: the WHO approach. *Community Dent Oral Epidemiol* 2004; 32: 319–21.

Water fluoridation, where technically feasible and culturally acceptable, has substantial advantages particularly for subgroups at high risk of caries.

Other Organizations Supporting Fluoridation (2005)

http://www.ada.org/sections/professionalResources/pdfs/fluoridation_facts.pdf

Academy of Dentistry International
Academy of General Dentistry
Academy for Sports Dentistry
Alzheimer's Association
America's Health Insurance Plans
American Academy of Family Physicians
American Academy of Nurse Practitioners
American Academy of Oral and Maxillofacial Pathology
American Academy of Orthopaedic Surgeons
American Academy of Pediatrics
American Academy of Pediatric Dentistry
American Academy of Periodontology
American Academy of Physician Assistants
American Association for Community Dental Programs
American Association for Dental Research
American Association for Health Education
American Association for the Advancement of Science
American Association of Endodontists
American Association of Oral and Maxillofacial Surgeons
American Association of Orthodontists
American Association of Public Health Dentistry
American Association of Women Dentists
American Cancer Society
American College of Dentists
American College of Physicians–American Society of Internal Medicine
American College of Preventive Medicine
American College of Prosthodontists
American Council on Science and Health
American Dental Assistants Association
American Dental Association
American Dental Education Association
American Dental Hygienists' Association
American Dietetic Association
American Federation of Labor and Congress of Industrial Organizations
American Hospital Association
American Legislative Exchange Council
American Medical Association
American Nurses Association
American Osteopathic Association
American Pharmacists Association
American Public Health Association
American School Health Association
American Society for Clinical Nutrition
American Society for Nutritional Sciences

American Student Dental Association
American Veterinary Medical Association
American Water Works Association
Association for Academic Health Centers
Association of American Medical Colleges
Association of Clinicians for the Underserved
Association of Maternal and Child Health Programs
Association of State and Territorial Dental Directors
Association of State and Territorial Health Officials
Association of State and Territorial Public Health Nutrition Directors
British Fluoridation Society
Canadian Dental Association
Canadian Dental Hygienists Association
Canadian Medical Association
Canadian Nurses Association
Canadian Paediatric Society
Canadian Public Health Association
Child Welfare League of America
Children's Dental Health Project
Chocolate Manufacturers Association
Consumer Federation of America
Council of State and Territorial Epidemiologists
Delta Dental Plans Association
FDI World Dental Federation
Federation of American Hospitals
Hispanic Dental Association
Indian Dental Association (U.S.A.)
Institute of Medicine
International Association for Dental Research
International Association for Orthodontics
International College of Dentists
March of Dimes Birth Defects Foundation
National Association of Community Health Centers
National Association of County and City Health Officials
National Association of Dental Assistants
National Association of Local Boards of Health
National Association of Social Workers
National Confectioners Association
National Council Against Health Fraud
National Dental Assistants Association
National Dental Association
National Dental Hygienists' Association
National Down Syndrome Congress
National Down Syndrome Society
National Eating Disorders Association
National Foundation of Dentistry for the Handicapped

National Head Start Association
 National Health Law Program
 National Healthy Mothers, Healthy Babies Coalition
 Oral Health America
 Robert Wood Johnson Foundation
 Society for Public Health Education
 Society of American Indian Dentists
 Special Care Dentistry
 -Academy of Dentistry for Persons with Disabilities
 -American Association of Hospital Dentists
 -American Society for Geriatric Dentistry
 The Children's Health Fund
 The Dental Health Foundation (of California)
 U.S. Department of Defense
 U.S. Department of Veterans Affairs
 U.S. Public Health Service
 -Centers for Disease Control and Prevention (CDC)
 -National Institute of Dental and Craniofacial Research (NIDCR)
 World Federation of Orthodontists

Legislation and Legal Challenges of Water Fluoridation

Provincial and Municipal Governments Role- (<http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/fluor-eng.php#prov>) The fluoridation of drinking water supplies is a decision that is made by each municipality, in collaboration with the appropriate provincial or territorial authority. This decision may also be taken in consultation with residents. For those communities wishing to fluoridate their water supply, the Federal-Provincial-Territorial Committee on Drinking Water has recommended an optimal fluoride concentration of 0.8 to 1.0 mg/L

Government of Canada's Role- (<http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/fluor-eng.php#prov>) Health Canada works in collaboration with the provinces and territories to maintain and improve drinking water quality. Together, both levels of government develop the Guidelines for Canadian Drinking Water Quality. These guidelines are reviewed and revised periodically to take into account new scientific knowledge. Fluoride is one of the many chemicals for which guidelines have been set. The maximum acceptable concentration of fluoride in drinking water is 1.5 milligrams per litre, a level at which Health Canada believes there is no undue health risks. The government of Canada created the Office of the Chief Dental Officer (OCDO) in October 2004 to improve the oral health status of Canadians and to increase awareness about the prevention of oral diseases.

Alberta Regulations

Those individuals/boards with legislative responsibility for water supplies, whether they be municipalities (or equivalent) or water commissions are those who have legal authority to make decisions regarding the addition of fluoride to public water supplies. Even with this authority, in many cases the question of fluoridation is put to plebiscite or public vote with an apparent attempt

to garner support for a given decision. This puts a significant power to influence the outcome of a fluoridation decision in the hands of the percentage of the adult population who vote. This does not ensure that a careful, balanced and evidence-based approach is taken to addressing this issue.

Potable Water Regulations

http://www.qp.alberta.ca/574.cfm?page=2003_277.cfm&leg_type=Regs&isbncln=0779723023

Standards and Guidelines for Municipal Waterworks, Waste Water and Storm Drainage Systems

<http://environment.gov.ab.ca/info/library/6979.pdf>

Application Form for New or Expanded Water System

<http://environment.alberta.ca/documents/Application-Form-and-Guide-for-a-New-or-Renewed-Approval-of-a-Municipal-Waterworks-System.pdf>

Recent Fluoridation Challenges in Alberta

- Lac la Biche- continued
- Smoky Lake 1998- continued
- Slave Lake- continued
- Ponoka- continued
- Fairview- continued
- Fahler- discontinued Fall 2007
- Red Deer- discontinued Oct 2007 due to inability to secure fluoride supply, continued again in 2009
- Lethbridge 2008- continued
- Drayton Valley- discontinued Dec 2008
- Henry Kroeger Water Commission- discontinued 2008
- Calgary- voted to continue 2009
- McLennan- discontinued 2010
- Grimshaw, Fairview, Hinton- currently considering

Newspaper Editorial Regarding Local Decision-making

Fluoride battle needs new venue

The Calgary Sun

2009 04 07

Section: Editorial/Opinion

Edition: Final

Byline: Ricky Leong

“Do you remember 1957? John Diefenbaker swept to power that year. The Cold War was about to get colder, with the Russians successfully launching Sputnik into Earth's orbit. I Love Lucy ruled the nascent TV sit-com universe. It was during this time that Calgary first dove into a debate over adding fluoride to the water supply. After multiple plebiscites coinciding with years of wrangling, the chemical was finally added in 1989.

Now, at least five of our aldermen want Calgarians to get moving and push back against the machine, getting rid of the fluoride added to our water. So brace yourself. As the economy sputters and governments everywhere are spending time counting pennies and helping people get through the tough times, Calgary could get sucked into a debate that's best left to world organizations and Canada's best scientists for now. The fuss is over whether the chemical is safe for human consumption. The answer is not nearly as clear-cut as you'd like. Fluoride detractors argue it's a chemical whose effects are detrimental to our health at worst and inconclusive at best. One group advocating this position is Canton, N.Y.,-based Fluoride Action Network. It boasts a large number of health professionals who support their anti-fluoride position. The indirect health effects of fluoride, they argue, have not been studied thoroughly enough. They point to the negative effect of ingesting fluoride on the kidney, bones and teeth. Then there's the question of risk of swallowing fluoride versus simply rinsing with it. Fluoride promoters argue it poses a minimal risk because we are exposed to so little of it.

Dental associations across the world tout the benefits of fluoride use in the prevention of cavities. Many places have been treating their water with fluoride for a long time and most people seem to get along just fine. Even if humans didn't add fluoride to water, it is already present, usually in very small concentrations. But fluoride supporters also warn against over-exposure to the chemical. Dental experts in the U.S. say we should avoid using fluoridated toothpaste to clean very young children's teeth because they could swallow the toothpaste. New parents have also been warned against using fluoridated tap water to mix infant formula. The World Health Organization reports exposure to high levels of naturally occurring fluoride in some cooking fuels (coal and anthracite) causes adults in some parts of the world to suffer from dental fluorosis, a condition where fluoride actually damages teeth. Then there's a long list of places where fluoride is not added to the water supply. Vancouver and Montreal have resisted the addition of fluoride for decades, as have huge swaths of Western Europe. There's no evidence people's dental health is worse in those places. So, who to believe?

The nature and scope of the fluoride debate is so wide and its effects so significant, it should not be left for individual cities and towns. No health issues should be dealt with in this piecemeal manner. (You would not expect the standard for E.coli and salmonella contamination to be lower in one place and higher in another.) Besides, it is wrong for aldermen to exploit a budget issue -- the need to upgrade our water treatment equipment -- and turn it into a health issue. The discussion on the safety and effectiveness of fluoride should be happening at a national and global level. It's not like there's a shortage of other things for our city politicians to do.

RICKY.LEONG@SUNMEDIA.CA

Examples of Recent Petitions to Government

- 8 petitions have been filed in recent past to provincial and federal government agencies regarding artificial water fluoridation.
- 7 petitions have been presented to the Office of the Auditor General of Canada under the Auditor General Act, section 22. A petitions catalogue is available and searchable by the petition number, by the issue or by the federal institution: http://www.oagbvg.gc.ca/internet/English/pet_lp_e_938.html
- 1 petition has been presented to the Environmental Commissioner of Ontario via the Ontario Environmental Bill of Rights, section 61, EBR# 07EBR014.R. This petition was an Appl. for Review which was accepted by the Ministry of the Environment Feb. 8, 2008.

These environmental petitions claim to be comprehensive literature reviews of the issues regarding artificial water fluoridation. These petitions claim to demonstrate how fluoridation chemicals impact the health of flora, fauna and humans. These petitions argue that the addition of CEPA designated toxic substances to drinking water is not environmentally sustainable.

Petitions:

No. 221

Health and environmental concerns regarding the fluoridation of drinking water

Petition 221: http://www.oag-bvg.gc.ca/internet/English/pet_221_e_30308.html

by Carole Clinch BA, BPHE, Research Coordinator, People for Safe Drinking Water

Issue(s): Environmental assessment, fisheries, human health/environmental health, toxic substances, and water

Date Received: 19 November 2007

Summary: The petitioner seeks responses from several departments on the addition to our drinking water of fluoride (hydrofluorosilicic acid), which she alleges contains arsenic, lead, and other toxic substances. She asks departments to provide toxicology studies demonstrating the safety of the chemical compound currently used to fluoridate drinking water. She also asks departments to warn those involved in the fisheries industry of the effects of water fluoridation on our ecosystem. The petitioner further asks what departments plan to do to protect children and other groups at risk (for example, diabetics) from fluoride in water and food.

Federal Departments Responsible for Reply: Environment Canada, Fisheries and Oceans Canada, Health Canada, Indian and Northern Affairs Canada, Natural Resources Canada

No. 221B

Follow-up petition – Incomplete dissociation and reassociation of Fluorosilicates

Petition 221B: http://www.oag-bvg.gc.ca/internet/English/pet_221B_e_31256.html

by Carole Clinch

Issue(s): Environmental assessment, fisheries, human health/environmental health, toxic substances, and water

Date Received: 7 April 2008

Summary: In this follow-up petition, the petitioner asks for more responses from several departments about the addition of fluoride (hydrofluorosilicic acid) to our drinking water, which she alleges is causing harm to humans, aquatic life, flora, and the environment. Among other things, the petitioner asks for toxicology reports and studies that demonstrate that the products currently used to add fluoride to drinking water are safe. The petitioner also asks about the potential impact of fluoride on western salmon stocks.

Federal Departments Responsible for Reply: Environment Canada, Fisheries and Oceans Canada, Health Canada, Public Health Agency of Canada

No. 221C

Follow-up petition – Dental Fluorosis and Artificial Water Fluoridation

Petition 221C: http://www.oag-bvg.gc.ca/internet/English/pet_221C_e_30942.html

by Carole Clinch

Issue(s): Human health/environmental health, toxic substances, and water

Date Received: 14 April 2008

Summary: In this follow-up petition, the petitioner seeks further responses from Health Canada

regarding the environmental health impacts of adding fluorosilicates to our drinking water, particularly as it relates to dental fluorosis. The petitioner alleges that water fluoridation is the main source of fluoride exposure and therefore serves as a major cause of dental fluorosis. The petitioner raises questions concerning the perceived social harm, financial burdens, and dental harm caused to Canadians by dental fluorosis.

Federal Departments Responsible for Reply: Health Canada, Public Health Agency of Canada

No. 221D

Follow-up petition - Comparison of Trace Metals

Petition 221D: http://www.oag-bvg.gc.ca/internet/English/pet_221D_e_31257.html

by Carole Clinch

Issue(s): Environmental assessment, fisheries, human health/environmental health, toxic substances, and water

Date Received: 14 April 2008

Summary: In this follow-up petition, the petitioner seeks further responses from several departments regarding the toxic effects of fluoride added to drinking water. The petitioner alleges that fluoride has been treated differently for risk assessment than other trace elements with similar long-lasting toxic effects. The petitioner asks that the recommended levels for fluoride intake be reduced and that the addition of fluoridation chemicals (hydrofluorosilicic acid and derivatives) to drinking water be discontinued.

Federal Departments Responsible for Reply: Environment Canada, Health Canada, Public Health Agency of Canada

No. 243

Fluorides in drinking water are unregulated drugs

Petition 243: http://www.oag-bvg.gc.ca/internet/English/pet_243_e_30927.html

by Rob Button BScPharm

Issue(s): Human health/environmental health, toxic substances, and water

Date Received: 17 April 2008

Summary: The petitioner seeks responses from the government on the addition of fluoride (fluorosilicates) to the water supply, which the petitioner alleges is a drug and is dispensed as a drug, but has never been approved as a drug. In addition, the petitioner claims that Canadian consumers cannot be reasonably expected to know the stated risks of fluoridated water. The petitioner raises questions concerning the government's definition, management, and regulation of fluoride.

Federal Departments Responsible for Reply: Health Canada, Public Health Agency of Canada

No. 244

Harm to susceptible populations of aquatic life and humans due to the addition of fluoride (fluorosilicates) in drinking water

Petition 244: http://www.oag-bvg.gc.ca/internet/English/pet_244_e_30930.html

by Dr. James Beck M.D., PhD

Issue(s): Fisheries, human health/environmental health, toxic substances, and water

Date Received: 18 April 2008

Summary: The petitioner seeks responses from the government on the addition of fluoride (fluorosilicates) in our drinking water, which he alleges causes adverse health effects on humans. The petitioner further claims that the addition of fluoride is also toxic and harmful to certain land species as well as to some species of fish. The petitioner raises several questions on the safe dosage and

concentration levels of fluoride.

Federal Departments Responsible for Reply: Health Canada, Public Health Agency of Canada

No. 245

Impact of fluorosilicate compounds on lead levels in drinking water and on water distribution infrastructure

Petition 245: http://www.oag-bvg.gc.ca/internet/English/pet_245_e_30941.html

by Peter Van Caulart Dip. A.Ed., CES, CEI, Director of the Environmental Training Institute

Issue(s): Environmental assessment, fisheries, human health/environmental health, toxic substances, and water

Date Received: 2 May 2008

Summary: The petitioner seeks responses from several departments on potential health concerns related to increased levels of lead in drinking water due to fluoridation. In addition, the petitioner alleges that fluorosilicates have a detrimental effect on water distribution infrastructure and asks whether the government has carried out related cost assessments.

Federal Departments Responsible for Reply: Environment Canada, Department of Finance Canada, Fisheries and Oceans Canada, Health Canada, Public Health Agency of Canada, Public Works and Government Services Canada, Treasury Board of Canada Secretariat

Joint Government of Canada Response to Environmental Petition 221 filed under Section 22 of the Auditor General Act, Received November 19, 2007: Letter from the Chief Dental Officer of Canada (April 2008): <http://www.fptdwc.ca/English/e-fluoridation.html#petition> "Dear Colleagues, Please find attached the [Joint Government of Canada Response to Environmental Petition No. 221 to discontinue water fluoridation](#). This response comes from the Minister of Health and the Minister for the Federal Economic Development Initiative for Northern Ontario, the Minister of the Environment, the Minister of Indian Affairs and Northern Development and Federal Interlocutor for Métis and Non-Status Indians, Transport Canada.

Within Health Canada, review and approval was obtained from the Healthy Environments and Consumer Safety Branch (HECSB), the Public Health Agency of Canada (PHAC), the Health Products and Food Branch (HPFB), the Office of the Chief Dental Officer (OCDO), the Audit and Accountability Bureau (AAB), Legal Services. The document takes a strong position on the value of fluoridated water in Canada. It states:

" The fluoridation of drinking water supplies is a well-accepted measure to protect public health and is strongly supported by scientific evidence. Fluoride is used internationally to protect dental health. It has been added to public drinking water supplies around the world for more than half a century, as a public health/dental health measure. The use of fluoride in the prevention of dental caries continues to be endorsed by over 90 national and international professional health organizations including Health Canada, the Canadian Dental Association, the Canadian Medical Association, the World Health Organization and the Food and Drug Administration of the United States."

Yours sincerely,

Dr. Peter Cooney, Chief Dental Officer, Health Canada"

<http://www.fptdwc.ca/assets/PDF/0804-JointGovernmentofCanadaresponse.pdf>

Expert Panel Review of Water Fluoridation

<http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/2008-fluoride-fluorure/index-eng.php> As part of its review of the health effects of exposure to fluoride in drinking water, Health Canada convened a panel of experts in January 2007 to discuss this topic and to provide recommendations to ensure that exposure to fluoride remains below levels that could cause adverse effects (i.e., moderate and severe dental fluorosis) while achieving the public health benefit of preventing dental caries. Discussions were based on topic-specific literature reviews developed and presented by some of the invited experts.

The Expert Panel was asked to provide expert advice and to make recommendations to Health Canada and the Federal-Provincial-Territorial Committee on Drinking Water (CDW) regarding fluoride in drinking water. Advice was sought from the Expert Panel on five specific issues of concern:

- Total Daily Intake of Fluoride;
- Dental Fluorosis;
- Other Health Effects;
- Risk Assessment; and
- Drinking Water Fluoridation: Risks and Benefits

The Expert Panel reached a consensus on all key issues identified, and its main conclusions and recommendations to Health Canada and the Federal-Provincial-Territorial Committee on Drinking Water on each issue are provided below.

Expert Panel Members

- Steven M. Levy, Iowa College of Dentistry
- Christopher Clark, University of British Columbia
- Robert Tardif, Université de Montréal
- Michael Levy, Institut National de Santé Publique du Québec
- Jayanth Kumar, New York State Department of Health
- Albert Nantel, Institut National de Santé Publique du Québec

Chief Dental Officer of Canada statement:

July 2008, Peter Cooney

<http://www.hc-sc.gc.ca/ahc-asc/branch-dirgen/fnihb-dgspni/ocdo-bdc/project-eng.php#a6>

“As the Chief Dental Officer for Canada, I would like to highlight some of the many benefits of water fluoridation. Water fluoridation is the process of adjusting the level of fluoride in the water to provide dental health benefits. Many governments and health organizations, including Health Canada, the Canadian Public Health Association, the Canadian Dental Association, the Canadian Medical Association and the World Health Organization endorse the fluoridation of drinking water to prevent tooth decay. Community water fluoridation has been identified by U.S. Centers for

Disease Control as one of 10 great public health achievements of the 20th century.

Canada has one of the best systems in the world to ensure water quality. Health Canada supports water fluoridation as a public health measure to prevent dental decay. Dental disease is the number one chronic disease among children and adolescents in North America; fluoridation can therefore be an important public health measure.

An expert panel was formed to provide Health Canada with advice and recommendations on the current state of relevant science with respect to the fluoridation of water. The report from the panel reinforces Health Canada's position that water fluoridation is important from a public health perspective and that our position on water fluoridation is sound. The report's recommendations are based on the latest science.

In undertaking the study, we consulted with a number of experts including scientists from the Universities of British Columbia, Toronto, Iowa; scientists from many areas of Health Canada; and also received input from the Canadian Dental Association, the U.S. Environmental Protection Agency and public health experts from Canada and the U.S.

The safety and efficacy of water fluoridation has been frequently studied and continues to be supported by current science. Canadian and international studies agree that water that was fluoridated at optimum levels does not cause adverse health effects. For example, an adult male would need to consume at least 15,000 litres of water that is fluoridated at optimum levels continuously in one sitting to get an acute toxic (lethal) dose of fluoride.

There is also *no* evidence to suggest that children should avoid drinking fluoridated water at the accepted levels in Canadian drinking water supplies.

The big advantage of water fluoridation is that it benefits all residents in a community, regardless of age, socioeconomic status, education, or employment. Health Canada continues to support water fluoridation as a safe, cost effective public health measure, and encourages Canadians to review respected and credible sources of information to reach their own conclusions about water fluoridation.”

The Fluoridation Debate

There has existed opposition to fluoridation virtually from the day it began. The evidence is extensive and complex. This is a complex issue requiring in-depth investigation and discussion to evaluate the full extent of the evidence and to determine the quality of that evidence.

Decisions should be based on a sound foundation of quality, scrutinized science or else the conclusions reached, albeit linked to some published papers or expert opinion, may stray far from truth and be erroneously making claims that cannot be properly founded.

As a result of the quantity and varying quality of the evidence available over the past decades, the ability to properly debate and determine where the evidence lies will not be something that can be

done using “sound bites” of information and statements of rhetoric, either for or against the practice. To properly arrive at a rational decision, the debate must be non-emotional and non-biased, looking clearly for science that is highest on the hierarchy of evidence in terms of quality and strength.

Opposition to Fluoridation (Fluoridation Facts, American Dental Association, pgs. 47-50, http://www.ada.org/sections/professionalResources/pdfs/fluoridation_facts.pdf)

Fluoridation is considered beneficial by the overwhelming majority of the health and scientific communities as well as the general public. However, a small faction continues to speak out against fluoridation of municipal water supplies. Some individuals may view fluoridation of public water as limiting their freedom of choice; other opposition can stem from misinterpretations or inappropriate extrapolations of the science behind the fluoridation issue.

A vast body of scientific literature endorses water fluoridation as a safe means of reducing the incidence of dental decay. Support for fluoridation among scientists and health professionals, including physicians and dentists, is nearly universal. Recognition of the benefits of fluoridation by the American Dental Association, the American Medical Association, governmental agencies and other national health and civic organizations continues as a result of published, peer-reviewed research.

Of the small faction that opposes water fluoridation for philosophical reasons, freedom of choice probably stands out as the most important single complaint. Some individuals are opposed to community action on any health issue, others because of environmental or economic arguments and some because they are misinformed. Opposition to fluoridation has existed since the initiation of the first community programs in 1945 and continues today with over 60 years of practical experience showing fluoridation to be safe and effective. An article that appeared in the local newspaper shortly after the first fluoridation program was implemented in Grand Rapids, Michigan, noted that the fluoridation program was slated to commence January 1 but did not actually begin until January 25. Interestingly, health officials in Grand Rapids began receiving complaints of physical ailments attributed to fluoridation from citizens weeks before fluoride was actually added to the water. Since that time, anti-fluoridation leaders and organizations have come and gone, but their basic beliefs have remained the same. These include: fluoride is toxic and causes numerous harmful health effects; fluoride does not prevent dental decay; fluoridation is costly; and fluoridation interferes with freedom of choice and infringes on individual rights. While the arguments against fluoridation have remained relatively constant over the years, the anti-fluoridationists have used different approaches that play upon the popular concerns of the public at the time. For example, in the 1950s fluoridation was a Communist plot. With America's growing concern for environmental issues in the 1960s, fluoridation was pollution. After the Vietnam War in the 1970s, the anti-fluoridationists capitalized on the popularity of conspiracy theories by portraying fluoridation as a conspiracy between the U.S. government, the dental-medical establishment and industry. As Americans became more concerned about their health in the 1980s, anti-fluoridationists claimed fluoridation caused AIDS and Alzheimer's disease. In the 1990s, claims of hip fractures and cancer were designed to resonate with aging baby boomers. With the new millennium, overexposure and toxicity, in association with lead and arsenic poisoning, have surfaced as common themes. None of these approaches has ever really disappeared, but are often recycled as anti-fluoridationists choose which approach will have the most effect on the intended audience. Anti-fluoridationists have eagerly embraced technology such as videos and the Internet to spread their message to the public. These two venues have allowed the

small faction of antifuoridationists to be linked across the country and around the world and promote their message economically.

A number of opposition videos are available from national antifuoridation organizations. These economically-priced videos make it affordable for every campaign to bring an antifuoridationist to the community via local cable access television. However, it has been the Internet that has breathed new life into the antifuoridation effort. The Internet has brought the antifuoridation message into voters' homes. With just a click of the mouse, search engines can locate hundreds of Web sites denouncing fluoridation, which may give the impression that this is a one-sided argument. Individuals who look to the Internet as a source of reliable information may fail to recognize that these sites often contain personal opinion rather than scientific fact. Newspaper stories, press releases and letters to the editor are often posted as documentation of the "science" behind antifuoridationists' claims. All too often, the public accepts this type of information as true simply because it is in print.

The techniques used by antifuoridationists are well known and have been discussed at length in a number of published articles that review the tactics used by antifuoridationists. "Junk science," a term coined by the press and used over the past decade to characterize data derived from atypical or questionable scientific techniques, also can play a role in provoking opposition to water fluoridation. In fact, decision makers have been persuaded to postpone action on several cost-effective public health measures after hypothetical risks have made their way into the public media. Junk science impacts public policy and costs society in immeasurable ways. More people, especially those involved in policy decisions, need to be able to distinguish junk science from legitimate scientific research. Reputable science is based on the scientific method of testing hypotheses in ways that can be reproduced and verified by others; junk science, which often provides too-simple answers to complex questions, often cannot be substantiated. In 1993 the U.S. Supreme Court issued a landmark decision that many view as likely to restrict the use of junk science in the federal courts and in those state courts which adopt this reasoning. The Court determined that while "general acceptance" is not needed for scientific evidence to be admissible, federal trial judges have the task of ensuring that an expert's testimony rests on a reasonable foundation and is relevant to the issue in question. According to the Supreme Court, many considerations will bear on whether the expert's underlying reasoning or methodology is scientifically valid and applicable in a given case. The Court set out four criteria judges could use when evaluating scientific testimony:

- (1) whether the expert's theory or technique can be (and has been) tested, using the scientific method,
- (2) whether it has been subject to peer review and publication (although failing this criteria alone is not necessarily grounds for disallowing the testimony),
- (3) its known or potential error rate and the existence and maintenance of standards in controlling its operation and
- (4) whether it has attracted widespread acceptance within a relevant scientific community, since a known technique that has been able to attract only minimal support may properly be viewed with skepticism.

The scientific validity and relevance of claims made by opponents of fluoridation might be best viewed when measured against these criteria. Opinions are seldom unanimous on any scientific subject. In fact, there may be no such thing as "final knowledge," since new information is continuously emerging and being disseminated. As such, the benefit evidence must be continually weighed against risk evidence. Health professionals, decision makers and the public should be

cooperating partners in the quest for accountability where decisions are based on proven benefits measured against verified risks.

Voter apathy or low voter turnout due the vote being held as a special election or in an “off” year, confusing ballot language (a “no” vote translates to support for fluoridation), blurring of scientific issues, lack of leadership by elected officials and a lack of political campaign skills among health professionals are some of the reasons fluoridation votes are sometimes unsuccessful. Social scientists have conducted studies to examine why fluoridation fails when put to a public vote. Among the factors noted are lack of funding, public and professional apathy, the failure of many legislators and community leaders to take a stand because of perceived controversy, low voter turnout and the difficulty faced by an electorate in evaluating scientific information in the midst of emotional charges by opponents. Unfortunately, citizens may mistakenly believe their water contains optimal levels of fluoride when, in fact, it does not.

Clever use of emotionally charged “scare” propaganda by fluoride opponents creates fear, confusion and doubt within a community when voters consider the use of fluoridation. Defeats of referenda or the discontinuance of fluoridation have occurred most often when a small, vocal and well organized group has used a barrage of fear-inspiring allegations designed to confuse the electorate. In addition to attempts to influence voters, opponents have also threatened community leaders with personal litigation. While no court of last resort has ever ruled against fluoridation, community leaders may be swayed by the threat of litigation due to the cost and time involved in defending even a groundless suit, not to mention threats of political fallout. The American Dental Association (ADA) knows of no cases in which community leaders have been found liable for their pro-fluoridation efforts. In no instance has fluoridation been discontinued because it was proven harmful in any way.

Opposition techniques-

Targeting Politicians and Community Leaders

Antifluoridation Web sites contain draft letters to be sent to newspaper publishers, water departments, and community public officials warning them of their “liability” should they support or endorse water fluoridation. Leaders are urged to remain “neutral” and allow fluoridation decisions to be put to a public vote therefore relieving the leaders of any and all responsibility in the matter. Antifluoridationists use the time gained to conduct a public referendum to bombard the public with misinformation designed to turn public opinion against fluoridation.

Unproven Claims

Antifluoridationists have repeatedly claimed fluoridation causes an entire laundry list of human illnesses including AIDS, Alzheimer’s disease, cancer, Down Syndrome, genetic damage, heart disease, lower intelligence, kidney disease and osteoporosis (hip factures). These allegations are often repeated so frequently during campaigns that the public assumes they must be true. Their appearance in print, even if only in letters to the editor of the local newspaper, reinforces the allegation’s credibility. With just a small amount of doubt established, the opposition slogan, “If in doubt, vote it out,” may ring true with voters.

Innuendo

The statement, “Fifty years ago physicians and dentists posed for cigarette ads,” is an example of innuendo or, more specifically, guilt by association. Even though fluoridation is not mentioned, individuals are expected to make the connection that the medical community changed its position on smoking so it is possible health professionals are wrong about fluoridation, too.

Outdated Studies and Statements from “Experts”

Antifluoridation Web sites often offer a list of “respected medical professionals and scientists” who have spoken out against fluoridation. One of those often quoted is Dr. Charles Gordon Heyd who is noted to be a Past President of the American Medical Association (AMA). What is not disclosed is the source of the quote or that Dr. Heyd was President of the AMA in 1936 – almost ten years before water fluoridation trials began. His decades-old quote certainly does not represent the current AMA position of support for water fluoridation and is characteristic of antifluoridationists’ use of items that are out of date. Additionally, antifluoridationists have claimed that fourteen Nobel Prize winners have “opposed or expressed reservations about fluoridation.” It should be noted that the vast majority of these individuals were awarded their prizes from 1929 through 1958.

Statements Out of context

One of the most repeated antifluoridation statements is, “Fluoride is a toxic chemical. Don’t let them put it in our water.” This statement ignores the scientific principle that toxicity is related to dosage and not just to exposure to a substance. Examples of other substances that can be harmful in the wrong amounts but beneficial in the correct amounts are salt, vitamins A and D, iron, iodine, aspirin and even water itself. In another example, a press release from the New York State Coalition Opposed to Fluoridation (NYSCOF) posted on the Internet in August 2001, and again in March 2005, stated, “Fluoridation is based more on unproven theories than scientific evidence, according to a revised dental textbook by leaders in the field.” The press release also includes a number of items “quoted” from the textbook. The American Dental Association contacted the textbook authors who immediately wrote a letter responding to the press release. Drs. Brian A. Burt and Dr. Stephen A. Eklund responded, “The NYSCOF article takes a series of disconnected quotes from our textbook (Burt BA, Eklund SE. *The Dentist, Dental Practice, and the Community* 5th edition. Philadelphia: Saunders, 1999) and puts its own interpretation on them. The result is to portray Drs. Burt and Eklund as being opposed to fluoridation, which is most definitely not the case.”

Moving targets

In venues ranging from the media to the courts, opponents have been known to shift their theories of opposition frequently and mid-stream. This often appears to occur when one of their originally advanced points of opposition has been unveiled as being without merit. Some examples: A parent who told the media that he would need to move his family out of town because of past allergies to fluoride had to change his position after it was disclosed that the family had previously lived in a fluoridated community; and opponents filing repeated amendments to their legal complaints, in one case moving from an all out attack to the position that that they are not opposed to fluoridation, but just to one particular chemical - without telling the court that the chemical has been safely and extensively used for decades.”

Armfield, JM. When public action undermines public health: a critical examination of antifluoridationist literature. Aust New Zealand Health Policy. 2007; 4: 25.

“The list of techniques and methods described and analysed above are by no means the full extent of techniques used by water fluoridation opponents, although they are perhaps most pertinent to their promulgated literature. Common additional ploys involve neutralising politicians by massive letter writing campaigns to give the illusion of controversy, requesting public plebiscites which often have low turnouts and are dominated by people opposing change, the use of so-called experts to lend credence to anti-fluoridation claims, urging that fluoridation be delayed until better research is conducted or until the fabricated doubts can be resolved, inventing organisations with official

sounding names in order to create credibility, and using public debates which give the illusion of scientific controversy and move dialogue away from scientific discussion by allowing rhetorical practices.

The evidence for the effectiveness of water fluoridation is incontrovertible. More than a dozen large-scale literature reviews have found water fluoridation, even against a backdrop of high discretionary fluoride use, to confer a caries preventive benefit in children. Further to this, water fluoridation and its effect on the tooth structure provides a benefit to adults across their lifespan. The situation whereby a small group of determined individuals can manage to deny half a century of science pays testimony to the power of emotional arguments and the potential of misleading propaganda. It is here that scientists must continue their stand, reinforcing the arguments for water fluoridation while using their knowledge of the literature and their understanding of anti-fluoridation tactics to assist health departments.

Despite more than half a century of implementation, the addition of fluoride to the water for the prevention of dental decay is still considered a controversial and debated public health measure by some segments of the population. In and of itself this state of affairs is nothing new. Campaigns have been waged over the addition of chlorine to water supplies, compulsory child immunisations, the compulsory wearing of seatbelts in cars and many other public health initiatives. However, water fluoridation suffers the inglorious distinction of being one of only a few public health initiatives to still be regularly thwarted as a result of public action based on emotional and often misleading appeals.”

Newbrun E. The Fluoridation War: a Scientific Dispute or a Religious Argument? *Public Health Dent* 1996;56(5):246-52.

TABLE 2

Principal Antifluoridation Arguments and Profluoridation Answers

Antifluoridation Arguments	Profluoridation Answers
Poison	Safe at 0.7 – 1.2 ppm
Ineffective	15-40% less caries
Delays caries	Less caries at all ages
Costly	Cheap: \$0.25 (median/person/year) \$0.50 (mean/person/year)
Freedom of choice, individual rights	Individual restraints in the interest of community public health.

Techniques Used by Opponents to Prevent Fluoridation

- Neutralizing politicians: creating the semblance of “controversy by using massive letter-writing campaigns, telephone calls, and even threats
- The big lie: alleging serious health hazards, including many different diseases attributed to fluoridation
- Half-truths: fluoride is a poison and causes dental fluorosis
- Innuendo: urging fluoridation be delayed until all doubts are resolved
- Statement out of context: citing only a portion of a study and misrepresenting the conclusions
- “Experts” quoted: all doctors are considered equal by viewers of TV or newspaper readers; some dentist, physician, or scientist can always be found who will oppose fluoridation
- Conspiracy gambit: health establishment, government, and industry are in cahoots

- Scare words: pollutant, toxic waste, cancer, artificial, chemical
- Debating the issue: debates give the illusion of scientific controversy, even though the vast majority of health professionals and scientists support fluoridation

1998 Expert Panel Review (Calgary) from 5 U of Calgary professors:

“...it is much easier to raise the [health] concerns on the basis of preliminary or partial scientific studies or person opinion, than it is to provide a sound substantiation of those concerns. The fact that concerns have been raised is not, in and of itself, enough to change practices...”

Specific Challenges for Fluoridation

There are many changing faces of opposition to fluoridation. Some of those most proudly touted by the anti-fluoridation movements are those who have changed their minds and are now against fluoridation where they were once supporters. Additionally there are individuals in Alberta who are actively publishing and advocating to remove fluoridation from our water systems. Finally, a series of groups advocating for “health” are well organized and maintain a very functional presence with websites and structured organizations.

1) Changing Opinions

Dr. Hardy Limeback- Dentist, Head of Preventive Dentistry, University of Toronto

Why I am now officially opposed to adding fluoride to drinking water

Dr. Hardy Limeback, BSc, PhD, DDS
Associate Professor and Head, Preventive Dentistry
University of Toronto
Toronto, Ontario, M5G-1G6
Fax (416) 979-4936
Tel(416) 979-4929
E-mail hardy.limeback@utoronto.ca

April, 2000

To whom it may concern:

Why I am now officially opposed to adding fluoride to drinking water

Since April of 1999, I have publicly decried the addition of fluoride, especially hydrofluosilicic acid, to drinking water for the purpose of preventing tooth decay. The following summarize my reasons.

New evidence for lack of effectiveness of fluoridation in modern times:

1. Modern studies (published in the 1980's/1990's) show dental decay rates are so low in North America that the effects of water fluoridation cannot be measured. Because of the low prevalence of dental decay, water fluoridation studies today must be carefully conducted to correct for mobility of subjects between fluoridated and non-fluoridated areas, access to fluoride from other sources, the lack of blinding and problems with the "halo" effect. Even when very large sample sizes are used to obtain statistically significant results, the benefit of water fluoridation is not a clinically relevant one (the number of tooth surfaces saved from dental decay per person is less than one half). Recent studies show that halting fluoridation will either result in only a marginal increase in dental decay which cannot be detected or no increase in dental decay at all.
2. The major reasons for the general decline of tooth decay worldwide, both in non-fluoridated and fluoridated areas, is the widespread use of fluoridated toothpaste, improved diets, and overall improved general and dental health (antibiotics, preservatives, hygiene etc).
3. There is now a better understanding of how fluoride prevents dental decay. What little benefit fluoridated water may still provide is derived primarily through topical means (after the teeth erupt and come in contact with fluorides in the oral cavity). Fluoride does not need to be absorbed to be effective. It is not an essential nutrient. Nor should it be considered a desirable "supplement" for children living in non-fluoridated areas. Fluoride ingestion delays tooth eruption and this may account for some of the differences seen in the past between fluoridated and non-fluoridated areas (i.e. dental decay is simply postponed). No fluoridation study has ever separated out the systemic effects of fluoride. Even if there were a systemic benefit from ingestion of fluoride, it would be minuscule and clinically irrelevant. The notion that systemic fluorides are needed in non-fluoridated areas is an outdated one that should be abandoned altogether.

New evidence for potential serious harm from long-term fluoride ingestion.

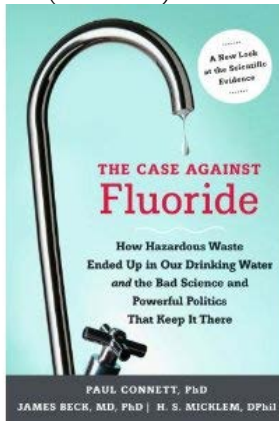
1. Hydrofluosilicic acid is recovered from the smokstacks (copper) during the production of phosphate fertilizer and sold to most of the major cities in North America, which use this industrial grade source of fluoride to fluoridate drinking water, rather than the more expensive pharmaceutical grade sodium fluoride salt. Fluorostackes have never been tested for safety in humans. Furthermore, these industrial-grade chemicals are contaminated with trace amounts of heavy metals such as lead, arsenic and radium that accumulate in humans. Increased lead levels have been found in children living in fluoridated communities. Osteosarcoma (bone cancer) has been shown to be associated with radium in the drinking water. Long-term ingestion of these harmful elements should be avoided altogether.
2. Half of all ingested fluoride remains in the skeletal system and accumulates with age. Several recent epidemiological studies suggest that only a few years of fluoride ingestion from fluoridated water increases the risk for bone fracture. The relationship between the milder symptoms of bone fluorosis (joint pain and arthritic symptoms) and fluoride accumulation in humans has never been investigated. People unable to eliminate fluoride under normal conditions (kidney impairment) or people who ingest more than average amounts of water (athletes, diabetics) are more at risk to be affected by the toxic effects of fluoride accumulation.
3. There is a dose-dependent relationship between the prevalence/severity of dental fluorosis and fluoride ingestion. When dental decay rates were high, a certain amount of dental fluorosis was considered an acceptable "trade off" of providing an "optimum" dose of 1.0 ppm fluoride in the water. However, studies published in the 1980's and 1990's have shown that dental fluorosis has increased dramatically in North America. Infants and toddlers are especially at risk for dental fluorosis of the front teeth since it is during the first 3 years of life that the permanent front teeth are the most sensitive to the effects of fluoride. Children fed formula made with fluoridated tap water are at higher risk to develop dental fluorosis. A relatively small percentage of the children affected with dental fluorosis have the more severe kind that requires extensive restorative dental work to correct the damage. The long-term effect of fluoride accumulation on dentin colour and biomechanics is also unknown. Generalized dental fluorosis of all the permanent teeth indicates that the bone is a major source of the excess fluoride. The effect of this excess amount of fluoride in bone is unknown. Whether stress bone fractures occur more often in children with dental fluorosis has not been studied.
4. A lifetime of excessive fluoride ingestion will undoubtedly have detrimental effects on a number of biological systems in the body and it is illogical to assume that tooth enamel is the only tissue affected by low daily doses of fluoride ingestion. Fluoride activates G-protein and a number of cascade reactions in the cell. At high concentrations it is both mitogenic and genotoxic. Some published studies point to fluoride's interference with the reproductive system, the pituitary gland and thyroid function. Fluoride is a proven carcinogen in humans exposed to high industrial levels. No study has yet been conducted to determine the level of fluoride that bone cells are exposed to when fluoride-rich bone is turned over. Thus, the issue of fluoride causing bone cancer cannot be dismissed as being a non-issue since carefully conducted animal and human cancer studies using the exact same chemicals added to our drinking water have not been carried out.

The issue of mass medication of an unapproved drug without the expressed informed consent of each individual must also be addressed. The dose of fluoride cannot be controlled. Fluoride as a drug has contaminated most processed foods and beverages throughout North America. Individuals who are susceptible to fluoride's harmful effects cannot avoid ingesting this drug. This presents a medico-legal and ethical dilemma and sets water fluoridation apart from vaccination as a public health measure where doses and distribution can be controlled. The rights of individuals to enjoy the freedom from involuntary fluoride medication certainly outweigh the right of society to enforce this public health measure, especially when the evidence of benefit is marginal at best.

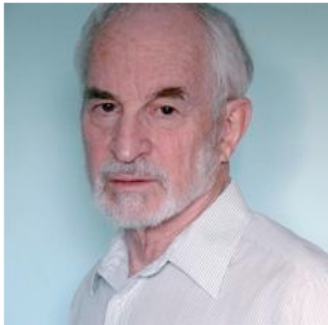
Based on the points outlined briefly above, the evidence has convinced me that the benefits of water fluoridation no longer outweigh the risks. The money saved from halting water fluoridation programs can be more wisely spent on concentrated public health efforts to reduce dental decay in the populations that are still at risk and this will, at the same time, lower the incidence of the harmful side effects that a large segment of the general population is currently experiencing because of this outdated public health measure.

Sincerely,
Dr. Hardy Limeback BSc PhD (Biochemistry) DDS

2) Local (Albertan) Authors:



James Beck



Dr. James S. Beck is a Professor Emeritus of Medical Biophysics at the University of Calgary and holds doctorates in medicine from Washington University School of Medicine and biophysics from the University of California, Berkeley. He lives in Calgary, Alberta, Canada.

3) Anti-fluoridation Internet sites

NHF- National Health Federation

<http://www.thenhf.com/fluoridation.html>

- Board of Governors
- Advisory Board
- Addresses many health issues not just fluoridation, collaboration from many other parties
- E-list
- Donations/Membership
- Articles
- News items
- Lobbying
- Linked to same people with People for Safe Drinking Water, FAN

HAN- Health Action Network

<http://www.hans.org/>

- Newsletter
- Board of Directors
- Donations
- Directory of Services- health professionals
- Magazine

FAN- Fluoride Action Network

<http://www.fluoridealert.org/>

- Professionals' Statement to End Fluoridation
 - 3,076 Signers by-degree as of September 9, 2010:
 - 491 Nurses (RN, MSN, BSN, ARNP, APRN, LNC, RGON
 - Chiropractic, includes M Chiro) - 10 PhD's, Doctor of Science; EdD (Doctor of Education); DrPH (Doctor of Public Health)
 - 282 Dentists (D D S, D M D, BDS)
 - 74 Lawyers (J D , LLB, Avvocato) • 67 RD H s (Registered Dental Hygienist); also DH, RDHAP, EFDA, RDAEF, and RDN
 - DPh, RPH) - 17 Acupuncturists (Ac and, MAc -Master Acupuncturist) (DMV, VMD, BVMS)
- News Articles
- Books, DVD's, Song
- Donations
- Bulletins
- Lobbying of politicians
- Articles

- 441 D C 's (
- 342 M D 's (
- 136 N D 's (
- 65 Pharm a
- 30 D O 's (

Waterloo Watch

<http://www.waterloowatch.com/home.html>

- Facebook group People for Safe Drinking Water
- People For Safe Drinking Water
 - Organisations - Advocacy Organisations
 - Mission: To promote awareness of the additives in most public water supplies and to educate the public as to their potential effects.
 - Vision: We strive towards the removal of harmful elements in our drinking water and wish to drive public policy towards a higher standard of water quality.
 - Values: We value the integrity of our public water supplies and the health and well-being of all individuals.
 - Goals: To abolish the archaic, unethical and illegal practice of water fluoridation and inform the public of measures they can take to protect their health and the health of their loved ones.

How much do you know about your tap water? Would it surprise you to know that it is being treated with a waste chemical from the phosphate fertilizer and aluminum industry? Would it also surprise you to know that contaminants in the chemical used include arsenic, lead and other toxic elements?

This chemical is called hydrofluosilicic acid and it is used in order to fluoridate our water despite never being tested for human consumption. Is fluoride itself really that safe? We're constantly told that it improves the resistance of our teeth to cavities, but is that true? at what cost? Is it ethical to mass medicate populations by doping the water supply, without receiving individual consent to be medicated, and without any control over the individual dose? Why has over 98% of Europe rejected or banned fluoridation as a public health measure?

These are questions you should all be asking. We hope that you will find the answers to those questions here and encourage people to join us in our mission to remove these unsafe and untested chemicals from our water supply.

- Books
- Video clips
- Donations
- Lobby information
- Referendum information

Scientific Inquiry

Key Elements in Reviewing Research (Fluoridation Facts, American Dental Association, pg. 7, http://www.ada.org/sections/professionalResources/pdfs/fluoridation_facts.pdf)

It is important to review information about fluoridation with a critical eye. Listed below are key elements to consider when reviewing information about fluoridation research.

- 1. Credentials:** The author's background and credentials should reflect expertise in the area of research undertaken.
- 2. Date:** The year of the publication should be apparent. The information should be relatively current, although well-designed studies can stand the test of time and scientific scrutiny. A review of existing literature can provide insight into whether the results of older studies have been superseded by subsequent studies.
- 3. Accuracy:** If the information is a review of other studies, it should be accurate and representative of the original research. Information quoted directly from other sources should be quoted in its entirety.
- 4. Statistical Methods:** The methods used to analyze the data should be generally accepted and appropriate.
- 5. Comparability:** The research should be applicable to community water fluoridation and use an appropriate type and amount of fluoride. Many research projects investigate the use of fluoride at much higher levels than recommended for community water fluoridation. For example, the results of a study using a concentration of 125 parts per million (ppm) fluoride are not comparable to research findings regarding water fluoridated at 0.7 to 1.2 ppm.
- 6. Type of Research:** How the research is conducted is relevant. Research conducted in vitro (outside the living body and in a laboratory environment) may not have the same results as research conducted in vivo (in a living human or other animal).
- 7. Research Model:** A good study will try to replicate real life situations as close as possible. For example, results from animal studies using high doses of fluoride that are injected rather than provided in drinking water should be cautiously interpreted. Such studies are highly questionable as a predictor of the effects of human exposure to low concentrations of fluoride, such as those used to fluoridate water.
- 8. Peer Review:** Publications presenting scientific information should be peer reviewed to help ensure that scientifically sound articles are published. Peer review involves evaluation and rating of the scientific and technical merit of an article by other qualified scientists.

9. Weight of Evidence: Conclusions from one particular study or one particular researcher should be weighed against the bulk of established, generally accepted, peer-reviewed science. No single study by itself is conclusive. If other researchers have not been able to replicate the results of a particular study or the work of one researcher, the results of that study or body of research should be viewed with some skepticism.

10. Easily Accessible: Reputable studies on fluoridation are typically published in peer-reviewed journals and other vehicles that are easily obtainable through a medical/dental library or through PubMed, a service of the National Library of Medicine which can be accessed via the Internet at <http://www.nlm.nih.gov/>.

Hierarchy of Evidence

There are a number of ways to evaluate evidence and determine best practices ranging from case studies, anecdotes, self-published reports through to expert opinion, observational and controlled experimental trials. The question of whether to fluoridate public water supplies has been studied extensively and there is a wealth of published evidence over decades, much of which has been subjected to the most rigorous scientific scrutiny. Hence the question is one that should be evaluated based on the highest level of evidence available and should not be something that is considered solely based on anecdotal or expert opinion.

Many health issues and decisions regarding treatment and preventive protocols in all aspects of medicine are not without controversy and debate over what is right or what is best to do. There are few questions where the evidence is only weighted on one side of the question or not. This reflects the fact that science is not infallible and so our best ability to weigh out complex questions is using principles of weight (quantity) and quality of evidence.

Weight of evidence is simple in concept; multiple studies from differing researchers, distinct locations and populations, and over long periods of time. Quality of evidence is not as simple and there are ranges of quality that need to be considered. Not all published articles, even in peer-reviewed journals are of the same level of quality. The following chart demonstrates currently accepted descriptions of the hierarchy of evidence used to determine the quality of scientific studies:

Level	Intervention	Aetiology/harms ^a
I ^b	A systematic review of level II studies	A systematic review of level II studies
II	A randomised controlled trial	A prospective cohort study
III-1	A pseudorandomised controlled trial (i.e. alternate allocation of some other method)	All or none ^c
III-2	A comparative study with concurrent controls Non-randomised experimental trial ^c Cohort study Case-control study Interrupted time series with a control group	A retrospective cohort study
III-3	A comparative study without concurrent controls Historical control study Two or more single arm studies ^d	A case-control study
IV	Case series with either post-test or pre-test/post-test outcomes	A cross-sectional study

^a If it is possible and/or ethical to determine a causal relationship using experimental evidence then the 'Intervention' hierarchy of evidence should be utilized. If it is only possible and/or ethical to determine a causal relationship using observational evidence (i.e. cannot allocate groups to a potential harmful exposure; e.g. nuclear radiation), then the 'Aetiology' hierarchy of evidence should be utilized.

^b A systematic review will only be assigned a level of evidence as high as the studies it contains, excepting where those studies are of level II evidence.

^c This also includes controlled before-and-after (pre-test/post-test) studies, as well as indirect comparisons (i.e. utilize A vs. B and B vs. C, to determine A vs. C)

^d Comparing single-arm studies (i.e. case series from two studies)

^e All or none of the people with the risk factor(s) experience the outcome. For example, no smallpox develops in the absence of a specific virus; and clear proof of the causal link has come from the disappearance of smallpox after large-scale vaccination.

Literature Review Results

- Key questions-
- 1) Does water fluoridation work? What are the benefits?
 - 2) Does water fluoridation cause harm? What are the risks?
 - 3) Is it ethical to fluoridate water supplies? What other options are there?

This literature review comprises the following:

- 1) A comprehensive and detailed systematic review of the fluoride literature was completed by the Government of Australia, 2007. This review covers literature from 1996-2007. This review is the basis for the evidence presented in this report.
- 2) A similar Medline search was completed using the same search terms as the report in 1) above and articles were reviewed for inclusion in this report.
- 3) An individual review of the journal "Fluoride" from 2007-2010 <http://www.fluoridresearch.org/>, which is not a journal currently accepted and listed on Medline, promotes itself as extensively covering fluoride research worldwide.
 - a. Very few of the articles in this journal over these years would qualify to be included in the systematic review. The majority were in abstract form. A significant amount were animal/plant based research and another significant amount did not look at the intervention of controlled water fluoridation and compare it to no fluoridation. So very few of the articles from this journal would fit the criteria for inclusion in this review and report.

National Health and Medical Research Council, [A Systematic Review of the Efficacy and Safety of Water Fluoridation](#), Australian Government

2007. <http://www.nhmrc.gov.au/publications/synopses/ch41syn.htm>

[Literature Synthesis](#) pgs. 30-32

"The aim of this review was to synthesise the highest level of evidence to answer each clinical question. The highest level of evidence for the assessment of an intervention (in this case fluoride) is a systematic review of randomised controlled trials, which is the study type least subject to various

biases. However, in some cases it is not possible or feasible to conduct a randomised (or non-randomised) controlled trial. This may be due to a number of factors including: (i) the nature of the intervention; (ii) the types of outcomes being assessed; and (iii) ethical or financial constraints.

With regards to the nature of the intervention, the use of fluoride for the prevention of dental caries can be implemented at the individual or population level. Topical fluorides such as toothpaste, mouthrinse, gel and varnish are implemented at the individual level. On the other hand, fluoride can also be implemented at the population level, such as is the case with water, milk or salt fluoridation. The most appropriate study type for assessing an intervention at the individual level is a RCT, and the highest level of evidence is a systematic review of RCTs. Alternatively, when an intervention is applied at the population level, individuals cannot be randomised to a treatment or control group, and different study types are required to assess the efficacy of the intervention. The most appropriate study type in this case would be a prospective, comparative cohort study. The highest level of evidence would be a systematic review of prospective, comparative cohort studies. Different study types are also more relevant depending on the outcome being assessed. Generally, RCTs are the study type of choice for assessing the efficacy of an intervention. However, safety/harms associated with an intervention may best be assessed using an observational study such as a cohort, case-control, cross-sectional or ecological study. This is particularly the case for rare outcomes or outcomes which develop long after an exposure or after prolonged exposure (eg, cancer, osteoporosis and cardiovascular disease).

Based on the different types of fluoride interventions available (ie, individually-applied and population-based) and the different types of outcomes to be assessed (ie, efficacy as measured by a reduction in caries, and potential harms such as fluorosis, decreased bone density/fracture, cancer and other adverse effects), two different types of evidence hierarchies were required: one for intervention studies, and one for aetiology/harm studies. The interim levels of evidence currently being trialled by the NHMRC for intervention and aetiological studies are summarised in [the table above].”

Based on types of intervention (ie, individual or population) and the outcomes assessed (efficacy or safety) the hierarchy of study types considered most relevant for answering each of the clinical questions defined in Section 4.1 is presented in Table 4. It should be noted that the levels of evidence accepted for fluoride intervention at the population level was based on those chosen for the McDonagh et al (2000a) review of water fluoridation. For each clinical question, the body of evidence using the highest available level of evidence would be assessed. Where a higher level of evidence was available, lower levels would not be assessed. For example, in the case of the assessment of harms associated with the use of topical agents, if RCTs were available then assessment would be limited to RCTs. The types of studies included to answer each clinical question will be discussed in the results section.

Table 4 Hierarchy of evidence accepted for each clinical question

	Intervention		Aetiology/Harms		
	Prevention of dental caries	Dental fluorosis	Fracture	Cancer	Other Adverse effects
<i>Population level intervention</i>					
Water fluoridation	Cohort study (Level III-2) Case-control study (Level III-2) Comparative cross-sectional study I ^a (Level IV)		Prospective cohort study (Level II)		
Milk fluoridation			Retrospective cohort study (Level III-2)		
Salt fluoridation			Case-control study (Level III-3) Comparative cross-sectional study I ^a (Level IV) Comparative cross-sectional study II ^b (Level IV)		
<i>Individual level intervention</i>					
Topical fluoride	RCT (Level II)		RCT (Level II- Intervention) Retrospective cohort study (Level III-2) Case-control study (Level III-3) Comparative cross-sectional study I ^a (Level IV) Comparative cross-sectional study II ^b (Level IV)		

^a Evaluated at multiple timepoints (for caries assessment), with baseline assessment associated closely with the implementation/cessation of intervention and the final assessment at a time sufficient for the intervention to have had an effect on the outcome under investigation.

^b Evaluated at a single timepoint (for fluorosis and other harms assessment), with sufficient time for the intervention to have had an effect on the outcome under investigation.

Literature Review Methodology

National Health and Medical Research Council, A Systematic Review of the Efficacy and Safety of Water Fluoridation, Australian Government 2007.

<http://www.nhmrc.gov.au/publications/synopses/eh41syn.htm>

“A search of the literature was undertaken in the MEDLINE and EMBASE databases using EMBASE.com. In addition, the Cochrane Systematic Review and Clinical Trial Databases were searched to help identify additional systematic reviews and original studies. Due to the availability of recent systematic reviews, searches were limited to publications from 1996 onwards. Searches were also limited to English-language publications. The search was conducted in December 2006. The search strategy is shown in Table 1.

Table 1 Search strategy

Search No.	Database	Date Searched	Search Terms	Citation
1	Medline, Embase	1996-2007	1. fluorid*: ab,ti OR fluorin*:ab,ti OR flurid*:ab,ti OR florin*:ab,ti AND [1996-2007]/py	13,177
			2. fluorid*: ab,ti OR fluorin*:ab,ti OR flurid*:ab,ti OR florin*:ab,ti AND [1996-2007]/py AND [english]/lim AND [humans]/lim	5,034
2	Cochrane Library	1996-2007	fluoride OR fluorine OR fluoridation OR fluoridated	2,635
Total				5,418

In total, 5418 non-duplicate citations were identified. Three reviewers assessed the eligibility of abstracts (approximately one third each). After applying the inclusion/exclusion criteria, 408 citations were considered potentially eligible for inclusion in the review (see Table 2).

Table 2 Reasons for exclusion

Reason for Exclusion	Description	Title/abstracts
<i>Total citations</i>		5418
Imaging study	Citation describes a study assessing radioactive fluorine for imaging	978
Not a clinical study	Citation does not describe the results of a systematic review, randomised controlled trial or observational study Narrative reviews, case reports, letters, <i>in vitro</i> , <i>ex vivo</i> and animal studies were excluded	2439
Wrong intervention	Citation did not examine the effect of fluoride ingested via water, milk or topical agents Industrial sources of fluoride (eg. from aluminum smelting) and consumption of brick tea and trono are excluded	826
Wrong comparator	Citation does not compare fluoride intake with no fluoride intake or different levels of fluoride intake	88
Wrong indication/population	Citation does not include the general population Specific populations included those treated for osteoporosis and those undergoing orthodontic work are excluded	59
Wrong outcomes	Citation does not include assessment of one of the included outcomes. Included outcomes are caries prevention (measured by DMFT/dmft, DMFS/dmfs) or any safety measure.	614
Not in English	Due to time constraints, only English-language articles were eligible for	5
Abstract only		1
<i>Citations remaining</i>		408

After the review of the full papers of potentially eligible articles, 77 citations were included in the review. More detail on the inclusion of studies is available in each section, while a full list of included and excluded citations and the reasons for exclusion, are available in Volume II.”

Following the same methodology, an additional MEDLINE search from 2007-2010 was completed by Dr. Steven Patterson. A total of 2850 articles were identified from the same search terms for these years. Following a similar exclusion criteria, 44 articles from 2007, 37 from 2008, 40 from 2009 and 21 from 2010 were selected for review (total 142).

The following is the exclusion/inclusion data for articles from the 2007-2010 Medline search:

Reason for Exclusion	# of Titles
Not a clinical study	40
Wrong intervention	36
Wrong comparator	1
Wrong outcome	11
Abstract	1
Incomplete information	1
Duplicates	3
<i>Total</i>	84

Reason for Inclusion (Primary focus of article)	# of Titles
Caries Prevention	22
Dental Fluorosis	19
Harm	7

Results

1) Does Water Fluoridation work? What are the benefits?

Selected Key Results from “National Health and Medical Research Council, A Systematic Review of the Efficacy and Safety of Water Fluoridation, Australian Government 2007. (for complete review- please see <http://www.nhmrc.gov.au/publications/synopses/eh41syn.htm>)

“Research question: *Is intentional water fluoridation more efficacious than no water fluoridation in the prevention of dental caries?*”

5.1.1.1. Identification of relevant studies

Of the 109 potentially relevant citations identified, three represented systematic reviews. The review by McDonagh et al (2000a,b) was considered to be the most relevant and comprehensive, and as such was chosen to form the basis of this section. The search for literature conducted by McDonagh et al (2000a) included up to February 2000. Therefore, literature from 2000 – 2007 from the original literature search was to be reviewed in order to identify additional original studies of the efficacy of water fluoridation in reducing dental caries. Only one original study was identified which met the same inclusion criteria as those defined by McDonagh and associates. Specifically, this study was: (i) a prospective study comparing at least two populations, one receiving fluoridated water and the other receiving non-fluoridated water; (ii) evaluating at least two time points; and (iii) a change in the level of fluoride in the water supply of at least one the study areas occurred within three years of the baseline survey. No relevant RCTs, cohort studies or case-control studies were identified by the literature search.

5.1.1.2. Systematic reviews

Two systematic reviews examining the effect of water fluoridation on dental caries have been published since 1996: Truman et al (2002) and McDonagh et al (2000a). Both of these studies were considered be of good methodological quality and provided Level III/IV evidence.

The Truman review (Truman et al, 2002) was conducted by the Task Force on Community Preventive Services in the US, with the aim being to develop recommendations on interventions to prevent oral disease (ie, dental caries, oral and pharyngeal cancers and sports-related craniofacial injuries). The component of the Truman review relevant to this review was the effect of water fluoridation on the prevention or control of dental caries. To be eligible for inclusion in the review, studies had to meet the following criteria: (i) be a report of a primary study; (ii) be published in English between 1966 and 2000; (iii) address the prevention or control of dental caries; (iv) compare a group of people exposed to the intervention (ie, water fluoridation) with a group of people who had not been exposed or who had been less exposed. Twenty one studies were included. The review concludes that there is “strong evidence that CWF [community water fluoridation] is effective in reducing the cumulative experience of dental caries within communities.”

The review by McDonagh et al (2000a) was commissioned by the Chief Medical Officer of the Department of Health in the UK. The review covered a number of objectives with the following being the most relevant to this section of the review: “what are the effects of fluoridation of water drinking supplies on the incidence of caries?” Eligibility of studies for inclusion in the review for dental caries was based on the following criteria: (i) prospective studies comparing at least two populations, one receiving fluoridated water and the other receiving non-fluoridated water, with at least two time points evaluated: (ii) a change in the level of fluoride in the water supply of at least one the study areas, within three years of the baseline survey; and (iii) assessing any measure of dental decay. Twenty-six studies (reported in 73 publications) were included. The authors concluded that “the meta-analysis showed a statistically significant effect of water fluoridation in reducing dental caries as measured by both dmft/DMFT and the proportion of caries-free children.” However, they also note that there was significant heterogeneity between studies, which was further examined using meta-regression. It should be noted that 12 of the 21 studies included in the Truman review were amongst the 26 studies included in the McDonagh review. The lack of overlap between the two reviews is predominantly due to the fact that the Truman review assessed both fluoridation vs no fluoridation and fluoridation vs fluoridation at a lower level, while the McDonagh review assessed only fluoridation vs no fluoridation. In addition, in the McDonagh review the search was not limited to English language studies, and studies published in a number of languages were translated. The McDonagh review was also more stringent in requiring data from two time points which enabled the change over time to be reported. This minimises the possibility of any difference in dental caries being due to other underlying differences between the populations. The McDonagh et al (2000a) review has been chosen to form the evidence base for the effect of water fluoridation on dental caries in this current review as it provides more detailed and comprehensive results than those shown in the Truman et al (2002) review. It should be noted that all studies included in the McDonagh review were considered to be B level evidence (moderate quality and a moderate risk of bias). The results of the McDonagh review are divided into two groups: (i) including studies in which fluoridation was initiated during the study time-frame, and (ii) including studies in which fluoridation was terminated during the study time-frame. The predefined outcomes assessed in the McDonagh review included the proportion of caries-free children and the mean difference in dmft/DMFT scores. As such, the percentage of caries-free children and the difference in dmft/DMFT will be the main outcomes used in this current review. For each study, data regarding the change from baseline to study end was measured for each outcome in each group (ie, fluoridated or non-fluoridated) and then the change from baseline was compared between groups (ie, fluoridated vs non-fluoridated). It should be noted that the results of a number of different outcomes are briefly noted in the McDonagh review, and these will be presented in this review also. These outcomes include change in DMFS score, average number of all approximal and approximal dental lesions, deft score, number of erupted permanent teeth per child and percentage with false teeth. The results of the analysis of change in the percentage of caries-free children following fluoridation of water is shown in **Table 10**. The majority of study analyses (20/30) of different ages and teeth types showed a significant increase in the percentage of caries-free children following the introduction of water fluoridation, while 7/31 analyses showed a non-significant increase. The remaining 3/31 analyses showed a small, non-statistically significant decrease in the percentage of caries-free children following water fluoridation. Pooling of the data shown below resulted in a mean difference of 15.4 % (95% CI 10.8, 20.1), $p < 0.001$. However, heterogeneity was high with the between study variance being 163.0. Univariate meta-regression analysis showed four variables to be significant (baseline percentage of caries free subjects, tooth type, setting and study duration). In addition, validity score was also included in the multivariate analysis. After adjustment for these

variables in a multivariate meta-regression model, the resulting mean difference was similar, being 14.3% (95% CI 6.7, 21.9), $p < 0.001$. The results suggest that the introduction of water fluoridation is strongly associated with an increase in the percentage of caries-free children.

Table 10 Initiation of water fluoridation: change in proportion of caries-free children between non-fluoridation and fluoridation (McDonagh et al, 2000)

Citation	Age	Teeth type	Mean difference (%) (95% CI)	
Kunzel (1997)	5	Primary	9.4 (0.9, 17.9)	
	8	Permanent	41.1 (36.0, 46.2)	
	8	Primary	19.4 (15.9, 22.9)	
	12	Permanent	25.2 (21.1, 29.3)	
	15	Permanent	9.5 (6.3, 12.7)	
Beal (1981)	5	Primary	16.0 (3.2, 28.8)	
	8	Permanent	19.0 (4.8, 33.2)	
	8	Primary	6.0 (-3.4, 15.4)	
	12	Permanent	-5.0 (-15.0, 5.0)	
DHSS (1969)	England	5	Primary	17.0 (2.1, 31.9)
		8	Not stated	18.0 (0.7, 35.3)
		12	Not stated	8.0 (-1.2, 17.2)
		14	Permanent	5.0 (-4.4, 14.4)
	Wales	5	Primary	14.0 (3.5, 24.5)
		12	Not stated	9.0 (1.2, 16.8)
		14	Permanent	3.0 (-2.9, 8.9)
	Scotland	5	Primary	14.6 (4.79, 24.4)
	Adriasola (1959)	5	Primary	5.1 (-1.9, 12.1)
8		Not stated	5.0 (0.1, 9.9)	
12		Not stated	-4.9 (-8.3, -1.5)	
Guo (1984)	5	Primary	-2.0 (-6.4, 2.4)	
	8	Permanent	64.1 (55.4, 72.8)	
	8	Primary	0.4 (-4.8, 5.6)	
	12	Permanent	28.5 (20.5, 36.5)	
	15	Permanent	34.4 (19.7, 49.1)	
Beal (1971)	5	Not stated	4 (-8.0, 16.0)	
Ast (1951)	5	Primary	22.1 (10.9, 33.3)	
Brown (1965)	12-14	Permanent	15.8 (11.8, 19.8)	
	9-11	Permanent	36.1 (30.5, 41.7)	
Gray (1999)	5	Primary	26.0 (19.4, 32.6)	
Unadjusted pooled result	Between study variance 163.0		15.4 (10.8, 20.1)	
Adjusted pooled result*	Between study variance 53.1		14.3 (6.7, 21.0)	

* After multivariate meta-regression analysis, adjusting for variables shown in the univariate analyses to be statistically significant. These include baseline percentage of caries-free children, setting and study validity score.

After multivariate meta-regression analysis, adjusting for variables shown in the univariate analyses to be statistically significant. These include baseline percentage of caries-free children, setting and study validity score. The unadjusted risk differences and numbers needed to treat to prevent one additional person developing dental caries were calculated by teeth type and age categories and are presented in **Table 11** and range from 3-11. It should be noted that there was significant heterogeneity for all analyses ($p < 0.001$); however, based on the results of the multivariate meta-regression shown in **Table 10** above, it is unlikely that adjusting for potentially confounding variables would have a major impact on the results.

Table 11 Initiation of water fluoridation: risk difference and NNT to prevent one additional person developing dental caries (McDonagh et al, 2000)

Age	Teeth type	Number of studies	Risk difference (95% CI)	Q-statistic	NNT (95% CI)
All	All	31	15.5 (10.7, 20.2)	1421.0	6 (5, 9)
	Primary	15	11.4 (6.5, 16.3)	354.4	9 (6, 15)
	Permanent	16	19.1 (11.4, 26.7)	751.3	5 (4, 9)
5	Primary	11	13.2 (6.8 (20.0)	137.5	8 (5, 15)
8	Primary	4	7.2 (-3.6, 18.0)	211.3	14 (6, ∞)
	Permanent	4	35.6 (22.4, 48.8)	39.1	3 (2, 5)
12	Permanent	6	13.1 (0.8, 25.5)	21.5	8 (4, 125)
14-15	Permanent	4	8.8 (0.7, 16.9)	36.8	11 (6, 143)

The results of the analysis of change in dmft/DMFT following fluoridation of water are shown in **Table 12**. Once again, the majority of study analyses which provided a measure of variance (14/15) showed a greater improvement in caries following the introduction of water fluoridation, while 1/15 analyses showed a non-significant increase. Pooling of the data shown below resulted in a mean difference in dmft/DMFT score of 2.3 (1.8, 2.8), $p < 0.001$. However, heterogeneity was high with the between study variance being 1.068. Univariate meta-regression analysis showed four variables to be significant (baseline dmft/DMFT, setting, validity score and age). After adjustment for these variables in a multivariate meta-regression model, the resulting mean difference was consistent, being 2.61 (2.31, 2.91), p value not reported. The results suggest that introduction of water fluoridation is strongly associated with an improvement in dmft/DMFT scores. However, it should be noted that the analyses did not take into account the use of other sources of fluoride, including topical agents.

Table 12 Initiation of water fluoridation: change in change in dmft/DMFT scores between non-fluoridation and fluoridation (McDonagh et al, 2000)

Citation	Age	Teeth type	Mean difference (95% CI)	
Kunzel (1997)	5	Primary	0.6 (0.2, 1.0)	
	8	Primary	2.1 (1.8, 2.4)	
	8	Permanent	1.3 (1.2, 1.4)	
	12	Permanent	2.9 (2.6, 3.2)	
	15	Permanent	3.7 (3.3, 4.1)	
Beal (1981)	5	Primary	1.7 (0.6, 2.8)	
	8	Permanent	0.5 (0.1, 0.9)	
	8	Primary	1.2 (0.4, 2.0)	
	12	Permanent	0.6 (-0.2, 1.4)	
DHSS (1969)	England	5	Primary	1.6
		8	Permanent	0.8
		12	Permanent	1.0
	Wales	14	Permanent	1.5
		5	Primary	2.1
		12	Permanent	2.5
Loh (1996)	7-9	Permanent	3.1	
	7-9	Permanent	2.1	
Guo (1984)	5	Primary	3.6 (2.6, 4.6)	
	8	Permanent	1.6 (1.4, 1.8)	
	8	Primary	4.4 (3.9, 4.9)	
	12	Permanent	2.6 (2.2, 3.0)	
	15	Permanent	3.8 (2.7, 4.9)	
Alvarez-Ubilia (1959)	5	Primary	2.2	
Arnold (1956)	8	Permanent	1.2	
	12	Permanent	1.2	
	15	Permanent	3.1	
Blayney (1960)	8	Permanent	1.8	
	12	Permanent	3.4	
Brown (1965)	12-14	Permanent	4.1 (3.4, 4.8)	
	9-11	Permanent	2.1 (1.7, 2.5)	
Unadjusted pooled result^a	Between study variance 1.068		2.3 (1.8, 2.8)	
Adjusted pooled result^{a,b}	Between study variance 0.111		2.61 (2.31, 2.91)	

^a Only studies which included data on variance have been included in meta-regression analysis.

^b After multivariate meta-regression analysis, adjusting for variables shown in the univariate analyses to be statistically significant. These include baseline dmft/DMFT, age, study duration and setting.

After multivariate meta-regression analysis, adjusting for variables shown in the univariate analyses to be statistically significant. These include baseline dmft/DMFT, age, study duration and setting. A number of additional caries outcomes were examined, but not meta-analysed. These are shown in **Table 13**. Once again the majority of the results show a caries benefit in favour of the fluoridated areas, with the exception of the number of erupted permanent teeth in eight year olds in the study by Ast (1951).

Table 13 Initiation of water fluoridation: other caries outcomes (McDonagh et al, 2000)

Citation	Age	Outcome	Mean difference (95% CI)
Hardwick (1982)	12	Increment in DMFS score	2.5 (1.0, 3.0)
	12	Increment in DMFT score	1.1 (0.4, 1.8)
Backer-Dirks (1961)	11-15	Average number of approximal lesions	2.7
	11-15	Average number of approximal dental lesions	1.4
Beal (1971)	5	deft score	2.5 (1.3, 3.7)
Arnold (1956)	5	deft score	1.6
	8		0.9
Ast (1951)	12	Number of erupted permanent teeth per child	0.1
	8		-0.3
	12	DMFT rate per 100 erupted permanent teeth	10.5
	8		7.1
Pot (1974)	5-55	Percentage with false teeth	11.2 (3.8, 18.6)

Summary

Research question: *Is intentional water fluoridation more efficacious than no water fluoridation in the prevention of dental caries?*

The existing body of evidence strongly suggests that water fluoridation is beneficial at reducing dental caries. After adjustment for potential confounding variables, McDonagh et al (2000a) showed in their systematic review that the introduction of water fluoridation into an area significantly increased the proportion of caries-free children, and decreased mean dmft/DMFT scores compared with areas which were non-fluoridated over the same time period. The findings of McDonagh et al (2000a) also suggest that cessation of fluoridation resulting in a narrowing of the difference in caries prevalence between the fluoridated and non-fluoridated populations. Only one additional relevant original study was identified in the current review and this did not change the conclusion of the existing systematic review.”

The summary of key findings are as follows:

- 1) Increase in the percentage of caries-free children with fluoridation- 14.3%
- 2) Number needed to treat to prevent one additional person developing caries- 6 people
- 3) Change in dmft/DMFT between fluoridated and non-fluoridated communities- 2.61 teeth

Review of the 22 articles from the 2007-2010 Medline search:

- No new evidence to counter the findings above.
- Several review articles and systematic reviews support the findings.

2) Does water fluoridation cause harm? What are the risks?

Selected Key Results from “National Health and Medical Research Council, A Systematic Review of the Efficacy and Safety of Water Fluoridation, Australian Government 2007. (for complete review- please see <http://www.nhmrc.gov.au/publications/synopses/eh41syn.htm>)

“Research question: *Does intentional water fluoridation result in dental fluorosis over and above no intentional water fluoridation?*”

5.2.1.1. Identification of relevant studies

The literature search identified 86 citations related to water fluoridation and fluorosis. From these, two systematic reviews were identified (3 citations). The review by McDonagh et al (2000a) was considered to be the most comprehensive, and as such was chosen to form the basis of this section. Therefore, the search for original studies was conducted for the period 2000- 2007 to identify studies not included in the McDonagh review. To be included, studies had to meet similar criteria as that required in the McDonagh review, as well as an additional criterion for this review. The inclusion criteria were: (i) the study had to compare groups with different fluoridation levels and (ii) the different levels of fluoridation had to include at least one low fluoride region (ie, < 0.4 ppm fluoride) and one optimal fluoride region (ie, 0.8 to 1.2 ppm fluoride). Following assessment of the identified citations, 10 cross-sectional original studies were included. No higher level studies (ie, RCTs, cohort studies or case-control studies) were identified.

5.2.1.2. Systematic reviews

The literature search identified two systematic reviews which examined the effect of water fluoridation on the development of dental fluorosis. The review by Khan et al (2005) aimed to determine trends in the prevalence of fluorosis at different water fluoride levels: ≤ 0.3 ppm (non-fluoridated), 0.3 to ≤ 0.7 ppm (intermediate) and > 0.7 to ≤ 1.4 ppm (fluoridated). A literature search was conducted between 1980 and 2000 and studies were eligible for inclusion if they met the following criteria: included subjects aged 0-19 (population or school samples); lifelong residents of the area, or have spend the first seven years in the area; be in an area with water fluoride up to 1.4 ppm; have a specified sample size; and report on fluorosis using any index. Fifty-five publications were included in the review. After quality assessment, this review was considered to be of poor methodological quality.

One of the aims of the review by McDonagh et al (2000a) was to examine whether water fluoridation has any negative effects. One of the negative effects assessed was dental fluorosis. Studies were considered for inclusion in this review if they considered fluoride within the water supply up to 5 ppm and involved two groups with different water concentrations. The literature search was conducted up until 2000. A total of 88 studies were considered relevant to the review, including four before-and-after studies, one case-control study and 83 single time-point cross-sectional studies. Two levels of dental fluorosis were assessed in the review: (i) ‘any fluorosis’ as defined by any fluorosis scale; and (ii) ‘fluorosis of aesthetic concern’, which was defined according to a previous study. In the McDonagh review, ‘fluorosis of aesthetic concern’ was defined as a score of ≥ 3 on the TF index, a Dean’s score of mild or worse, or a TSIF score of ≥ 2 . This review was considered to be of good methodological quality. As the best quality and most comprehensive of the two reviews, the McDonagh et al (2000a) review will form the basis of this section. The results will be divided into two sections: (i) assessing any level of fluorosis (‘any fluorosis’; and (ii) assessing levels of fluorosis considered to be of aesthetic concern ‘fluorosis of aesthetic concern’.

The results of the analysis of ‘any fluorosis’ conducted in the McDonagh review are shown in **Table 39**. These results show a significant relationship between level of water fluoride and fluorosis prevalence, with prevalence increasing with increasing fluoride concentration. Results of the multivariate analysis and univariate analysis were the same. It should be noted that apart from fluoride concentration, two other variables were also shown to be significantly related to fluorosis

prevalence: method of assessment (ie, clinical, photograph, both or not stated) and type of teeth (ie, primary, permanent, both or not stated).

Table 39 Water fluoridation: estimated proportion of the population with 'any fluorosis' (McDonagh et al, 2000)

Fluoride level (ppm)	Percent prevalence of fluorosis (95% CI)
0.1	15 (10, 22)
0.2	23 (17, 30)
0.4	33 (26, 41)
0.7	42 (34, 51)
1	48 (40, 57)
1.2	52 (43, 60)
2	61 (51, 69)
4	72 (62, 80)
<i>Univariate analysis</i>	<i>Odds 2.05 (1.75, 2.39)</i>
<i>Multivariate analysis^a</i>	<i>Odds 2.05 (1.77, 2.38)</i>

^a Adjusted for fluorosis index, average age, source of fluoridated water, mean altitude, average temperature, type of teeth, method of assessment, study location, water source, year of study report and study validity score.

A comparison of fluorosis prevalence at different fluoride levels (0.7, 1.0 and 1.2 ppm) with a reference level of 0.4 ppm was evaluated. These results (shown in **Table 42**) indicate that approximately six people would need to consume water fluoridated to a level of 1.0 ppm to result in one additional person with fluorosis.

Table 42 Water fluoridation: estimated difference in the proportion of the population with 'any fluorosis' and the NNH in fluoridated water vs low fluoride (McDonagh et al, 2000)

Fluoride level	Difference in proportions (95% CI)	NNH
0.7 ppm vs 0.4 ppm	9.3 (-1.9, 20.6)	11
1.0 ppm vs 0.4 ppm	15.7 (4.1, 27.2)	6
1.2 ppm vs 0.4 ppm	18.9 (7.2, 30.6)	5

The results of the analysis of 'fluorosis of aesthetic concern' conducted in the McDonagh review are shown in **Table 43**. These results also show a significant relationship between level of water fluoride and fluorosis prevalence. The results of the univariate analysis were similar to that of 'any fluorosis' with an odds ratio of 2.29 (95% CI 1.69, 3.12). In the multivariate analysis, four variables were found to be significantly associated with fluoride prevalence. These included fluoride level, method of assessment (ie, clinical or photographic), method of fluoridation (natural or artificial), and the interaction between fluoride level and method of fluoridation.

Table 43 Water fluoridation: estimated proportion of the population with 'fluorosis of aesthetic concern' (McDonagh et al, 2000)

Fluoride level (ppm)	Percent prevalence of fluorosis (95% CI)
0.1	6.3 (3.2, 12.4)
0.2	6.9 (3.5, 13.1)
0.4	8.2 (4.2, 14.9)
0.7	10.0 (5.0, 17.9)
1	12.5 (7.0, 21.5)
1.2	14.5 (8.2, 24.4)
2	24.7 (14.3, 39.4)
4	63.4 (37.9, 83)
<i>Univariate analysis</i>	<i>Odds 2.29 (1.69, 3.12)</i>

* Adjusted for fluorosis index, average age, source of fluoridated water, mean altitude, average temperature, type of teeth, method of assessment, study location, water source, year of study report and study validity score.

A comparison of fluorosis prevalence at different fluoride levels (0.7, 1.0 and 1.2 ppm) with a reference level of 0.4 ppm was evaluated. These results (shown in **Table 45**) indicate that an increase in water fluoride level from 0.4 ppm to 1.0 ppm would lead to one additional person with fluorosis of aesthetic concern for every 22 people consuming fluoridated water. However, it should be noted that as the confidence interval includes zero, there is the potential that there is no increased risk.

Table 45 Water fluoridation: estimated difference in the proportion of the population with 'fluorosis of aesthetic concern' and the NNH in fluoridated water vs low fluoride (McDonagh et al, 2000)

Fluoride level	Difference in proportions (95% CI)	NNH
0.7 ppm vs 0.4 ppm	2.0 (-6, 10)	50
1.0 ppm vs 0.4 ppm	4.5 (-4.5, 13.6)	22
1.2 ppm vs 0.4 ppm	6.5 (-3.3, 16.2)	15

Summary

Research question: *Does intentional water fluoridation result in dental fluorosis over and above no intentional water fluoridation?*

There is consistent Level III/IV evidence from existing systematic reviews that water fluoridation results in the development of dental fluorosis. However, the majority of dental fluorosis is mild and is not considered to be of 'aesthetic concern'. The number needed to harm (NNH) with water fluoridation at an optimal level compared with no fluoridation to get one additional person with 'any fluorosis' is approximately 6. The corresponding NNH to get one additional person with 'fluorosis of aesthetic concern' is approximately 22. Meta-analysis of additional original studies provides results consistent with those seen in the existing systematic reviews."

The summary of key findings is as follows:

- 1) Percentage all fluorosis at 1.0 ppm- 48%
- 2) NNH with water fluoridation to get one additional person with any fluorosis- 6
- 3) Percentage 'aesthetic' fluorosis at 1.0 ppm- 12.5%
- 4) NNH with water fluoridation to get one additional person with 'aesthetic' fluorosis- 22

“Research question: *Does intentional water fluoridation result in fracture over and above no intentional water fluoridation?*”

5.3.1.1. Identification of relevant studies

The literature search identified 20 potentially relevant citations which examined the possible association between water fluoridation and fracture. Of these, four citations related to three systematic reviews. The review by McDonagh et al (2000a) was chosen to form the basis of this section. As such, the aim was to identify original studies published between 2000 and 2007. An additional 3 original studies were identified.

5.3.1.2. Systematic reviews

Table 56 Systematic reviews of the effect of water fluoridation on fracture

Citation Level of Evidence Study Quality	Number and type of included studies	Intervention	Comparator	Outcomes
Jones et al (1999) Level III/IV Fair/good	21 observational studies (10 ecological, 11 cross-sectional and 3 cohort)	Water fluoridation	Lower level of water fluoridation (generally but not always no fluoridation)	Fracture (also BMD and diagnosis of osteoporosis)
McDonagh et al (2000a,b) Level III/IV Good	27 studies (4 prospective cohort, 6 retrospective cohort, 15 ecological, 1 case-control, 1 case-control & ecological). 2 other studies were excluded from analyses.	Water fluoridation (or level nearest to 1 ppm)	No water fluoridation (or lowest water fluoride level)	Fracture
Demos et al (2001) Level III/IV Poor	27 human studies (6 ecological, 4 cross-sectional, 1 ecological & cross-sectional, 3 cohort, 12 clinical trials, 1 case-control)	Water fluoridation (also fluoride for osteoporosis treatment but not included here)	Non-fluoridation of low concentration	Fracture (also BMD and bone strength)

The review by Jones et al (1999) aimed to determine whether water fluoridation is associated with altered fracture risk at the population level. Broadly speaking they included studies that had compared fluoridation with no fluoridation, although some of the studies included fluoridation up to 4 or 5 ppm (higher than recommended with intentional water fluoridation). A literature search was conducted covering 1966 to Nov 1997. Only English language papers were included, but other inclusion and exclusion criteria were not explicitly stated. After quality assessment, this systematic review was considered to be of fair/good methodological quality. The pooled results of the included studies lead to a relative risk of 1.02 (95%CI 0.96–1.09) indicating no effect of fluoride upon fracture risk, although there was considerable heterogeneity between studies. The authors concluded that water fluoridation at levels aimed at preventing dental caries, and possibly at somewhat higher naturally occurring levels, appears to have little effect on fracture risk - either protective or deleterious.

The review by Demos et al (2001) did not state a specific research question, however reviewed papers published since the 1991 NHMRC report, up to December 1998. Only English language papers were included. Both animal (n=6) and human studies (n=27) were included, however only human results are discussed here. Twelve of the studies related to the therapeutic use of fluoride in patients with osteoporosis, not a subject of the current review. After quality assessment, this systematic review was considered to be of poor methodological quality. Data were not formally pooled. The authors conclude that the studies indicate that the addition of fluoride to drinking water

at level of approximately 1 ppm, does not increase the incidence of fracture or decrease BMD, when compared to drinking unfluoridated water. The authors suggest that the body of epidemiological evidence suggests either no association or a slight beneficial effect of water fluoridation upon bone strength, bone density and fracture risk.

One of the aims of the review by McDonagh et al (2000a) was to examine whether water fluoridation has any negative effects, including upon bone, specifically fracture. Studies were considered for inclusion in this review if they reported data for two different levels of fluoride, one of which was indicative of a population receiving non-fluoridated water. The literature search was conducted up until 2000. A total of 29 studies were considered relevant to the review. This included four prospective cohort studies, six retrospective cohort studies, fifteen ecological investigations, one case-control study, and one study that was both case-control & ecological that were ultimately included in the analyses. Two studies were excluded from analyses (one because the control group fluoride level was more similar to a intentional water fluoridation level, and the other as it was only available in abstract form. This review was considered to be of good methodological quality. As the best quality and most comprehensive of the three systematic reviews, the McDonagh et al (2000a) review will form the basis of this section. Eighteen studies investigated the association between water fluoridation and hip fracture. When subgroups of men, women or both were considered, a total of 30 analyses were presented. Five individual analyses showed a statistically significant protective effect, four found a statistically significant harmful effect and the remaining 21 studies found no effect. A univariate analysis that included no adjustment for covariates was undertaken by the authors. This analysis (analogous to a standard meta-analysis) resulted in a pooled estimate of 1.00 (95%CI, 0.94– 1.06), however the between studies heterogeneity was statistically significant. A multi-variate analysis indicated that the duration of the study has the potential to influence the relationship between fluoridation and fracture.

Summary

Research question: *Does intentional water fluoridation result in fracture over and above no intentional water fluoridation?*

The authors of the three existing systematic review concur that water fluoridation at levels aimed at preventing dental caries has little effect on fracture risk - either protective or deleterious. The results of the subsequent original studies support this conclusion, although suggest that optimal fluoridation levels of 1 ppm may indeed result in a lower risk of fracture when compared to excessively high levels (well beyond those experienced in Australia). One study also indicated that optimal fluoridation levels may also lower overall fracture risk when compared to no fluoridation (the latter was not the case when hip fractures were considered in isolation)."

The summary of key findings are as follows:

- 1) One systematic review showed a relative risk of 1.02 or virtually no effect of fluoride on fracture.
- 2) One systematic review showed mixed results with a relative risk of 1.00- no effect.

“Research question: *Does intentional water fluoridation increase the risk of cancer over and above no intentional water fluoridation?*

5.4.1.1. Identification of relevant studies

The literature search identified six potentially relevant citations assessing the association between water fluoridation and cancer. Of these, one was a systematic review by McDonagh et al (2000a). As

the McDonagh review was to form the basis of this section, only original studies published from 2000-2007 were to be included. One study was excluded as it was published prior to 2000, resulting in five included original studies.

5.4.1.2. Systematic reviews

The literature search identified one systematic review that examined the effect of water fluoridation on cancer incidence and mortality. The review by McDonagh et al (2000a) examined a total of 26 studies. For the cancer outcome, the McDonagh review included studies that compared a non-fluoridated control area with an area (or areas) with fluoridation of any level, ie, natural or artificial. Therefore in many cases the included studies related to fluoridation levels many times the optimal level for intentional water fluoridation. The review included 10 before and after studies, 11 ecological studies, and 3 case-control studies. A further two studies were not included in the analyses because they had mixed control groups (ie, not entirely unfluoridated control areas). The included studies were generally of poor quality (5 moderate quality, 21 low quality evidence). None of the included studies involved prospective follow-up or reported any form of blinding. The McDonagh review focuses on the outcomes for all-cause cancer, bone cancer and thyroid cancer.

The authors conclude that there is no clear association between water fluoridation and overall cancer incidence or mortality (for 'all cause' cancer). When considering all of the analyses, 11 found the direction of the association to be positive (fewer cancers with fluoridation), 2 found no association, and 9 found the direction to be negative (more cancers with fluoridation). Only two studies reported statistically significant associations - one study reporting a *decrease* in cancer mortality (Smith et al, 1980) and one reporting an *increase* in cancer incidence in two of the eight subgroups they investigated (Lynch et al, 1985). The McDonagh review also discusses in more detail the controversy surrounding various published analyses of data from the same set of US cities (10 fluoridated and 10 non-fluoridated). These data have been published by at least four authors. All of the studies used a before and after study design, simply comparing cancer incidence or mortality before and after the introduction of water fluoridation in half of the cities. McDonagh et al report that the original US study by Yiamouyiannis in 1977 found an association between fluoridation and cancer incidence that suggested more cancers, however this study did not take into account demographic differences between the cities at baseline and across the time period of interest. For example, the proportion of the population who were non-white and over 65 years of age increased more rapidly in the fluoridated areas - which may have contributed to the increased cancer incidence. When the later studies standardised for age, gender and ethnic group, there was no association between fluoride and cancer mortality. The study with the highest validity and corrected data (Smith et al, 1980) was included by the McDonagh reviewer in their main analyses (see above). This study showed a mean difference in the change in SMRs of -4.4 (95%CI -7.5, -1.3). As discussed above, the results of this study indicate a statistically significant protective effect. This comparison of publications relating to essentially the same dataset, reiterates the importance of controlling for potential confounding factors.

With respect to bone cancer generally, the results show the direction of the association to be positive (fewer cancers) in three analyses, no association in one analyses, and negative in four analyses. None found a statistically significant relationship.

With respect to osteosarcoma specifically, the direction of the association was positive (fewer cancers) in seven analyses, no association in two, and negative (more cancers) in three analyses. One study reported a statistically significant result - Cohn et al, 1992 reported a statistically significant

increased prevalence of osteosarcoma in males. However, this study had the lowest validity score (2.5 out of 8). The study was based on census data comparing crude osteosarcoma rates from areas where >85% or <10% of the population received fluoridated water - although there is no information regarding the level of fluoridation. There was no correction for confounding factors, although the results are presented in age and gender categories. The McDonagh review included two studies that investigated the impact of water fluoridation upon thyroid cancer. Both of these studies indicated a lack of association between fluoride and thyroid cancer. In summary, McDonagh et al (2000a) conclude that the evidence relating fluoridation to cancer incidence or mortality is mixed, with small variations on either side of the effect.

Summary

Research question: *Does intentional water fluoridation increase the risk of cancer over and above no intentional water fluoridation?*

The existing systematic review by McDonagh et al (2000a) concluded that there is no clear association between water fluoridation and overall cancer incidence or mortality (for 'all cause' cancer, and specifically for bone cancer and osteosarcoma). The authors state that the evidence relating fluoridation to cancer incidence or mortality is mixed, with small variations on either side of the effect. The current literature review identified four additional studies that investigated the relationship between water fluoridation and cancer incidence or mortality, including three Level IV ecological studies and one Level II-3 matched case-control study (Bassin et al, 2006). The latter study compares the fluoride exposure of histologically-confirmed osteosarcoma cases with that of matched controls - a sub-set of patients from a larger case-control study initiated by the Harvard School of Dental Medicine that is yet to report its findings. After adjusting for significant differences at baseline between the cases and controls, the results of Bassin et al (2006) suggest an increased risk of osteosarcoma amongst young males (but not females) with water fluoridation. However, the attention of the reader is drawn to a Letter to the Editor by co- investigators of Bassin in which the letter authors point out that they have not been able to replicate these findings in the broader Harvard study, that included prospective cases from the same 11 hospitals. Furthermore, the bone samples that were taken in the broader study corroborate a *lack* of association between the fluoride content in drinking water and osteosarcoma in the new cases. The final publication of the full study is not yet available, and the authors of the Letter caution readers not to over-interpret the results of Bassin and colleagues in the interim."

The summary of the key findings is as follows:

- 1) There is mixed evidence with small variations on either side of the effect.
- 2) There is no clear association between cancer and water fluoridation.

Statement from Canadian Cancer Society

http://www.cancer.ca/Canada-wide/Prevention/Whats%20being%20studied/Water%20fluoridation.aspx?sc_lang=en

“Fluoride and cancer: the evidence

While decades of research have shown that water fluoridation helps to prevent tooth decay, there is also a smaller and significantly weaker body of scientific evidence about a potential relationship between exposure to high levels of fluoride in drinking water and cancer, particularly osteosarcoma in boys younger than 19. Osteosarcoma is a type of rare [bone cancer](#). According to [Canadian Cancer Statistics](#), 170 cases of osteosarcoma were reported in between 1997 and 2001, an average of

34 cases per year. Numerous studies have shown no link between water fluoridation and an increased risk of osteosarcoma in either humans or rats. For example, the United States Food and Drug Administration evaluated the incidence of bone cancer for the period 1958-1987, using 40 international cancer registries. No relationship was observed between water fluoridation and bone cancer incidence. At least 7 additional studies, by groups including the Department of National Health and Welfare (now Health Canada), the Government of Canada, the United States Department of Health and Human Services and independent academic investigators have failed to observe a link between water fluoridation and the incidence of osteosarcoma.

However, a few studies have suggested a possible link. For example, a study on rats and mice conducted in 1990 by the National Toxicology Program of the United States found uncertain evidence that exposure to very high levels of fluoride in drinking water (100 or 175 parts per million, or milligrams per litre) increases the risk of osteosarcoma in male rats, but not in female rats or in male or female mice. However, subsequent studies have not confirmed this observation. Instead, the National Toxicology Program recently performed this experiment again using even higher levels of fluoride in drinking water (200 parts per million, or 200 milligrams per litre) and found no increase in osteosarcoma. It is important to recognize that the rats in this study were drinking water fluoridated at 200 times the recommended level in Canada.

In human beings, some early research showed a link between water fluoridation and an increased risk of cancer. However, this relationship disappeared when researchers controlled for socio-economic differences. More recently, an analysis led by Dr EB Bassin showed an increased risk of osteosarcoma in young boys (ages 6-8) consuming water that met the target level for fluoridation, relative to boys who consumed water containing 70% less fluoride. No such effect was observed in girls. The authors of the Bassin article acknowledge that their work has limitations, including a small number of study participants and potential misclassification. They admit that further research is needed to confirm their exploratory analysis.

The Bassin article is a preliminary analysis of 15-year effort to study fluoride and osteosarcoma by the Harvard School of Dental Medicine and collaborating organizations. The study's principal investigator, Dr CW Douglass, is currently analyzing data gathered over a longer time period than was used in the Bassin article, providing a larger sample size. Dr Douglass reports that his study has not found the same association reported by Dr Bassin. Publication of his results will provide important further information as to whether and to what extent an association may exist between osteosarcoma and exposure to fluoride.

In May 2009, the California Environmental Protection Agency announced that they would be evaluating the cancer risks associated with fluoride consumption. This review has been designated as a high priority.

The Canadian Cancer Society will continue to monitor this issue and inform Canadians about the health impacts of the fluoride in their drinking water. At this time, the weight of the scientific evidence, as assessed by independent committees of experts and analysis of the findings of individual and combined studies does not support an association between water fluoridated at levels optimal for health and the risk for cancer, including osteosarcoma.

Our position

The Canadian Cancer Society recognizes the importance of weighing the possible risks and the benefits for complex issues. On the basis of current evidence, it appears unlikely that water fluoridation increases the risk of osteosarcoma in humans. At the same time, the health benefits of water fluoridation have been proven, especially for people who have less access to dental care. As new research on the health impacts of water fluoridation becomes available, the Canadian Cancer Society will evaluate it thoroughly and keep Canadians informed.

We urge the governments of Canada to make sure people are aware of the fluoride levels in their drinking water and of any steps they need to take to avoid negative health impacts. We also ask government agencies to work together to ensure that fluoride in drinking water is reduced to the lowest level required to optimize its health benefit.”

“Research question: *Is intentional water fluoridation associated with other adverse effects over and above no intentional water fluoridation?*”

5.5.1.1. Identification of relevant studies

The literature search identified 12 citations potentially related to other harms of water fluoridation. Of these, two were systematic reviews. As the most comprehensive of these reviews (McDonagh et al, 2000) was conducted in 2000, the search of additional original studies encompassed the period 2000-2007.

5.5.1.2. Systematic reviews

The literature search identified two systematic reviews of other potentially negative effects of water fluoridation. One of these covered any other negative effects (other than fluorosis, fracture and cancer (McDonagh et al, 2000; Level III/IV), whilst the other focused upon Down's syndrome (Whiting et al, 2001; Level IV).

The McDonagh systematic review investigated whether water fluoridation was associated with other negative effects. They included 25 studies comprising six before and after studies, one retrospective cohort study, 12 ecological studies, five cross-sectional studies, and one case control study. They also briefly report on an additional eight studies that met the inclusion criteria but were not included in the main analyses for various methodological reasons. The quality of the studies was low, with all studies assigned the lowest level of evidence by the reviewers. None of the studies had a prospective follow-up and none incorporated any form of blinding. The results are presented in **Table 62**. Where studies reported an adjusted measure, this is presented. For studies reporting a difference measure (eg. mean difference) a negative result suggests a benefit of fluoridation and a positive result suggests harm. For ratio measurements, a ratio less than one suggests a benefit whilst a ratio greater than one suggests harm.

Table 62 Other potential harms of water fluoridation (McDonagh et al, 2000)

Citation	Outcome	Age	Sex	Summary measure	Results (95% CI)	Validity Score
Forbes (1997)	Alzheimer's disease Impaired mental functioning	76	Both	Adjusted odds ratio	1.22 (1.0–1.5) 0.49 (0.3–0.9)	4.0
Still (1980)	Primary degenerative dementia	55+	Both	Crude RR	0.18	3.0
Jacqmin-Gadda (1994)	Cognitive impairment	≥ 65	Both	Crude RR	0.93	4.5
Griffith (1963)	Anaemia during pregnancy	Not stated	Women	Rate difference	2.03 (-5.0–9.0)	2.3
Farkas (1983)	Age at menarche	7–18	Girls	Mean difference	0	1.5
Erickson (1976)	Congenital malformations		Both	Crude RR	1.08 (p>0.05) 0.95 (p<0.05) 1.16 (p>1.05) 0.96 (p>0.05)	3.5
Erickson (1980)	Down's syndrome Congenital malformations		Both	Crude RR	1.00 (0.9–1.1) 0.93 (0.7–1.2)	3.5
Berry (1958)	Down's syndrome		Both	Crude RR	0.84–1.48	1.8
Needleman (1974)	Down's syndrome		Both	Crude RR	1.14	2.0
Rapaport (1957) ^a	Down's syndrome		Both	Crude RR	1.5 2.3 2.2 2.2	2.0
Rapaport (1963)	Down's syndrome Infant mortality		Both	Crude RR	3.0 1.3	2.0
Dick (1999)	Sudden infant death syndrome	Not stated	Both	Odds ratio	1.19 (0.8–1.7)	7 (of 9)
Overton (1954)	Infant mortality		Both	Difference in RR	0.06	2.8
Erickson (1978)	Mortality	All	Both	Adjusted rate-ratio	1.01	3.8
Hagan (1954)	Mortality	Not stated	Both	Adjusted rate-ratio	1.01	3.5
Rogot (1978)	Mortality	Not stated	Both	Difference in RR	0	4.1
Schatz (1976) ^b	Mortality Infant Mortality	Not stated	Both	Difference in RR	-0.1 0.5	2.8
Weaver (1944)	Mortality	Not stated	Both	Difference in RR	0	1.8
Zhao (1996)	IQ	7–14	Both	Mean difference	-7.7	2.5
Lin (1991)	IQ Mental retardation	7–14	Not stated	Mean difference Crude RR	-6 1.6 (1.15–2.34)	1.5
Jolly (1971)	Skeletal fluorosis	Not stated	Both	Prevalence	Increased prevalence of skeletal fluorosis at higher fluoride concentrations	2.7
Gedalia (1963)	Goitre	7–18	Female	Crude RR	0.16–1.80	2.5
Jooste (1999)	Goitre	6, 12 & 15	Both	Crude RR	0.3–1.2	1.8
Lin (1991)	Goitre	7–14	Not stated	Crude RR	1.11 (1.04–1.20)	1.5

^a Multiple areas studied.

^b Briner (1966) reported data from the same areas and some of the same years but is not presented here because Schatz reported more years and included infant mortality.

Only three of the studies showed a statistically significant result. Forbes (1997) found a significant negative effect of water fluoride on Alzheimer's disease (increased incidence) but a significant positive effect on impaired mental functioning (decreased incidence). Erickson (1976) found a positive association with congenital malformations in one of two sets of data but not in the other. Lin (1991) found a significant negative association of combined low iodine and high fluoride with goitre and mental retardation.

All of the studies investigating other possible negative effects used study designs that measured population level fluoride exposure, rather than individual level exposure. Because of this they are susceptible to confounding by exposure. If the populations differ in other respects, that may influence the outcome measure in question, then confounding is likely. As a result, these studies represent low level and poor quality evidence. In summary, the authors conclude that the studies examining other possible negative effects provide insufficient evidence on any particular outcome to reach a conclusion.

The systematic review of Whiting et al (2001) was commissioned by the UK Department of Health to investigate whether water fluoridation had any impact upon the incidence of Down's syndrome.

six ecological studies were included in the review, all with low validity scores. The studies were published between 1957 and 1980. None of the studies had prospective follow-up, incorporated blinding, had a baseline survey or stated how the level of water fluoride was calculated. Confounding factors such as maternal age and race were discussed in most papers but only adjusted for in the studies of Erickson. The reviewers conclude that the evidence for an association between water fluoride level and the incidence of Down's syndrome is weak, and that all the identified studies were of poor quality, in particular the older studies of Rapaport (1957 and 1963) that reported a significant association.

Summary

Research question: *Is intentional water fluoridation associated with other adverse effects over and above no intentional water fluoridation?*

The authors of previous systematic reviews concluded that the studies examining other possible negative effects of water fluoridation provide insufficient evidence to reach a conclusion.”

Review of the 26 articles from the 2007-2010 Medline search:

- 19 articles added support to the evidence that exposure to water fluoridation contributes to higher levels of dental fluorosis.
- 7 articles related to health impacts of fluoridation and would need to be added to the overall body of evidence giving equivocal reports on harm.

3) Is it ethical to fluoridate public water supplies?

This argument has been discussed in a number of articles weighing the merits of a population intervention such as fluoridation against rights of individuals. There are logical and sound arguments on both sides of the fluoridation debate however both sides base their arguments and operate on presumptions related to the validity of the scientific evidence for either benefit or harm of fluoridation. The acceptance of either side of the ethical argument is based on an acceptance or dismissal of those foundational scientific evidences related to the effectiveness and safety of fluoridation and makes it difficult for principles such as beneficence, autonomy and weighing of individual vs. population rights to be adequately discussed when agreement on the science is not obtained. It would appear that either side of this debate will be able to argue their point using ethical reasoning as long as the science is viewed to be less than definitive. The following are excerpts from a number of articles that highlight the two sides of this argument:

1) Coggon D, Cooper C. Fluoridation of water supplies. *British Medical Journal* 1999, 319: 269-270.

Key Points:

- If we infringe on personal liberty in the interests of public health we must be confident benefits outweigh risks.
- Those who most benefit are not those most at risk for side effects by the intervention.
- Highlights need for lay people to understand the science, calling for clear communication from scientists and responsible journalism.

“Fluoridation raises ethical issues because it can be viewed as an infringement of personal liberty: individuals have no choice in the water that they use— unless they buy expensive bottled water.

There are circumstances in which it is considered acceptable to impose measures on a population in the interests of public health (as with the use of seat belts), but to justify such action we must be more confident that benefits outweigh risks than when the individual is free to opt out. A further complication arises because the people who would benefit most from fluoridation (deprived children) are not necessarily those who would be put at most risk by the intervention (people with high intakes of fluoride from other sources). Again, it is accepted that sometimes one section of society may reasonably be disadvantaged for the benefit of another (as with restrictions on driving in people with epilepsy), but where the balance is drawn is arguable. Because of these ethical issues decisions about fluoridation must take account of public opinion, but before lay people can make a meaningful contribution to the debate they need an understanding of the science. This is difficult because inevitably there are uncertainties, and the evaluation of the scientific evidence is to some extent subjective. Often the media are more interested in highlighting disagreement and controversy than in establishing the extent of consensus, and this leads to confusion and distrust. The government's new review will again bring the arguments for and against fluoridation to the fore. The best hopes for constructive discussion will lie in clear communication from scientists and responsible journalism."

2) Calgary Herald April 6, 2009

Dr. Tom Feasby, Dean, & Dr. Tom Noseworthy, Head, Department of Community Medicine, Faculty of Medicine, University of Calgary

Key Points:

- Fluoridation is a population-level intervention similar to many others designed to benefit the public good.
- Although gaining the right to individual choice is important, no evidence exists to support they will receive a gain in health while others will lose out on a potential benefit to their health.
- Toxicity of any agent is related to dose. Many of the other chemicals used in water and food and healthcare would similarly be toxic in excessive doses. The dose of water fluoridation is well below toxicity levels.

"This public health issue has recycled around the world since the introduction of water fluoridation treatments in the 1940's. Like so many other public health issues, this one is polarized and argued as an issue of the "public good" versus "individual rights." Many other examples exist—iodide in salt, B vitamins in flour, iron in infant formula. Beyond such examples are vaccinations for communicable diseases—demonstrating another recent public health controversy in relation to human papilloma virus vaccination to reduce cancer of the cervix.

These examples are population-level interventions; they are not treating one patient at a time. Understandably some individuals oppose the imposition of any measure upon themselves, without their consent. In a world of absolute self-determination they are, of course, right. But in this world we might ask, who stands to gain the most and who loses if we remove fluoride from water? Those who gain are the anti-fluoride advocates. They gain the right to individual choice—important indeed! However, no evidence exists to support the proposition that they will also receive a gain in their health. Regrettably, those who lose are often children without access to good nutrition, let alone a dentist. Similarly affected are the poor. We might ask our parents or grand-parents what it was like before fluoridation and imagine what it could be like for the young and poor today, albeit

there is now fluoride in some toothpastes. Not helpful if you do not use or own a toothbrush. For most of us, we would simply have to visit the dentist more often for cavities and fillings.

Another argument used by anti-fluoridationists is that fluoride is a toxic chemical and therefore a poison. So too then is chlorine in water and iodide in salt. In fact, warfarin, a commonly used blood thinner for many human conditions is also used as a rat poison. The issue here is not the substance but the dose. Even vitamin C can be toxic in high doses. In fact, it's been said that if you eat enough lettuce you can get fat. Dose matters. Fluoride in the correct dose, minute quantities in our water, is far more beneficial than harmful.

Food and water fortification, and measures to protect the public's health, must strike the right balance with individual's rights. In the case of fluoride, we believe that the evidence in support for public water fluoridation far outweighs the evidence against. Also in support of this position is the World Health Organization, the U.S. Centers for Disease Control (CDC), the American Public Health Association and the Canadian Dental Association, to name a few. To remove fluoride from Calgary's water would be a big step backward for public health."

3) John Harris, B.A., D.Phil, Centre for Social Ethics & Policy, University of Manchester
ADA Updater, June 1998

Key Points:

- Evidence supports the benefit and safety of fluoridation.
- Those who oppose fluoridation are depriving benefit to the community for the sake of their personal preference.
- The right to a fluoride free water source is not a basic civil right. Not all constraints on free choice are constraints on liberty.
- We must consider whether those espousing the right to fluoride free water should be able to impose the risks, damages and costs of failure to fluoridate on the community at large.

"The issue of the ethics of fluoridation seems to me to be both simple and straightforward. The issue depends on establishing that fluoridation is both harmless and beneficial. Relying on the evidence from a number of sources there is no reason to suppose that fluoridation of the public water supply to the level of one part per million that is envisaged, is anything but safe. If this is right, then the issue is clear. Those who object to it are in the position of depriving the community of a benefit at no cost to themselves, save that of having their personal preference frustrated. Now to this it might be replied that if personal liberty is to mean anything at all, then the community must be prepared to accept some cost in order to protect it.

But the right to have access to a fluoride free water supply is not a basic civil right. It is not a right of importance comparable to free speech, freedom of assembly, or equal protection before the law. It is not a right, which is needed in order to secure an individual's entitlement to the protection of his human dignity and standing as a citizen, or to protect his entitlement to the same concern and respect as is accorded any other citizen. Neither is it a right required in order to secure access to the political process, or in order to prevent injustice or one which affects an individual's ability to make autonomous choices or to pursue their own chosen goals and objectives in their own way. In short, not all constraints on free choice are constraints on liberty. The good citizens of Hartlepool are not less free than those of Manchester because they have naturally occurring fluoride in their water

supply. They do not have fewer civil rights in consequence than do the people of Wigan. Indeed if this were so, if they did have fewer rights it would be a major priority to remove the naturally occurring fluoride from the water supply of Hartlepool or to provide them with alternative sources of water.

In considering the ethics of fluoridation one might legitimately reverse the question and ask if fellow citizens are entitled to impose, not only a disadvantage on the community at large, but impose actual deaths and the risk of death on children for the sake of a minor diminution in the range of choices available? We should ask not are we entitled to impose fluoridation on unwilling people but are the unwilling people entitled to impose the risks, damage and costs of failure to fluoridate on the community at large. When we compare the freedoms at stake, the crucial is surely the one which involves liberation from pain and disease.

To take one example only, in the course of their dental care, 32,000 general anaesthetics were provided in the North Western Health Region to children under 10 in 1985 alone and in the five years to 1988 at least four children have died in the region under anaesthetic. If it is true that fluoridation would halve the incidence of decay, and hence then need for extractions and anaesthetics, then drinking the waters of Hartlepool is a small price to pay to save the lives of even one or two children, let alone the massive misery and waste of resources caused by dental caries.”

4) McNally M, Downie J. The Ethics of water fluoridation. *J Can Dent Assoc* 2000; 66:592-3.

Key Points:

- Current evidence supports physical benefits of fluoridation outweigh harms. Attention should however, be paid to harms and research supported to continue to determine effects of fluoridation.
- Economic benefits accrue to individuals and communities, especially noted as dental care is often not included in publicly-funded healthcare.
- Restriction of some individual rights is defensible on the basis of benefit to vulnerable groups of the population.
- Canadian society has established a core set of values that accept that some public policies must put the common good above the desires of some individuals.
- We need to consider an important yet frequently ignored question: “In debates about fluoridation, are you hearing the voices of the vulnerable? A great deal of concern has been expressed by contemporary health care ethicists about health policies being made without consideration of the interests and desires of members of society who do not have a voice.

“Water fluoridation is known to be one of the greatest public health and disease-preventive measures of all time. Its greatest documented benefit is that, by reducing caries, tooth structure is preserved and much pain, infection, tooth loss and restorative treatments are prevented. Water fluoridation protects everyone and is easy to deliver, safe, equitable, and economically efficient. However, concerns have been raised about the potential harm of water fluoridation. It is possible that fluoridation is causing an increase in prevalence of fluorosis and, it is argued, this is a reason not to support fluoridation. It has also been suggested that fluoride may be an environmental pollutant and may contribute to “multiple chemical sensitivities” syndrome, although these observations are largely anecdotal and are not well documented in the scientific literature. We would conclude, on the basis of the evidence currently available, that the physical benefits of fluoridation outweigh the harms. However, we would also argue that attention should be paid to the potential harms, and that

research should be supported to determine the effect of fluoridation on fluorosis, the health consequences of fluorosis, the impact of fluoridation on the environment, and the effect of fluoridation on multiple chemical sensitivities syndrome.

There are considerable economic benefits associated with water fluoridation. By reducing caries, water fluoridation minimizes the need for restorative dental treatment and thus has an enormous impact on lifetime oral health utilization costs. This is a particularly important benefit for Canadians since most oral health care services are not included in publicly funded health programs. Dental caries can result in serious and sometimes life-threatening infections requiring costly hospital and medical care. Fluoridation reduces these potential costs as well as costs for those provinces whose publicly funded health care system includes dental care for children, seniors and the poor. Concerns have been raised about the potential negative economic consequences of fluorosis, and the argument made that the economic benefits of water fluoridation may be over-estimated since restorative dental treatment may be needed to treat fluorosis. We would conclude that, without further evidence on the acceptability and restorative sequelae of fluorosis, the economic argument in support of fluoridation is stronger than the economic argument against it. However, in order to resolve the uncertainty around economic benefits and harms, research should be supported to compare the economic consequences of fluoridation and fluorosis.

It might be argued that restricting choice about the public source of drinking water is morally wrong because it violates the principle of respect for the autonomy of individuals by taking away their freedom to choose not to consume fluoride. It might also be argued that this violation of autonomy is indefensible given that the benefits of fluoride can be realized in other ways (i.e., those who wish to consume fluoride can rely on other sources such as supplements, fluoride mouth rinses and professionally applied fluorides). However, restricting choice for the entire population may be defended on the basis that it benefits vulnerable populations. Commercially available sources of fluoride and professional dental treatment are costly. Not everyone in society can afford these. Yet, regardless of education, socioeconomic status, age, race, or access to professional dental care, everyone can benefit from fluoride simply by drinking fluoridated water. When it is available in public water supplies, fluoride is no longer a discretionary commodity available only to those who are familiar with its benefits, can afford it and have access to it. When public policy supports fluoridation of water supplies, it is the most vulnerable in our society who benefit the most. The liberal individualist arguments against the involuntary medication of populations may initially seem compelling. However, Canadian society has established a core set of values which allow for the infringement of individual rights in certain instances. For example, mandatory vaccinations, fortification of foods with essential nutrients, and testing for certain genetic diseases at birth are accepted public health measures despite the fact that these measures can be seen as an infringement on individual rights. Although we are a society dominated by individual rights, Canadians accept that some public policies must put the common good above the desires of some individuals. Fluoridation of the water supply fits into this philosophical framework. For Canadians, improving oral health by reducing dental caries is a good. Economic benefit to both society and to individuals is a good. The protection of vulnerable populations is a valued good. It is on the basis of this good that we would argue that CDA (Canadian Dental Association) should continue to support water fluoridation. Before closing, we would challenge CDA members to consider an important yet frequently ignored question: "In debates about fluoridation, are you hearing the voices of the vulnerable?" When political arguments erupt between policy-makers, interest groups and oral health professionals, are the groups who are most vulnerable even part of the discussions? For good reason, there is a great

deal of concern being expressed by contemporary health care ethicists about health policies being made without consideration of the interests and desires of members of society who do not have a voice. When decisions are being made about public health policy, members of society who may be disadvantaged by a lack of education, resources and access to proper health care must be part of the discussions. It is not clear that they are when it comes to the issue of water fluoridation. CDA members should ensure that they seek out these voices before taking a final position on this issue.”

5) Nuffield Council on Bioethics, Public Health: ethical issues. Nov. 11, 2007 <http://www.nuffieldbioethics.org/sites/default/files/Public%20health%20-%20ethical%20issues.pdf>

Key Points:

- The evidence for harm and benefit is weak based on the York Review.
- The stewardship model justifies water fluoridation by reducing health inequities, reducing ill health and giving concern to a vulnerable group, children.
- Should seek to identify the situations in which this [addition of potentially beneficial substances to water] may be appropriate.
- The acceptability of any public health policy involving the water supply should be considered in relation to: (i) the balance of risks and benefits; (ii) the potential for alternatives that rank lower on the intervention ladder to achieve the same intended goals; and (iii) the role of consent where there are potential harms.
- Regional variations should determine through democratic processes the need for water fluoridation.
- Water fluoridation policies and evidence should be objectively reviewed and information disseminated should be accurate.

“Fluoride occurs naturally in the water supply in some regions, and it has been suggested that adding fluoride to the water supply more generally may reduce tooth decay. Water fluoridation schemes have been in place for over 50 years in parts of the UK and elsewhere. A major literature review published in 2000, the ‘York review’, found that there was evidence that water fluoridation improved the health of teeth although this benefit is difficult to quantify. The review also found evidence that ingesting fluoridated water could be associated with harms, in particular fluorosis. Overall, however, the evidence both for benefits and for harms was found to be weak (paragraphs 7.4–7.7, 7.31). This is somewhat surprising, given that fluoridation has been implemented as a policy option for several decades.

Three elements of the stewardship model could, in principle, be used to justify water fluoridation: the reduction of health inequalities; the reduction of ill health; and concern for children, who constitute a vulnerable group. Water fluoridation has the potential to contribute to these goals, particularly where the health need of a particular locality is high. However, three further ethical principles need also to be considered: minimising interventions that affect important areas of personal life; not coercing ordinary adults to lead healthy lives; and consent. The principles of avoiding coercive interventions and minimising interventions in personal life could be used to argue against the addition of any substance to the water supply. However, we do not accept that the addition of potentially beneficial substances to the water supply should always be prohibited. Rather, we seek to identify the situations in which this may be appropriate (paragraph 7.25). The acceptability of any public health policy involving the water supply should be considered in relation

to: (i) the balance of risks and benefits; (ii) the potential for alternatives that rank lower on the intervention ladder to achieve the same intended goals; and (iii) the role of consent where there are potential harms (paragraph 7.26).

Alternative fluoride-based interventions are in use in other parts of the world, including fluoride supplements and fluoridation of salt or milk, which rank lower than water fluoridation on the 'intervention ladder' (see paragraph 7.13, Box 7.4 and paragraphs 3.37–3.38). Their relative costs and benefits both to population health and individual liberty should be assessed when considering water fluoridation. With water fluoridation, a whole area either receives fluoridated water or does not. Populations do not remain static, as people move to and from an area. In practical terms it would therefore not be feasible to seek individual consent. In this situation it could be suggested either that the intervention never be implemented because individual consent cannot be obtained, or that an alternative approach to obtain mandate is used (paragraphs 2.22–2.25).

Both action (adding fluoride) and inaction (not adding it) might disadvantage some groups of people, either through limiting personal choice or through preventing individuals from receiving any health benefits of the measure. Overall the prevalence of caries has reduced considerably over recent decades, but inequalities between regions persist. Therefore, the extent to which people might be affected by these two options varies. The most appropriate way of deciding whether fluoride should be added to water supplies is to rely on democratic decision-making procedures. These should be implemented at the local and regional, rather than national level, because the need for, and perception of, water fluoridation varies in different areas. Account should be taken of relevant evidence, and of alternative ways of achieving the intended benefit in the area concerned. Whatever policy is adopted, dental health and any adverse effects of fluoridation should be monitored (paragraph 7.40).

Recommendation 20: The UK health departments should monitor the effects of water fluoridation, including the incidence and severity of fluorosis and other possible harms. Water fluoridation policy should be objectively reviewed by the UK health departments on a regular basis in light of the findings of ongoing monitoring and further research studies. Furthermore, the conclusions and their basis should routinely be published. (Paragraph 7.42) Information about the evidence is important in policy decisions, particularly where people are asked to vote or contribute to policy decisions. Neither the public nor policy makers are helped by information that makes it difficult for the non-expert to obtain a good understanding of current evidence (paragraphs 7.43–7.47).

Recommendation 21: All the groups involved in the fluoridation debate should ensure that the information they produce presents a balanced account of risks and benefits, and indicates accurately the strengths and weaknesses of the evidence base. (Paragraph 7.47) For contentious issues such as fluoridation, the media have a responsibility to report research findings accurately. In this context, we reiterate the earlier recommendation, made in relation to vaccination, about the reporting of research and how this should be conducted (see Recommendation 6 and paragraphs 4.33–4.35, 7.47).”

6) Cohen H, Locker D. The science and ethics of water fluoridation. *J Can Dent Assoc* 2001;67(10):578-80.

Key Points:

- There is an inherent conflict between beneficence and autonomy that does not appear to be able to be resolved in this argument.
- Which values concerning the conflict between beneficence and autonomy should inform decision making with respect to water fluoridation: those of health professionals or those of the community?
- Little evidence exists for effectiveness of water fluoridation currently.
- Truthfulness demands accurate portrayal of benefits and risks avoiding misleading percentage reductions in caries and characterizing fluorosis as only a cosmetic concern.
- The conventional view that these ethical dilemmas can be resolved by balancing the benefits and harms presumes that such a balance can be achieved. This view needs to be replaced by a moral account showing an appreciation for the ineradicability of the conflict of values that water fluoridation engenders.
- Past experience is not good enough and there is a need for current sound science upon which to work out sound ethics.

“Beneficence denotes the practice of good deeds and signifies an obligation to benefit others or seek their good. How this principle is put into practice depends on whose notion of good is applied. Health policy-makers and professionals, in advocating for the addition of fluoride to drinking water, are making moral decisions about the well-being of individuals and applying their own notions of good. If beneficent acts are to benefit the recipients of the actions, the basis for the goodness of the actions must lie in the values or preferences of autonomous, self-determining individuals. In practice, however, beneficent acts such as water fluoridation tend to be in conflict with autonomy. Since it is effectively impossible for individuals to opt out, fluoridation takes away the freedom to choose.

Advocates of water fluoridation argue that the benefits accruing to society through reductions in dental caries outweigh any harm to individual autonomy. Defenders of autonomy argue that fluoride is available from many sources, and so its benefits can be realized without violating the principle of autonomy. However, this presumes that everyone in society can access these alternative sources. The most vulnerable in society, it is countered, would surely miss out on the benefits of fluoride. Therefore, considering the benefit that accrues to disadvantaged groups in society, advocates of fluoridation contend that water supplies should be fluoridated on the grounds that everyone, regardless of socioeconomic status, can benefit. The claim here is that water fluoridation promotes social equity. This solution still leaves the conflict of beneficence and autonomy unresolved. In fact, there appears to be no escape from this conflict of values, which would exist even if water fluoridation involved benefits and no risks. However, water fluoridation does involve risks, in the form of increases in the prevalence and severity of dental fluorosis. Moreover, as Coggon and Cooper indicate, those most likely to benefit from water fluoridation are not necessarily those placed at most risk. This complicates considerably any attempt to balance beneficence and autonomy.

Advocates of water fluoridation, in seeking to strike a balance between competing values, are attempting to reconcile irreconcilables: the demands of moral autonomy cannot be made compatible with what could be regarded as the involuntary medication of populations. This situation gives rise to the question of which values concerning the conflict between beneficence and autonomy should

inform decision making with respect to water fluoridation: those of health professionals or those of the community?

An assessment of the ethics of water fluoridation must also take into account the moral issues surrounding scientific inquiry in order for health professionals to be justified in advising or compelling others how to act. This aspect pertains to the principle of truthfulness, whereby health professionals are obligated to tell their patients the truth, for one cannot influence the way others act without first being justified in one's own beliefs.

The conventional view is that policy-makers are presented with a clear moral choice when weighing the benefits and harms associated with water fluoridation. Historically this may have been the case. The original community trials of water fluoridation indicated a substantial effect. However, over the past 25 years there has been a marked reduction in rates of dental caries among children, such that the benefits of water fluoridation are no longer so clear. Although current studies indicate that water fluoridation continues to be beneficial, recent reviews have shown that the quality of the evidence provided by these studies is poor. In addition, studies that are more methodologically sound indicate that differences in rates of dental decay between optimally fluoridated and nonfluoridated child populations are small in absolute terms. Canadian studies of fluoridated and nonfluoridated communities provide little systematic evidence regarding the benefits to children of water fluoridation. Moreover, studies of the benefits to adults are largely absent, and there is little evidence that water fluoridation has reduced social inequalities in dental health.

Truthfulness entails a proper appraisal of the benefits and risks. Currently, the benefits of water fluoridation are exaggerated by the use of misleading measures of effect such as percent reductions. The risks are minimized by the characterization of dental fluorosis as a "cosmetic" problem. Yet a study of the psychosocial impact of fluorosis found that "10 to 17 year olds were able to recognize very mild and mild fluorosis and register changes in satisfaction with the colour and appearance of the teeth." The investigators also stated, "The most dramatic finding was that the strength of association of [fluorosis] score with psycho-behavioural impact was similar to that of overcrowding and overbite, both considered key occlusal traits driving the demand for orthodontic care." In the absence of a full account of benefits and risks, communities cannot make a properly informed decision whether or not to fluoridate, and if so at what level, on the basis of their own values regarding the balance of benefits and risks.

In the absence of comprehensive, high-quality evidence with respect to the benefits and risks of water fluoridation, the moral status of advocacy for this practice is, at best, indeterminate, and could perhaps be considered immoral.

These scientific and moral issues must be addressed and resolved if policy and practice with respect to water fluoridation are to be considered ethically sound. Yet it is not clear that this work can be accomplished satisfactorily. The conventional view that the ethical dilemmas posed by water fluoridation can be resolved by balancing the benefits and harms actually begs the question, for it presumes that such a balance can be achieved. The preceding arguments indicate that this view needs to be replaced by a moral account showing an appreciation for the ineradicability of the conflict of values that water fluoridation engenders. They also raise the question of whose values should take precedence when decisions regarding water fluoridation are being made.

Ethically, it cannot be argued that past benefits, by themselves, justify continuing the practice of fluoridation. This position presumes the constancy of the environment in which policy decisions are made. Questions of public health policy are relative, not absolute, and different stages of human progress not only will have, but ought to have, different needs and different means of meeting those needs. Standards regarding the optimal level of fluoride in the water supply were developed on the basis of epidemiological data collected more than 50 years ago. There is a need for new guidelines for water fluoridation that are based on sound, up-to-date science and sound ethics. In this context, we would argue that sound ethics presupposes sound science.

7) Cross DW, Carton RJ. Fluoridation: A violation of medical ethics and human rights. *Int J Occup Environ Health* 2003; 9:24-29.

Key Points:

- Medical ethics demands wishes of individual take precedence over actions imposed by the state.
- Fluorides are medicines and should be governed as such. Silicofluorides have not been tested for safety.
- Those sensitive to fluoride exposure have no means of regulating their intake and those “medical practitioners” administering the drug have no means of monitoring the dosage.
- Principles of informed consent are not met by water fluoridation procedures. Those receiving fluoridation are patients and should be accorded full rights of disclosure and legal consent.
- Government policy has been aided by bias and fraud.

“The ethical issues raised by fluoridation are ultimately grounded in the Nuremberg Code. This code established the basis for all modern medical research and treatment involving human subjects. All subsequent codes of medical ethics have their origins in this document. While the wording of various codes may differ, they all incorporate the fundamental basic requirement: research, or even routine medical procedures, must be done with the voluntary cooperation of the subjects, who must be fully informed of the risks and benefits of the medical procedures in which they are involved. Medical ethics unequivocally demands that the wishes of the individual must take precedence over actions imposed by the state, unless there is a valid and wider public health concern. A state’s interest may legitimately override an individual’s wishes if a person with a potentially life-threatening and contagious disease such as measles or Lassa fever refuses to accept treatment and/or quarantine. Obviously tooth decay does not qualify as such a disease, requiring the state to usurp individual rights. States continue, nonetheless, to insist on their “police power,” having convinced the public through press releases that fluoridation is completely benign.

At the heart of the medical ethics debate is the nature of the substances being administered. It would appear obvious that fluoridation chemicals are medicines, yet this is challenged by a number of states. The British Government’s regulatory body, the Medicines Control Agency (MCA), claims that fluoridated water is not a medicine. The U.S. tactic is not to deny that fluoride is a medicine, but to refuse to apply the laws governing medications to fluoridation. Most states have some definition of what constitutes a medicinal substance. The definition of a medicinal substance has been established by the European Union since February 2002 by the Codified Pharmaceutical Directive 2001/83/EEC. Article 1 defines them as: Any substance or combination of substances presented for treating or preventing disease in human beings or animals . . . Any substance or combination of

substances which may be administered to human beings or animals with a view to making a diagnosis or to restoring, correcting or modifying physiological function in human beings or animals is likewise considered a medicinal product. This is almost identical to the American Food and Drug Administration's definition, Fluoride, when used in the diagnosis, cure, mitigation, treatment, or prevention of disease in man or animal, is a drug that is subject to Food and Drug Administration (FDA) regulation.

In the United States, no safety tests have been carried out on silicofluorides. In a response to Congressman Calvert, House Committee on Science, concerning hydrofluosilicic acid and sodium fluorosilicate, the substances used in over 90% of U.S. fluoridation programs, the EPA states:

In collecting the data for the fact sheet, EPA was not able to identify chronic studies for these chemicals. The FDA has stated: "No New Drug Applications have been approved or rejected for fluoride drugs meant for ingestion." However, silicofluorides have been tested in Europe, and have been almost universally rejected for failing the safety standards. Consequently, their use has been banned in most EU countries. Since they contain arsenic as a contaminant, it is impossible to use them without contaminating drinking water supplies with arsenic, a known human carcinogen.

Article 2 of the Council of Europe's Convention for the Protection of Human Rights and Dignity of Human Beings with Regard to the Application of Biology and Medicine, 1999 (referred to as the "Biomedical Convention" hereafter for convenience) affirms the primacy of the individual over the sole interest of science or society, establishing that the wishes of an individual in respect to his or her exposure to treatment for medical conditions takes precedence over state objectives. Those who elect not to have their dental caries treated (by any form of treatment) present no public health risk to the state, so the imposition of fluoridation is therefore covered by Article 2, and is subject to the consent of the individual.

In the case of fluoridation, the intervention is imposed upon the whole population, regardless of the medical condition of the individuals—consider, for example, the quite common example of those members of the population, particularly the elderly, who are toothless. Nor does it take into account any additional sources of fluoride that may be derived from other sources, such as highly fluoridated dentifrices or processed foods prepared with fluoridated water. And crucially, it does not permit those members of the population that are more susceptible to fluoride intoxication to regulate their intake by avoiding this component of their overall exposure. The U.S. EPA notes that subsets of the population listed as sensitive include: elderly, 52,000,000; cardiovascular disease, 22,000,000; renal disorders, 2,000,000; vitamin C deficiency, 27%; magnesium deficiency, 37%; calcium deficiency, 44%.

Nor does it allow their medical advisers to monitor their reactions to the unregulated dosages of these medicinal substances. Fluoridation is therefore the indiscriminate medication of patients without any of the fundamental precautions and protections that medical ethics demands from qualified medical practitioners working under specified codes of medical practice. Anyone involved in the administration of fluoridation to the public is a "health care professional" under the definitions of the Convention. In both the private and the public sectors that are variously responsible for delivering fluoridated water supplies to the public, the treatment is applied by engineers and other corporate workers with no medical qualifications or clinical experience. They have no access, nor right of access under the law, to the medical records of each consumer (or as they should be classed, each patient) and no mandate to provide medication to the public, other than

the permission of the state itself. Nor are they qualified to determine whether an alternative treatment would be appropriate for any member of the public. Since the right to medical treatment includes the right to refuse medical treatment unless there is an overriding public health interest, this is a gross violation of the rights of the individual to proper medical treatment, even if the individual consented to it.

Consent must be based on an understanding by the subject of the nature and the potential consequences of fluoridation and its alternatives. The subject must have been informed by health care professionals about all relevant facts, including the risks, which must include a full assessment of the risks related to the individual characteristics of each patient, such as age or the existence of other disease. Clearly, in the case of the fluoridation of the public water supply no such actions have been taken or are planned, so no informed consent is possible. Nor has the state the power to take upon itself the right to make such a decision on behalf of the individual.

In the case of any state medical intervention, each person exposed is regarded as a patient, and must be accorded his or her full rights as such. Failure to do so constitutes medical malpractice. Yet there has been no example of fluoridation of the public water supply in which every member of the public living in, or visiting, a target area has been informed, directly and individually, by the state or by its medical agents at any level, of the risks they may personally face from any of the known adverse effects of water fluoridation. The need for full disclosure poses some extremely difficult problems for advocates of fluoridation. It would require health authority representatives to explain the risk to all people in a target area. Freedom to consent to an intervention also demands that such consent may be withdrawn at any time. But in the case of fluoridation, once exposed the subjects cannot effectively opt out. Around half of the fluoride contained in drinking water is absorbed and permanently stored in the body, especially in bone tissue. Thus, the issue of consent is a major obstruction to state policies of fluoridation, since it is not possible to secure legal consent (in the full medical definition) from whole populations, and there will always be large numbers of people within any population who are in any case incapable of providing consent except through their legal guardians.

In the United States, the adoption of the standard of “strict scrutiny” in reviewing the complaints of citizens objecting to the use of state police powers to justify fluoridation should be tested in court, eliminating the anomaly of the use of the lesser standard of “rational basis” that assumes that all legislation is, by definition, constitutional. An independent evaluation of allegations that government policy has been supported by deliberate bias and fraud should be investigated, and should assist greatly in challenging fluoridation in court if these allegations are upheld.”

8) The following excerpt from the “Joint Government of Canada Response to Environmental Petition No. 221 filed under section 22 of the Auditor General Act, Received November 19, 2007” (<http://www.fptdwc.ca/assets/PDF/0804-JointGovernmentofCanadareponse.pdf>) answers specific questions from the original petition, regarding the concerns about fluoridation being considered a medication or drug:

9. Can any Canadian or provincial government department or agency force an individual to be medicated with a substance that has not been specifically approved for the purpose it is intended, and especially approved in the manner it is administered? Does the approval of one substance, or manner of delivery, translate to an approval for another similar substance or different mode of delivery?

Health Canada Response:

The purpose of fluoridating municipal drinking water is to provide a commonly available source of fluoride. Hydrofluorosilicic acid (HFA) or any other form of fluoride used in drinking water fluoridation is a source of the mineral nutrient fluoride. Fluoride, when added at the recommended level, has been determined to provide the daily intake that is considered adequate for optimal nutrition by various health agencies. Health Canada does not regulate fluoridation additives added to drinking water supplies because provincial and territorial governments are responsible for the safety and quality of public drinking water supplies in municipalities. Under the *Food and Drug Act*, approval of a drug and its manner of delivery does not automatically translate to an approval for another similar substance or different mode of delivery. However, since fluoride used in drinking water fluoridation is not considered a drug, the approval requirements are not considered applicable.

15. *Is fluoride considered to be a drug that is subject to Health Canada or any other regulation(s)?*

Health Canada Response:

When fluoride is offered for sale in a final dosage form, used in large concentration and with a drug delivery system (e.g., dental rinse, toothpaste) and is labeled for therapeutic use (or makes therapeutic claims), the products are considered drugs under the *Food and Drugs Act* and are regulated under the *Natural Health Product Regulations*. Since the *Natural Health Product Regulations* came into force on January 1, 2004 with a transition period till December 31, 2009, some of the products may still be regulated under the *Food and Drug Regulations*. Where minerals are added or where food is fortified with a mineral (e.g., iron in cereals), the food does not become a drug. Fluoride used in drinking water fluoridation is; therefore, not a considered a drug under the *Food and Drugs Act*.

16. *Have fluorosilicates ever been approved as a drug in Canada?*

Health Canada Response:

There are a number of drugs that contain various forms of fluoride that have received market authorization. Three of these drugs with valid Drug Identification Numbers (DIN) contain fluorosilicates. Of these three, two are homeopathics and one is an over-the-counter anti-fungal product. Information for the two homeopathics products and for the anti-fungal product can be obtained from the following links:

[http://www.hc-sc.gc.ca/dhp-](http://www.hc-sc.gc.ca/dhp-mps/prodpharma/databasdon/index_e.html)

[mps/prodpharma/databasdon/index_e.html](http://www.hc-sc.gc.ca/dhp-mps/prodpharma/databasdon/index_e.html)

[http://cpe0013211b4c6d-](http://cpe0013211b4c6d-cm0014e88ee7a4.cpe.net.cable.rogers.com/dpdonline/displayInfo.do?drugCode=6L6aHfFUgEY%3D)

[cm0014e88ee7a4.cpe.net.cable.rogers.com/dpdonline/displayInfo.do?drugCode=6L6aHfFUgEY%3D](http://cpe0013211b4c6d-cm0014e88ee7a4.cpe.net.cable.rogers.com/dpdonline/displayInfo.do?drugCode=6L6aHfFUgEY%3D)

To date, no Natural Health Products (NHP) containing fluorosilicates have been licensed for sale in Canada. Should Health Canada one day licence for sale a fluorosilicate-containing NHP, this would bear an NPN or DIN-HM on the label.

Other options to fluoridation

There are many other ways to deliver fluoride to regularly provide low doses of exposure in the oral cavity (topical application). They vary in terms of cost, accessibility for the general public, and requirements for health professional application. Extensive literature on the efficacy and safety of many other forms of systemic and topical fluorides has been published. The previously quoted Australian Government systematic review contains a brief summary of that literature.

National Health and Medical Research Council, A Systematic Review of the Efficacy and Safety of Water Fluoridation, Australian Government 2007, pg. 56

<http://www.nhmrc.gov.au/publications/synopses/eh41syn.htm>

“Research question: *Is the use of topical fluoride supplementation more efficacious than no topical fluoride supplementation in the prevention of dental caries?*”

Research question: *Is a combination of topical fluoride supplementation products more efficacious than a single topical fluoride supplementation product in the prevention of dental caries?*

There is consistent Level I evidence from existing systematic reviews and a review of additional original studies that topical fluoride agents reduce caries in children, when compared to no topical fluoride supplementation. When compared to placebo/no treatment the magnitude of the effect achieved with varnish is greater than the other topical agents. However, when compared directly to each other, there is no significant difference between agents. There is also Level I evidence that some combinations of topical agents may be more effective at preventing/reducing caries than single agents.”

Appendices

Dental Caries Photographs (2000-2010)

- Photographs of dental caries in Albertan schoolchildren taken by Dr. Steven K. Patterson.



Dental Fluorosis Photographs

- Examples of dental fluorosis

Very mild to mild:



Moderate:



Severe:



Suggested responses to anti-fluoridationist arguments

(Armfield, JM. When public action undermines public health: a critical examination of anti-fluoridationist literature. Aust New Zealand Health Policy. 2007; 4: 25.)

Anti-fluoride argument	Suggested response
Water fluoridation confers no oral health benefit	Numerous systematic literature reviews from a number of countries have found water fluoridation to provide a significant caries preventive effect.
Water fluoridation causes hip fractures, cancers, Alzheimer's, reduced intelligence in children, etc.	Research finding associations between water fluoridation and various diseases offer no proof, as causality cannot be established in these studies. Water fluoridation opponents handpick studies and may misrepresent the results so as to support their views. Large-scale systematic reviews have not confirmed any associations between water fluoridation and the large list of diseases linked to it by opponents of water fluoridation.
Fluoride is a toxic poison.	Fluorine is a naturally occurring element that, like many other natural substances, can be toxic if consumed in excess. Water fluoridation ensures ingestion of fluoride well below any toxic level, both for adults and children.
Fluoride is used in rat poison and other dangerous substances.	It is dose that determines the level of toxicity. Many essential and commonly occurring elements form poisonous or toxic substances.
Numerous other countries have rejected water fluoridation.	Some other countries have elected not to introduce water fluoridation because they prefer, or already have, other approaches to improving dental health. Nonetheless, many countries do have water fluoridation and benefits are conferred to all people, including those at high risk who may not effectively use individual fluoride exposures.
Water fluoridation is supported only by 'shoddy' science.	Decades of research and hundreds of scientific articles published in peer-reviewed journals support water fluoridation. This research is so convincing that almost all major dental and health authorities support it.
There should be a public plebiscite. It is undemocratic to have water fluoridation forced upon us.	In almost all democratic systems representatives of a population are elected to make decisions on behalf of the population. Plebiscites or public referendums are not required to pass legislation that is compatible with the constitution or charter under which the country operates. Water fluoridation fits within a government's duty of care to the country's citizens.
Tooth decay has declined in countries with and those without water fluoridation. Water fluoridation makes no	Declines in tooth decay have occurred as a result of changing exposures to fluoride and dietary changes. Regardless, water fluoridation reduces tooth decay above and beyond these other effects. Ecological comparisons of some countries with others

Anti-fluoride argument difference.	Suggested response
Most people do not want water fluoridation.	offer no support for or against water fluoridation as many other factors may account for differences in disease experience from one country to the next. Water fluoridation does make a difference. Independent research in most places where water fluoridation is being considered shows that people support water fluoridation. Generally, the more knowledge people have the more likely they are to support it.
Water fluoridation is costly and not economically viable.	Research has previously found water fluoridation to be cost-effective. Newer technologies have made water fluoridation cost-effective for increasingly smaller populations. In addition to being cost-effective, it is also necessary to keep in mind the reduction in dental disease and therefore the pain and suffering reduced as a result of water fluoridation.
Water fluoridation infringes freedom of choice and individual rights and is unconstitutional.	Adding fluoride to water is just one of many instances where a chemical or nutrient is added to a food or beverage for public health benefits. It already occurs in water with the addition of chlorine, which aids greatly in eliminating water borne disease, as well as in several foodstuffs. Water fluoridation sets no precedent.
Water fluoridation is being pushed on us as a result of 'big business' interests.	The scientists researching the effectiveness of water fluoridation as well as health officials and dentists do not receive money from sugar, aluminium or any other companies for their research or opinions.
There is more caries in fluoridated X than in non-fluoridated Y. This proves water fluoridation does not work.	Ecological comparisons involving the arbitrary selection of fluoridated and non-fluoridated communities or areas do not provide credible evidence of the effectiveness or otherwise of water fluoridation as any differences may be the result of other factors which are linked to tooth decay but differ across the areas. Scientific research has found water fluoridation to be effective.
We should wait until water fluoridation is proved to be safe.	Water fluoridation has been implemented in some places for more than half a century – long enough that any dangers would be apparent if they existed. The weight of evidence strongly indicates that water fluoridation is safe.

Alberta Towns/Cities Over 1,000 population without Fluoridation

Brooks- 13, 581
Lloydminster- 17,402
Medicine Hat- 61,097
Banff- 8,721
Bassano- 1,390
Beaverlodge- 2,264
Bentley- 1,132
Black Diamond- 2,308
Bowden- 1,236
Canmore- 12,226
Carstairs- 2,656
Claresholm- 3,700
Coalhurst- 1,810
Cochrane- 15,424
Crossfield- 2,648
Didsbury- 4,599
Drayton Valley- 6,893
Eckville- 1,002
Fort Macleod- 3,072
Fox Creek- 2,278
Grande Cache- 3,783
Hanna- 2,847
High River- 11,346
Innisfail- 7,883
Magrath- 2,254
Mayerthorpe- 1,474
Nanton- 2,124
Olds- 7,248
Oyen- 1,190
Penhold- 2,114
Rainbow Lake- 1,082
Raymond- 3,674
Redcliff- 5,096
Rimbey- 2,496
Rocky Mountain House- 7,231
Sexsmith- 2,255
Strathmore- 11,838
Sundre- 2,518
Sylvan Lake- 11,115
Three Hills- 3,322
Trochu- 1,113
Turner Valley- 2,022
Vulcan- 1,940
Wembley- 1,443

Alberta Communities with Controlled or Naturally Occurring Fluoride

Community	Year of Fluoridation
Airdrie	1991
Argentia Beach	natural
Athabasca	1962
Barrhead	1964
Beaumont	1967
Beiseker	natural
Big Valley	natural
Blackfalds	natural
Blairmore	1975
Bonnyville	1962
Bow Island	1968
Brant Colony	natural
Bruderheim	1982
Calgary	1991
Calmar	1984
Camrose	1986
Cardston	1972
Cereal (*discontinued 2008)	1988*
Chestermere Lake	1991
Chinook (*discontinued 2008)	1988*
Chipman	1982
Coaldale	1963
Cold Lake	1983
College Heights	natural
Coronation	natural
Delia (*discontinued 2008)	1988*
Devon	1959
Drayton Valley (*discontinued 2008)	1973*
Drumheller	1967
Edmonton	1967
Edson	natural
Elkpoint	1984
Elmspring	natural
Etzikon	natural
Eumary	natural
Fahler (*discontinued 2007)	1977*
Fairlane Colony	natural
Fairview	1958
Foremost	natural
Forestburg	1980
Ft. McMurray	1965
Ft. Saskatchewan	1967

Frank	1975
Gadsby	natural
Gibbons	1976
Grand Centre	1983
Grande Prairie	1959
Grimshaw	1983
Hanna (*discontinued 2008)	1968*
Hardieville	1972
Hays	1969
High Level	1985
High Prairie	1990
High River Colony	natural
Hinton	1969
Hoping	natural
Hugenden	natural
Huxley Colony	natural
Hythe	natural
Irricana	natural
Josephburg	natural
Keho Lake Colony	natural
Killam	1976
Lac la Biche	1976
Lacombe	natural
Lamont	1982
Leduc	1967
Legal	1989
Lethbridge	1976
Linden	natural
Manning	1981
Manyberries	natural
McLennan (*discontinued 2010)	1980*
Milk River	1964
Millet	natural
Morinville	1973
Mountview Colony	natural
Mulhurst	natural
Mundare	1982
Munson (*discontinued 2008)	1986*
Nacmine	1986
Nemiskam	natural
New Brigden	natural
New Rockport Colony	natural
Okotoks	1984
Oyen (*discontinued 2008)	1988*
Parkland Colony	natural
Peace River	1963

Peerless Lake	natural
Pibroch Village	natural
Picture Butte	1966
Pincher Creek	1968
Pinehill Colony	natural
Pipestone	natural
Ponoka	1985
Provost	1979
Red Deer	1958
Redwater	1974
Richdale	1988
River Road Colony	natural
Rock Lake Colony	natural
Rosedale	1986
Ryley	1992
St. Albert	1962
St. Paul	1968
Scotfield (*discontinued 2008)	1988*
Sherwood Park	1967
Silver Beach	natural
Skiff	natural
Slave lake	1973
Smoky Lake	1982
Spirit River	1981
Spruce Grove	1971
Stahlville Colony	natural
Stanmore	1988
Stettler	1985
Stirling	1989
Stony Plain	1971
Swalwell	natural
Swan Hills	1983
Taber	1970
Thorsby	1977
Tofield	1992
Torrington	natural
Two Hills	natural
Valleyview	1976
Valleyview Colony	natural
Vauxhall	1974
Vegreville	1976
Vermilion	1977
Viking	1976
Vimy	natural
Wainwright	1986
Warburg	natural

Westlock	1968
Wetaskiwin	1974
Whitecourt	1965
White Lake Colony	natural
Wilson Colony	natural
Wimborne	natural
Youngstown (*discontinued 2008)	1988*

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