

INFORMATION REPORT

TO: Mayor and Members Board of Health	WARD(S) AFFECTED: CITY WIDE
COMMITTEE DATE: April 26, 2011	
SUBJECT/REPORT NO: Water Fluoridation: New Data and Recent Developments BOH08024(b) (City Wide)	
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Council Direction: The Board of Health, at its meeting on March 29, 2011, directed Public Health Services staff to provide an information report regarding recent developments with respect to water fluoridation.

Information:

A systematic review was conducted of the peer-reviewed medical literature since the last Public Health Services report on safety and effectiveness of water fluoridation. A basic environmental scan was also conducted to identify recent decisions by municipal bodies to fluoridate or not to fluoridate drinking water supplies and as well as any potential policy changes at the provincial or national level. Details of findings are in Parts 1 and 2 below; background information is in the final section of this report. In summary:

- There have been some decisions recently by municipalities in Ontario and elsewhere in North America to begin or continue water fluoridation, and some decisions to discontinue water fluoridation.
- Recent scientific literature strengthens the evidence that water fluoridation is effective at preventing dental cavities (caries) in the modern context.
- Recent scientific literature provides additional data showing that water fluoridation is safe at the levels used at Hamilton's Woodward Avenue Water Treatment Facility, though it may be associated with some cases of very mild or mild dental fluorosis (discolouring of the teeth usually not noticeable except during a clinical exam).

Part 1: Recent Developments

Water fluoridation has been discussed in various forums recently. The following summarizes the most relevant municipal decisions and provincial and national policy directions. Most recent items are presented first.

a) Toronto continues water fluoridation

In April 2011, the City of Toronto Board of Health voted unanimously to continue water fluoridation.ⁱ The Board heard four hours of both pro- and anti-fluoridation arguments. Toronto has fluoridated its water supplies since 1963 after a referendum supported water fluoridation, and currently fluoridates at 0.6 parts per million (ppm).

b) Ontario Chief Medical Officer of Health issues new position statement

The Chief Medical Officer of Health for Ontario published a position statement in April 2011 summarizing the scientific evidence about water fluoridation's safety and effectiveness.ⁱⁱ The statement directly addressed the discontinuation of water fluoridation in Waterloo, expressing the Chief Medical Officer's concern about the oral health of residents of that community. The statement also identified that water fluoridation:

- Combats tooth decay
- Reduces dental expenses
- Is particularly beneficial to people on low income
- Does cause some cases of very mild or mild fluorosis (white spots on teeth)
- Does not cause serious health effects

The statement described how dental health is important for overall health as poor oral health is linked to diabetes, heart disease and respiratory conditions.

c) London continues water fluoridation

In February of 2011, the Board of Health in London, Ontario voted unanimously to support water fluoridation. The Board considered several hours of arguments from advocates for and against water fluoridation.

d) Calgary discontinues water fluoridation

Calgary's city council voted in February, 2011 to discontinue the fluoridation of city water. The City of Calgary does not have a public health department, and so professors from the University of Calgary's medical school offered to help interpret the scientific research. According to media reports, the aldermen rejected the offer, and made their decision mainly based on consultations with groups opposed to water fluoridation.ⁱⁱⁱ The

City of Calgary initiated water fluoridation in 1989 after a supportive referendum. In 1998, another referendum confirmed support in Calgary for water fluoridation.

e) San Diego begins water fluoridation

In February 2011, the City of San Diego, California initiated water fluoridation at its three water treatment plants. California state law requires that drinking water be fluoridated except where there is not adequate funding. The municipality did not have adequate funding until recently, when a non-profit group that promotes the health and wellbeing of young children in San Diego raised \$3,927,016 to fund the capital costs and first two years of operation for the municipality.^{iv} The City chose to accept this funding and began fluoridating the water supply for its 1.4 million residents at 0.7 ppm this year.

f) US focuses fluoridation target to low end within previous range

In January 2011, the United States Department of Health and Human Services (HHS) announced that they were proposing a new target for the optimal level of fluoride in drinking water. The target proposed is 0.7 ppm which is in the same range but on the low end of the previous recommendation of 0.7 to 1.2 ppm. The City of Hamilton's Woodward Avenue Water Treatment Plant currently has a target of 0.6 ppm fluoride, just below the US target.

In his comments about the announcement, HHS's Assistant Secretary for Health reiterated "one of the most effective prevention choices for a community is to advance oral health through community water fluoridation."^v He stated that the low end of the previous range can be used because people are now exposed to other sources of fluoride, such as toothpaste, but that water fluoridation is useful particularly because it protects oral health for all members of the community.

g) Waterloo discontinues water fluoridation

In October 2010, by a vote of 50.3 per cent, Waterloo residents declined water fluoridation. The vote was 15461 to 15266. The City of Waterloo initiated water fluoridation in 1967 after a supportive referendum.

h) Health Canada report and new Canadian data indicate water fluoridation is safe and effective

In 2009, Health Canada published a draft document for consultation that included a detailed review of the science of water fluoridation.^{vi} The document cited considerable evidence that water fluoridation is effective in preventing dental caries, and concluded that dental fluorosis (discolouration of the teeth) is the only side effect of water fluoridation that can be expected to occur with any frequency. The document further

stated that skeletal fluorosis (brittle bones) is rare in Canada and not likely associated with water fluoridation, and data does not support a link between water fluoridation and more serious health effects. The document included a recommendation that the maximum concentration of fluoride in water be set at 1.5 ppm. This is more than twice the level in Hamilton water.

The Canadian Health Measures Survey examined approximately 1200 children between ages 6 and 12. This study found that less 5% of children had mild fluorosis, and less than 0.3% had either moderate or severe fluorosis.^{vii} Although exact numbers were not published, the Chief Dental Officer indicates that less than 4 of the 1200 children had any significant fluorosis, and these children were all recent immigrants,^{viii} suggesting that the level of fluoride in Canadian drinking water does not measurably increase the risk of moderate or severe fluorosis.

Part 2: Review of Medical Literature since 2008

a) Research Question and Search Strategy

We conducted a review of the medical literature to identify if there was any new data about the safety or effectiveness of water fluoridation published since our last review in 2008. Our main research questions were:

- Is water fluoridation still beneficial for dental health in the current context?
- Is there any new evidence suggesting that water fluoridation is harmful?

A summary of our search strategy is found in Table 1 at bottom.

b) Studies identified

Our initial search for primary research studies and reviews of research studies about “water fluoridation” generated 48 articles. On closer examination, most of the articles studied some use of fluoride other than in drinking water, or were mainly policy or opinion about water fluoridation, not primary research.

We found 16 primary studies and research review articles that were relevant to the questions of safety and effectiveness. Of these, 11 made conclusions about effectiveness, five made conclusions about safety, and five addressed both effectiveness and safety.

Effectiveness

Of the 11 studies making conclusions about effectiveness, all 11 concluded that water fluoridation is effective at preventing dental caries. These included:

1. A general review conducted by researchers in England concluding that water fluoridation is safe and effective, though it does cause dental fluorosis^{ix}
2. A primary study showing that children in communities with water fluoridation in Australia have less dental caries^x
3. A primary study showing that for children in communities with water fluoridation in New York State, costs paid by insurance companies for dental procedures were lower^{xi}
4. A general review conducted by researchers in Ireland concluding that water fluoridation is safe and effective, though it does cause dental fluorosis^{xii}
5. A primary study in Australia showing that water fluoridation saves between \$69.86 and \$249.45 per person, with minimal up-front costs^{xiii}
6. A general review of studies that were conducted in Brazil concluding that water fluoridation in Brazil is safe and effective, though it does cause dental fluorosis^{xiv}
7. A primary study in Denmark showing that water fluoridation may be effective even at lower concentrations than currently recommended^{xv}
8. A general review conducted by researchers in India concluding that water fluoridation is safe and effective, though it does cause dental fluorosis^{xvi}
9. A general review conducted by researchers in Ireland concluding that water fluoridation is safe and effective, though it does cause dental fluorosis^{xvii}
10. Another primary study showing that children in communities with water fluoridation in Australia have less dental caries^{xviii}
11. A primary study in Lithuania showing that increased fluoride content in drinking reduces dental caries in children^{xix}

d) Safety

Of the studies focussing more on safety, none identified any new risks or provided any data supporting speculation about any substantial health risks. Some studies confirmed or clarified the known risk of dental fluorosis. A number of studies provided evidence against some of the previous claims that water fluoridation may have more severe risks. Some highlights:

1. Does water fluoridation harm bones? No. A study co-authored by Harvey Limeback, one of the main anti-fluoridation advocates in Canada, was designed to look for substantive impacts of water fluoridation on bones, but found none.^{xx}
The study concluded that:
“Many decades of epidemiological studies have shown minimal evidence of any effects of fluoride administration on bone, and it is therefore very unlikely that municipally fluoridated water affects adults with healthy bone. In this study, no effects of fluoride on mineralization... and no substantive

negative effects of fluoride administration on bone mechanical properties were observed.”

2. Is artificial fluoride used in water fluoridation more dangerous? No. Some individuals have claimed that the type of fluoride used in water fluoridation (H_2SiF_6) is more poisonous than the type that is found in most surface water, such as Lake Ontario (NaF). Two studies found that this was not the case, and the human body reacts to both types of fluoride the same way.^{xxi xxii}
3. Is drinking formula part of the cause of the known risk of dental fluorosis compared to drinking breast milk? Possibly. A review conducted by US researchers found that each increase of 0.1 ppm in drinking water used to make formula may be associated with a 5% relative increase of fluorosis. However, the study found substantial evidence of publication bias that meant that it could not make definitive conclusions. Regardless, this potential risk is consistent with Public Health Services messaging about the importance of breast feeding.^{xxiii}
4. Does the method of supplementation affect the overall dose of fluoride ingested? Yes, and water fluoridation may be the safest route. Researchers in Brazil assessed total intake of fluoride associated with four sources of fluoride: naturally fluoridated water; artificially fluoridated water (what we call “water fluoridation”); fluoridated salt and fluoridated milk. Their data indicates that the total dose of fluoride consumed is relatively low and/or less variable with water fluoridation than other fluoridation approaches. They concluded that further work is needed in this area.^{xxiv}
5. All of the general reviews mentioned under Section c) Effectiveness above identified the primary risk of mild or very mild fluorosis, and that rare cases of moderate or severe fluorosis do occur. Some mention the risk of bone fluorosis in association with large doses of fluoride, beyond the levels found in fluoridated water. All concluded that claims about more severe risks are not substantiated by the existing evidence.

There were no studies in any of the 48 studies identified, including those that are not discussed in detail here because they were not relevant to the safety or effectiveness questions,^{xxv-lvi} that provided evidence of any health risks attributable to community water fluoridation beyond dental fluorosis.

Background

Water fluoridation is the practice of adding small amounts of fluoride to municipal water supplies in order to prevent dental caries (cavities). Hamilton has fluoridated its municipal water supply since two referendums in the 1960’s indicated public support. The cost of water fluoridation is less than \$3 per person per year, and is paid by users through the capital component of the water rate.

As of 2009, over 70% of the population of Ontario had access to fluoridated water.^{lvii} Water fluoridation has been described as one of the ten great public health achievements of the 20th century,^{lviii} in part because it helps improve the oral health of the entire population, including those who cannot afford dental care. Water fluoridation is supported by over 90 Canadian and international medical and dental organizations.

Figure 1: Exposure required for various health impacts

Exposure	Required quantity of water fluoridated at 0.6 ppm (Hamilton water)	Health Impact
Drinking water at 2.0 ppm	Child (under the age of 8 years) consumes 17 glasses of water daily for a prolonged period,* and swallows no toothpaste†	Mild dental fluorosis
Drinking water at 8.0 ppm	Child or adult consumes 67 glasses daily for a prolonged period*	Skeletal fluorosis
16 mg oral/kg body weight	A 20 kg child drinks 2666 glasses of water, or 333 jugs of orange juice (2 litre) in one sitting*	Acute lethal dose (child)
2,500-10,000 mg oral	An adult male would need to consume at least 4167 litres of water (28 bath tubs) in one sitting*	Acute lethal dose (adult)

* Water consumption of this magnitude would result in severe illness directly from the effects of the water before approaching levels required for severe fluoride effects.

† Toothpaste contains concentrated fluoride. Swallowing toothpaste poses the greatest risk of fluorosis.^{lix} Table adapted from UK MRC and TPH Reports.^{lx lxi}

The practice of adding small amounts of a substance to supplies of a certain food or drink is not unique to water fluoridation. Several similar strategies are used in Canada and other countries:

- Folic acid is added to virtually all flour to prevent birth defects
- Calciferol (vitamin D), a steroid, is added to virtually all milk to prevent deficiency and help with calcium absorption
- Iodine is added to virtually all salt to prevent goiter

Like many substances, acute or chronic exposure to large doses of fluoride can have health risks. However, water fluoridation at the low levels used in Canada is considered safe, and is associated primarily with very mild and mild fluorosis (white mottling of the teeth), which occurs in less than 20% of the population.^{vii} This condition is not noticeable to most people.

Estimates of the extremely large amounts of water that would need to be consumed in order to produce serious health effects provide further evidence of safety. See Figure 1 for a summary. Many claims have been made that water fluoridation causes serious health risks, but existing scientific evidence refutes these claims.

In 2008, Public Health Services conducted an assessment of a number of issues associated with water fluoridation, including economic and environmental impacts. This review determined that water fluoridation is substantially less costly than other methods of delivering fluoride to the population of Hamilton, and that the practice has no impact on the Hamilton environment. Findings are summarized in [BOH08024 \(a\)](#).

In Ontario, the Fluoridation Act and the Municipal Act define various processes by which a municipality may initiate or discontinue water fluoridation.

Table 1: Search Strategy

Date of Search:	Feb 18, 2011
Database:	PubMed (peer-reviewed scientific health literature)
Search Term:	“water fluoridation”
Date Span Searched:	Jul 2, 2008 – Feb 18, 2011
Search Limits:	Include the following study types: <ul style="list-style-type: none">• Clinical Trial• Meta Analysis• Review• Comparative Study• Evaluation Study
Relevance Criteria:	Focused on primary research studies or reviews of primary research devoting attention to safety or effectiveness of water fluoridation.

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