

Fluoridation of Toronto Tap Water

Date:	April 30, 2007
To:	Board of Health
From:	Medical Officer of Health
Wards:	All
Reference Number:	

SUMMARY

This report responds to requests from the Board of Health (BOH) and the Works Committee for reports from the Medical Officer of Health on whether to stop adding fluoride to Toronto's tap water.

Fluoridation of drinking water provides important oral health benefits. This position is supported by evidence compiled by the Centres for Disease Control in the United States, who, based on that evidence have declared that water fluoridation is one of the ten great public health achievements of the 20th century (1). In addition, eighty experts from thirty countries, together with the World Health Organization, FDI World Dental Federation and the International Association for Dental Research (IADR) reaffirmed the efficiency, cost-effectiveness, and safety of the daily use of optimal fluoride through the Global Consultation on Oral Health through Fluoride held in 2006 (2).

Credible scientific evidence supports the view that at 0.6 p.p.m., the amount level in Toronto water, the benefits of fluoridation outweigh any risks.

Financial Impact

There is no financial impact arising from this report.

DECISION HISTORY

At the April 10, 2006 Board of Health meeting, representatives from the Ashbridges Bay Treatment Plant Neighbourhood Liaison Committee (ABTP NLC) submitted a resolution proposing that "the addition of fluoride [hydrofluorosilic acid] to our drinking water be

stopped [suspended] for the time period beginning on April 1, 2006 to September 30, 2006 in order to monitor the pH [of the drinking water] and the metals levels in the biosolids.”

In this proposal the ABTP NLC also stated the following:

1. The fluoridation chemical added to Toronto’s drinking water is the industrial byproduct hydrofluorosilic acid of low pH with confirmed corrosive effects of dissolving metals into wastewater especially from older infrastructure, even at low concentration in water;
2. The dental benefits of fluoride are confirmed by the Centers for Disease Control (1999) as resulting from topical application of toothpaste and dental fluoride treatments, and not from the ingestion of hydrofluorosilic acid in drinking water and accumulation in the body;
3. The ingestion of fluorides from food, beverage and dental product sources, and inhalation of fluoride from air pollution, provide cumulative daily intake and exposure which have been deemed by public health authorities at the Centers for Disease Control (2005) to be in significant excess of requirements without the addition of fluoridated drinking water;
4. The suspension of the addition of hydrofluorosilic acid from the drinking water for a six month trial will allow pH neutralization to be accomplished with reduced additions of ammonia;
5. The suspension of the addition of hydrofluorosilic acid from the drinking water for the six month trial over the summer will allow accurate assessment of pH remediation and metals reduction in biosolids during the hot weather months when it is most problematic;

The Medical Officer of Health (MOH) responded to the issues raised by ABTP NLC through a briefing note to the Board of Health on April 10, 2007. An evaluation of fluoride emissions from ABTP done by Toronto Public Health (TPH) showed that water leaving the ABTP had the same level of fluoride as wastewater entering the plant. This means that fluoride is not substantially evaporated or precipitated out of water into biosolids or into the air. Hence, the MOH did not support the ABTP NLC request to suspend the addition of fluoride to Toronto’s water. The Board of Health requested the MOH to provide more detailed information on water fluoridation.

At its November 8 and 9, 2005 meeting, the Works Committee recommended, in part, that the MOH report through the Board of Health to the Works Committee on whether fluoride can be removed from Toronto’s water.

ISSUE BACKGROUND

Water fluoridation, the practice of adjusting the level of fluoride in potable drinking water to maximize its benefit to oral health, has been ongoing for over 60 years. Fluoride has been, and continues to be, extensively studied worldwide to examine the possibility of any

adverse health effects from low-level consumption. Several adverse health effects have been attributed to fluoride by people opposed to the addition of fluoride to drinking water. However, the body of credible scientific evidence world-wide, attests to the fact that fluoridation of community water supplies is safe and effective.

The level of fluoride in Toronto's water was reduced from 1.2 p.p.m. to 0.8 p.p.m. in 1999 and to 0.6 p.p.m. in 2005. This reduction was implemented to comply with the revised Ministry of the Environment target fluoride concentration for water fluoridation and to address concerns that there was an increase in the number of children exhibiting the mild form of fluorosis. Dental fluorosis is a change in the appearance of teeth caused when higher than optimal amounts of fluoride is ingested in early childhood during the time that the teeth are forming. However, very mild or mild forms of fluorosis that occur in areas where the level of fluoride in water is adjusted, are of a cosmetic nature rather than an adverse health effect.

COMMENTS

Fluoride is a naturally occurring substance in ground water. Generally, surface water sources such as lakes, rivers and streams have a very low concentration of fluoride. The naturally occurring level of fluoride in Lake Ontario is 0.15 p.p.m. Lake Ontario is the principal source of water supply for Toronto. Water fluoridation is the adjustment of the naturally occurring level of fluoride to an optimum level to maximize the protective health effect of fluoride on dental health.

In the 1920's and 1930's it was discovered that there was a correlation between fluoride levels in the water and reduced incidence of dental decay (1). In 1940, four community wide studies were conducted to examine the effect on dental health, of adding sodium fluoride to fluoride deficient water supplies. The studies were conducted in Grand Rapids Michigan, Newburgh, New York, Brantford, Ontario, and Evanston, Illinois. The results of these studies confirmed that fluoridation is a practical and safe public health measure to prevent tooth decay. Since that time, fluoride has been the subject of numerous additional studies (3).

After conducting a plebiscite, Toronto started to adjust the level of fluoride in its water on September 4, 1963 to an average concentration of 1.2 to 1 p.p.m. In 1999, in order to meet revised Canadian water standards, the concentration of fluoride in Toronto's water was reduced to 0.8 p.p.m. The current level of fluoride in Toronto's water is 0.6 p.p.m.

The practice of adjusting the level of fluoride in drinking water has been in place for over 60 years and it is estimated that over 405 million people world wide are the beneficiaries of water fluoridation (3).

Fluoride works to prevent tooth decay by increasing the resistance of tooth enamel to decay both topically and systemically. The systemic application of fluoride occurs when fluoride is ingested during the formation of teeth. The fluoride becomes incorporated into the tooth structures. The ingested fluoride is also deposited throughout the entire tooth surface and provides long lasting protection against tooth decay. The major source of

systemic fluoride in Toronto is fluoridated water. In some countries (e.g. in Germany), fluoride is given systemically by adding it to salt or giving it as supplements.

Topical fluorides are applied after the teeth are already present in the mouth. The fluoride is incorporated into the surface of the teeth making them more resistant to tooth decay. The major source of topical fluoride in Toronto is toothpaste, professionally applied fluoride foams, gels and varnishes.

It should be noted that systemic fluoride also provides protection topically. After ingestion from sources such as water fluoridation, low levels of fluoride present in saliva and in plaque, a film covering the teeth, can also prevent and reverse the process of dental decay. The maximum protection from tooth decay is realised when fluoride is available both systemically and topically. Water fluoridation provides both types of exposure (3).

Health Effects of Fluoride

While exposure to low levels of fluoride has beneficial effects on teeth, exposure to too much fluoride can cause adverse health effects. Various effects of fluoride on health have been studied including impacts on blood, bone, kidney, liver, lungs, and reproduction. Concern has also been expressed about the carcinogenic effect of fluoride. One credible scientific study has indicated a potential link between exposure to fluoride and osteosarcoma in young males (4). However, the researchers caution that this is the only study that has shown this association, that there are limitations to the study and that the study should be repeated in other jurisdictions to confirm the findings. The overall assessment of the scientific evidence is that fluoride is not a likely cause of cancer at levels optimal for oral health (5). Of all the potential adverse effects dental and skeletal fluorosis – impact on teeth and bone structure – are the most well documented. These effects are most common in areas where natural levels of fluoride in water are very high and in excess of the concentration used when the level of fluoride in potable water is adjusted.

Health Canada established a tolerable daily dose of 0.122 mg/kg-day for fluoride, based on protection from moderate dental fluorosis. The US EPA has established a reference dose of 0.06 mg/kg-day, a level at which no adverse impacts would be expected.

Protection from dental fluorosis also protects from other potential adverse effects that may occur at higher levels of exposure.

Toronto-Specific Total Exposure Assessment

Any adverse impacts from fluoride would result not only from exposure to fluoride in drinking water, but also from other sources. Therefore, Toronto Public Health used the levels of fluoride in Toronto drinking water together with estimates of the amount of fluoride from other sources such as air, soil, food, toothpaste, infant formula and breast milk, to calculate the total exposure that might occur in Toronto. This assessment showed that toddlers, formula and breast fed infants, are exposed to 0.07, 0.04 and 0.01 mg/kg/day, respectively. These exposures are similar to estimates in other parts of North America with fluoridated drinking water.

Thus, based on a Toronto-specific total exposure assessment for fluoride, toddlers may be exposed to a total level of fluoride that slightly exceeds the US EPA reference dose but is lower than Health Canada's tolerable daily intake for protection from moderate dental fluorosis. It is not expected that this exposure level is associated with any adverse health impact (6).

Fluoridation of Toronto's Tap Water

To address the issues raised by the ABTP NLC regarding the chemistry and treatment of Toronto's tap water, TPH's staff consulted with staff in Toronto Water. The following information has been largely provided by Toronto Water.

In Ontario, the Safe Drinking Water Act, 2002 (SDWA) provides for the protection of human health and the prevention of drinking-water health hazards through the control and regulation of drinking-water systems and drinking-water testing. Schedule 7-4 of Ontario Regulation 170/03 under the SDWA stipulates that if a drinking water system provides fluoridation, the concentration of the fluoride should be maintained between 0.5 and 0.8 milligrams per litre (mg/L).

In Toronto, a liquid fluoride compound called hydrofluosilicic acid is added during the water treatment process to maintain a fluoride target level of 0.6 mg/L in the water. Addition of all treatment chemicals to Toronto's drinking water is stringently controlled using modern chemical feed equipment and is rigorously monitored, using state-of-the-art computer systems. The quality of the hydrofluosilicic acid added is guaranteed by the fact that Toronto Water uses only those chemicals that are certified to the NSF/ANSI STANDARD 60 which deals with Health Effects of Drinking Water Treatment Chemicals.

Fluoridation Impact on Tap Water Quality

At the concentration at which it is received, hydrofluosilicic acid has a low pH and is corrosive. However, due to the low concentration that is applied to drinking water, a slight depression of pH is experienced only in poorly buffered waters. As Lake Ontario water is of moderately high alkalinity, such depression has not been noted.

Discernible changes in finished water pH are mainly attributed to changes in pH of incoming water and the addition of other treatment chemicals at greater concentrations. Most notably, pH is depressed by the addition of alum (or alternate coagulants), chlorine (for disinfection) and sulphur dioxide (for dechlorination to acceptable levels). The addition of ammonia (as part of the chloramination practice for secondary disinfection) serves to raise the pH very slightly. Ammonia is not, and cannot be used for the purpose of pH adjustment. It is applied in a precise ratio to the amount of free chlorine in the water and its application must be carefully controlled. Excess ammonia can serve as a nutrient and promote the growth of bacteria which can lead to nitrification, loss of chlorine residual and an actual decrease in pH.

While attention to the prevention of corrosion is prudent, the chemistry of corrosion is complex and factors other than pH can play a significant role. Given the chemistry of

Lake Ontario water, suspending fluoridation in Toronto will have no effect on the pH of tap water even if such suspension continued for a six-month period or longer.

Metals in Biosolids

Currently, biosolids cake generated at the Ashbridges Bay Treatment Plant (ABTP) is applied to agricultural land as a fertilizer. During periods when land application is not possible, biosolids cake is directed to landfill.

The practice of applying biosolids to agricultural land is regulated by the Ontario Nutrient Management Act, 2002 (NMA) and accompanying Regulation 267/03. This Act sets out a comprehensive and integrated approach to all land applied materials containing nutrients and ensures that they are managed in a sustainable, beneficial manner that results in environmental and water quality protection.

Biosolids cake generated at the ABTP is sampled and analyzed on a semi-monthly basis for all regulated parameters as required by Regulation 267/03 under the NMA. The regulated parameters include eleven heavy metals: arsenic, cadmium, cobalt, chromium, mercury, nickel, lead, selenium, zinc, molybdenum and copper.

For all the heavy metals tested, City of Toronto biosolids generated at the ABTP are well below the maximum metal concentrations listed in Regulation 267/03. A steady decrease in the concentration of heavy metals in biosolids from the ABTP has been observed over the past 25 years. These decreases can be attributed to the implementation of the City's Sewer Use By-law which places strict limits on influent constituents to the City's sewer network.

Suspension of Tap water fluoridation in Toronto

Where a municipality owns and operates a waterworks system, the process for fluoridating and the discontinuance of adding fluoride to its water, is governed by the Fluoridation Act R.S.O 1990, Chapter F.22. Section 3. The Act specifies that a municipality may not pass a bylaw to initiate or discontinue water fluoridation without submitting the question to the electors of the municipality and receiving a majority vote in favour.

The effect of discontinuance of water fluoridation on the oral health of Toronto's population should be the prime concern of the Toronto Board of Health and Toronto City Council.

Studies done on Toronto's children 12 years after the introduction of water fluoridation and again in 2000, show that by 2000, there was a 77.4 per cent mean reduction in decayed, missing and filled baby teeth for five year old children and a 390% increase in the percentage of children with no tooth decay. Similarly in 13 year olds, by 2000 there was a 79.4 per cent reduction in decayed, missing and filled permanent teeth and a 501% increase in the percentage of children who were decay free. These results are in comparison to children of similar ages in 1963, when water fluoridation was implemented in Toronto. While not all the improvement in dental health can be attributed to water fluoridation, water fluoridation is a contributing factor to this dramatic improvement in oral health for Toronto's children.

This decline in caries for children in Canada is consistent with other industrialized countries where there is water fluoridation or access to other systemic forms of fluoride and/or comprehensive preventive and treatment dental programs that are publicly funded. This is not true for developing countries that are experiencing very high caries rates in children, due to changes in diet including higher content of refined carbohydrates, combined with the lack of access to fluoride and to regular professional dental care.

Current scientific evidence shows mixed results on the oral health status of populations when water fluoridation is discontinued. In Antigo, Wisconsin, after five and one-half years of cessation of water fluoridation, second graders had over 200% more decay, fourth graders 70% and sixth graders 91% more decay. Similar results were observed in Wick, Scotland and Stranraer, Scotland (3).

There are several studies that report no increase in dental decay following the discontinuance of fluoridation. However in these cases, implementation of other preventive measures were introduced at the time that water fluoridation was discontinued. For example in La Salud, Cuba a study showed that the rate of dental decay did not increase after water fluoridation was stopped. However when water fluoridation was stopped, children received regular fluoride mouthrinses, and fluoride varnish was placed on teeth in a comprehensive school preventive dental program (3).

Similarly in Finland a longitudinal study of Kuopio (fluoridated from 1959 to 1992) and Jyväskylä (low levels of natural fluoridation) showed little difference in decay rates. However, Finland has a government-sponsored free, comprehensive dental program where Finnish children are exposed to a regimented, professionally supervised preventive dental program of topical fluorides and dental sealants (3).

In East Germany when water fluoridation was discontinued, salt fluoridation and other preventive measures were introduced and so there was no significant increase in dental decay (3).

The study that gives the greatest indication of what might happen in Toronto if water fluoridation is discontinued, is a study conducted in British Columbia, Canada. This study found that removing water fluoridation led to an increase in dental caries compared to the fluoridated control site. This relationship was determined for both the prevalence and incidence of caries when other risks were controlled. Over the three years of the study, 14 year olds from the site where fluoride was discontinued, acquired 2.29 cavities compared to 1.82 in the site that was still fluoridated (7).

If Toronto discontinues water fluoridation, it is incumbent on the Toronto Board of Health and Toronto City Council to ensure that sufficient funds are allocated to implement a comprehensive, preventive and treatment dental program for all Toronto children to reduce the likelihood that the oral health of Toronto's population will deteriorate.

However, the scientific evidence and Toronto's experience of fluoridating water for the last 44 years, show that water fluoridation is a safe, economical and effective oral health preventive measure that has resulted in improved oral health for Toronto's population.

Health Canada has initiated a review of the exposure to fluorides from drinking water, and their potential effects. This review will update the recommendation for the Maximum Allowable Concentration (MAC) for water fluoridation and the optimum level of fluoride. When these new guidelines are issued, TPH will review the current concentration of fluoride in Toronto's water to ensure that the total exposure to fluoride strikes a balance between providing maximum dental benefits while minimizing dental fluorosis.

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