

# THE FLUORIDE TECHNICAL STUDY GROUP

## Executive Summary

The Fluoride Technical Study Group (FTSG) was charged with compiling a report that assesses risks and benefits of community water fluoridation in order to assist risk managers (The Larimer County Board of Health, the City of Fort Collins Water Board, and the Fort Collins City Council) to decide whether to continue, alter or discontinue the City's water fluoridation program.

A more complete discussion of the FTSG's work and a description of the studies and findings are contained in the attached report. This summary begins with five of the most important considerations underlying the report and its findings, and then presents the findings themselves:

These are some of the essential considerations:

The FTSG elected to use a tiered approach to reviewing the existing literature on water fluoridation, turning first to already conducted and published scientific literature research reviews and compilations. Only when a gap in the data became evident or when a specific need for more information was needed did the group turn to and evaluate published, peer-reviewed primary studies.

2. The FTSG, for the most part, limited consideration to scientific studies of drinking water fluoridation at or around 1 milligram per liter (mg/L) or 1 part per million (ppm), because it is the target amount of fluoride added to the City of Fort Collins water supply (range of 0.7 – 1.2 mg/L with data indicating stringent control at 1.0 mg/L).
3. The levels of fluoride in untreated water range from 0.15 - 0.25 mg/L fluoride ion. If the City were to end its water fluoridation program, the drinking water in Fort Collins would continue to contain some fluoride.
4. The United States Environmental Protection Agency (EPA), under the Safe Drinking Water Act (42 USC 300), promulgates the National Primary Drinking Water Regulations. These regulations set the maximum contaminant levels (MCLs) for chemicals in finished water supplied by public water systems. The EPA has established an MCL for fluoride of 4.0 mg/L.
5. The FTSG endeavored to create a balanced product for use by decision-makers that took into account the most current and best available analysis of the weight of the scientific evidence on the risks and benefits of community water fluoridation. The group also acknowledged that there are gaps in the knowledge and uncertainties are inherent in the ability to fully understand what may be subtle, yet important health effects that are yet to be detected via a weighted evidence approach. Thus, the report includes stated uncertainties and areas where additional research is needed to better understand the true benefits and risks.

## FINDINGS

After considering public concerns and discussion—then focusing—the list of important questions, the FTSG has developed consensus findings in four categories:

The effectiveness of drinking water fluoridation.

2. The risks of drinking water fluoridation and of cumulative exposure to fluoride from all sources, including drinking water (over time) with specific attention to cancer, bone fractures, skeletal fluorosis, dental fluorosis, thyroid function, and immune system effects.

3. The costs and benefits of fluoridating the drinking water supply, and of not fluoridating the drinking water supply, including assessing the distribution costs and benefits (equity), and including the costs and benefits of using alternative methods to deliver fluoride.
4. The potential for increased contaminant levels in the drinking water due to the use of hydrofluorosilicic acid in the fluoridation process.

### **Finding #1 – The Effectiveness of Drinking Water Fluoridation in Preventing Caries (Cavities)**

The weight of the evidence suggests that there is caries (cavities) reduction in populations exposed to water fluoridation at or near an optimal level. The primary mode of action of fluoride in preventing caries is its topical action on the surface of the teeth; systemic action from ingestion is now thought to play a minor role. It appears that community water fluoridation is effective in all age groups in preventing dental caries. This benefit amounts to a relative caries reduction of 25% and an absolute prevalence difference of 1.14 surfaces with caries in primary teeth and 0.5 surfaces with caries in permanent teeth in children according to the most recent U.S. surveys of schoolchildren. Among the four studies of caries prevention in adults, the most recent study showed that community water fluoridation reduced surfaces with caries by 0.35 surfaces per year of fluoride exposure. The benefit of drinking water fluoridation decreases as individuals in the population receive fluoride from other sources (e.g., toothpastes, dental care, etc.). Even with the limitations of some of the studies, there appears to be a net benefit in caries reduction from drinking water fluoridation over and above that from toothpaste and other sources of fluoride. Among the 14 recent studies (completed after 1985) reviewed in which water fluoridation was discontinued, nine showed an increase in caries rates. Five communities (all of them in other countries) that suspended water fluoridation did not find that caries rates increased. It is uncertain to what degree changes in oral health behaviors, introduction of new preventive programs and increased delivery of professional treatments in response to cessation of fluoridation can account for these findings. Since these studies were conducted in foreign communities in which there was socialized dental care and school-based oral health programs, their results may not apply to Fort Collins.

### **Finding #2 – The Risk of Drinking Water Fluoridation**

#### **Total Fluoride Exposure**

Total fluoride exposure must be considered when evaluating health effects. The amount of total fluoride ingested will vary between individuals and is not precisely known. The FTSG review of the literature finds that likely total exposure values for children older than six months living in communities with water fluoridated at up to 1.2 mg/L (ppm) do not exceed the upper limit set to be protective of moderate dental fluorosis by the Institute of Medicine. Total dietary exposures of fluoride can exceed this threshold amount (0.7mg/day) in infants fed formula reconstituted with optimally fluoridated water.

#### **Cancer**

Although a small increase in cancer risk cannot be excluded, there is no consistent evidence from human or animal studies that exposure to optimally fluoridated drinking water and other sources causes any form of cancer in humans, including bone and joint cancer. The agreement between the epidemiological and toxicological literature reduces the uncertainty associated with any one line of evidence finding.

Additional research is needed to address the remaining uncertainty whether community water fluoridation may cause cancer in humans following long-term exposures of greater than 40 years.

#### **Bone Effects**

The FTSG agrees with the conclusion of the Medical Research Council of Great Britain that states, “The possibility of an effect on the risk of hip fracture is the most important in public health terms. The available evidence on this suggests no effect, but cannot rule out the possibility of a small percentage change (either an increase or a decrease) in hip fractures” (Medical Research Council 2002, page 3).

### **Skeletal Fluorosis**

At the concentrations of fluoride provided in Fort Collins water including exposures from all sources over a lifetime, skeletal fluorosis caused by drinking water exposure is not likely to be a health issue. The available data are not consistent with a likelihood of increased human skeletal fluorosis from city water fluoridation.

Additional research is needed to reduce the remaining uncertainty if cumulative exposure to all sources of fluoride (including drinking water fluoride at levels of 1 mg/L) over a lifetime may lead to pre-clinical or milder forms of skeletal fluorosis in some sensitive populations

### **Dental Fluorosis**

At the concentrations of fluoride provided in Fort Collins water, in combination with other sources of fluoride, as many as one in four children under age 8 may develop very mild to mild dental fluorosis. This degree of fluorosis may or may not be detectable by the layperson. With oral health as the goal, this degree of dental fluorosis is considered an acceptable adverse effect given the benefits of caries prevention. Since about 60% of dental fluorosis can be attributed to other sources of fluoride, particularly toothpaste and other dental products, parental supervision over tooth paste swallowing in their young children and proper prescribed supplementation in infants will likely reduce development of enamel fluorosis more than the removal of added fluoride in drinking water.

### **Thyroid Effects**

In the literature reviewed, doses appropriate for caries reduction were not shown to negatively impact thyroid function. Studies in which humans received doses significantly higher than the optimum fluoride intake for long periods of time showed no negative impact on thyroid function. For those with hypothyroidism, the risks of alteration of thyroid structure or function are very low. The absence of our finding any conclusive evidence that drinking water fluoride exposures causes increased risk to thyroid function does not prove that fluoride can not affect thyroid function. The available data are consistent with a finding of a low likelihood of risk to human thyroid function from water fluoridation.

### **Immunological Effects**

Overall, evidence is lacking that exposure to fluoride through drinking water causes any problems to the human immune system. The absence of our finding any conclusive evidence that drinking water fluoride exposures causes increased risk to human immune system function does not prove that fluoride is harmless to the human immune systems.

### **Other Health Effects**

The potential for other health effects was reviewed by the FTSG. There was not adequate evidence to consider any of these other potential adverse effects a concern with respect to fluoridation of Fort Collins water supplies. The absence of our finding any conclusive evidence that drinking water fluoride exposures causes other potential health effects does not prove that fluoride can not cause other potential health effects.

### **Finding #3 – Costs and Benefits, Including the Distribution of Costs and Benefits**

The research indicates that the public health goal of a reduction in the incidence of caries is better achieved through community water fluoridation than through individual approaches. It requires minimal behavioral changes compared to alternative delivery methods. It is effective in reaching people in all socioeconomic strata.

The FTSG finds that, even in the current situation of widespread use of fluoride toothpaste and lower baseline caries risk, it is likely that community water fluoridation remains effective and cost saving at preventing dental caries. Based on best available evidence, suspending fluoridation of water in Fort

Collins would yield a net increase in costs of preventing and treating caries of approximately \$4.25 per person per year (range \$3.22 - \$10.31). The burden of caries is disproportionately borne by those with lower socio-economic status. There is some evidence that water fluoridation reduces this inequality in oral health.

Not considering the costs of enamel fluorosis or other potential adverse health effects may have led to an over-estimation of the cost-savings of water fluoridation in Fort Collins. The magnitude of the costs of adverse effects is likely to fall well below the estimated net savings.

In summary, this cost analysis assumes that there is a significant benefit from community water fluoridation in preventing caries and that suspending community water fluoridation would result in a relative increase in caries. It also assumes that potential adverse health effects are not significant. The analysis also assumes that the city will continue using current fluoride additives (hydrofluorosilicic acid). Using this set of assumptions, there appears to be a net cost benefit to community water fluoridation. If any of these assumptions are not valid the cost-benefit picture could change significantly.

The FTSG did not review any study or measure that will achieve the same levels of prevention as water fluoridation for the same resources.

#### **Finding #4 – The Potential for Increased Contaminant Levels Due to the Use of Hydrofluorosilicic Acid**

The FTSG's review identified three potential concerns associated with hydrofluorosilicic acid (HFS). 1) co-contamination (i.e. arsenic and lead), 2) decreased pH leading to increased lead solubility or exposure, and 3) potential toxicological effects from incomplete dissociation products of HFS. The FTSG used the raw and finished water quality data for the City of Fort Collins to determine whether the addition of HFS was responsible for the potential addition of contaminants such as heavy metals to the city's drinking water. There was no evidence that the addition of HFS increased the concentrations of copper, manganese, zinc, cadmium, nickel, or molybdenum. The concentrations of arsenic and lead were below the detection limit for the Fort Collins Water Quality Control Laboratory in both the source water and the finished water and below the maximum contaminant level (MCL) for these naturally occurring elements. There was no evidence that the introduction of HFS changed the pH of the water appreciably. Concern that HFS incompletely dissociates may be unfounded when the fundamental chemical facts are considered. Therefore, it is unlikely that community water fluoridation poses a health risk from the exposure to any of these chemicals present in the water as it leaves the plant. Further studies related to the health effects of HFS are in progress.