To: Health Commission of the National Assembly of Quebec
From: James S. Beck, MD, PhD
Re: Fluoridation of public water supplies in Quebec

Please accept this submission for your deliberations on the matter of fluoridation of public water supplies in Quebec.

I am a physician and scientist and have studied the scientific basis and ethics of fluoridation over the past decade. The relevant aspects of my qualifications on this issue include:

Nationality: Canadian (1975)

Education:

Washington University School of Medicine, St. Louis, Missouri; M.D., 1957
University of California, Berkeley; Ph.D. (Biophysics), 1962

Professional Positions:

Research Associate Biophysicist, Lawrence Radiation Laboratory, University of California; 1962
Assistant Professor of Physiology and Lecturer in Physics, University of Minnesota, Minneapolis; 1962-1969
Associate Professor, Division of Medical Biophysics, Faculty of Medicine, University of Calgary, Calgary, Alberta; 1969-1976
Professor, 1976-1991
Professor Emeritus of Medical Biophysics; 1991-present

Books authored:

Biomembranes: Fundamentals in Relation to Human Biology. Hemisphere/McGraw-Hill, New York, 1980.
The Case Against Fluoride, Chelsea Green, White River Junction, Vermont, 2010 (co-authored with Drs. Paul Connett and H. Spedding Micklem).

Research:

Over a span of 34 years, research in radiobiology, pharmacokinetics, the biophysical properties of red blood cells and theoretical work in collaborations in other biomedical fields.

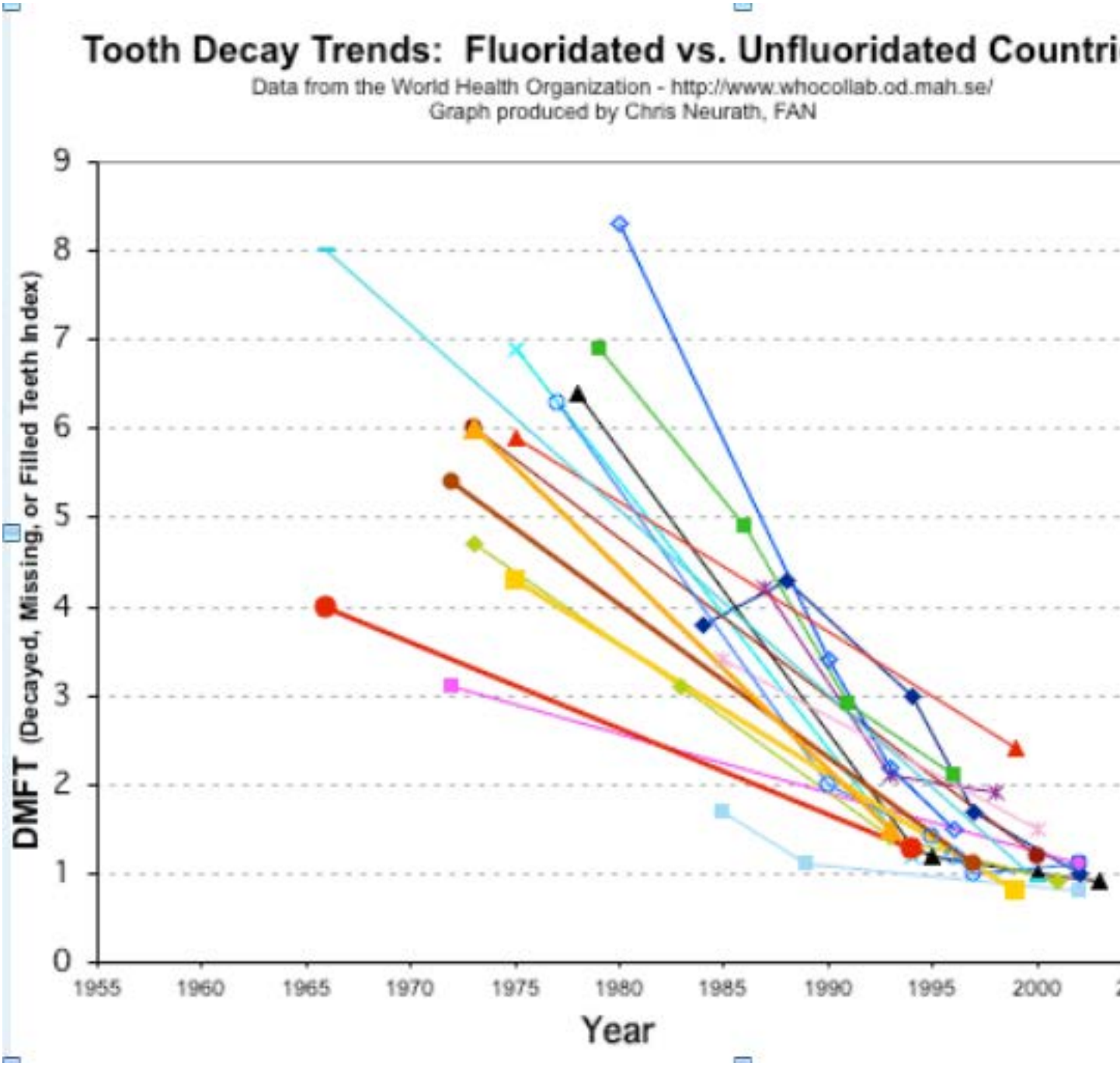
Comments to the Commission:

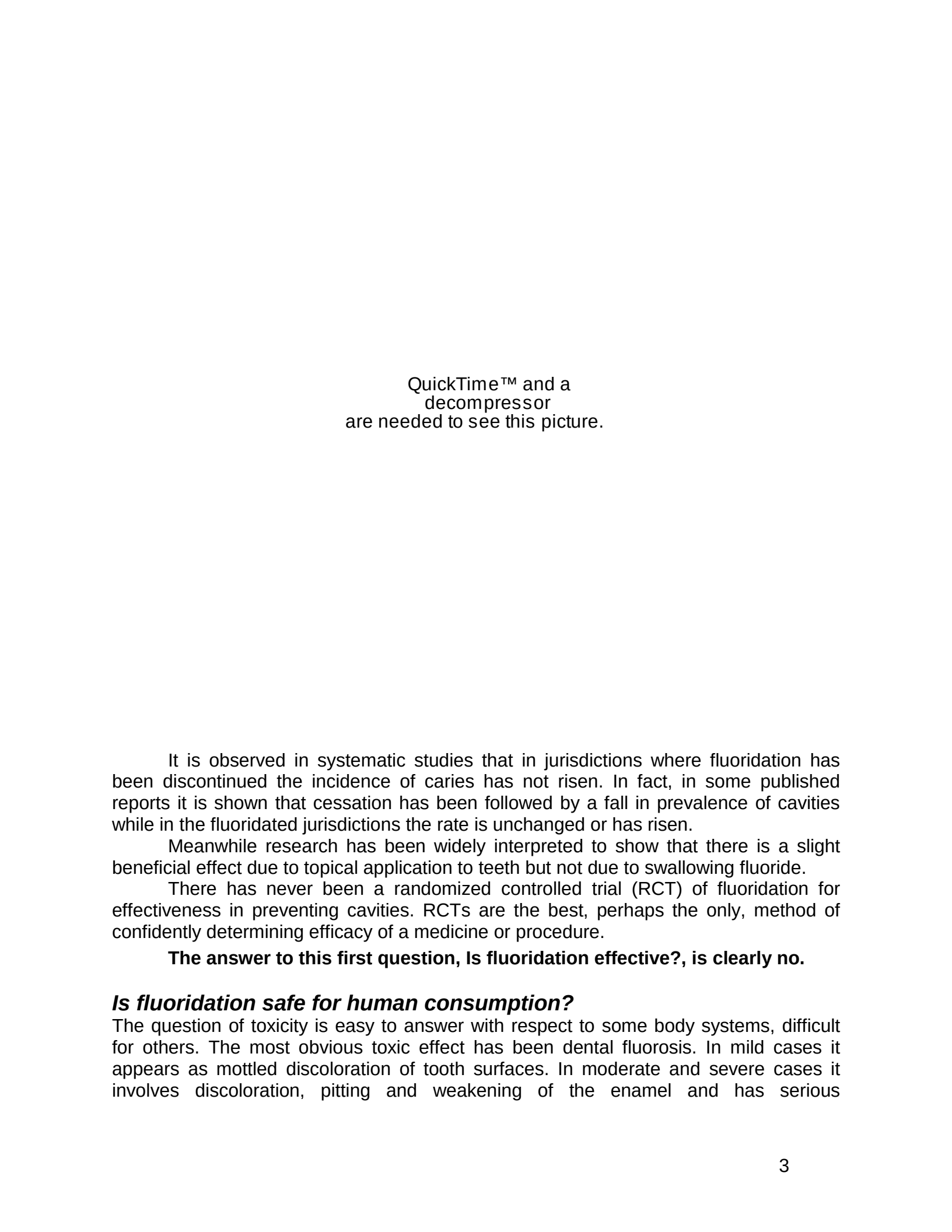
I have come to the conclusions that fluoridation is not effective, is not safe and is not ethical. Some reasons are given below. In addition to these comments on science and ethics, I will add brief discussions of the substances used to fluoridate municipal water supplies, of the application of the precautionary principle to fluoridation and a bit of recent history of fluoridation in Alberta.

Is fluoridation effective in preventing cavities?

Fluoridation of public water supplies has been in effect somewhere in the world for seven decades now. Over that time the prevalence of dental caries (cavities) has fallen in industrialized countries. This has been taken by many to indicate efficacy. But research has consistently shown that the decrease has occurred in countries without fluoridation to the same or greater degree as in those with fluoridation. Below are two graphic representations of interest. The first is from data of the World Health

Organization. It shows a steady decline in cavities in industrialized countries from the time fluoridation started to the year 2004. Tooth decay has occurred to the same extent in the fourteen nonfluoridated countries as in the four fluoridated countries; clearly the decline is not a result of fluoridation. The second graphic is out of date; some of the percentages fluoridated are now appreciably lower due to the growing number of jurisdictions stopping fluoridation, especially in Alberta where the percentage of the population using fluoridated water is now close to 30%.





It is observed in systematic studies that in jurisdictions where fluoridation has been discontinued the incidence of caries has not risen. In fact, in some published reports it is shown that cessation has been followed by a fall in prevalence of cavities while in the fluoridated jurisdictions the rate is unchanged or has risen.

Meanwhile research has been widely interpreted to show that there is a slight beneficial effect due to topical application to teeth but not due to swallowing fluoride.

There has never been a randomized controlled trial (RCT) of fluoridation for effectiveness in preventing cavities. RCTs are the best, perhaps the only, method of confidently determining efficacy of a medicine or procedure.

The answer to this first question, Is fluoridation effective?, is clearly no.

Is fluoridation safe for human consumption?

The question of toxicity is easy to answer with respect to some body systems, difficult for others. The most obvious toxic effect has been dental fluorosis. In mild cases it appears as mottled discoloration of tooth surfaces. In moderate and severe cases it involves discoloration, pitting and weakening of the enamel and has serious

consequences. (The terms “mild”, “moderate” and “severe” are used in a clinical classification. Even the mild level can be disturbingly disfiguring.) In Canada the treatment of this condition costs tens of thousands of dollars per patient. Even if this effect were only cosmetic, it can have serious negative effects on a child’s or teenager’s life.

Evidence uncovered over the last two decades has shown an association of fluoride in drinking water, at concentrations comparable to those where water is artificially fluoridated, with lower IQ (so-called intelligence quotient) in children. There are now 36 published studies showing this association. In 2012 a meta-analysis from the Harvard School of Public Health was published in a respected, peer-reviewed journal (Choi et al., *Environ Health Perspect.* 2012 October; **120**(10): 1362–1368. Developmental Fluoride Neurotoxicity: A Systematic Review and Meta-Analysis : http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3491930/). A meta-analysis is a formal, standard way of examining and combining the results of investigations on a question. The first step is to look at all accessible published studies on the question and to evaluate each one of them. The Harvard group of three authors found 27 studies they considered worthy of inclusion in their analysis. These papers were reports of the IQs of children in groups using water with higher concentrations of fluoride and of those using water with lower concentrations. One of the studies revealed a slightly higher mean IQ in the group using water with higher concentration of fluoride. Twenty-six showed higher IQ associated with lower concentration. The result of combining the results of the individual studies was a difference of 6.9 IQ points, higher IQ for lower fluoride. Such a shift in the mean IQ of a population would have dramatic effects: a major increase in the number of persons requiring medical and social services and a significant decrease in the number of intellectually gifted persons.

Such an effect on the development of the brain is not so surprising. In laboratory studies of animals and of spontaneously aborted human fetuses an association of fluoride exposure with abnormalities of cells of the brain has been found. Also studies of animals other than humans have shown behavioral effects. It has been shown that fluoridation is associated with high levels of lead, a known neurotoxin, in the blood of children.

On the basis of strong evidence widely accepted it is clear that fluoride intake is a cause of impaired thyroid function. In this case we have not only epidemiological evidence, but we have laboratory evidence for the mechanisms by which fluoride effects thyroid function. Indeed fluoride was once used medically to suppress thyroid function as treatment for hyperthyroidism.

Deleterious effects on reproductive systems in humans have been found to be associated with fluoridation: in girls, early onset of menstruation; in men, low sperm counts and lower sperm quality.

We now have strong evidence of the association of osteosarcoma in boys and young adult males with fluoridation. Osteosarcoma is a bone cancer which is often fatal. The evidence shows a positive relation between death by osteosarcoma by age 20 years and use of fluoridated water by boys during the ages 6, 7 and 8 years, a time of accelerated growth (Bassin et al. *Cancer Cause and Control,* 2006).

The possible association of bone fracture with fluoridation has been studied with mixed results. A particularly convincing investigation is presented in a paper by Li *et al*.

published in 2001 which shows a rising prevalence of hip fracture correlated with a rising concentratioon of fluoride in drinking water, starting with concentrations comparable with those used in fluoridation in North America. And this is just one example that suggests that hip fracture is associated with fluoridated water.

Fluoride adversely affects kidneys. Recently two papers have appeared on studies showing adverse effects on the heart and the aorta. And there are other possible toxicities.

A study of possible toxicities of fluoride and fluoridation done by a panel of twelve scientists was published in 2006. It is probably the best such effort ever done. It was sponsored by the National Research Council in the United States. These scientists and experts in risk analysis had the help of dozens of consultants. They worked on this for over three years and produced a book of 507 pages citing over one thousand papers. They concluded that there are several adverse effects which are definitely associated with ingestion of fluoride at doses resulting from fluoridation of tap water.

The multiplicity of demonstrated and possible toxicities is not surprising when one recognizes that fluoride reacts with many components of the human body. For example, fluoride has been used in thousands of laboratory investigations as an inhibitor of enzymes, the proteins that catalyze (facilitate) biochemical reactions. It is also well known that fluoride, in combination with other elements such as aluminum and with components of cell membranes, disrupts normal signalling of hormones and other messengers across the membanes that activate or moderate cellular functions. In view of these effects on enzymes and on signalling across cell membranes, multiple toxicities are to be expected.

There are groups in any sizable population that are especially susceptible to adverse effects of swallowing fluoride. These groups include infants and young children, the elderly, persons with low iodide in their diet, persons with impaired kidney function, and persons who, because of work and recreational activities, drink a lot of water. Also there is considerable evidence that a small fraction of people are especially sensitive to severe, acute effects, but this has not been subjected to large-scale, systematic investigation.

So the answer to the second question, Is it safe?, is clearly no.

All that I have said here is backed up by scientific reports in peer-reviewed journals. References are available on the websites <fluoridealert.org> and <slweb.org> and are discussed in a book published in September, 2010, and reviewed at <www.fluorideresearch.org/433/files/fj2010_v43_n3_p170-173.pdf>.

Is fluoridation ethical?

Given the evidence that fluoridation is at best minimally effective and that it is unsafe, the question of ethicality is easily answered in the negative. But even if it were effective, it would not be acceptable for the following reasons.

- It is unethical to administer a substance or procedure to a person without the informed consent of that person. Informed consent means that the recipient of the medicine or procedure must have been given after being informed of the reasons for the administration and after being told of possible side effects.

- It is unethical to administer a substance or procedure that has not been approved for the purpose by a qualified body.
- The dose and/or intensity must be monitored and controlled (controlling the concentration in tap water does not control the dose which is the amount swallowed or injected per unit time; a more important form of dose is the amount ingested per unit time per unit body weight). The amount of water a person drinks in a day easily varies by a factor of twenty. Infants and children drink much more per kilogram body weight than adults, as do persons suffering diabetes, a common disease.
- The effects on individuals must be monitored by a qualified professional.
- The recipient must be able to stop the administration at will.

These are simple precepts of medical ethics and they are a matter of human rights. Fluoridation of a public water supply fails on all these ethical requirements.

So the answer to the third question, Is fluoridation ethical?, is no.

Fluoridation chemicals

Almost all of the substances used to fluoridate in North America are hydrofluorosilicic acid (HFSA) or its sodium salt. These have not been tested or approved for human consumption, even though such testing is required by law for substances added to drinking water. HFSA is a by-product of industrial processes. It was a waste product that caused damage to crops and domestic animals; so its release into the environment was made illegal. It is still illegal to put it into rivers, lakes, oceans and air. But it is disposed of, sold for profit, by putting it into tap water for human consumption. It arrives at the water plant as a 23% aqueous solutions, dangerous to transport and to handle. These solutions delivered to water-treatment plants are not pharmaceutical grade, not purified. They contain toxic elements including lead, arsenic and uranium.

It is argued by promoters of fluoridation that this solution is diluted to an extreme extent and is therefor harmless and that the HFSA is dissociated (separated into componenst of the original molecule). It is largely true that HFSA dissociates almost completely when diluted to this extent, but that is irrelevant. What is important is what results for the contents of the stomach. The stomach content is very acidic. In an acidic solution the fluoride derived from the addition of HFSA to tap water will combine with hydrogen ions to form hydrofluoric acid (HF), a very corrosive and toxic chemical that crosses the walls of the stomach and intestines to enter the blood where it is distributed to all the tissues of the body. HF crosses cell membranes and does damage both inside and outside the cells of the body.

HFSA and fluoride as used in fluoridation are drugs (medicines) because they are used to prevent a disease (dental caries). By definition and by judgements of courts, including the Supreme Court of Canada (1957) fluoride in fluoridated water is a drug. Still they are not approved as drugs or as water additives. Most or all Canadian Provinces stipulate that such an additive must be certified to meet specific conditions. The institution (National Sanitation Foundation) required to certify has not done or acquired the toxicological studies required.

Promoters have said that fluoride is a nutrient. A nutrient is a natural substance that is necessary in the diet for maintenance of health. It has never been found that fluoride is necessary for humans or any other mammal. It is not a nutrient or “essential

element” for humans. HFSA is not found in nature.

Application of the precautionary principle to fluoridation

The details of the precautionary principle provide a systematic process for deciding whether a procedure intended to protect the health of a population should be implemented or stopped. It is a way of weighing possible benefit against risk. The questions to ask and the answers required in applying the principle to fluoridation of a public water supply follow below.

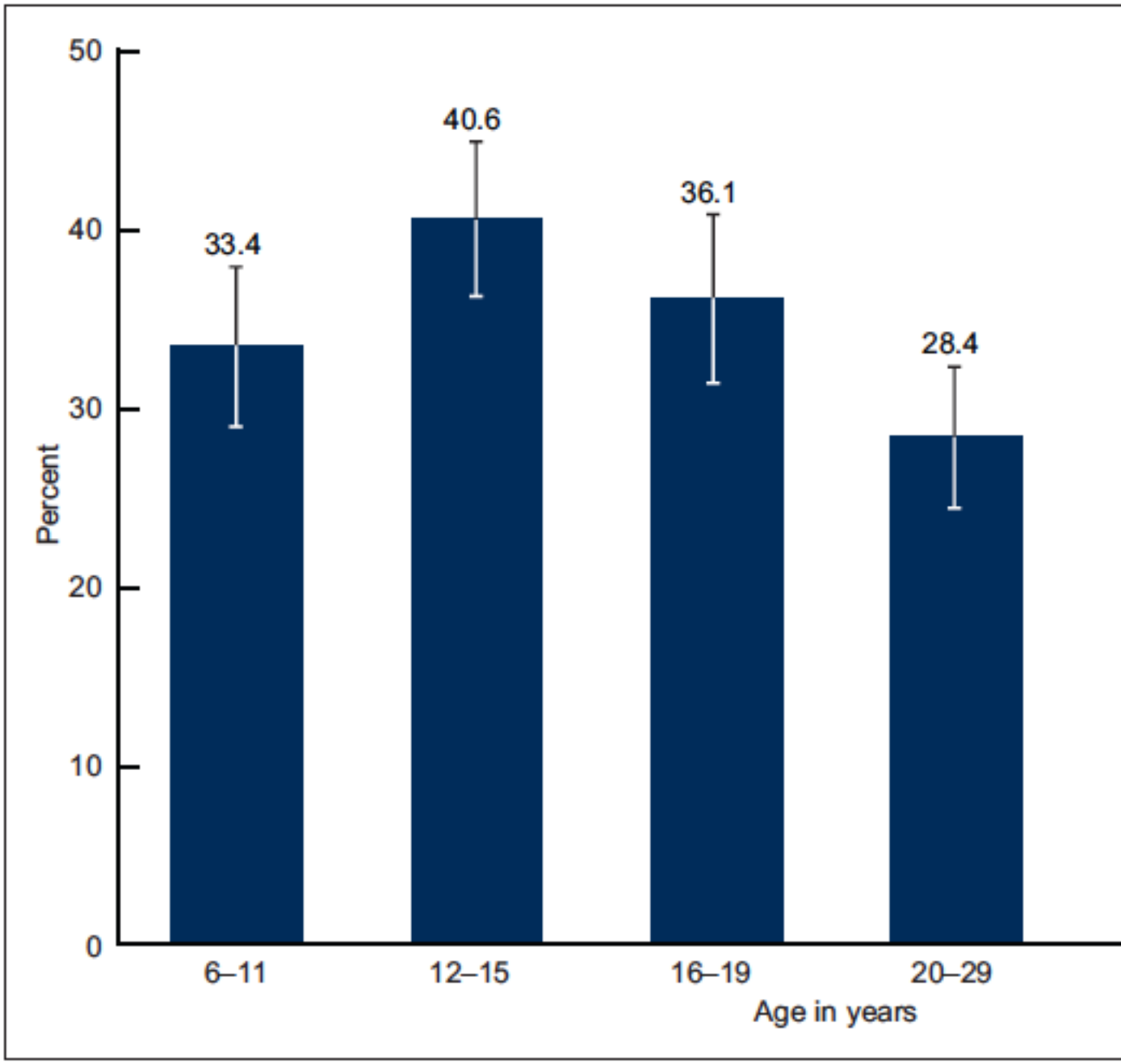
Is the expected benefit a substantial improvement in health?

There is no doubt that dental caries (cavities) can compromise health and well-being. But the evidence as reported in many credible scientific publications shows that fluoridation is associated with either no fewer cavities or with a very small saving. A strong study of 39,000 children showed a saving of less than one tooth surface out of 128 tooth surfaces in children (Brunelle and Carlos, *Journal of Dental Research* (1990), **69:** Special Issue, pp. 723-727). And such differences between fluoride-exposed and non-exposed can be explained by a fluoride-caused delay in eruption of the teeth (coming through the gum into the mouth where teeth are subject to caries) which has been observed in many investigations. There is at best very little benefit.

Is there credible evidence of immediate or potential harm?

There is much evidence of harm. Dental fluorosis, which can be very serious, is certainly caused by fluoridation. According to the Centers of Disease Control and Prevention of the US over 30% of the US population and 41% of children 12-15 years of age have dental fluorosis (see graph below).

Figure 2. Prevalence of dental fluorosis among persons aged 6–49, by age group: Unit



NOTES: Dental fluorosis is defined as having very mild, mild, moderate, or severe forms and is based on Dean's Fl
confidence intervals.

SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 1999–2004.

Thyroid suppression is also certain. Hip fracture is very likely, as are some adverse effects on the reproductive system. There is considerable evidence of lower IQ being associated with exposure to fluoride in drinking water at levels comparable to those used in North America. There is evidence of other effects which have not been investigated sufficiently to be certain.

Are the possible harms reversible?

Some effects, certain and possible, are reversible but some are not. Effects on the development of teeth and of the nervous system, for examples, are not reversible. Reversibility of a harm, of course, is important, but even a reversible effect can be very serious and/or can take a long time to reverse.

Are there safe and accessible alternatives for obtaining the benefit?

The decrease in the prevalence of cavities equally in fluoridated and non-fluoridated industrialized countries over the past five decades suggests strongly that the benefit is not due to fluoridation and that there are other causes such as improved diet, better dental hygiene and better access to dental services. Evidence indicates that direct action of fluoride on tooth enamel is moderately effective. Topical application is available in dental offices and from use of fluoridated toothpaste. There is evidence that suggests that adequate amounts of vitamin D in the diet prevents cavities.

If the procedure is in practice, is there any risk associated with stopping it?

This question bears heavily on the case of fluoridation, because promoters often threaten municipal councils with a disastrous rise in the incidence of cavities if they stop fluoridation. The fact is that systematic investigations have many times shown that after cessation of fluoridation the incidence of cavities either does not change or decreases. Here are quotes from four, out of many, published papers:

> "The prevalence of caries decreased over time in the fluoridation-ended community while remaining unchanged in the fluoridated community."
> SOURCE: Maupome G, Clark DC, Levy SM, Berkowitz J. (2001). Patterns of dental caries following the cessation of water fluoridation. *Community Dentistry and Oral Epidemiology* **29**: 37-47.

> "The fact that no increase in caries was found in Kuopio despite discontinuation of water fluoridation and decrease in preventive procedures suggests that not all of these measures were necessary for each child."
> SOURCE: Seppa L, Karkkainen S, Hausen H. (2000). Caries Trends 1992-1998 in Two Low-Fluoride Finnish Towns Formerly with and without Fluoridation. *Caries Research* **34**: 462-468.

> "In contrast to the anticipated increase in dental caries following the cessation of water fluoridation in the cities Chemnitz and Plauen, a significant fall in caries prevalence was observed."
> SOURCE: Kunzel W, Fischer T, Lorenz R, Bruhmann S. (2000). Decline of caries prevalence after the cessation of water fluoridation in the former East Germany. *Community Dentistry and Oral Epidemiology* **28**: 382-9.

> "In 1997, following the cessation of drinking water fluoridation, in contrast to an expected rise in caries prevalence, DMFT and DMFS values remained at a low level for the 6- to 9-year-olds and appeared to decrease for the 10/11-year-olds. In the 12/13-year-olds, there was a significant decrease, while the percentage of caries-free children of this age group had increased..."
> SOURCE: Kunzel W, Fischer T. (2000). Caries prevalence after cessation of

water fluoridation in La Salud, Cuba. *Caries Research* **34**: 20-5.

It is clear that fluoridation does not pass the precautionary test.

With respect to possible harm it must be recognized that the rational procedure is to withhold a procedure until it is certain that it is safe, not to continue it until it is certain that it is not safe. With the uncommon exception where an intervention is uniquely preventive of life-threatening harm, if there is doubt on safety the cautious way is the better way.

A bit of informative history from Alberta

My involvement in the fluoridation issue began in 1999. I have participated in the proceedings in nine provinces, mostly by testifying before municipal councils and submitting written comments to councils. Since that time many jurisdictions have stopped or refused to start fluoridation. In the case of Calgary, a city of 1.3 million people in Alberta, the councillors were lobbied to stop fluoridation and educated themselves on the matter for a decade or so. Most of the councillors were re-elected during that time, so by 2011, when fluoridation was stopped, only the new mayor and one new councillor felt themselves inadequately informed on the issue and opted not to change the status quo. With one long-standing councillor there were three votes against the motion to stop from a council of fifteen members.

Over the past decade the fraction of Albertans using fluoridated water has fallen from 74% to around 30%. Many councillors have come to the conclusion that the advice from the medical and dental officers of health of Alberta Health Services is not reliable. It is certainly true that these professionals who have the responsibility of protecting the health of Albertans have denied the existence of evidence that appears in scientific journals, have misrepresented conclusions of competent panels on fluoridation, have apparently misunderstood critical papers on the subjects of efficacy and toxicity, and have failed to cite any credible studies that show fluoridation to be either effective or safe. The same criticism, and the growing distrust of the health officials who promote fluoridation, applies to all of the provinces I have been involved with. Quebec is the one province where I have not observed or participated.

However, I have been told by councillors that the scientific arguments—with experts and supposed experts coming from both sides of the argument—was difficult to deal with. They have said that ultimately it was the ethical argument that most moved them to oppose fluoridation.

I recognize that I am addressing a parliamentary commission, not a city council. But both situations involve politicians with a profound responsibility, thrust on them by law in the case of a town or city council. Acting to stop or to prevent fluoridation, whether at the provincial or the municipal level, is a responsible act that would save many citizens from ill health and possibly from early death. And many would greatly appreciate having more freedom with respect to managing their own health.

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