

Water Fluoridation: a Review of Recent Research and Actions

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ABSTRACT

Fluoridation of drinking water began 60 years ago in the United States, and it continues in 60% of public water supplies in the country today. Much of Australia, Canada, Ireland, and New Zealand have fluoridated water, but most developed non-English speaking countries have rejected this practice as nonbeneficial and possibly harmful.

Current fluoridating agents, sodium hexafluorosilicate and hexafluorosilicic acid, which replaced sodium fluoride by 1980, differ from the calcium fluoride in naturally fluoridated water, which was the basis for claims of tooth decay prevention in early epidemiologic studies. Studies reported in the past 15 years support only possible slight benefits from water fluoridation for the deciduous teeth of 5-year-old children, although topical fluoride treatments may be effective.

Harmful effects may include bone and tooth fractures and increased cancer rates.

Complex legal maneuvers have been used in an effort to prevent or stop fluoridation. The case against it has been weakened by opponents' condemnation of all organofluorine compounds.

Individuals can use several methods to remove fluoride from water.

Essential Chemistry

Fluorine (F_2 or $F-F$) is element #9 in the Periodic Table. The fluoride ion (F^-), which has one negative charge, must be accompanied by a cation such as sodium (Na^+), as in sodium fluoride (Na^+F^- or NaF). Other inorganics, such as liquid hydrofluoric acid (HF , often called hydrogen fluoride as a gas), hexafluorosilicic acid (H_2SiF_6), and compounds with a $P-F$ bond, such as the sodium monofluorophosphate (Na_2PO_3F) used in toothpaste, as well as organics, such as methansulfonyl fluoride (CH_3SO_2F) and acetyl fluoride (CH_3COF), also form F^- in water or alkali.

The trifluoromethyl group (CF_3-) or the fluorophenyl group (FC_6H_4-) are often incorporated into drug molecules to make them more resistant to being metabolized. Organic polymers (Teflon) and refrigerants with $-CF_2-$ groups are usually extremely stable both chemically and thermally.

Brief History of Fluoridation

By the early 1900s it was noticed that inhabitants of some areas of the United States, especially parts of Colorado and Texas, had mottled teeth (dental fluorosis), and that children with fluorosis tended to have fewer cavities.¹ Usually the natural mineral fluorite, calcium fluoride (CaF_2), is the source of fluoride ion.

Industries that produced large quantities of fluoride byproducts were especially interested in this effect and have been accused by

antifluoridation activists of promoting water fluoridation as a method of toxic waste disposal.^{2,3} Information concerning the quantities of the waste and the proportion used in fluoridation has been unobtainable. The purported value of fluoridation for dental health has, however, served to mitigate concerns about the toxicity of fluoride wastes.

The Manhattan Project made use of uranium hexafluoride gas, fluoroorganic lubricants for metal bearings, and other fluorine-containing materials. Aluminum production, which increased greatly in World War II, utilized cryolite (Na_3AlF_6). Zinc and fluorocarbon production also soared with emissions of fluoride ion or its precursors.

An Alcoa-sponsored biochemist, Gerald J. Cox, fluoridated some laboratory rats in a study and concluded that fluoride reduced cavities, writing that: "The case should be regarded as proved."⁴ On Sept 29, 1939, at a meeting of the American Water Works Association in Johnstown, Pa., "...Cox proposed that America should now consider adding fluoride to the public water supply."²

In the 1940s, certain major figures in the Manhattan Project and in fluoride-waste-producing industries succeeded in using some epidemiologic studies, now discredited,⁵ to allow public water supplies to have sodium fluoride added in order to prove that 1 ppm of fluoride ion would "prevent tooth decay in children." None of these or later studies followed other dental or medical outcomes of fluoride consumption over long periods, a flaw that remains in many medical trials to this day.⁶

Henry Trendley Dean, D.D.S., a U.S. Public Health Service researcher, at first opposed the addition of fluorides to city water supplies because of toxicity. He later changed his mind, perhaps believing that mottled teeth were a small price to pay for less decay, or perhaps for other reasons. He later became the first Director of the National Institute of Dental Research (NIDR), and then, in 1953, a top official of the American Dental Association (ADA), two organizations that remain unshakably committed to fluoridation.⁷ They claim the credit for the drop in tooth decay in the United States during the past 50 years.

Once opposition by professionals was overcome, largely through the ADA and NIDR, the selling of fluoridation to the public was aided by hiring Edward L. Bernays, often called "the father of public relations," who had been hired earlier by the tobacco industry to persuade women to take up smoking.³

Fluoridation with sodium fluoride (NaF) was begun in the United States in 1945. Today, fluoridation uses hexafluorosilicic acid (H_2SiF_6) and its sodium salt (Na_2SiF_6) almost exclusively. These are not pure, but recovered in crude form by scrubbing the gaseous emissions from the treatment of phosphate ores with sulfuric acid. They contain variable amounts of lead, arsenic, beryllium, vanadium, cadmium, and mercury.¹ Because of this change in fluoridation agents, old studies based on the use of natural calcium fluoride or on chemically pure sodium fluoride are irrelevant, even had they been done correctly. Calcium is a strong

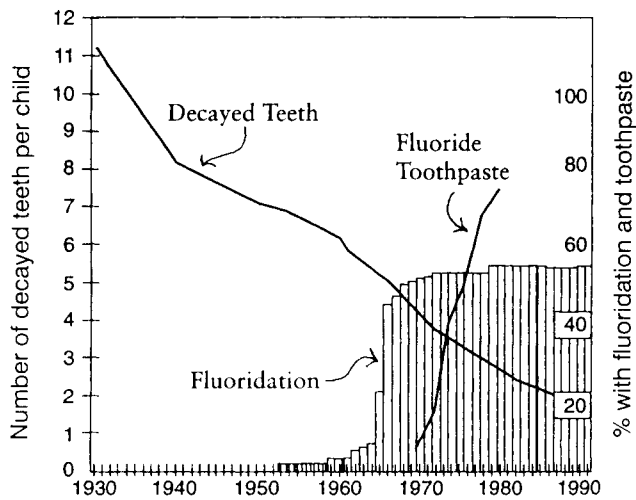


Figure 1. Tooth decay rates in 5-year-old children (left scale) vs. water fluoridation percentage (right scale) and fluoride toothpaste percentage (right scale). From Colquhoun,⁹ cited in Groves,¹ reprinted with permission.

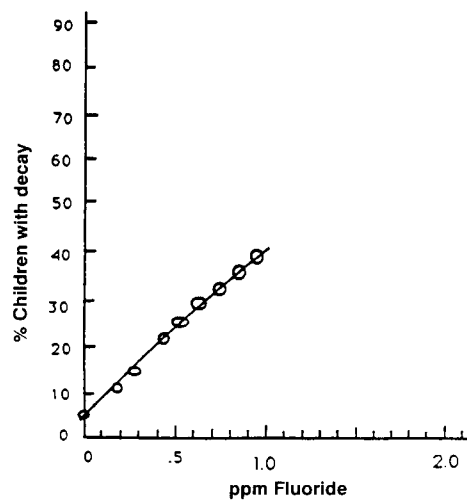


Figure 2. Study of tooth decay in 29,000 elementary schoolchildren in Tucson, Ariz., vs. fluoride content of their drinking water. Reprinted from Judd⁵, with permission.

antagonist of fluoride, reduces its concentration in plasma, and inhibits its absorption from the intestine.⁷

Fluoridation at 1 ppm fluoride reached its current extent by 1965. The proportion of fluoridated public water supplies is about 60% in the United States, 66% in Ireland, 55% in Canada, and 10% in England. Australia and New Zealand also use fluoridation extensively. At present almost none of the public water supplies in Austria, Germany, Luxemburg, Denmark, Finland, Norway, Sweden, the Netherlands, Switzerland, France, Italy, Belgium, Switzerland, Spain, Hungary, Portugal, Greece, Japan, and China are fluoridated. About half of these countries tried fluoridation, saw no benefit, and stopped it.¹

U.S. studies on the toxicity of fluorine compounds, not necessarily the ones used to fluoridate water, have reportedly been suppressed, classified, censored, and removed from the National Archives.² Some of this activity has been traced to Harold Carpenter Hodge, Ph.D., a biochemist and toxicologist at the University of Rochester, where he supervised experiments for the Manhattan Project involving the injection of unsuspecting hospital patients with uranium and plutonium compounds. He later became chairman of the National Research Council's Committee on Toxicology and the leading promoter of fluoridation in the United States during the Cold War. In 1953, Hodge, using data from a European study,¹ estimated that the amount of daily fluoride intake for 10-20 years that would *not* cause crippling skeletal fluorosis was 20-80 mg/day. It was later found that he had confused mg/kg with mg/lb. An American antifluoride campaigner, Darlene Sherrell, used the same European study from 1937 to estimate that skeletal fluorosis might be avoided with intakes of no more than 10-25 mg/day.¹

In 1975, the U.S. Food and Drug Administration (FDA) explicitly designated fluoride as "not generally recognized as safe" and permitted no fluoride whatsoever to be added to food or to over-the-counter dietary supplements. Nevertheless, the Department of Health, Education and Welfare (now Health and Human Services) exempted fluoridated water from this ban, including fluoridated water used to process food.¹

In 1985, the U.S. Environmental Protection Agency (EPA) set 4 ppm (up from 2 ppm) as the safe level for fluoride in drinking water and prevailed in a lawsuit challenge.¹

While the ADA, the Centers for Disease Control and Prevention (CDC), and the NIDR of the National Institutes for Health (NIH) still support fluoridation, some 17 U.S. organizations have withdrawn their support since 1990, including the American Academy of Allergy and Immunology, the American Academy of Diabetes, the American Cancer Society, the American Diabetes Association, the American Nurses Association, the American Psychiatric Association, the National Kidney Foundation, and the Society of Toxicology.¹

Discussion of the scientific studies on fluoridation, as presented in the following sections, has been neglected by most of the media in the United States. The unique journal *Fluoride* is not covered by PubMed. Michael Easley, M.P.H., national spokesman on fluoridation for the ADA, posted the following on the internet for dentists in 1996: "...anti-fluoride cultists will not be dissuaded by the truth.... Let them spew their garbage, ignore them, and go on with your discussions as if they weren't there.... [T]heir twisted minds have accepted the notion that it is OK to lie, slander, libel, exaggerate, misquote.... [S]ee what kooks they really are."¹ Some of the purported "lies" are presented in the next sections.

Does Water Fluoridation Prevent Tooth Decay?

Dean ran the first trial of fluoridation in Grand Rapids, Mich., in 1945, declaring it a success in comparison with nonfluoridated Muskegon, Mich. Since that time, he twice confessed in court that statistics from the early studies were invalid.¹

Newburgh, N.Y., next to be fluoridated in 1945, was compared with Kingston, N.Y., as a control. Early reports were favorable. But by 1989 workers at the New York State Department of Health found a difference of less than 1 fewer teeth decayed in 7-14-year-old children in Newburgh, favoring fluoridation. And by 1995 children's teeth in Kingston had slightly less tooth decay and half as much damage from fluoride.¹ This negative result was possibly caused by a change in the fluoridation agent, or possibly by more accurate reporting.

North Shields, England, has no natural fluoride in its water, while South Shields has 1.4 ppm. While children of the same age had fewer decayed teeth in fluoridated South Shields, it was noticed that the onset of decay was merely delayed 3 years.¹ This finding

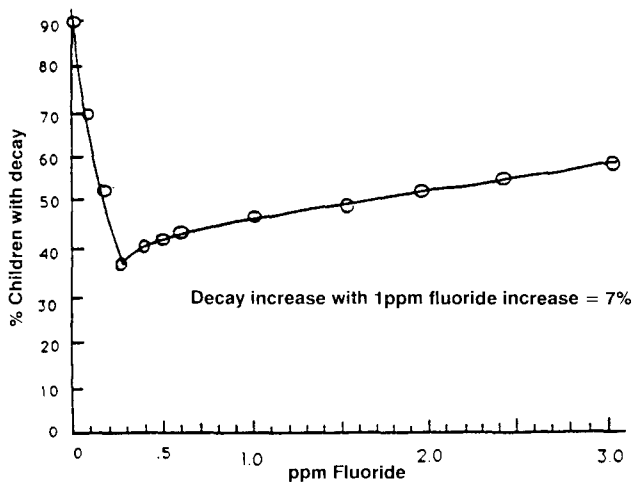


Figure 3. Study of tooth decay in 22,000 Japanese schoolchildren vs. fluoride content of their drinking water. Reprinted from Judd,⁵ with permission.

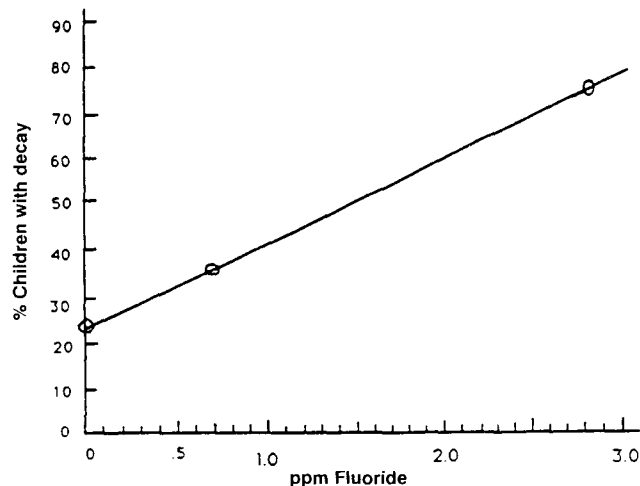


Figure 4. Study of tooth decay in 400,000 Indian schoolchildren vs. fluoride content of their drinking water. Reprinted from Judd,⁵ with permission.

may invalidate the early Michigan and New York trial results and confirm the findings by Yiamouyiannis⁸ that fluoride lowers decay of deciduous teeth only.

A favorable report on fluoridation from New Zealand was found to be biased by the deliberate choice of the nonfluoridated communities with the highest tooth decay rate in comparison with the two fluoridated communities with the lowest decay rates. When all decay rates for all children in that area of New Zealand were compared, there was no difference with respect to fluoridation.⁹ Also, in New Zealand the number of decayed teeth per 5-year-old child has decreased steadily from 12 teeth in 1930 to 3 teeth in 1990. Neither the introduction of fluoridated water nor fluoridated toothpaste changed the downward slope of the graph of decay (see Figure 1). Because of this, John Colquhoun, appointed to promote fluoridation in New Zealand, now opposes it.⁹

According to World Health Organization (WHO) figures, the most fluoridated country in the world, Ireland at 66%, does not have the least tooth decay. The five countries with less tooth decay (Finland, Denmark, UK, Sweden, and the Netherlands) had little or no water fluoridation (the rate was 10% in the UK).¹

Chile began fluoridating water in 1985, but stopped it when the average of 6.0 decayed teeth per 12-year-old child, which dropped to 5.3 by 1991, increased to 6.7 in 1995.¹

A study of 29,000 elementary school children in Tucson, Ariz., showed much more tooth decay when the fluoride level in the drinking water was higher (see Figure 2).⁵ The extremes ranged from 6% of children with some decay in areas with water containing 0.0 ppm fluoride to 40% of children with some decay in areas with water containing 1.0 ppm fluoride.

Fluoridation was forced on parts of Japan during its occupation by the United States. A study reported in 1972 on 22,000 schoolchildren (median age 13, range 5-17) showed 90% with some tooth decay at 0.0 ppm fluoride. This high number was attributed to the absence of calcium in the water. A minimum in decay (38% of children) occurred with 0.3 ppm fluoride and more calcium content. This increased to 44% at 1.0 ppm fluoride and further to 55% with decay at 3.0 ppm fluoride and still more calcium (see Figure 3). Japan subsequently reduced the maximum allowed fluoride level to 0.05 ppm.⁵

The largest study on fluoridation and tooth decay involved 400,000 students (median age 13, range 5-17) in India (see Figure

4). The percentage of children with decay was 23% at 0.0 ppm F; 35% at 0.7 ppm; and 75% at 2.75 ppm.^{5,7} Other studies over a 30-year period prompted Teotia and Teotia to write: "...dental caries were caused by high fluoride and low dietary calcium intakes, separately and through their interactions.... The only practical and effective public measure for the prevention and control of dental caries is the limitation of the fluoride content of drinking water to <0.5 ppm, and adequate calcium...(> 1 g/day)."⁷

Over a 20-year period from 1965-1985, the average number of decayed, missing, or filled teeth (DMFT) in 12-year-old children dropped by 50% in the United States. Proponents of fluoridation and vendors of fluoridated dental rinses and toothpastes took credit for this. However, the following nonfluoridated countries had even greater reductions in DMFT during similar 20-year periods: the Netherlands, 72%; Sweden, 82%; Finland, 98%.^{5,10} No adjustments were made for some of the obvious confounders, such as consumption of refined carbohydrates and the other mineral contents of water supply.^{5,7} Native Americans on reservations in this country have by far the most decay of any ethnic group in the United States, despite forcible fluoridation of their water and free dentistry for more than 50 years.⁵

There was an overall increase in children 5-17 years old (median age 13) with tooth decay after initiation of water fluoridation. The tooth decay rate of children living in nonfluoridated American cities with average decay rates was 65% with natural fluoride levels of 0.4 ppm fluoride. This increased to 67% with fluoridation to 1 ppm. In high-decay cities, the decay rate of 71% with 0.4 ppm fluoride increased to 75% with fluoridation to 1 ppm, according to a 1990 study of 39,207 children, aged 5-17, in 84 areas in the United States.^{5,8} Reinterpretation of data from a 1986-1987 study by dentists trained by the NIDR showed that the decay rate of *deciduous* teeth in 5-year-olds was significantly lower in fluoridated areas (1.5 teeth per child) than in nonfluoridated areas (2.0 teeth per child), as shown in Figure 5.⁸ However, the decrease was no longer significant in 6-year-olds, and did not exist in children age 7 or older. Moreover, decay rates in *permanent* teeth in children aged 5-17 did not differ significantly at any age in areas with no, partial, or total fluoridation of water supplies (see Figure 6).⁸ Earlier, widely accepted claims of caries reduction of 60% by fluoridation, published in the *Journal of the American*

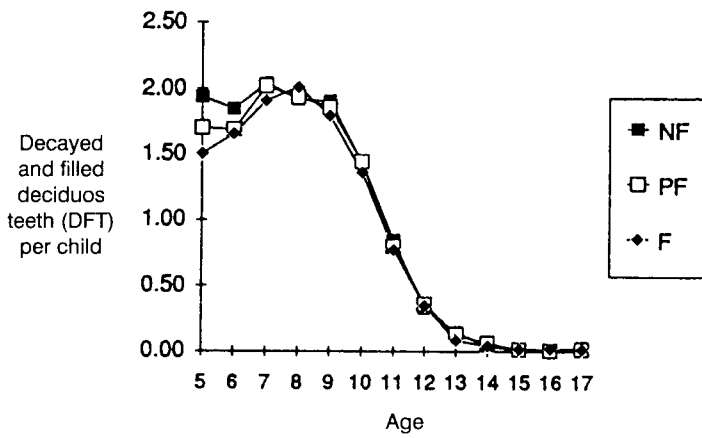


Figure 5. Decay of deciduous teeth in 39,207 white children in 84 areas in the United States. F, fluoridated; PF, partially fluoridated; NF, nonfluoridated areas. Reprinted from Yiamouyiannis,⁸ with permission.

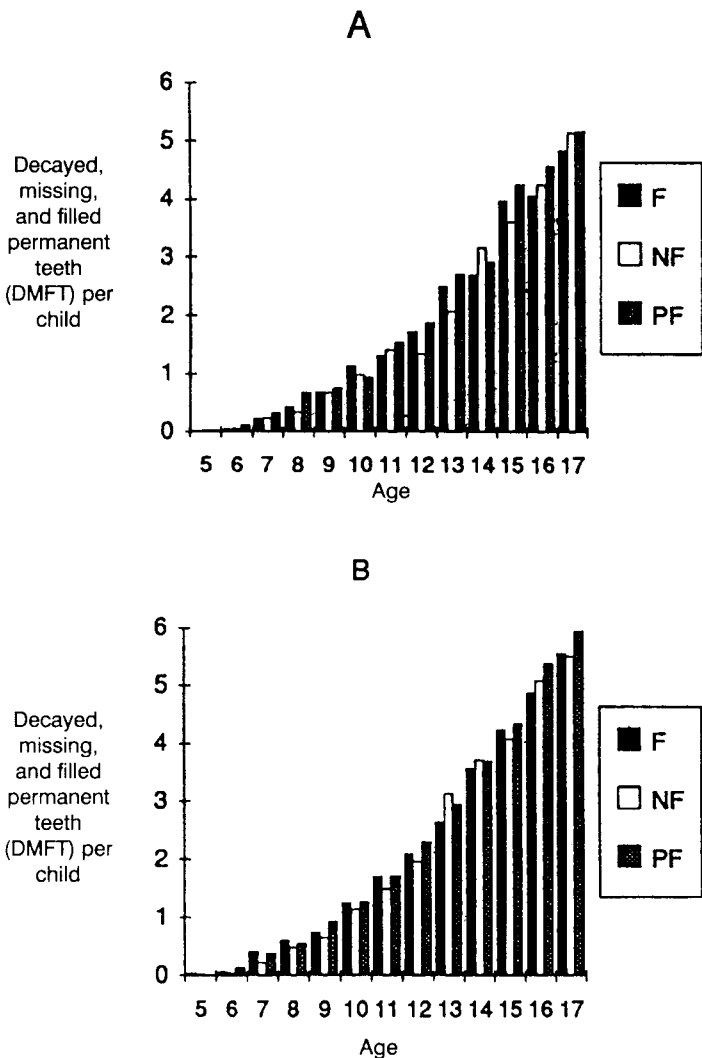


Figure 6. Decay of permanent teeth in 39,207 white children in 84 areas in the United States. F, fluoridated; PF, partially fluoridated; NF, nonfluoridated areas. Reprinted from Yiamouyiannis,⁸ with permission.

Medical Association and the *Journal of Dental Research* using data from the same source, were not substantiated by Yiamouyiannis.

On the basis of observational studies, Hardy Limeback, B.Sc., Ph.D., D.D.S., head of the Department of Preventive Dentistry for the University of Toronto and President of the Canadian Association for Dental Research, announced a reversal of his earlier profluoridation views. In an April 1999 interview, Limeback, once the primary promoter of fluoridation, stated: "Children under three should never use fluoridated toothpaste or drink fluoridated water. And baby formula must never be made up using Toronto tap water. Never." He remarked that "Vancouver, never fluoridated, has a lower cavity rate than Toronto, which has been fluoridated for 36 years [through 1999]."^{11,12}

In a recent article in the *Journal of the American Dental Association*, Featherstone wrote that: "Fluoride incorporated during tooth development is insufficient to play a significant role in caries protection."¹³ In fact, fluoridation of municipal water supplies *increases* tooth decay overall in some studies and has not been demonstrated to be effective in prevention of decay in the most convincing studies, such as those of Colquhoun, Kalsbeek, and Yiamouyiannis, he concluded.

The effects of fluoridation were praised in a 2004 book, *Fluorides in the Environment: Effects on Plants and Animals* by L.H. Weinstein and A. Davison, but expert reviewers considered the book to be blatantly biased.¹⁴

Fluoride Supplements and Topical Application

No adequate evidence for the effectiveness of fluoride supplements as pills or drops, or topical application of fluoride by means of toothpaste or dental rinses, had ever been presented.¹ Colquhoun's study concluded there was also no benefit from fluoridated toothpaste.⁹

"Until recently, the rationale for most caries preventive programs using fluoride was to incorporate fluoride into the dental enamel. The relative role of enamel fluoride in caries prevention is now increasingly questioned, and based on rat experiments and reevaluation of human clinical data, it appears to be of minor importance..."¹⁵ In fact, "...the prevalence of dental caries in a population is not inversely related to the concentration of fluoride in enamel, and a higher concentration of enamel fluoride is not necessarily more efficacious in preventing dental caries."¹⁶ Limeback found on reexamining the literature that topical effects of fluoride on newly erupted teeth were more likely to explain any benefit of fluoride than swallowing it in water or pill form.¹³ In vitro experiments showed that topical fluoride might protect tooth enamel by inhibition of bacterial metabolism, limiting acid generation.¹⁷

Is Fluoridation Safe for the General Population?

In a report authored by Perry D. Cohn, Ph.D., M.P.H., for the New Jersey Department of Environmental Protection and the New Jersey Department of Health, the rates of bone cancer in fluoridated and nonfluoridated areas were compared. Both by counties or by municipalities, males under the age of 50 had 3 to 7 times as many bone cancers in the fluoridated areas. Males 10-19 years old fared the worst.¹⁸ An external review panel found no serious flaws with the study.

Cancer rates in the ten largest fluoridated cities in the United States and in the ten largest nonfluoridated cities were found to be the same before fluoridation began. After 20 years, the ten fluoridated cities had 10% more cancer deaths than the nonfluoridated cities. The cancers were found in the tongue, mouth, pharynx, esophagus, stomach, colon, rectum, pancreas, larynx, bronchi, and lungs.¹

Hip fractures in two cities in Utah were compared: fluoridated Brigham City and nonfluoridated Cedar City. In the fluoridated (1 ppm) city, the hip fracture rate was twice as high as in the nonfluoridated city, in women around age 75. Men aged 80-85 also had twice the hip fracture rate in fluoridated Brigham City.¹⁹ The insidious nature of fluoride toxicity is that it does not cause bone density loss as found in osteoporosis by bone scans, but causes an increase in bone density with no clinical benefit. Fluoride makes both bones and teeth more brittle.¹²⁰ Early reports of supposed benefits of fluoridation to bone were quoted without citing later corrections or retractions.²⁰

Dr. A. K. Susheela of the India Institute of Medical Sciences in New Delhi found that fluoride severely disrupts formation of bone matrix, inhibiting the hardening of bones. She found that about 20 countries in the world have serious health problems due to excess fluoride. Her work showed that high levels of fluoride in drinking water were associated with birth defects, stillbirths, and early infant mortality.¹

Excess fluoride may also have detrimental neurologic effects. Rats given sodium fluoride in their drinking water at a concentration producing a plasma level of fluoride equivalent to that found in humans consuming water with 4 ppm of fluoride developed symptoms resembling attention deficit-hyperactivity disorder.²¹

Gerard F. Judd, Ph.D., lists 113 ailments reportedly caused by fluoride, all with literature citations to studies, of which 13 were double-blinded.⁵ So far, there are no known naturally occurring compounds of fluorine in the human body.²² Fluorine is not listed as even a trace element in whole body assays,²³ showing that there is no requirement for it at all.

Water fluoridated to 1 ppm fluoride is not safe in the general population. How much of the toxicity results from the arsenic and heavy metal contamination in the newer fluoridating agents is not yet known. Additionally, certain populations such as patients with diabetes or renal impairment are at increased risk, especially if they drink more than average amounts of water.²⁴ A study comparing 25 young adults with fluorosis against 25 matched controls showed very significant impairment of glucose tolerance in those with fluorosis, which, however, was reversible when water with low fluoride levels was given.²⁵

How Antifluoridationists Have Weakened Their Case

Groups such as Parents for Fluoride Poisoned Children (PFPC), based in British Columbia, Canada, and the National Pure Water Association Ltd. in the UK justifiably attempt to prevent fluoridation of water. Unfortunately, they suffer from chemophobia, which is not only a fear of all "chemicals," but a fear of consulting with chemists. As a result, they list any material that contains fluorine in any form as a danger by claiming that it contains "fluoride," and certain book authors and many website authors opposing fluoridation repeat this unsound assertion. The list includes Teflon and Tefal non-stick pan coatings, fluorocarbon

propellants, and many drugs. Drugs that contain fluorine include: fluoxetine (Prozac), ciprofloxacin (Cipro), flunitrazepam (Rohypnol), fluconazole (Diflucon), fluticasone (Flixonase or Flixotide), trifluoperazine (Stelazine), flucoxacin (Floxapen), cerivastatin (Baycol), cisapride (Propulsid), astemizole (Hismanal), and fenfluramine (Pondimin). In fact, none of these materials either contain fluoride ion or are metabolized to generate any significant amount of fluoride ion. All contain the very stable carbon-fluorine bond in the form of trifluoromethyl (CF₃—), difluoromethylene (—CF₂—), fluoroalkane (—CHF—), or fluorophenyl (FC₆H₄—) groups. The fluoro groups are chosen for the drugs to retard their metabolism, increasing the duration of effective drug levels in the body. Judd, a chemist, did not make the mistake of confusing fluorine with fluoride in his book.⁵

For Teflon, the maximum continuous service temperature is listed as 260°C or 500°F in the *Chemical Rubber Co. Handbook* of 1976-1977. Overheating Teflon may produce an irritant, perhaps perfluorooctanoic acid, but the irritant is unlikely to be fluoride ion. Asked for evidence on the toxicity of Teflon, the scientific advisor to one of the antifluoridation groups sent citations to four papers on the decomposition of Teflon by ionizing radiation. Clearly this is irrelevant to ordinary use in cooking.

Fluorocarbon refrigerants and propellants such as R12, and fluorine-containing general anesthetics such as halothane and methoxyflurane, are metabolized very slowly or not at all. However, some of the fluorine in the general anesthetics enflurane, desflurane, and isoflurane is metabolized to fluoride ion.²⁶

Asked for evidence on the toxicity of fluorinated drugs, the scientific advisor to one of the antifluoridation groups provided citations to 13 papers. Ten of the 13 were published in 1952 or earlier. Some concerned analytical methods and methods of synthesis of fluorine-containing compounds. Citations from the 1930s showed the toxicity of sodium fluoride from its interference with thyroid hormone biosynthesis.²⁷ Another from 1949 showed that that 3-fluoro-5-bromo(or iodo)tyrosine was toxic in mice, and five other fluorophenyl compounds less so.²⁸ The toxicity of 3-fluorotyrosine and 3,5-difluorotyrosine was confirmed, including in humans,²⁹⁻³¹ but this is a special case in which these amino acid derivatives interfere with thyroid hormone biosynthesis.

Ciprofloxacin, like all drugs, is associated with some toxicity—but not from fluoride. The scientific advisor to one of the antifluoridation groups cited a report showing elevated serum and urine levels of fluoride in children after administration of this drug.³² The actual elevation of fluoride in serum was from 0.08 to 0.21 ppm in 12 hours, and could not account for more than a fraction of the fluorine (23 mg) in the 400 mg doses used of ciprofloxacin; moreover, there was no follow-up measurement. The elevation of fluoride in urine from 0.97 to 1.12 ppm after a week was not statistically significant. The authors did not try to measure fluorinated metabolites or unchanged drug, and after MRI scans and about 2 years of follow-up by physical examinations, they pronounced short courses of ciprofloxacin safe in children. Although ciprofloxacin liberates fluoride under UVB illumination in vitro, it is metabolized in vivo mostly by hydroxylation and N-sulfation, not by loss of fluoride ion.²⁶

The risk of rhabdomyolysis, the major toxicity of the statin drugs, is about the same with atorvastatin and pravastatin, which contain fluoro groups, and simvastatin, which does not.³³ A group at Duke University Medical Center searched the literature from

November 1997 to February 2002 to find 60 cases of statin-induced memory loss, of which 36 were due to simvastatin, 23 to atorvastatin, and 1 to pravastatin.³⁴ Clearly, there is no correlation with the presence of a fluoro group.

Thus, the scientific evidence presented by members of certain anti-fluoridation groups and by others does not support their assertion that all fluorinated organic compounds are toxic because they contain fluorine. The case against fluoridation needs to be made solely on the basis of the effects of fluoride ions and their precursors in drinking water.

Who Benefits from Fluoridation?

Groves's book does not explain how water fluoridation can be continued despite all the evidence against it. Bryson's book, however, suggested that many corporations benefit. These included: US Steel, DuPont, Alcoa, Alcan, Reynolds Metals, Kaiser Aluminum, Pennsalt Chemicals (now ELF Atochem), Allied Chemical, and the Florida phosphate fertilizer industry. Philadelphia, Pa., obtains its hexafluorosilicic acid from Solvay Fluoride. A dozen other manufacturers of hexafluorosilicic acid are listed on an anti-fluoridation website sponsored by the Fluoride Action Network Pesticide Project. It is stated that industry is able to profit by selling 155,000 tons of fluoride byproducts per year for water fluoridation instead of having to dispose of them as toxic waste at great expense.² Another consideration might be avoiding enormous tort liability that could be incurred if toxicity were officially recognized (especially in the absence of the EPA's "safe" level of 4 ppm).

How Can Fluoridation of Water Be Stopped?

Despite evidence for negligible benefit and considerable risk, the ADA, the American Medical Association (AMA), the CDC, the NIDR, the British Fluoridation Society, the WHO, and others have not retreated from their support for fluoridation. Because opposition has been marginalized, primarily by ignoring it, the only route to change appears to be through litigation.

Had there been only one or two failed lawsuits over the years, one might conclude that the anti-fluoridation cause is hopeless. In fact, lawsuits have met with some success. Anti-fluoridation lawsuits were argued by attorney John Remington Graham in non-jury trials in Pittsburgh, Pa., in 1978; Alton, Ill., in 1980; and Houston, Tex., in 1982. In all cases, the judges found for the plaintiffs and issued injunctions against fluoridation on the grounds that it caused cancer and other ailments in humans. Based on the injunction in the Pittsburgh case, the Province of Quebec, Canada, stopped fluoridating. However, all three cases were overturned on appeal on trivial legalistic grounds. In spite of the appellate actions, however, the judicial findings of fact, namely that fluoridation is an unreasonable risk to public health, remain on the record and unchallenged. After the Alton case, an attorney for the ADA, who was a member of the Rules Committee of the Illinois Supreme Court, told an audience that he was the one who had secured a stay of the execution of the non-fluoridation injunction.³⁵

There have been five lawsuits resulting in judgments against fluoridation: two in Pennsylvania and one each in Indiana, Ohio, and Missouri. None were decided on the merits of fluoridation, only on legal technicalities.³⁶

Since fluorides have been shown in some studies to increase the risk of cancer, addition of any of them in any amount to water violated the Delaney Clause of the 1958 Amendment to the Food, Drug, and Cosmetic Act of 1938.³⁷ The Delaney Clause was repealed in 1996 with passage of the Food Quality Protection Act. A stronger argument based on the cancer issue is that adding fluoride violates the EPA policy on setting drinking water standards under the Safe Drinking Water Act. Under this provision, the Maximum Contaminant Level Goal (a pure health-based standard) for carcinogens is zero, so adding any fluoride should be banned. This is apparently why the 1990 National Toxicology Program bioassay on sodium fluoride was "revised" so that the findings went from "clear evidence of carcinogenicity" to "equivocal" evidence. Without that change, the fluoridation program would have been unsustainable under law. Bottled water in a local supermarket sports an FDA-style food label, making it a food under the law. The FDA position that fluoride is neither an essential nor probably essential nutrient and is not safe at any level is inconsistent with its allowing fluoride to be added to a food.¹

Fluoride in water is also a medication that is forced upon people who do not want it. This is arguably a violation of law, because in the United States, people may not be medicated without their permission. Fluoridation is different from chlorination of water because the chlorine is used to kill microbes, not to medicate people.

In India, the government constructed *defluoridation* plants and attempted to end sales of fluoridated toothpaste, based on Susheela's work on the toxicity of fluoride.¹ Unfortunately, in the United States, class-action lawsuits may be the only way to influence municipal authorities, who are operating on the basis of old, erroneous information on which legal precedent rests.

Removal of Fluoride Ion from Tap Water

Since prevention or ending fluoridation of public water supplies is so difficult, your patients may wish to remove fluoride ion from their drinking water. Filters do not work because the diameter of a fluoride anion is 0.064 nm. Activated carbon "filters" are not effective, nor are water-softeners based on cation exchange resins designed to take out calcium, magnesium, and iron, not anions. It might be possible to make effective anion exchangers.

There are three effective methods: use of a cartridge containing activated alumina adsorbent, the most expensive because the cartridge must be changed so often; reverse osmosis; and distillation, the least expensive method. Distillation costs about 7 cents per liter for electricity and about 2 cents per liter for depreciation of a distiller costing \$135 at Sears, assuming a 5-year life. Distilled water is often passed through an activated carbon filter to remove volatile organics, and aerated for flavor.^{38,39}

Conclusions

Artificial fluoridation of drinking water by municipalities at 1 ppm of fluoride ion probably does not reduce tooth decay, except for a minor effect on deciduous teeth. Hexafluorosilicic acid and its sodium salt, which contain other toxic substances because they are not purified, certainly have no significant benefit.

Proponents of fluoridation have censored most media, ignored intelligent discussion of fluoridation, slandered most opponents of fluoridation, and overturned legal judgments against fluoridation in

a manner that demonstrates their political power. Many published studies that had conclusions favoring fluoridation were later found unsupported by their raw data.

There is evidence that fluoridation increases the incidence of cancer, hip fractures, joint problems, and that by causing fluorosis it damages both teeth and bones. Other medical problems may also occur, including neurologic damage.

Antifluoridationists compromise their credibility by unwarranted assertions that many stable fluorine-containing materials are harmful.

The EPA should set the enforceable Maximum Contaminant Level at 0.4 ppm fluoride in drinking water.

The FDA should reverse its position on permitting sale of products containing fluoride that claim dental benefit without proof of safety or effectiveness.

Fluoridation of municipal water should cease. Defluoridation of naturally fluoridated water down to 0.4 ppm of fluoride should be mandated. Individuals should remove fluoride from their tap water if fluoridation cannot be stopped.

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