Think Twice about Fluoride:
Recognizing the Lack of Safety for this Chemical

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Fluoride's Lack of Safety: Overview of Concern about this Chemical

Sources of human exposure to fluoride have drastically increased since community water fluoridation began in the U.S. in the 1940's. In addition to water, these sources now include food, air, soil, pesticides, fertilizers, dental products used at home and in the dental office (some of which are implanted in the human body), pharmaceutical drugs, cookware (non-stick Teflon), clothing, carpeting, and an array of other consumer items used on a regular basis. Official regulations and recommendations on fluoride use, many of which are not enforced, have been based on limited research and have only been updated after evidence of harm has been produced and reported.

Exposure to fluoride is suspected of impacting every part of the human body, including the cardiovascular, central nervous, digestive, endocrine, immune, integumentary, renal, respiratory, and skeletal systems. Susceptible subpopulations, such as infants, children, and individuals with diabetes or renal problems, are known to be more severely impacted by intake of fluoride. Accurate fluoride exposure levels to consumers are unavailable; however, estimated exposure levels suggest that millions of people are at risk of experiencing the harmful effects of fluoride and even toxicity, the first visible sign of which is dental fluorosis.

A lack of efficacy, lack of evidence, and lack of ethics are apparent in the current status quo of fluoride usage. These circumstances clearly demonstrate that there is an alarming lack of safety for the numerous chemical applications of fluoride in commonly used products.

Lack of Efficacy for Fluoride's Uses: The First Sign of the Lack of Safety for this Chemical

The fluoride in toothpastes and other consumer products is added because it allegedly reduces dental caries. The suggested benefits of this form of fluoride are related to its activity on teeth of inhibiting bacterial respiration of Streptococcus mutans, the bacterium that turns sugar and starches into a sticky acid that dissolves enamel.[1] In particular, the interaction of fluoride with the mineral component of teeth produces a fluorohydroxyapatite (FHAP or FAP), and the result of this action is said to be enhanced remineralization and reduced demineralization of the teeth. While there is scientific support for this mechanism of fluoride, it has also been established that fluoride primarily works to reduce tooth decay *topically* (i.e. scrubbing it directly onto to teeth with a toothbrush), as opposed to *systemically* (i.e. drinking or ingesting fluoride through water or other means).[2]

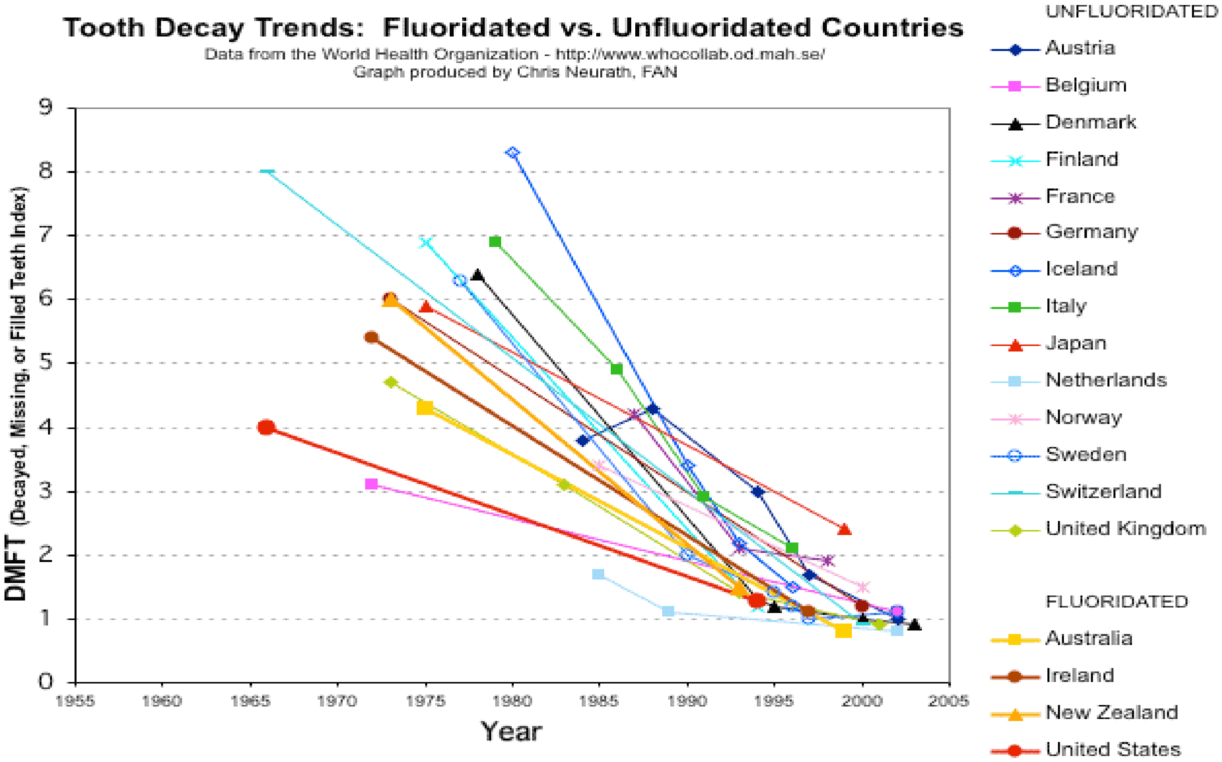
Although the *topical* benefits of fluoride have been distinctly expressed in scientific literature, research has likewise questioned these benefits. For example, researchers from the University of Massachusetts Lowell explained several controversies associated with topical uses of fluoride in an article published in the *Journal of Evidence-Based Dental Practice* in 2006. After citing a 1989 study from the National Institute of Dental Research that found minimal differences in children receiving fluoride and those not receiving fluoride, the authors referenced other studies demonstrating that cavity rates in industrialized countries have decreased without fluoride use.[3] The authors further referenced studies indicating that fluoride does not aid in preventing pit and fissure decay (which is the most prevalent form of tooth decay in the U.S.) or in preventing baby bottle tooth decay (which is prevalent in poor communities).[4]

As another example, early research used to support water fluoridation as a means of reducing dental caries was later re-examined, and the potential of misleading data was identified. Initially, the reduction of decayed and filled deciduous teeth (DFT) collected in research was interpreted as proof for the efficacy of water fluoridation. However, subsequent research by Dr. John A. Yiamouyiannis suggested that water fluoridation could have contributed to the delayed eruption of teeth.[5] Such delayed eruption would result in less teeth and therefore, the absence of decay, meaning that the lower rates of DFT were actually caused by the lack of teeth as opposed to the alleged effects of fluoride on dental caries.

Other examples in the scientific literature have questioned fluoride's use in preventing tooth decay. A 2014 review affirmed that fluoride's anti-caries effect is reliant upon calcium and magnesium in the tooth enamel but also that the remineralization process in tooth enamel is not dependent on fluoride.[6] Research published in 2010 identified that the concept of "fluoride strengthening teeth" could no longer be deemed as clinically significant to any decrease in caries linked to fluoride use.[7] Furthermore, research has suggested that *systemic* fluoride exposure has minimal (if any) effect on the teeth,[8] [9] and researchers have also offered data that dental fluorosis (the first sign of fluoride toxicity[10]) is higher in U.S. communities with fluoridated water as opposed to those without it.[11]

Still other reports show that as countries were developing, decay rates in the general population rose to a peak of four to eight decayed, missing, or filled teeth (in the 1960's) and then showed a dramatic decrease (today's levels), regardless of fluoride use. It has been hypothesized that increased oral hygiene, access to preventative services, and more awareness of the detrimental effects of sugar are responsible for the visible decrease of tooth decay. Whatever the reasons might be, it should be noted that this trend of decreased tooth decay occurred with <u>and without</u> the systemic application of fluoridated water,[12] so it would appear that factors other than fluoride caused this change. Figure 1 below exhibits the tooth decay trends by fluoridated and non-fluoridated countries from 1955-2005.

Figure 1: Tooth Decay Trends in Fluoridated and Unfluoridated Countries, 1955-2005



Several other considerations are relevant in any decision about using fluoride to prevent caries. First, it should also be noted that fluoride is not an essential component for human growth and development.[13] Second, fluoride has been recognized as one of 12 industrial chemicals "known to cause developmental neurotoxicity in human beings."[14] And finally, the American Dental Association (ADA) called for more research in 2013 in regard to the mechanism of fluoride action and effects:

> Research is needed regarding various topical fluorides to determine their mechanism of action and caries-preventive effects when in use at the current level of background fluoride exposure (that is, fluoridated water and fluoride toothpaste) in the United States. Studies regarding strategies for using fluoride to induce arrest or reversal of caries progression, as well as topical fluoride's specific effect on erupting teeth, also are needed.[15]

Lack of Evidence in Fluoride Research: The Second Sign of the Lack of Safety for this Chemical

References to the unpredictability of levels at which fluoride's effects on the human system occur have been made throughout this position paper. However, it is important to reiterate the lack of evidence associated with fluoride usage, and thus, Table 1 provides an abbreviated list of stringent warnings from governmental, scientific, and other pertinent authorities about the dangers and uncertainties related to utilizing fluoridated products.

Table 1: Selected Quotes about Fluoride Warnings Categorized by Product/Process and Source

PRODUCT/ PROCESS REFERENCED	QUOTE/S	SOURCE OF INFORMATION
Fluoride for dental uses, including water fluoridation	"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." "Few studies evaluating the effectiveness of fluoride toothpaste, gel, rinse, and varnish among adult populations are available."	Centers for Disease Control and Prevention (CDC). Kohn WG, Maas WR, Malvitz DM, Presson SM, Shaddik KK. Recommendations for using fluoride to prevent and control dental caries in the United States. *Morbidity and Mortality Weekly Report: Recommendations and Reports*. 2001 Aug 17:i-42.
Fluoride in drinking water	"Overall, there was consensus among the committee that there is scientific evidence that under certain conditions fluoride can weaken bone and increase the risk of fractures."	National Research Council. *Fluoride in Drinking Water: A Scientific Review of EPA's Standards.* The National Academies Press: Washington, D.C. 2006.
Fluoride in drinking water	"The recommended Maximum Contaminant Level Goal (MCLG) for fluoride in drinking water should be zero."	Carton RJ. Review of the 2006 United States National Research Council Report: Fluoride in Drinking Water. *Fluoride.* 2006 Jul 1;39(3):163-72.
Water fluoridation	"Fluoride exposure has a complex relationship in relation to dental caries and may increase dental caries risk in malnourished children due to calcium depletion and enamel hypoplasia..."	Peckham S, Awofeso N. Water fluoridation: a critical review of the physiological effects of ingested fluoride as a public health intervention. *The Scientific World Journal.* 2014 Feb 26; 2014.
Fluoride in dental products, food, and drinking water	"Because the use of fluoridated dental products and the consumption of food and beverages made with fluoridated water have increased since HHS recommended optimal levels for fluoridation, many people now may be exposed to more fluoride than had been anticipated."	Tiemann M. Fluoride in drinking water: a review of fluoridation and regulation issues. *BiblioGov*. 2013 Apr 5. Congressional Research Service Report for Congress.

Fluoride intake in children	"The 'optimal' intake of fluoride has been widely accepted for decades as between 0.05 and 0.07 mg fluoride per kilogram of body weight but is based on limited scientific evidence." "These findings suggest that achieving a caries-free status may have relatively little to do with fluoride intake, while fluorosis is clearly more dependent on fluoride intake."	Warren JJ, Levy SM, Broffitt B, Cavanaugh JE, Kanellis MJ, Weber-Gasparoni K. Considerations on optimal fluoride intake using dental fluorosis and dental caries outcomes–a longitudinal study. *Journal of Public Health Dentistry*. 2009 Mar 1;69(2):111-5.
Fluoride-releasing dental restorative materials (i.e. dental fillings)	"However, it is not proven by prospective clinical studies whether the incidence of secondary caries can be significantly reduced by the fluoride release of restorative materials."	Wiegand A, Buchalla W, Attin T. Review on fluoride-releasing restorative materials—fluoride release and uptake characteristics, antibacterial activity and influence on caries formation. *Dental Materials*. 2007 Mar 31;23(3):343-62.
Dental material: silver diamine fluoride	"Because silver diamine fluoride is new to American dentistry and dental education, there is a need for a standardized guideline, protocol, and consent." "It is unclear what will happen if treatment is stopped after 2-3 years and research is needed."	Horst JA, Ellenikiotis H, Milgrom PM, UCSF Silver Caries Arrest Committee. UCSF Protocol for Caries Arrest Using Silver Diamine Fluoride: Rationale, Indications, and Consent. *Journal of the California Dental Association*. 2016 Jan;44(1):16.
Drinking water with poly- and perfluoroalkyl substances (PFASs)	"Drinking water contamination with poly- and perfluoroalkyl substances (PFASs) poses risks to the developmental, immune, metabolic, and endocrine health of consumers." "…information about drinking water PFAS exposures is therefore lacking for almost one-third of the U.S. population."	Hu XC, Andrews DQ, Lindstrom AB, Bruton TA, Schaider LA, Grandjean P, Lohmann R, Carignan CC, Blum A, Balan SA, Higgins CP. Detection of Poly-and Perfluoroalkyl Substances (PFASs) in US Drinking Water Linked to Industrial Sites, Military Fire Training Areas, and Wastewater Treatment Plants. *Environmental Science & Technology Letters*. 2016 Oct 11.

Topical fluoride for dental use	"The panel had a low level of certainty regarding the benefit of 0.5 percent fluoride paste or gel on the permanent teeth of children and on root caries because there were few data on the home use of these products." "Research is needed concerning the effectiveness and risks of specific products in the following areas: self-applied, prescription-strength, home-use fluoride gels, toothpastes or drops; 2 percent professionally applied sodium fluoride gel; alternative delivery systems, such as foam; optimal application frequencies for fluoride varnish and gels; one-minute applications of APF gel; and combinations of products (home-use and professionally applied)."	Weyant RJ, Tracy SL, Anselmo TT, Beltrán-Aguilar ED, Donly KJ, Frese WA, Hujoel PP, Iafolla T, Kohn W, Kumar J, Levy SM. Topical fluoride for caries prevention: Executive summary of the updated clinical recommendations and supporting systematic review. *Journal of the American Dental Association.* 2013;144(11):1279-1291.
Fluoride "supplements" (tablets)	"Evident disagreements among the results show that there's a limited effectiveness on fluoride tablets."	Tomasin L, Pusinanti L, Zerman N. The role of fluoride tablets in the prophylaxis of dental caries. A literature review. *Annali di Stomatologia.* 2015 Jan;6(1):1.
Pharmaceuticals, fluorine in medicine	"No one can responsibly predict what happens in a human body after administration of fluorinated compounds."	Strunecká A, Patočka J, Connett P. Fluorine in medicine. *Journal of Applied Biomedicine.* 2004; 2:141-50.
Occupational exposures to fluoride and fluoride toxicity	"Review of unpublished information regarding the effects of chronic inhalation of fluoride and fluorine reveals that current occupational standards provide inadequate protection."	Mullenix PJ. Fluoride poisoning: a puzzle with hidden pieces. *International Journal of Occupational and Environmental Health.* 2005 Oct 1;11(4):404-14.
Review of safety standards for exposure to fluorine and fluorides	"If we were to consider only fluoride's affinity for calcium, we would understand fluoride's far-reaching ability to cause damage to cells, organs, glands, and tissues."	Prystupa J. Fluorine—a current literature review. An NRC and ATSDR based review of safety standards for exposure to fluorine and fluorides. *Toxicology Mechanisms and Methods.* 2011 Feb 1;21(2):103-70.

Lack of Ethics in the Fluoride Industry: The Third Sign of the Lack of Safety for this Chemical

Another major concern about fluoride exposure from drinking water and food is related to the production of the fluorides used in community water supplies. According to the Centers for Disease Control and Prevention (CDC), three types of fluoride are generally used for community water fluoridation:

- Fluorosilicic acid: a water-based solution used by most water systems in the United States. Fluorosilicic acid is also referred to as hydrofluorosilicate, FSA, or HFS.
- Sodium fluorosilicate: a dry additive, dissolved into a solution before being added to water.
- Sodium fluoride: a dry additive, typically used in small water systems, dissolved into a solution before being added to water.[16]

Controversy has arisen over the industrial ties to these ingredients. The CDC has explained that phosphorite rock is heated with sulfuric acid to create 95% of the fluorosilicic acid used in water fluoridation.[17] The CDC has further explained: "Because the supply of fluoride products is related to phosphate fertilizer production, fluoride product production can also fluctuate depending on factors such as unfavorable foreign exchange rates and export sales of fertilizer."[18] A government document from Australia has more openly stated that hydrofluosilicic acid, sodium silicofluoride and sodium fluoride are *all* "commonly sourced from phosphate fertilizer manufacturers."[19] Safety advocates for fluoride exposures have questioned if such industrial ties are ethical and if the industrial roots of these chemicals might result in a cover-up of the health effects caused by fluoride exposures.

A specific ethical issue that arises with such industry involvement is that profit-driven groups seem to define the evolving requirements of what constitutes the "best" evidence-based research, and in the meantime, unbiased science becomes difficult to fund, produce, publish, and publicize. This is because funding a large-scale study can be very expensive, but industrial-based entities can easily afford to support their own researchers. They can also afford to spend time examining different ways of reporting the data (such as leaving out certain statistics to obtain a more favorable result), and they can further afford to publicize any aspect of the research that supports their activities. Unfortunately, history has shown that corporate entities can even afford to harass independent scientists as a means of ending their work if that work shows harm generated by industrial pollutants and contaminants.

Indeed, this scenario of unbalanced science has been recognized in fluoride research. Authors of a review published in *the Scientific World Journal* in 2014 elaborated: "Although artificial fluoridation of water supplies has been a controversial public health strategy since its introduction, researchers—whom include internationally respected scientists and academics—have consistently found it difficult to publish critical articles of community water fluoridation in scholarly dental and public health journals."[20]

Additionally, a conflict of interest can be directly related to studies about dietary exposures to perfluorinated compounds (PFCs). In an article published in 2012, research about food intake from PFCs was examined by country. The author revealed that data from the U.S. was very limited, consisting only of a 2010 publication by a number of American academic researchers, as well as a 3M sponsored survey that served as the primary research prior to the 2010 publication (and alleged that most samples of food had contaminant levels below detection.)[21] Yet, the academic researchers produced different findings than the 3M report and wrote in their 2010 publication: "Despite product bans, we found POPs [persistent organic pollutants] in U.S. food, and mixtures of these chemicals are consumed by the American public at varying levels. This suggests the need to expand testing of food for chemical contaminants."[22]

Conflicts of interest have also been known to infiltrate government agencies involved in toxic chemical regulation. A 2014 *Newsweek* article by Zoë Schlanger entitled "Does the EPA Favor Industry When Assessing Chemical Dangers?" included a quote from ecologist Michelle Boone that alleged "'all or most of the data used in risk assessments may come from industry-supplied research, despite clear [conflicts of interest].'"[23]

It is easily recognizable that the dental industry has a major conflict of interest with fluoride because profits are made by corporations that produce fluoride-containing dental products. Additionally, procedures involving fluoride administered by the dentist and dental staff can also earn profits for dental offices,[24] [25] and ethical questions have been raised about pushing these fluoride procedures on patients.[26]

In relation to the ethics of medical and dental practices, a cornerstone of public health policy known as the precautionary principle must be considered as well. The basic premise of this policy is built upon the centuries-old medical oath to "first, do no harm." Yet, the modern application of the precautionary principle is actually supported by an international agreement.

In January 1998, at an international conference involving scientists, lawyers, policy makers, and environmentalists from the U.S., Canada and Europe, a formalized statement was signed and became known as the "Wingspread Statement on the Precautionary Principle."[27] In it, the following advice is given: "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof."[28]

Not surprisingly, the need for the appropriate application of the precautionary principle has been associated with fluoride usage. Authors of a 2006 article entitled "What Does the Precautionary Principle Mean for Evidence-Based Dentistry?" suggested the need to account for cumulative exposures from all fluoride sources and population variability, while also stating that consumers can reach "optimal" fluoridation levels without ever drinking fluoridated water.[29] Additionally, researchers of a review published in 2014 addressed the obligation for the precautionary principle to be applied to fluoride usage, and they took this concept one step further when they suggested that our modern-day understanding of dental caries "diminishes any major future role for fluoride in caries prevention."[30]

Conclusion on Fluoride's Lack of Safety: A Dangerous Chemical

Based on the alarming lack of safety, informed consumer consent is needed for all uses of fluoride. This pertains to water fluoridation, as well as all dental-based products, whether administered at home or in the dental office.

Many consumers are not aware of the fluoride added to hundreds of products they routinely use. Some citizens do not even know that fluoride is added to their water, and because there are no food or bottled water labels, consumers are likewise not aware of those sources of fluoride. While toothpaste and other over-the-counter dental products include disclosure of fluoride contents and warning labels, the average person has no context for what these ingredients or contents mean (if they are fortunate enough to read the small font on the back of their product). Materials used at the dental office provide even less consumer awareness as informed consent is generally not practiced, and the presence and risks of fluoride in dental materials is, in many instances, never mentioned to the patient.[31]

In addition to the imperative need for informed consumer consent, education is likewise essential. Providing education about fluoride risks and fluoride toxicity to medical and dental professionals, medical and dental students, consumers, and policy makers is crucial to improving the future of public health.

There are fluoride-free strategies in which to prevent dental caries. **Given the current levels of exposure, policies should reduce and work toward eliminating avoidable sources of fluoride, including water fluoridation, fluoride-containing dental materials, and other fluoridated products, as means to promote dental and overall health.**

FOR MORE DETAILS ON THIS TOPIC, CLICK HERE TO READ IAOMT'S FLUORIDE POSITION PAPER**.**

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[1] Cole G. Fluoride: death of the precautionary principle. (Book chapter that is not yet published.)
[2] *As explained in the Journal of the American Dental Association, "fluoride incorporated during tooth development is insufficient to play a significant role in cavity protection" (Featherstone 2000, at 891). The Centers for Disease Control has confirmed the primacy of fluoride's topical mechanisms, declaring that "fluoride's predominant effect is posteruptive and topical" (CDC 2001, at 4). The NRC has confirmed this as well, stating that "the major anticaries benefit of fluoride is topical and not systemic" (NRC 2006, at 13).*
In Connett M. Citizen petition under Toxic Substances Control Act regarding the neurotoxic risks posed by fluoride compounds in drinking water. November 22, 2016. To the United States Department of Environmental Protection (EPA) by the Fluoride Action Network (FAN), the International Academy of Oral Medicine and Toxicology (IAOMT), the American Academy of Environmental Medicine (AAEM), Food & Water Watch (FWW), Moms Against Fluoridation, the Organic Consumers Association, Audrey Adams, Jacqueline Denton, Valerie Green, Kristin Lavelle, and Brenda Staudenmaier. Online at http://fluoridealert.org/wp-content/uploads/epa-petition.pdf. Accessed March 31, 2017.
[3] *See* Tickner J, Coffin M. What does the precautionary principle mean for evidence-based dentistry? Journal of Evidence Based Dental Practice. 2006 Mar 31;6(1):6-15. Page 11.
[4] *See* Tickner J, Coffin M. What does the precautionary principle mean for evidence-based dentistry? Journal of Evidence Based Dental Practice. 2006 Mar 31;6(1):6-15. Page 11.
[5] Yiamouyiannis JA. Water fluoridation and tooth decay: Results from the 1986-1987 national survey of U. S. school children. Fluoride. 1990 Apr;23(2):55-67.

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[8] *"In addition, a body of information has developed that indicates the major anticaries benefit of fluoride is topical and not systemic (Zero et al. 1992; Rölla and Ekstrand 1996; Featherstone 1999; Limeback 1999a; Clarkson and McLoughlin 2000; CDC 2001; Fejerskov 2004). Thus, it has been argued that water fluoridation might not be the most effective way to protect the public from dental caries."*

In National Research Council. Fluoride in Drinking Water: A Scientific Review of EPA's Standards. The National Academies Press: Washington, D.C. 2006. Pages 15-16.

See also Kalsbeek H, Kwant GW, Groeneveld A, Backer Dirks O, Van Eck AA, Theuns HM. Caries experience of 15-year-old children in The Netherlands after discontinuation of water fluoridation. Caries Research. 1993 Jul 1;27(3):201-5.

And Seppä L, Kärkkäinen S, Hausen H. Caries Trends 1992–1998 in Two Low–Fluoride Finnish Towns Formerly with and without Fluoridation. Caries research. 2000 Nov 8;34(6):462-8.

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And Jackson RD, Kelly SA, Katz BP, Hull JR, Stookey GK. Dental fluorosis and caries prevalence in children residing in communities with different levels of fluoride in the water. Journal of public health dentistry. 1995 Mar 1;55(2):79-84.

And Williams JE, Zwemer JD. Community water fluoride levels, preschool dietary patterns, and the occurrence of fluoride enamel opacities. Journal of Public Health Dentistry. 1990 Jun 1;50(4):276-81.

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[13] National Research Council. Health Effects of Ingested Fluoride. The National Academy Press: Washington, D.C. 1993. p. 30.

And European Commission. Critical review of any new evidence on the hazard profile, health effects, and human exposure to fluoride and the fluoridating agents of drinking water. Scientific Committee on Health and Environmental Risks (SCHER). 2011.

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[14] *See Table 2 on page 334 of* Grandjean P, Landrigan PJ. Neurobehavioural effects of developmental toxicity. The Lancet Neurology. 2014 Mar 31;13(3):330-8.

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[30] Peckham S, Awofeso N. Water fluoridation: a critical review of the physiological effects of ingested fluoride as a public health intervention. The Scientific World Journal. 2014 Feb 26;2014. Online at http://downloads.hindawi.com/journals/tswj/2014/293019.pdf. Accessed November 2, 2016.
[31] In the United States, brochures have been created to educate patients about their choices for dental fillings (mainly because of concerns related to dental amalgam mercury) in California, Connecticut, Maine, and Vermont. Only Connecticut and Maine even mention that fluoride is in some fillings, and both states only mention its presence in glass ionomer fillings. Some of these brochures are legally required to be presented to dental patients, but there is an apparent lack of enforcement for this measure.
To view the brochures in Connecticut and Maine, see
State of Connecticut Department of Environmental Protection. Fillings: The Choices You Have. Hartford, CT; Revised May 2011. Online at http://www.csda.com/docs/default-source/regulations/amalgam. Accessed November 8, 2016.
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