Community Water Fluoridation (CWF)

A RESOURCE LIBRARY

As of June 2019, a search of the key word "fluoridation" within the U.S. National Library of Medicine's online database revealed more than 6,500 published research papers on the topic. This resource library is not intended to share or summarize all of the research that has been published by the scientific and academic communities. Instead, our objective is to share a representative sample of key studies, analyses and other documents that cover the many aspects of fluoridation. Given that CWF is practiced in more than 20 nations, an effort was made to include relevant research or resources from a variety of countries.

How to use this: To find resources in which they are interested, users should type Ctrl + F and then enter a key word (example: "fluorosis" or "cessation") to find helpful resources. If a user seeks to find information on oral health and fluoridation's connection to military readiness, appropriate search words might include "military" and "defense". By contrast, a user wishing to identify research or resources on the impact of ceasing water fluoridation might choose some permutation of the words "cessation" or "cease".

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SECTION A:
The History of Water Fluoridation

Document A-18: "57 Years Ago in IDPH History," Illinois Department of Public Health, accessed in July 2017, http://www.idph.state.il.us/webhistory22.htm

> **Summary:** This web page recalls Illinois' role in ushering in the era of CWF. Evanston—just north of Chicago—was one of the first three communities in America where fluoridation was initiated to determine its effectiveness and safety.

Document A-17: "New York's Fluoridation Fuss, 50 Years Later," *New York Times,* February 23, 2015, https://www.nytimes.com/2015/02/24/health/new-yorks-fluoridation-fuss-50-years-later.html

> **Summary:** This article examines the political dynamics that shaped New York City's decision to begin CWF, including the impressive coalition that backed fluoridation and the mayor's initial hesitance to support the initiative. In 1956, the city's board of health announced its recommendation that New York City begin fluoridation, but then-Mayor Robert F. Wagner was hesitant to step into the debate. Supporters of CWF created an advocacy group called the Committee to Protect Our Children's Teeth. This committee was chaired by Dr. Benjamin Spock, the noted pediatrician. Other members included Eleanor Roosevelt, baseball star Jackie Robinson, former Governor Herbert H. Lehman, and AFL-CIO President George Meany. Still, resistance from many corners delayed a decision to fluoridate. CWF wasn't approved by New York City until 1965.

Document A-16: "The Story of Fluoridation," National Institute of Dental and Craniofacial Research (NIH), updated in February 2014
https://www.nidcr.nih.gov/OralHealth/Topics/Fluoride/TheStoryofFluoridation.htm

> **Summary:** This brief article reviews the history of the research that began in the early 1900s in Colorado and culminated with the 1945 experimental trial in Grand Rapids, Mich., demonstrating CWF's benefits. The article summarizes the crucial roles played by Dr. Frederick McKay, Dr. H. Trendley Dean and others.

Document A-15: K. Oldham. "Seattle voters defeat fluoridation proposal and oust longtime incumbent Mayor William Devin on March 11, 1952," HistoryLink.org, Feb. 26, 2014, https://www.historylink.org/File/4049

> **Summary:** It took three tries before a voter referenda in 1968 successfully initiated a CWF program in the city of Seattle. Ballot measures to begin fluoridation failed in 1952 and 1963. This article focuses on the first referenda (1952) and the local political dynamics that shaped the outcome. In 1951, before the initial council hearing, Water Superintendent Roy W. Morse said his department was taking a "strictly neutral" position on the issue. Nonetheless, by the time the Seattle City Council decided to refer the issue to voters for the March 1952 ballot, Morse was making his skeptical views toward CWF widely known. He

said more research was needed because the city lacked "reliable knowledge concerning the ultimate systemic effects" of fluoride. The city's health director was supportive of CWF. The public debate was intense—"a red-hot campaign," in the words of the *Seattle Times*. Although the health and medical establishment generally supported CWF, there were some dental and medical professionals who were not. A retired Seattle dentist called the length of completed fluoride studies "ridiculously short" and urged local officials to wait 10 or 15 years to observe the results of fluoridation elsewhere. The 1952 vote was nearly two-to-one against CWF.

Document A-14: "The History of Fluoride," a video produced by Delta Dental, 2013 https://www.youtube.com/watch?v=CtpsOTh9UNw

Summary: This video (duration of 2:43) explains how fluoride's benefits were discovered when health researchers in Colorado tried to solve a mystery.

Document A-13: W.H. Bowen, "Pointing the way to better oral health," *Journal of the American Dental Association*, July 2013, Vol. 144, No. 7, https://pdfs.semanticscholar.org/26ef/b50d7d1b9b0aaaa0d1b918001e5b7f68f1a6.pdf

Summary: Highly publicized experimental trials were launched in the mid-1940s to examine the impact of adding fluoride to a public water system. This article cites research in the preceding decades that offered new insights and built momentum for those trials. For example, a 1937 study explored the oral health of American Indian children and offered fluoride as one explanation for regional variations in these children's decay rates: "Fluorides are well known as enzyme inhibitors, and it may be suggested that perhaps a measure of the responsibility for low caries attack rates in the southwestern areas may be the result of the drinking of fluoride waters." In 1938, two studies produced more insights. A study conducted in two northern Texas cities confirmed that a higher rate of dental fluorosis was associated with a lower rate of tooth decay. The author of this article explained that until then, the "prevailing dogma . . . was that damaged enamel was highly susceptible to decay. It was inconceivable that mottled enamel could possibly be more resistant to carious attack." Another 1938 study strengthened the theory that fluoride had anti-decay properties by revealing that healthy tooth enamel harbored more fluoride than decayed tooth enamel did.

Document A-12: Deborah Blum, "A Natural History of Fluoride," *Wired* magazine, May 23, 2013, https://www.wired.com/2013/05/a-natural-history-of-fluoride/

Summary: This article explores critics' use of the term "chemical" as a means to brand it as toxic or harmful. Blum explores the gaps in the public's knowledge of science overall and of fluoride specifically.

Document A-11: D. Schneider and D.E. Lilienfeld, eds., *Public Health: The Development of a Discipline,* Rutgers Univ. Press: New Brunswick, N.J., 2011, Vol. 2, http://bit.ly/31sZK1D

Summary: This is a one-page excerpt from a public health textbook. Although the crucial scientific discoveries related to fluoride occurred in the U.S., the initial exploration of fluoride's benefits began at least as far back as 1874 when a German physician referred to fluoride's potential to play a preventive role. This physician had observed that a dog's tooth enamel were strengthened after being fed with potassium fluoride. That same year, a patent application was filed in the U.S. by another researcher for a syrup that was fortified with fluoride.

Document A-10: Becky Bowers, "Truth about fluoride doesn't include Nazi myth," PolitiFact Florida, October 6, 2011, https://www.politifact.com/florida/statements/2011/oct/06/critics-water-fluoridation/truth-about-fluoride-doesnt-include-nazi-myth/

Summary: *The Miami Herald* and *Tampa Bay Times* jointly operate PolitiFact Florida, an initiative aimed at fact-checking various claims that are made about politics or public policy. In this edition, a reporter investigated a claim that numerous opponents make about fluoride—namely, that it was used by the Nazis on Jews. This investigation rated the assertion a "pants on fire" falsehood.

Document A-09: Joe Mullen, "History of Water Fluoridation," *British Dental Journal*, 2005, Vol. 199, https://www.nature.com/articles/4812863

Summary: Although Dr. Frederick McKay is credited with laying the groundwork for the long-term research that demonstrated fluoride's crucial role in cavity prevention. Yet other dentists explored the potential role of fluoride, and these dentists are noted by Dr. Joe Mullen, the author of this article. Mullen also cites research outside of the U.S. that was conducted in other nations during the same era.

Document A-08: "Achievements in Public Health, 1900-1999: Fluoridation of Drinking Water to Prevent Dental Caries," *Morbidity & Mortality Weekly Report,* October 22, 1999 https://www.cdc.gov/mmwr/preview/mmwrhtml/mm4841a1.htm

Summary: This article explains why the Centers for Disease Control and Prevention named CWF as one of the 10 great public health achievements of the 20th century. The article summarizes the research during the early decades of the century that led to the discovery of fluoride's preventive benefits.

Document A-07: "Fluoridation Revisited," *Journal of the Connecticut State Dental Association*, October 1985, Vol. 59, No. 4, http://bit.ly/2F7QeaD

Summary: This special edition of the Journal recalls the challenges that oral health leaders faced as they spearheaded a successful campaign to enact the first state law guaranteeing the public access to fluoridated drinking water. Connecticut's law was passed in 1965. The article includes a brief interview with John Dempsey, the pro-CWF governor who was in office when the legislative campaign reached its successful climax.

Document A-06: **"**Decayed, Missing, and Filled Teeth in Adults**,** United States**,** 1960–1962," U.S. Department of Health, Education and Welfare, DHEW Publication No. (HRA) 74-1278**,** August 1973**,** https://www.cdc.gov/nchs/data/series/sr_11/sr11_023.pdf

Summary: Nearly all of the adults covered by this 1960-62 oral health survey would have entered adulthood without exposure to fluoridated water. As the data showed, the average U.S. adult had 17.9 decayed, missing or filled teeth (DMFT) in the early 1960s.

Document A-05: Col. G.F. Jeffcott, *United States Army Dental Service in World War II*, Office of the Surgeon General, Department of the Army, 1955 & Lt. Gen. Leonard D. Heaton, *Internal Medicine in World War II, Volume II: Infectious Diseases*, Department of the Army, 1963, http://bit.ly/2ZtX1Dj

Summary: Although this report does not mention fluoride, it provides important historical context for the impact of dental disease. The experiences of the Army during World War II contributed to the sense of urgency among U.S. public health officials to explore the ability of fluoride to reduce disease. In this 1955 report, the U.S. Army Medical Department states that the number of men disqualified for dental reasons "far exceeded all expectations." Over a 10-month period leading up to U.S. entry into the war, nearly 1 in 11 inductees examined was disqualified. The problem was so significant that military officials relaxed their standards for dental health. In fact, the report notes that "the mounting importance of dental defects as a cause for rejection" led to the military's decision in 1941 to include dentists on local induction boards.

Document A-04: "Former Communist Agent Reveals Plot," Common Sense, an advertisement that appeared in various newspapers, citing affidavit filed by Oliver Kenneth Goff, June 22, 1957, http://bit.ly/31oHK8m

Summary: During the McCarthism era of the 1950s, many opponents of CWF tried to link fluoridation to communism. In this notarized statement, a Colorado man named Oliver Kenneth Goff claimed that he was a former member of the Communist Party who "attended Communist underground training schools" in New York City and other cities. Goff's statement alleged that he and other communists "discussed quite thoroughly the fluoridation of water supplies and how we were using it in Russia as a tranquilizer in the prison camps." Goff's statement contended that the objective was to "keep the general public docile during a steady encroachment of Communism." The notarized statement is dated June 22, 1957.

Document A-03: J.C. Furnas, "The Fight over Fluoridation," *Saturday Evening Post*, May 19, 1956, http://bit.ly/2IDGzt5

Summary: This article examines the messages and tactics used by opponents to attack or delay the start of CWF. As *The Post* also explained, delays in the start of fluoridation have exposed the tendency of opponents to report health concerns that they expected CWF would cause. When the planned date for fluoridation arrived in Charlotte, N.C., some

people blamed it for killing goldfish, causing asthma attacks and other problems—unaware that CWF actually had been postponed for technical reasons. *The Post* wrote that critics attack fluoridation as a form of mass medication and socialized medicine. "It is also highly suspicious to some antis that the American Dental Association is keen on a scheme which obviously takes business away from dentists. The fact is, of course, that dentists want tooth decay reduced because there aren't nearly enough dentists for the nation's present needs. They'd like to concentrate more on preventive mouth medicine . . . instead of grinding away forever as repairmen."

Document A-02: H.B. McCauley, "How Fluoridation Facts Were Presented to the Citizens of Baltimore, Md.," *American Journal of Public Health,* July 1954, https://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.44.7.892

Summary: In this article, a dentist recalls the reports and discussions that preceded the decision by Baltimore officials to add fluoride to the city's drinking water. For example, in a report to the mayor, the city's Bureau of Dental Care predicted that after fluoridation, a distinct drop in tooth decay would be seen within about five years. During the last few months of 1950, Baltimore newspapers printed "numerous news items, editorials, and letters to the editor on the proposed fluoridation of the city's water supply" and most supported CWF. However, in June 1951, the city health commissioner advised the city council to delay CWF until a committee of the National Research Council issued its findings on water fluoridation. City leaders agreed to the delay. After the NRC committee issued a report that was favorable to CWF, momentum in the city grew. Once a local judge dismissed a lawsuit from two local taxpayers, fluoridation proceeded. The process was initiated in November 1952.

Document A-01: D.B. Ast, "The Caries-Fluorine Hypothesis and a Suggested Study to Test Its Application," *Public Health Reports*, June 4, 1943, Vol. 58, No. 23, https://www.jstor.org/stable/4584480?seq=1#page_scan_tab_contents

Summary: By 1943, oral health experts were actively talking with officials in various cities about testing the potential benefits of CWF. In this article, David B. Ast, who oversaw New York State's oral health programs, recommended the protocols that researchers should use to conduct such studies. "Much care must be exercised in the selection of study areas which should be comparable in as many essential factors as possible," he wrote, adding that careful consideration is necessary "to rule out variables which may possibly affect the end result." Ast acknowledged that fluoride could be toxic at certain high levels, and he encouraged research trials to assess any such toxic effect: "In a consideration of the chronic toxicity of fluorine, particular attention should be given to the hard tissues and supporting structures of the body, since it is in these tissues and structures that the first and probably the most severe indications of fluorosis are seen."

SECTION B:
The Practice of Water Fluoridation

Document B-15: D.M. O'Mullane et al., "Fluoride and Oral Health," *Community Dental Health*, Vol. 33, 2016, https://www.ncbi.nlm.nih.gov/pubmed/27352462

> **Summary:** CWF critics often characterize fluoridation as a "systemic" form of exposure. Yet, as these coauthors observed: "Fluoridated water also has a significant topical effect in addition to its systemic effect." This is because drinking fluoridated water helps to maintain a low concentration of fluoride in the oral cavity, where it becomes incorporated in dental plaque and saliva, as well as on the surfaces of soft tissues within the mouth. As the coauthors noted, when fluoride is present in dental plaque and saliva, it delays the demineralization of the tooth enamel. "It is well known," the coauthors wrote, "that salivary and plaque fluoride (F) concentrations are directly related to the F concentration in drinking water. This versatility of action adds to fluoride's value in caries prevention." In addition, the coauthors note that fluoride also interferes with glycolysis, the process through which decay-causing bacteria metabolize sugars to produce acid.

Document B-14: "U.S. Public Health Service Recommendation for Fluoride Concentration in Drinking Water," *Public Health Reports*, July-August 2015 http://www.ada.org/~/media/EBD/Files/PHS_2015_Fluoride_Guidelines.pdf?la=en

> **Summary:** This article explains the U.S. Public Health Service's 2015 decision to change from recommending an optimal range of fluoride to a target level of 0.7 mg/L. Previously, local water systems fluoridated within a range of 0.7 to 1.2 mg/L, depending on their location within the U.S.

Document B-13: J. Wurzburg and C. Propas Parver, "Community Water Fluoridation around the Nation: Significant Case Law and Legislation," *Health Law & Policy Brief*, Washington College of Law (American University), Spring 2013, Vol. 7, Issue 1, https://digitalcommons.wcl.american.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1002&context=hlp

> **Summary:** This law school article identifies the 13 U.S. states with laws guaranteeing public access to fluoridated drinking water, and it provides a summary of key provisions in most state laws. In addition, the article notes that CWF critics have frequently sought to cease or prevent fluoridation using lawsuits. However, as the article explains, "courts have consistently upheld fluoridation programs. Moreover, the United States Supreme Court has declined to grant certiorari in cases surrounding water fluoridation."

Document B-12: "Community Water Fluoridation Across Canada (2012)," Community Dental Health Services Research Unit, Dental Research Institute, Faculty of Dentistry, University of Toronto, 2017, https://www.canada.ca/content/dam/hc-sc/documents/services/publications/healthy-living/community-water-fluoridation-across-canada-2017/community-water-fluoridation-across-canada-2017-eng.pdf

> **Summary:** The charts in this report by researchers at the University of Toronto's dental school revealed the percentage of Canadians with access to drinking water from fluoridated water systems. As of 2012, two provinces—Manitoba and Ontario—provided fluoridated water to a majority of their populations. Table 5 shows the trend of CWF coverage by province, starting in 2007.

Document B-11: "The Extent of Water Fluoridation," *One in a Million: The Facts About Water Fluoridation,* British Fluoridation Society, updated in 2012, https://docs.wixstatic.com/ugd/014a47_0776b576cf1c49308666cef7caae934e.pdf

> **Summary:** This 56-page booklet identifies all cities or communities within the United Kingdom and other nations around the globe that benefit from natural fluoridation or fluoridation achieved by adding more of the mineral. As the booklet reveals, more than 20 nations practice fluoridation, including Australia, Brazil, Ireland, Korea, Spain and Vietnam.

Document B-10: G. Tse Feng Chong and Patrick Tseng, "A Review of the Uses of Fluoride and Outcomes of Dental Caries Control in Singapore," *Singapore Dental Journal*, Vol. 32, No. 1, June 2011, https://core.ac.uk/download/pdf/82723478.pdf

> **Summary:** In 1950, Singapore became the first Asian nation-state to adopt a CWF policy covering 100% of its population. Over a 10-year period, annual oral health surveys compared the oral health of Singapore children with those in the non-fluoridated city of Malacca, Malaysia. The data revealed that while children in Malacca experienced a 63% rise in tooth decay, Singapore children saw a 31% decline in cavity experience. In this journal review, the coauthors wrote that although there was no initial organized opposition to fluoridation, criticism has increased in recent years "probably due to a better educated and well-travelled populace that has found its political voice and the myriad of anti-fluoridation material that is readily accessible off the internet..."

Document B-09: E.D. Beltran-Aguilar et al. "Total Water Intake: Lack of association between daily temperature and children's water intake in the United States, 1999-2004," findings posted by the Centers for Disease Control and Prevention, 2008, http://bit.ly/2wPEsgp

> **Summary:** The recommended range for CWF (0.7-1.2 ppm) adopted in 1962 by the U.S. Public Health Service (PHS) was based on prior research showing that children's water intake varied based on the ambient temperature where they resided. Basically, children in warmer climates were found to consume more water than those living in cooler areas of the U.S. However, these data released in 2008 showed that water intake levels were fairly

consistent across the country. The coauthors attributed this change to the increased use of air conditioning and a decline in children's outdoor physical activity. This finding about water intake influenced the PHS's decision in 2015 to change its recommendation from a range to a single target of 0.7 ppm.

Document B-08: "The effective use of fluorides in public health," *Bulletin of the World Health Organization*, 2005
http://www.who.int/bulletin/volumes/83/9/670.pdf

Summary: This article examines the various kinds of systemic fluorides used around the world to reduce the incidence of tooth decay. The co-authors recommend that communities, states or nations rely on only one systemic fluoride modality (water, salt or milk) combined with encouraging the public's use of fluoride toothpaste. The coauthors write that in countries that have a well-developed public health infrastructure, supportive public and appropriately trained water personnel, water fluoridation is "the method of choice."

Document B-07: K.E. Heller et al., "Dental Caries and Dental Fluorosis at Varying Water Fluoride Concentrations," *Journal of Public Health Dentistry*, Vol. 57, No. 3, Summer 1997, https://www.ncbi.nlm.nih.gov/pubmed/9383751

Summary: This research review contributed to the decision by the U.S. Public Health Service to move from a recommended range for CWF (0.7 ppm to 1.2 ppm) to a recommended target level of 0.7 ppm of fluoride. These researchers reviewed data from the 1986-87 National Survey of U.S. schoolchildren and concluded that a "suitable trade-off between caries and fluorosis appears to occur around 0.7ppm F. Data from this study suggest that a reconsideration of the policies concerning the most appropriate concentrations for water fluoridation might be appropriate for the United States."

Document B-06: *Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride*, Institute of Medicine (Food and Nutrition Board), 1997, Summary of the 448-page report, https://www.ncbi.nlm.nih.gov/books/NBK109832/

Summary: Critics of CWF often dismiss fluoride as a non-essential mineral, ignoring the fact that this 1997 report classifies fluoride as a nutrient. The report, issued by the Food and Nutrition Board of the Institute of Medicine, reviewed research to provide recommended Adequate Intake (AI) levels for calcium, phosphorus, magnesium, Vitamin D and fluoride. This document is a summary of the much more detailed report. In its reference to fluoride, the summary states that "the data are strong on (cavity) risk reduction."

Document B-07: L.K. Barker et al., "Knowledge of the Purpose of Community Water Fluoridation – United States, 1990," MMWR, Dec. 11, 1992, https://www.cdc.gov/mmwr/preview/mmwrhtml/00018113.htm

Summary: This article used a 1990 survey of U.S. adults to assess public knowledge of CWF. Specifically, adults were asked to cite the purpose of adding fluoride to drinking

water. The survey revealed that 62% of Americans correctly identified CWF's purpose. Persons with more than a high school education were more than twice as likely than those with less than a high school education (76% versus 36%) to correctly cite the purpose of CWF. Among persons with less than a high school education, 30% believed the purpose of fluoridation was to purify water, compared with 36% who knew it was for preventing tooth decay.

Document B-04: Environmental Protection Agency, "Drinking Water Technical Assistance; Termination of the Federal Drinking Water Additives Program," *Federal Register*, Vol. 53, No. 130, 1988, http://bit.ly/2KPRByb

Summary: In this 1988 announcement in the Federal Register, the Environmental Protection Agency (EPA) summarized which agencies or entities have authority related to fluoride and fluoridation rulemaking. For example, EPA noted that it had delegated authority for testing and certifying fluoride or other water additives to a consortium comprised of the American Water Works Association, the National Sanitation Foundation, the Conference of State Health and Environmental Managers and the Association of State Drinking Water Administrators. In addition, the EPA also stated that a 1979 Memorandum of Understanding (MOU) clarified that it has authority (through the Safe Drinking Water Act) over setting guidelines for the safety and quality of tap water. The Food & Drug Administration (FDA) acknowledged in this MOU that its authority in this specific area was repealed. The MOU stated that the FDA would continue to have authority over fluoride's presence in bottled drinking water or water used in the processing of food products.

Document B-03: C.S. Leukhart, "An update on water fluoridation: triumphs and challenges," *Pediatric Dentistry*, Vol. 1, No. 1, 1979, http://bit.ly/2WJBWYw

Summary: This article assessed progress in the number of public water systems initiating fluoridation. In addition, the article reviewed the earliest state laws that were passed to ensure CWF, noting that these laws differed in significant ways. These differences included the ability of localities to exempt themselves and the threshold of population needed to require CWF. In Kentucky, the legislature delegated to the state board of health the ability to require fluoridation. In 1970, South Dakota's CWF law survived the challenge of a statewide referendum. In 1978, Michigan weakened its state law by allowing communities to discontinue CWF by either local council action or a referendum. The author also explained that ballot initiatives are both costly and pose a deterrent to fluoridation. "They favor the opposition, since they are conducted in an atmosphere that needs only to plant a suspicion of doubt—easily done by scare tactics and dissemination of irrelevant or misleading information," she wrote.

Document B-02: "Fluoridation Census 1975," Public Health Service, U.S. Department of Health, Education and Welfare, April 1977, https://www.cdc.gov/fluoridation/pdf/statistics/1975.pdf

Summary: By the end of 1975, more than 105 million Americans lived in homes with access to fluoridated water, and 22 U.S. states had enough fluoridated water systems to serve a majority of their populations. Table 5 of this report provides information on the popularity of the various types of fluoride additives. Of the nearly 6,800 communities with fluoridation, 72% had started the practice based on a local vote by a city council, county commission or other governing entity. Although only 7% of fluoridated communities approved the process in a voter referendum, ballot initiatives were most likely to have authorized CWF (12%) in communities with populations between 10,000 and 25,000.

Document B-01: "Status of Controlled Fluoridation in the United States, 1945-57," *Public Health Reports*, U.S. Department of Health, Education and Welfare, Vol. 73, No. 7, July 1958, http://bit.ly/2ILtEFQ

Summary: By 1957, the number of fluoridated water systems had grown to serve just over 33 million Americans, and 7 million other residents received drinking water with at 0.7 ppm of fluoride. According to this report, 82% of the fluoridated systems began this practice following decisions by their city council or other governing entity. Five percent of the fluoridated systems was authorized to start CWF after a public referendum. The remaining 13% began fluoridation after a utility commission's vote or did not disclose the source of their decision. By this time, 12 of the 18 U.S. cities with populations exceeding 500,000 were served by fluoridated water systems. This report also provides a chart (Table 1) showing the year-by-year progress in expanding CWF. Between 1950 and 1955, for example, the number of fluoridated communities rose from 96 to 1,300. Even after starting fluoridation, a number of communities reversed course, perhaps because CWF opponents gained a majority on the city council or other entity that had oversight of this decision. Some of these reversals were, in turn, reversed. Between 1945 and 1957, 94 communities discontinued fluoridation—of these, 13 had resumed the practice by the end of 1957.

SECTION C:

The Benefits of Water Fluoridation

Document C-43: J. Meyer et al. "Consequences of community water fluoridation cessation for Medicaid-eligible children and adolescents in Juneau, Alaska," *BMC Oral Health*, 2018, Vol. 18, https://bmcoralhealth.biomedcentral.com/articles/10.1186/s12903-018-0684-2

> **Summary:** Cessation studies are one way to assess the cavity-prevention benefits of CWF. In 2018, this study examined the impact after Alaska's capital city (Juneau) ceased fluoridation, focusing on the effect this had on low-income children who were enrolled in Medicaid. The researchers found that after cessation, the costs of treating tooth decay rose by 47%, even after adjusting those costs for inflation. The study showed that a Juneau child living in a fluoridated city was 25% less likely to need cavity treatments than a child of the same age was after cessation. Jennifer Meyer, the study's lead author, told National Public Radio that the study reveals that after CWF ended, the typical preschool-age child in Juneau needed one additional procedure to treat decay and at a cost of about $300 more per child.

Document C-42: NHMRC Public Statement 2017: Water Fluoridation and Human Health, National Health and Medical Research Council (Australia), https://www.nhmrc.gov.au/sites/default/files/documents/reports/fluoridation-public-statement.pdf

> **Summary:** Following its review of the scientific evidence, this statement from a prestigious Australian panel concluded, "There is reliable evidence that community water fluoridation helps to prevent tooth decay. … Fluoridation of drinking water particularly benefits children, and those on a lower income who tend to have higher rates of dental decay and less access to dental treatment and other forms of fluoride."

Document C-41: *Information Paper – Water fluoridation: dental and other human health outcomes*, National Health and Medical Research Council (Australia), July 2017, https://www.nhmrc.gov.au/_files_nhmrc/file/your_health/fluoridation/17378_nhmrc_-_information_paper.pdf

> **Summary:** This highly respected panel of Australian medical and scientific experts reported: "Over sixty years of research shows that water fluoridation helps to prevent tooth decay by protecting against damage and helping with the repair of teeth." Based on its review of available research, the NHMRC found that water fluoridation reduces tooth decay by 26% to 44% in children, teenagers and adults. As in the United States, water fluoridation is common in Australia.

Document C-40: L. McLaren et al., Measuring the short-term impact of fluoridation cessation on dental caries in Grade 2 children using tooth surface indices," *Community Dentistry and Oral Epidemiology*, 2016, https://www.ncbi.nlm.nih.gov/pubmed/26888380

Summary: One way to identify CWF's benefits is by examining the impact when fluoridation has ceased in a city or town. These researchers compared the trend of children's tooth decay in two large Canadian cities: Calgary and Edmonton. At the initial data point of the study, both cities had fluoridated water systems. The second set of oral health data was collected after Calgary ceased water fluoridation. (Edmonton was fluoridated throughout the study period). The tooth decay rate increased in both cities during the period studied, but the rate of increase in Calgary was far more dramatic—a 146% jump among second grade students. The researchers wrote: "Trends observed for primary teeth were consistent with an adverse effect of fluoridation cessation on children's tooth decay, 2.5–3 years post-cessation. Trends for permanent teeth hinted at early indication of an adverse effect."

Document C-39: J. Rogers et al., "Impact of Socioeconomic Status, Access to Community Water Fluoridation, and Access to Dental Health Professionals on Potentially Preventable Dental Hospitalisations of Young Children," a presentation at the 94th General Session of the International Association for Dental Research (Seoul, South Korea), in June 24, 2016, http://bit.ly/2F4W8sL

Summary: Australian researchers analyzed hospital admission records for preschool-age children (ages 0-4) in the state of Victoria who had been admitted and treated for dental conditions that were considered preventable. If a majority of the population within a postal code had access to drinking water with an optimal concentration of fluoride, such a postal card was designated as "fluoridated." Other postal codes were designated as "non-fluoridated." After comparing the two sets of postal codes, the researchers determined that preschool-age children in fluoridated postal codes had a 43% lower rate of being admitted to hospitals for potentially preventable dental conditions.

Document C-38: M.A. Peres et al., "Access to Fluoridated Water and Adult Dental Caries: A Natural Experiment," *Journal of Dental Research*, 2016, https://www.ncbi.nlm.nih.gov/pubmed/27053119

Summary: This study from Brazil revealed that adults with access to fluoridated water for at least 75% of their lives had distinctly less tooth decay than those who had access for less than 50% of their lives. The study's coauthors noted that their data "may have underestimated the actual effect of water fluoridation on dental caries prevention in adults" because of the so-called halo effect.

Document C-37: L. McLaren et al., "Equity in children's dental caries before and after cessation of community water fluoridation: differential impact by dental insurance status and geographic material deprivation," *International Journal for Equity in Health*, 2016, Vol. 15, No. 24, https://www.ncbi.nlm.nih.gov/pubmed/26864565

Summary: The purpose of this study was to compare the socio-economic patterns of children's tooth decay in Calgary, Canada before and after CWF was ceased by a vote of

city councilors. The researchers concluded that "results are consistent with increasing inequities in dental caries following cessation of CWF."

Document C-36: A.J. Rugg-Gunn et al., "Critique of the review of 'Water fluoridation for the prevention of dental caries' published by the Cochrane Collaboration in 2015," *British Dental Journal,* April 2016, Vol. 220, https://www.nature.com/articles/sj.bdj.2016.257

Summary: In this analysis, researchers from seven nations voiced disappointment with the Cochrane Oral Health Group's (COHG) 2015 review of the evidence supporting CWF. Citing COHG's restrictive criteria for the studies included in its review, the coauthors declared that COHG's conclusions "should not be confused with, or taken to imply, an absence of (CWF's) effect. There is a risk that the Cochrane Review will be inadvertently, or deliberately, misinterpreted in this way." The coauthors contended that COHG was unjustified in insisting upon a "two points in time" longitudinal study design. "The most appropriate study design for [examining CWF's impact] is a single cross-sectional study with controls and does not require examination 'at two time points' . . . the value of this (cross-sectional) approach in estimating the impact of an intervention has increased with the improvement of study design and data collection, the mainstreaming of powerful and fast computing and the application of new more sophisticated statistical methods."

Document C-35: N. Young et al., "Community water fluoridation and health outcomes in England: a cross-sectional study," *Community Dentistry & Oral Epidemiology,* 2015, https://www.ncbi.nlm.nih.gov/pubmed/26153549

Summary: Roughly 6 million people in England live in areas where the water is optimally fluoridated. This cross-sectional study found "strong evidence of lower prevalence of dental caries among children living in fluoridated areas," adding that these children also had fewer teeth on average affected by decay and lower hospital admission rates for tooth extraction. In fact, the average hospital admission rate was 45% lower in fluoridated areas.

Document C-34: K. Weno, "Comments Regarding the Cochrane Review of Water Fluoridation for the Prevention of Dental Caries," a letter from the U.S. Department of Health and Human Services (Public Health Service), July 2, 2015, http://bit.ly/2Zp6POQ

Summary: In June 2015, the Cochrane Oral Health Group (COHG) released a research review on the impact of fluoridation. The COHG review drew attention because some people interpreted it as casting doubt on the benefits of CWF. On behalf of the U.S. Public Health Service, this letter was written by the director of the CDC's Division of Oral Health, seeking to clarify the COHG review and put it in the proper context. In fact, COHG reported that CWF reduced tooth decay in primary teeth by 35% and reduced decay in permanent teeth by 26%. As the letter explained, COHG relied on restrictive criteria that meant they did not include a number of studies in its review. For example, COHG's approach favors randomized controlled trials—a study design that is not feasible for public health programs like CWF that occur on a community-wide level. "Although valid, peer-reviewed studies document the effectiveness of community water fluoridation in children

and adults even after the use of fluoride toothpaste became widespread, these studies were not considered by Cochrane," the letter stated. And the letter added that "we want to assure you that HHS maintains its confidence in water fluoridation as a valuable tool to prevent tooth decay in children as well as adults, and views it as the basis for the primary prevention of tooth decay."

Document C-33: R. Koh et al., "Effects of Water Fluoridation on Caries Experience in the Primary Dentition in a High Caries Risk Community in Queensland, Australia," *Caries Research*, Vol. 49, 2015, https://www.ncbi.nlm.nih.gov/pubmed/25661315

Summary: Some studies have attempted to determine how soon (after initiation) the positive impact of CWF occurs. In this study, researchers found significant improvements in oral health among children in this Australian community after only 36 months of CWF. The prevalence of tooth decay fell from 87% to 75% and the overall rate of decay for children in this community dropped by 19%.

Document C-32: E. Ferreira et al., "Untreated Dental Caries in Brazilian Children Five Years Old and Associated Factors," presentation at the General Session (June 24, 2015) of the International Association for Dental Research in Seoul, South Korea, http://bit.ly/2MWGy8W

Summary: In this presentation, the researchers reported that nearly 50% of all Brazilian children have untreated tooth decay. In addition, they found untreated dental decay among 5 year-olds was more common in areas with less access to fluoridated drinking water. Lack of CWF was one of four factors that researchers identified as linked to higher cavity rates.

Document C-31: A.S. Blinkhorn et al., "A 4-year assessment of a new water-fluoridation scheme in New South Wales, Australia," *International Dental Journal*, 2015; Vol. 65, https://www.ncbi.nlm.nih.gov/pubmed/25913418

Summary: This study was designed to monitor the changes in the tooth decay prevalence of 5- to 7-year-old Australian children living in three districts: a fluoridated area, a newly fluoridated area and in an area without water fluoridation. Gosford City, the newly fluoridated area, began CWF in December 2008. Only two years later, the percentage of cavity-free children in Gosford City and the other fluoridated area was 68%. By contrast, only 55% of children in the non-fluoridated area were cavity-free. The coauthors concluded that "the presence of fluoride in the water certainly adds an extra bonus of [cavity] reductions for young children when compared with their counterparts living in areas without fluoridation."

Document C-30: T.B. Elmer et al., "An alternative marker for the effectiveness of water fluoridation: hospital extraction rates for dental decay, a two-region study," *British Dental Journal*, Vol. 216, 2014, https://www.nature.com/articles/sj.bdj.2014.180.pdf?origin=ppub

Summary: This study examined the rate of hospital admissions for tooth extractions caused by dental disease (not sports injuries or other accidents). It divided the hospital data

into two sets of local health districts. One set came from districts in the West Midlands, a region of England where fluoridation programs have reached a significant portion of the population for many years. The other set came from a region to the north, where most public water supplies are *not* fluoridated. Hospital admission rates differed dramatically—19 of the 20 districts with the highest hospital admission rates for tooth extractions were in the non-fluoridated region. In addition, the study revealed that the most economically disadvantaged district in the non-fluoridated region had a hospital admission rate for tooth extractions that was **27 times higher** than the rate of the most disadvantaged fluoridated district in the West Midlands.

Document C-29: H.J. Cho et al., Systemic effect of water fluoridation on dental caries prevalence," *Community Dentistry and Oral Epidemiology*, 2014, https://www.ncbi.nlm.nih.gov/pubmed/24428350

Summary: These Korean researchers examined tooth decay trends by comparing children in non-fluoridated areas with children in areas where water fluoridation once existed but had been stopped. One of the age groups they studied was 11-year-olds. One of the groups in this age group had never been exposed to fluoridated water, but the 11-year-olds in the fluoridation-ceased area had access to fluoridated water for approximately 4 years after birth. The study showed that 11-year-old children in the fluoridation-ceased area had a far lower rate of tooth decay (DMFT) than those in the non-fluoridated area. After adjusting the sample of children to account for dietary habits, family income levels and other factors, the average DMFT in the fluoridation-ceased area was 42% lower for 11 year-olds than in the area that had never been fluoridated. This finding, the researchers wrote, "suggests that the systemic effect of fluoride intake through water fluoridation could be important for the prevention of dental caries."

Document C-28: *Life Course Indicator: Fluoridation*, Association of Maternal and Child Health Programs, Winter 2013-14, http://www.amchp.org/programsandtopics/data-assessment/LifeCourseIndicatorDocuments/LC-05_Fluoridation_Final-5-4-2014.pdf

Summary: In 2013, the Association of Maternal and Child Health Programs (AMCHP) released a set of 59 "Life Course Indicators"—factors that help improve maternal and child health. Fluoridation was one of the 59 indicators chosen by AMCHP. According to AMCHP, fluoridation strengthens a community's ability "to improve health disparities, public health, and individual health throughout the life course."

Document C-27: M.G. McGrady et al., "The association between social deprivation and the prevalence and severity of dental caries and fluorosis in populations with and without water fluoridation," *BMC Public Health,* December 2012, http://bit.ly/2Xfw88u

Summary: The coauthors of this British study compared tooth decay prevalence in fluoridated Newcastle and non-fluoridated Manchester. Based on clinical examinations of nearly 1,800 children, the coauthors found that the average rate of decayed, missing and filled teeth (DMFT) in Manchester was about 50% higher than in Newcastle. The coauthors

concluded that their finding reinforces "the existing evidence from other studies conducted in the U.K. that water fluoridation reduces inequalities in health by reducing the social gradient between deprivation and dental caries."

Document C-26: *The State of Oral Health in Europe*, a report commissioned by the Platform for Better Oral Health in Europe, September 2012, http://www.oralhealthplatform.eu/wp-content/uploads/2015/09/Report-the-State-of-Oral-Health-in-Europe.pdf

Summary: Critics of fluoridation often portray Western Europe as a region where fluoridation is disdained or prohibited. Yet, in this 2012 report, the Platform for Better Oral Health in Europe cited CWF as one example of a "good practice" to improve prevention of tooth decay. The Platform called fluoridated water "one of the few public health interventions that directly reduces disparities in dental decay between high and low socioeconomic status groups."

Document C-25: "Fluoride Supplement," *Journal of the Irish Dental Association*, Vol. 58, No. 3 (Supplement) June/July 2012, https://www.dentist.ie/_fileupload/JIDA/pdfs%20of%20Journal/2012/2012%20-%2058%20No_%203%20-%20June%20July%20-%20FlourideSupplement.pdf

Summary: Water fluoridation in Ireland began in the mid-1960s. By 1970, most major Irish cities were served by fluoridated water systems. As this supplemental report explained, the tooth decay trends for Irish teens showed dramatic changes in the years after CWF had been implemented. For 15- year-olds, for example, the average number of decayed teeth (DMFT) was 8.2 in 1960. Data collected in 1983-84 showed the DMFT for 15-year-olds had plunged to 4.1 for lifetime residents of fluoridated communities and 5.4 for residents .4 in residents of non-fluoridated communities.

Document C-24: J. Klejka et al., "Dental Caries in Rural Alaska Native Children – Alaska, 2008," *Morbidity and Mortality Weekly Report*, September 23, 2011, Vol. 60, No. 37, https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6037a2.htm

Summary: Researchers conducted a study of tooth decay and associated risk factors in a remote region of Alaska, relying on a sample of Native Alaskan children who lived in five villages (two villages were fluoridated, and the other three were not). Only two factors were significantly associated with children's severity of decay: soda pop consumption and a lack of water fluoridation.

Document C-23: P. Frazão et al., "Drinking water quality and fluoride concentration," *Rev Saúde Pública*, 2011, Vol. 45, No. 5, https://pdfs.semanticscholar.org/cd4c/338f654de9efa04297c1a6e179b890ef8567.pdf

Summary: Water fluoridation is extensive in Brazil, and it was first implemented in 1953 in the city of Baixo Guandu. Fluoridation of public water systems has been required since a Brazilian law was passed in 1974 (Federal Law 6050). Between 1986 and 2003, the average DMFT (Decayed, Missing and Filled Teeth) for 12 year-olds fell from 6.7 to 2.8.

The coauthors conclude that the use of fluoride in water and toothpaste "has been responsible for a significant decline in the levels of dental caries" among Brazilian children and teens.

Document C-22: Letter from deans of the Harvard Medical School, Harvard School of Dental Medicine, and Harvard School of Public Health to Dr. Myron Allukian, March 22, 2013, http://bit.ly/2XPbqta

Summary: In 2013, these Harvard deans wrote this letter citing CWF as a "vital public health measure" and declaring their view that CWF "has made an enormous impact on improving the oral health of the American people."

Document C-21: John Conger, Acting Deputy Undersecretary of Defense, U.S. Department of Defense, memorandum to Army, Navy and Air Force officials, March 18, 2013, http://bit.ly/2MLLmOw

Summary: In 2011, the U.S. Secretary of Defense for Health Affairs issued a memorandum instructed military bases that operate water systems to ensure that such systems are fluoridated. In the memo, this senior Defense official explained the justification for this order: "Providing optimally fluoridated water is a proven disease prevention program that improves and sustains the military readiness and health of military personnel." The memo provided additional context for the order, noting that tooth decay continues to be "a significant reason for personnel to be classified as non-deployable."

Document C-20: M. Neidell et al., "The Association Between Community Water Fluoridation and Adult Tooth Loss," *American Journal of Public Health*, October 2010, Vol. 100, No. 10, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2936985/

Summary: Researchers conducted an analysis of exposure to CWF over the course of Americans' lives. They found a significant link between fluoridation in the community where a person was born and a lower risk of tooth loss. For every 100 people who currently lived in a county that was fluoridated when they were born, 25 teeth were saved. The coauthors concluded, "Many studies have documented strong benefits from CWF exposure during childhood on a child's oral health, but our evidence suggests that the benefits may be even larger than previously believed because prior studies may not have captured the full benefits from CWF."

Document C-19: M. Ditmyer et al., "A case-control study of determinants for high and low dental caries prevalence in Nevada youth," *BMC Oral Health*, 2010, Vol. 10, No. 24, https://www.ncbi.nlm.nih.gov/pubmed/21067620

Summary: This study of more than 4,100 teens in Nevada examined the impact of multiple forms of prevention on rates of Decayed, Missing and Filled Teeth (DMFT). Lack of community water fluoridation was one of the three highest risk factors for tooth decay. And

those living in areas where there is no community water fluoridation were nearly twice as likely as those in fluoridated areas to have high DMFT scores.

Document C-18: L. Kirkeskov et al., "The association between fluoride in drinking water and dental caries in Danish children: Linking data from health registers, environmental registers and administrative registers," *Community Dentistry and Oral Epidemiology*, December 2009, http://bit.ly/2WJl7rE

Summary: This study examined the link between the fluoride concentration in drinking water and tooth decay among children in Denmark. The study was based on data collected from the Danish National Board of Health over a 10-year period for 5- and 15-year-old children. The coauthors wrote that a "clear dose–response relationship was seen between fluoride concentration in drinking water and caries in all [age groups of children]." This connection was found "in spite of the extensive use of fluoridated toothpaste and caries-preventive programs implemented by the municipal dental services in Denmark." The study found that children living in areas where water had a fluoride concentration of at least 1 mg/L had roughly half the odds of experiencing tooth decay as children living in areas with very low fluoride concentrations in the water (0–0.1249 mg/L).

Document C-17: J.M. Armfield, "Community Effectiveness of Public Water Fluoridation in Reducing Children's Dental Disease," *Public Health Reports,* Sept.-Oct. 2010, Vol. 125, https://www.ncbi.nlm.nih.gov/pubmed/20873281

Summary: This study examined oral health data and related measures for more than 111,000 children in Australia. The researcher reported a "strong and consistent pattern of results" showing that children living in fluoridated areas had lower rates of tooth decay. Cavity experience and prevalence were higher for every age group in the non-fluoridated areas. The prevalence of tooth decay among 15 year-olds was 29% higher in the non-fluoridated areas.

Document C-16: Community Water Fluoridation: A Position Paper Prepared by the Office of Oral Health and the Science Advisory Committee, Arkansas Department of Health, March 12, 2008, https://www.healthy.arkansas.gov/images/uploads/pdf/ArkansasFluoridationPaper.pdf

Summary: Three years before Arkansas enacted a state law guaranteeing access to fluoridated water, the state health department co-released this position paper. At the time this paper was released, 64.5% of Arkansans had access to fluoridated drinking water. This paper shares 2002 data comparing tooth decay rates for kindergarten students in Perry County with kindergarteners in the town of Morrilton, 10 miles north of the county. The public water system was fluoridated in Morrilton but not in Perry County. The average number of decayed teeth in Perry County (3.4 per child) was twice as high as the rate in Morrilton (1.7 per child).

Document C-15: M. Levy, "The Use of Scientific Data to Influence the Taking of a Policy Position, Case Study: Water Fluoridation in the City of Dorval," La Société Française des Acteurs de la Santé Publique Bucco-dentaire, Proceedings of the 8th Day of Dental Public Health, (Créteil, France), November 2008, http://bit.ly/2IhJCZd

> **Summary:** In 2003, the Canadian city of Dorval—situated 12 miles west of Montreal—stopped water fluoridation, mostly due to the age of its water infrastructure and a financing accord. Until it stopped, Dorval had been one of only a few communities in Québec with fluoridated drinking water. In 2006, when Dorval considered resuming CWF, its water infrastructure was then controlled by Montreal officials, who decided not to allow Dorval to re-start CWF. Between 2003 and 2005, following the cessation of fluoridation, the rate of children at risk of cavities in Dorval moved from 7.4% to 16%. In addition, in 2003, only 3% of Dorval kindergarten children had untreated decay, a percentage well below that found in other Québec regions. Yet, between 2003 and 2005, this percentage climbed to 12%. These disturbing trends led to a campaign that succeeded in resuming CWF in Dorval in 2008.

Document C-14: S.O. Griffin et al., "Effectiveness of Fluoride in Preventing Caries in Adults," *Journal of Dental Research*, Vol. 86, 2007, https://www.ncbi.nlm.nih.gov/pubmed/17452559

> **Summary:** In the early years after fluoridation began, the prevailing view was that CWF reduced cavities for children but had a negligible or minor benefit for adults. Research began to challenge this initial view. This systematic review examined nine studies to determine the impact of CWF on adults. These researchers concluded that fluoridation reduces decayed, missing and filled surfaces (DMFS) by 27%.

Document C-13: "Caries Prevention Associated with Water Fluoridation Increases with Age," a chart created by Howard Pollick, Univ. of California San Francisco, 2005, http://bit.ly/2KPOMgt

> **Summary:** This chart was created by Dr. Howard Pollick, a fluoride research advisor and spokesperson for the American Dental Association. Its purpose is to respond to fluoridation critics who misrepresent the 1990 Brunelle-Carlos study. Critics cite this study to downplay the reductions in tooth decay resulting from fluoridation. Although the Brunelle-Carlos study found that the average difference in tooth decay for all children (ages 5-17) was 0.6 decayed tooth surfaces, this difference increases steadily with age. By the age of 17, the average child in a fluoridated area has 1.6 fewer cavities than a child living in a non-fluoridated community.

Document C-12: B.A. Burt, "Fluoridation and Social Equity," *Journal of Public Health Dentistry*, Vol. 62, No. 4, Fall 2002, https://www.ncbi.nlm.nih.gov/pubmed/12474623

> **Summary:** In this commentary, Dr. Burt (University of Michigan) contended that fluoridation "should be retained as the cornerstone of caries control in public health." Largely because "fluoridation moves us toward achieving social equity in oral health, and is a practical and relatively inexpensive method of doing so."

Document C-11: "Water Fluoridation and Costs of Medicaid Treatment for Dental Decay – Louisiana, 1995–1996," *Morbidity & Mortality Weekly Report*, Vol. 48, No. 3, 1999, https://www.cdc.gov/mmwr/preview/mmwrhtml/mm4834a2.htm

> **Summary:** The costs of treating tooth decay in young children can be significant, particularly if treatment requires extensive procedures and general anesthesia in a hospital operating room (OR). In this study, the Louisiana Department of Health and Hospitals (LDHH) and the Centers for Disease Control and Prevention reviewed Medicaid dental claims for a 12-month period (1995-96) for children of ages 1 to 5. This analysis revealed that Medicaid-eligible children in non-fluoridated communities were three times more likely than those in fluoridated communities to receive dental treatment in hospital ORs.

Document C-10: J.C. Riley et al., "The effect of water fluoridation and social inequalities on dental caries in 5-year-old children," *International Journal of Epidemiology*, Vol. 28, 1999, https://www.ncbi.nlm.nih.gov/pubmed/10342695

> **Summary:** The researchers examined the tooth decay rates for 5-year-old children in seven fluoridated districts and seven non-fluoridated districts of the United Kingdom. In all, data was collected for more than 40,000 children from 439 wards in central and northern England. The researchers reached this conclusion: "Water fluoridation reduces dental caries experience more in materially deprived wards than in affluent wards, and the introduction of water fluoridation (in new wards) would substantially reduce inequalities in dental health."

Document C-09: J.D.B. Featherstone, "Prevention and reversal of dental caries: role of low level fluoride," *Community Dentistry and Oral Epidemiology*, Vol. 27, 1999, https://www.ncbi.nlm.nih.gov/pubmed/10086924

> **Summary:** The author put the beneficial role of CWF in an appropriate and helpful context. "It is well established," he wrote, "that fluoride in drinking water reduces dental caries, but does not eradicate it. Fluoride in the drinking water provides fluoride at levels in the mouth which can inhibit demineralization and enhance remineralization, and tip the caries balance towards protection, provided the challenge is not too great." In other words, fluoridated water is unlikely to keep children decay-free if they are regularly consuming many sugar-sweetened beverages over the course of a day. Equally important was the author's recognition that fluoridated water is not simply a systemic form of fluoride; rather, because trace levels of fluoride become incorporated into saliva, they can reach the surface of teeth and help remineralize the enamel. He wrote, "The mechanism of action of fluoride in the drinking water is therefore as a topical delivery system."

Document C-08: W.S. Driscoll et al., "Prevalence of dental caries and dental fluorosis in areas with negligible, optimal and above-optimal concentrations in drinking water," *Journal of the*

American Dental Association, Vol. 113, July 1986, https://www.ncbi.nlm.nih.gov/pubmed/3461057

> **Summary:** This study analyzed oral health data for 807 children (ages 8-16) in Western Illinois whose parents reported that the local tap water was their primary source of drinking water. The fluoride level in the drinking water for these communities either met or exceeded the recommended level for cavity prevention. The oral health of these Illinois kids was compared to 316 children in the same age group who lived in Iowa communities in which the drinking water was below the recommended optimal level. The average number of decayed, missing or filled surfaces (DMFS) in the Illinois children with an optimal level of fluoride in their water was 38.1% below the average DMFS for the Iowa children.

Document C-07: G.K. Stookey et al., "Prevalence of dental caries in Indiana school children: results of 1982 survey," *Pediatric Dentistry*, Vol. 7, No. 1, 1985, https://pdfs.semanticscholar.org/45bf/a5e8ac511d1780e2f2342b79a23e53b6141f.pdf

> **Summary:** This article reviews a 1981-82 oral health survey that was conducted of Indiana school children. The article notes that after collecting oral health data on 6,363 children, it was determined that the prevalence of tooth decay had declined dramatically—a decline of approximately 70% during the past 23 years and a decline of about 50% during the past 10 years. CWF was one of the factors cited by researchers for this significant fall in tooth decay.

Document C-06: J.L. Hardwick et al., "Caries increments over 4 years in children aged 12 at the start of water fluoridation," *British Dental Journal*, Vol. 153, September 21, 1982, http://bit.ly/2XLKoTB

> **Summary:** This study examined tooth decay rates over a four-year period for nearly 700 children in northern England. Some of the children lived in a fluoridated community, and the control group of kids did not. The coauthors reported that the study's results "have shown conclusively that children aged 12 at the start of water fluoridation develop substantially less [tooth decay] than similar children in a non-fluoride area …"

Document C-05: "Decayed, Missing, and Filled Teeth among Persons 1-74 Years, United States," *Vital & Health Statistics,* U.S Department of Health and Human Services (National Center for Health Statistics), DHHS Publication No. (PHS) 81-1673, August 1981, http://bit.ly/2WMIBRB

> **Summary:** This report explored the impact of CWF in reducing tooth decay, drawing from a national oral health survey conducted in 1971-74. The report included a graph (p. 13) showing that 15-year-olds in a fluoridated community had an average of about 6 decayed, missing and filled teeth (DMFT), compared to non-fluoridated areas where 15-year-olds had an average of about 10 DMFT. Additionally, this report pointed to 1964 research showing that Illinois teens (ages 13-17) who had consumed non-fluoridated water for all

their lives averaged 9.0 decayed, missing or filled teeth (DMFT). By contrast, those teens who drank only fluoridated water averaged 4.2 DMFT.

Document C-04: "Caries-Free Teenagers Increase with Fluoridation," U.S. Department of Health, Education and Welfare, Document 00-3190, May 1978, http://bit.ly/2KQj6b6

Summary: This briefing document from federal health officials shares data from numerous cities in North America to identify dental health improvements after CWF was implemented. For example, the report pointed out that in 1965 the percentage of cavity-free children (13 year-olds) in Milwaukee was eight times higher than the percentage in 1950. Data from Philadelphia and other cities shows the significant reductions in dental cavities that resulted after fluoridation was initiated.

Document C-03: H.K. Brown et al., "The Brantford-Sarnia-Stratford Fluoridation Caries Study: Final Survey, 1963," *Canadian Journal of Public Health*, August 1965, Vol. 56, No. 8, http://bit.ly/2XJzWf3

Summary: This article provided the final survey of data comparing dental health and other health measures for children in three communities of Ontario, Canada. The communities were Brantford (newly fluoridated), Stratford (naturally fluoridated) and Sarnia (non-fluoridated). Brantford started fluoridation in 1945. Table VI offers one example of the study's findings — the average number of decayed, missing or filled permanent teeth (upper incisors) in non-fluoridated Sarnia was more than four times higher than the number in Brantford and Stratford. In addition, the coauthors reported seeing no cases of mottled enamel (fluorosis). "Neither did we observe any ill effects attributable to the presence of fluoride in the water supply," they added. "The health authorities and the practising physicians of Brantford and Stratford did not report any ill effects either."

Document C-02: O.B. Dirks et al., "The Results of 6½ Years of Artificial Fluoridation of Drinking Water in the Netherlands," *Archives of Oral Biology,* Vol. 5, 1961, https://www.sciencedirect.com/science/article/pii/0003996961900656

Summary: This study sought to assess the impact of water fluoridation on tooth decay "under Dutch living conditions" by comparing cavity trends in two cities—Tiel was fluoridated starting in 1953 at 1.1 mg/L, and Culemborg served as the control city (fluoride in water fell below 0.2 mg/L). As the coauthors noted, "there were no significant differences (in tooth decay prevalence) between Tiel and Culemborg present at the beginning of the water fluoridation. After CWF began, Tiel's tooth decay rates fell. After six and a half years of CWF, the researchers reported that fluoridation provided "an important caries inhibiting effect" on the teeth of children aged 11 to 15.

Document C-01: F.A. Arnold Jr. et al., "Effect of Fluoridated Public Water Supplies on Dental Caries Prevalence," *Public Health Reports,* Vol. 71, No. 7, July 1956, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2031043/pdf/pubhealthreporig00151-0024.pdf

Summary: This article examined the findings of the Grand Rapids-Muskegon study after 10 years of analysis. The coauthors reported that a "striking reduction in the prevalence of dental caries" was achieved for primary teeth and a "marked reduction" was observed in permanent teeth. For children born since fluoridation initiated in Grand Rapids, the decay rate for permanent teeth fell by an average of about 60%. These benefits were achieved, the coauthors wrote, without observing an "undesirable cosmetic effect from dental fluorosis."

SECTION D:
The Safety of Water Fluoridation

Document D-36: American Fluoridation Society, April 23, 2019 press statement on dental fluorosis data, http://bit.ly/2KjNQSm

Summary: Critics of CWF often present dental fluorosis as if it were a safety issue. When a set of U.S. data showed an increase in fluorosis, critics seized the chance to express concern. However, federal health officials subsequently issued a statement casting serious doubt on these data. This statement by the American Fluoridation Society speaks to this issue.

Document D-35: C.A. McPherson et al. "An Evaluation of Neurotoxicity Following Fluoride Exposure from Gestational Through Adult Ages in Long-Evans Hooded Rats," *Neurotoxicity Research,* 2018, Vol. 34, https://www.ncbi.nlm.nih.gov/pubmed/29404855

Summary: At the direction of the National Toxicology Program (NTP), these scientists examined rats that consumed water and food with different concentrations of fluoride, including fluoride exposure during prenatal development. At these exposure levels, the NTP researchers wrote that they "observed no exposure-related differences in motor, sensory, or learning and memory performance" for any of the nine different tests they conducted. Furthermore, thyroid hormone levels (TSH) were not altered as a function of 10 or 20 parts per million (ppm) of fluoride. The only side effect the NIEHS study found—inflammation of the prostate gland—occurred only at a fluoride exposure that was the equivalent of more than five times the exposure humans typically experience by drinking fluoridating water.

Document D-34: "Total Diet Study 2014-2016: Assessment of Dietary Exposure to Fluoride in Adults & Children in Ireland," report by the Food Safety Authority of Ireland, April 30, 2018, https://www.fsai.ie/news_centre/tds_fluoride_30042018.html

Summary: This report by the Food Safety Authority of Ireland (FSAI) tested more than 200 of the most commonly-consumed foods and beverages to estimate "typical" fluoride consumption from these sources. Once the estimates of intake levels were developed, these levels were closely examined to assess safety. The report by FSAI's Scientific Committee concluded that "there is currently no scientific basis for concerns about the safety of children and adults in Ireland from exposure to fluoride from foods and beverages." Dr. Pamela Byrne, FSAI's chief executive added: "This study reaffirms the FSAI's and its scientific committee's view that exposure to fluoride from the diet for all population groups in Ireland is not of concern."

Document D-33: NHMRC Public Statement 2017: Water Fluoridation and Human Health, National Health and Medical Research Council (Australia), https://www.nhmrc.gov.au/sites/default/files/documents/reports/fluoridation-public-statement.pdf

Summary: Following its review of the scientific evidence, this statement from a prestigious Australian panel concluded, "There is no reliable evidence of an association between community water fluoridation at current Australian levels and any health problems."

Document D-32: Environmental Protection Agency, "Fluoride Chemicals in Drinking Water; TSCA Section 21 Petition; Reasons for Agency Response," *Federal Register*, Vol. 82, No. 37, February 27, 2017, https://www.govinfo.gov/content/pkg/FR-2017-02-27/pdf/2017-03829.pdf

Summary: In November 2016, several anti-fluoride groups filed a petition under section 21 of the Toxic Substances Control Act (TSCA) asking the EPA to exercise its authority under TSCA to "prohibit the purposeful addition of fluoridation chemicals to U.S. water supplies.'' The Fluoride Action Network (FAN) took the lead in filing this petition. The EPA rendered it decision in early 2017, declaring that "the petition has not set forth a scientifically defensible basis to conclude that any persons have suffered neurotoxic harm as a result of exposure to fluoride" through water fluoridation or from other fluoride exposures. In its response, the EPA wrote that the petition "ignores a number of basic data quality issues" in the studies that were cited. The agency also observed that 19 of the studies that were filed with the petition "were considered to pose a very serious overall risk of bias" because of their methodology or the absence of relevant data.

Document D-31: A.M. Barberio et al., "Fluoride exposure and reported learning disability diagnosis among Canadian children: Implications for community water fluoridation," *Canadian Journal of Public Health*, Vol. 108, No. 3, 2017, https://link.springer.com/article/10.17269%2FCJPH.108.5951

Summary: These researchers relied on urine samples to explore links between fluoride exposure and the incidence of learning disabilities in Canadian children (ages 3–12). The researchers reported finding no association between fluoride exposure and learning disabilities.

Document D-30: M. Bashash et al., "Prenatal Fluoride Exposure and Cognitive Outcomes in Children at 4 and 6–12 Years of Age in Mexico," *Environmental Health Perspectives*, 2017, https://ehp.niehs.nih.gov/doi/10.1289/EHP655

> **Summary:** This study examined urinary fluoride levels in 299 Mexican mothers during pregnancy to explore any association between these levels and children's cognitive skills. The study reported that higher prenatal fluoride exposure "was associated with lower scores on tests of cognitive function" in children. However, some of the coauthors cautioned against drawing firm conclusions based on this study. Morteza Bashash, the lead author, told a reporter that "we have a lot of uncertainty in the results." Howard Hu, another coauthor, said the study "needs to be reproduced in other populations by other scientists." And coauthor Angeles Martinez-Mier told a reporter: "We don't have the whole picture." Their public statements are a reflection of various issues with the study's design or data. For example, the study reported urinary fluoride levels based on "spot samples," a sampling method that can be skewed by sharp fluctuations. Additionally, the study's coauthors could not determine how many women might have been exposed to "double fluoridation"—consuming both fluoridated salt *and* water with elevated levels of natural fluoride. A few days after the study was released, the American Congress of Obstetricians and Gynecologists posted a social media message reaffirming its recommendation that pregnant women should drink fluoridated water.

Document D-29: "Article Review on 'Prenatal Fluoride Exposure and Cognitive Outcomes in Children at 4 and 6–12 Years of Age in Mexico'," Public Health Ontario, 2017, https://www.publichealthontario.ca/-/media/documents/fluroide-iq-mexico.pdf?la=en

> **Summary:** After the Bashash study (see Document D-29) was published, Public Health Ontario researchers analyzed the study's design and conclusions. In this review, Public Health Ontario reported that this IQ-related study "is methodologically better than many others in the literature and incorporates individual level, rather than ecological, exposure assessment. However, not all potential confounders were fully addressed and this remains a possible explanation for the association found." This review also noted that the Bashash study relied on two labs for urine analysis and that one of these labs lost a substantial amount of data—21% of its urine samples—based on quality control criteria. As for this data loss, Public Health Ontario wrote: "This is unusually high but it is difficult to understand how this might have impacted the study results without additional details."

Document D-28: A.M. Barberio et al., "Fluoride exposure and indicators of thyroid functioning in the Canadian population: implications for community water fluoridation," *Journal of Epidemiology and Community Health,* Vol. 71, 2017, https://www.ncbi.nlm.nih.gov/pubmed/28839078

> **Summary:** These researchers analyzed data from the Canadian Health Measures Survey and found no evidence of a relationship between fluoride exposure and the diagnosis of a thyroid condition. There was no statistically significant association between fluoride exposure and abnormal TSH levels—which are measured to diagnose thyroid conditions.

The researchers even took the additional step of redoing their analysis with a subset of people known to get their drinking water primarily from the tap; this secondary analysis also revealed no association between fluoride exposure and thyroid problems.

Document D-27: L. Aggeborn & M. Ohman, The Effects of Fluoride in the Drinking Water, research compiled and posted online, June 27, 2016, https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=EEAESEM2016&paper_id=206

Summary: These researchers reviewed a rich data set of public registers in Sweden and compared labor market outcomes with the fluoride levels to which Swedish residents were exposed. The researchers reported that "we find a zero effect of fluoride on cognitive ability, noncognitive ability and education (measured by test scores on a national math test)." On the contrary, these researchers reported finding evidence that "fluoride is a positive factor for later labor market outcomes, which indicates that better dental health is a positive factor on the labor market."

Document D-26: R.B. Rebhun et al., "Evaluation of optimal water fluoridation on the incidence and skeletal distribution of naturally arising osteosarcoma in pet dogs," *Veterinary and Comparative Oncology*, 2016, https://www.ncbi.nlm.nih.gov/pubmed/26762869

Summary: CWF opponents have sometimes voiced concern about fluoridation exposure's impact on animals. This case-control study gathered data on more than 400 dogs that had been diagnosed with different forms of cancer by the University of California at Davis Veterinary Medical Teaching Hospital. These data were coded to reflect the fluoridation status of the community where the dogs' owners lived. The study's coauthors reported that their findings "indicate that exposure to optimally fluoridated water does not appear to alter the overall risk of developing OSA in pet dogs."

Document D-25: State of the Science: Community Water Fluoridation, Web Report #4641, Water Research Foundation, 2015, http://www.waterrf.org/resources/StateOfTheScienceReports/Fluoride_StateOfTheScience.pdf#search=fluoridation

Summary: The Water Research Foundation examined the research related to nine common concerns that critics raise about CWF. These concerns included skeletal fluorosis, cancer and neurological effects. Its conclusion? "Concerns with community water fluoridation and fluoride exposure have been examined based on the latest science," adding that "a balance of scientific studies showed that none of these issues poses a risk to public health at CWF levels." In addition, the Foundation concluded that "the average or even maximum water consumption does not approach fluoride exposures that would pose health risks."

Document D-24: N. Young et al., "Community water fluoridation and health outcomes in England: a cross-sectional study**,"** *Community Dentistry & Oral Epidemiology,* 2015, https://www.ncbi.nlm.nih.gov/pubmed/26153549

Summary: This cross-sectional study examined whether there was strong evidence showing a link between exposure to water fluoridation and a variety of health or medical conditions or injuries—hip fracture, Down syndrome, overall cancer incidence, bladder cancer, osteosarcoma, kidney stones and overall mortality rates. After evaluating the data, the researchers found no such evidence pointing to a link between CWF and any of these adverse health conditions.

Document D-23: "Fluoride Safety: A Guide for Health Professionals," Campaign for Dental Health (American Academy of Pediatrics), 2015
http://ilikemyteeth.org/wp-content/uploads/2014/10/FluorideSafetyforHealthProfessionals.pdf

Summary: This two-page guide for health professionals helps physicians, nurse practitioners and others have productive, fact-based conversations about fluoride with their patients.

Document D-22: "Fluoride in Water Isn't Going to Hurt You," Dr. Aaron Carroll, Healthcare Triage, September 22, 2014
https://www.youtube.com/watch?v=6Hml1CL0Idk

Summary: Narrated by Dr. Aaron Carroll of Indiana University, this 8:38 video reviews the claims that fluoride is linked to lower IQ scores. It also summarizes the overall evidence behind the safety of water fluoridation.

Document D-21: *Health effects of water fluoridation: A review of the scientific evidence,* a report on behalf of the Royal Society of New Zealand and the Office of the Prime Minister's Chief Science Advisor, August 2014, https://royalsociety.org.nz/assets/documents/Health-effects-of-water-fluoridation-Aug-2014-corrected-Jan-2015.pdf

Summary: This scientific panel reached a unanimous conclusion that "there are no adverse effects of fluoride of any significance arising from fluoridation at the levels used in New Zealand. In particular, no effects on brain development, cancer risk or cardiovascular or metabolic risk have been substantiated, and the safety margins are such that no subset of the population is at risk because of fluoridation." In addition, the panel added that "the scientific issues raised by those opposed to fluoridation are not supported by the evidence."

Document D-20: U.E. Onoriobe et al., "Caries and Fluorosis Impacts on Oral Health-Related Quality of Life," poster presentation at the National Oral Health Conference, delivered in April 2014, http://bit.ly/2Igt2sv

Summary: Critics of CWF often try to portray dental fluorosis as a safety issue. An oral health survey was conducted of more than 7,600 North Carolina children in grades k-12) and their parents. The goal was to determine what impact, if any, tooth decay and dental fluorosis had on the oral health-related quality of life (OHRQoL) of children and parents. The researchers found no link between the dental fluorosis and the OHRQoL of children or their families. However, tooth decay was significantly associated with a negative OHRQoL

in older children and parents of all children. The researchers concluded that while cavity experience had a negative impact on OHRQoL, "fluorosis prevalence or severity had no impact" on OHRQoL.

Document D-19: J.M. Broadbent et al., "Community Water Fluoridation and Intelligence: Prospective Study in New Zealand," *American Journal of Public Health*, 2014, https://ajph.aphapublications.org/doi/10.2105/AJPH.2013.301857

Summary: The coauthors of this study examined data from IQ tests that had been conducted on New Zealand children at ages 7, 9, 11 and 13 (using a consistent testing method) and then performed on these individuals at the adult age of 38. "The findings do not support the assertion that fluoride exposure in the context of CWF can affect neurologic development or IQ," reported the coauthors. In addition, the coauthors explained that no significant drops in IQ scores have been observed after widespread implementation of CWF or the introduction of fluoride toothpastes. On the contrary, the coauthors pointed out, "historical comparisons have documented substantial IQ gains across countries (that adopted fluoridation programs) since the mid-1900s." When it comes to widely circulating claims that fluoridation and IQs are linked, the coauthors offered this advice: "Scientists and policy makers should be reminded of the necessity of caution in attributing causality when evidence for it does not exist."

Document D-18: K. Blakey et al., "Is fluoride a risk factor for bone cancer? Small area analysis of osteosarcoma and Ewing sarcoma diagnosed among 0–49-year-olds in Great Britain, 1980–2005," *International Journal of Epidemiology*, 2014, https://www.ncbi.nlm.nih.gov/pubmed/24425828

Summary: The study sought to explore whether there was any link between fluoride exposure and bone cancer cases in the United Kingdom (2,566 osteosarcoma and 1,650 Ewing sarcoma cases). After reviewing the data, these researchers found no evidence of an association between bone cancer risk and fluoride in drinking water.

Document D-17: I.A. Jolaoso et al., "Does fluoride in drinking water delay tooth eruption?" *Journal of Public Health Dentistry*, Vol. 74, No. 3, summer 2014, https://www.ncbi.nlm.nih.gov/pubmed/24635653

Summary: Opponents of fluoridation have asserted that exposure to fluoridated water causes a delay in the formation and appearance of children's permanent teeth. In this study, researchers examined data of more than 13,000 children ages 5-17 from the 1986-1987 National Survey of Oral Health of U.S. Schoolchildren. They concluded that exposure to fluoridated drinking water did not delay the eruption of permanent teeth.

Document D-16: P. Näsman et al., "Estimated Drinking Water Fluoride Exposure and Risk of Hip Fracture: A Cohort Study," *Journal of Dental Research*, 2013, https://www.ncbi.nlm.nih.gov/pubmed/24084670

Summary: Using a large sample of Swedish residents, this study investigated a possible link between the risk of hip fractures and fluoride exposures from drinking water. Individuals were exposed regularly to varying levels of fluoride, and these exposures were used to assess a potential link to hip fractures. After analyzing the data, the researchers "found no association between chronic fluoride exposure and the occurrence of hip fracture."

Document D-15: Transcript of an email message sent by John Doull to the Pew Charitable Trusts, March 19, 2013 at 6:42 pm ET, https://ilikemyteeth.org/wp-content/uploads/2013/03/Doull-Email-on-CWF-March-2013.pdf

Summary: John Doull, a renowned toxicologist, chaired the National Research Council's Committee on Fluoride in Water, which released a 2006 report. Critics of CWF have repeatedly misrepresented the findings of the NRC committee. In 2013, an employee of the Pew Charitable Trusts asked Doull for his views on the safety of water fluoridation. In his email reply, Doull made his position clear, writing: "I do not believe there is any valid scientific reason for fearing adverse health conditions from the consumption of water fluoridated at the optimal level."

Document D-14: "NSF Fact Sheet on Fluoridation Products," NSF International, February 15, 2013, https://www.nsf.org/newsroom_pdf/NSF_Fact_Sheet_on_Fluoridation.pdf.

Summary: Founded in 1944, NSF International acts as an independent, non-governmental agency that performs tests on water treatment chemicals or water additives such as fluoride. All additives are required to comply with Standard 60, which was developed by a team of scientists and water experts. Critics of fluoride claim that fluoride additives contain harmful levels of arsenic and other heavy metals. However, in this fact sheet, NSF reports that its data "demonstrate that very low concentrations of contaminants are associated with fluoridation chemicals. In fact, NSF was only able to detect the reported trace amounts by dosing the chemicals into water at ten times the manufacturers maximum use level (as required by the Standard). If the products had been dosed into water at the manufacturer's maximum use level, all contaminant levels would have been below the analytical method detection limits."

Document D-13: A. Choi et al., "Developmental Fluoride Neurotoxicity: A Systematic Review and Meta-Analysis," *Environmental Health Perspectives,* Vol. 120, No. 10, 2012, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3491930/pdf/ehp.1104912.pdf

Summary: The 27 studies that were reviewed by these researchers are often cited by CWF opponents as a major reason why fluoridation is too risky. Critics choose to overlook the significant flaws in these studies, ignoring the coauthors' observation that "each of the [studies] reviewed had deficiencies, in some cases rather serious ones, that limit the conclusions that can be drawn." For example, the studies did not use a consistent method to measure IQ scores and did not focus on the same age groups. Six of the 27 studies did not provide both the high fluoride level and control (reference) level that were used to compare

IQ scores. And six of the 27 studies measured fluoride exposure from coal-burning or other methods—not from drinking water. Many of the 27 studies tested small samples of children; 10 of the 27 studies had samples of fewer than 75 children. Interestingly, the average fluoride level in the low-fluoride (reference) cohort of children is very close to the optimal level used for fluoridation in the United States. Therefore, opponents are misleading the public when they suggest that the high-fluoride cohort (with lower IQ scores) is comparable to children in fluoridated areas of the U.S.

Document D-12: J. Woodcock and M.M. Landa, Letter from the U.S. Food and Drug Administration to Cynthia Oshita of the Office of Environmental Health Hazard Assessment (State of California), received on Sept. 6, 2011, http://bit.ly/2XfNrX0

Summary: In 2010, in accordance with the voter-approved Proposition 65, California's Office of Environmental Health Hazard Assessment was asked to reach a decision on whether fluoride was a carcinogen. In 2011, before the agency rendered its decision, a senior official at the U.S. Food and Drug Administration (FDA) wrote the California agency to express its concerns. In its letter, the FDA informed California officials "that we have determined that the available data do not support a conclusion that exposure to fluoride in FDA-regulated products causes cancer." The FDA added that placing a cancer warning on the labeling of FDA-regulated products containing fluoride (such as toothpaste and bottled water) "would misbrand these products in violation of the Federal Food, Drug, and Cosmetic Act (FD&C Act) and, therefore, would be preempted."

Document D-11: O. Chankanka et al., "A literature review of aesthetic perceptions of dental fluorosis and relationships with psychosocial aspects⁄oral health-related quality of life," *Community Dentistry and Oral Epidemiology,* Vol. 38, 2010, https://www.ncbi.nlm.nih.gov/pubmed/20002631

Summary: Opponents have made dental fluorosis one of their leading arguments in attacking CWF. In doing so, they typically mischaracterize what fluorosis is. This study provides helpful context for educating key stakeholders and the public about dental fluorosis. In this research review, the coauthors examined more than 30 studies that explored the relationship between dental fluorosis and people's satisfaction with their appearance—their Oral Health-Related Quality of Life (OHRQoL). After conducting their review, the researchers concluded that there "were no negative effects on respondents' OHRQoL" due to mild forms of fluorosis, and, in fact, there was "some evidence suggesting enhanced OHRQoL" when people had teeth with mild forms of fluorosis. In addition, the researchers wrote that more recent studies with better methodology showed that mild dental fluorosis "clearly was not a concern. In fact, sometimes it was associated with improved oral health-related quality of life, probably due to the public's greater emphasis on white teeth."

Document D-10: E.D. Beltrán-Aguilar et al., "Prevalence and Severity of Dental Fluorosis in the United States, 1999–2004," NCHS Data Brief, No. 53, November 2010, https://www.cdc.gov/nchs/data/databriefs/db53.pdf

> **Summary:** These data showed that less than 1 in 4 Americans (ages 6-49) had teeth with dental fluorosis. Less than 3% of Americans had moderate or severe forms of fluorosis. This report showed that the prevalence of fluorosis rose to 41% for teens. Mild forms of fluorosis, often too subtle for individuals to notice, do not cause pain and do not affect the health or function of the teeth.

Document D-09: "Substantial Consumption of Fluoride Increases Chance of Mild Fluorosis: Researchers Continue to Recommend Benefits of Fluoride to Prevent Tooth Decay," news release by the American Dental Association, (Chicago) October 25, 2010, https://www.sciencedaily.com/releases/2010/10/101025161156.htm

> **Summary:** At times, CWF critics have pointed to fluoride exposures during infancy as a reason for opposing fluoridation. After the *Journal of the American Dental Association* published research in 2010 about fluoride and infant formula, critics misrepresented the findings of this study. The research found that young children who consume substantial amounts of fluoride through infant formula and other beverages mixed with fluoridated water (or by swallowing fluoride toothpaste) have an increased chance of developing mild forms of dental fluorosis, but the ADA issued a news release to clarify the implications of this research. "Children can continue using fluoridated water and fluoride toothpaste because fluoride has been proven to prevent tooth decay, and mild fluorosis does not negatively affect dental health or quality of life," the ADA stated in its release. The ADA added that the American Academy of Pediatrics recommends breastfeeding for infants. "If parents are concerned about reducing the chances of their infants developing mild fluorosis through consuming substantial amounts of infant formula mixed with fluoridated water, the researchers suggest that they consult with their family dentist or physician."

Document D-08: *Independent critical appraisal of selected studies reporting an association between fluoride in drinking water and IQ*, Bazian (London, UK), February 11, 2009, http://bit.ly/2MPSv0f

> **Summary:** In 2009, Bazian, a London-based firm that analyzes health policy and research, reviewed 20 studies that examined potential links between fluoride and IQ scores in children. Most of the studies were conducted in China. Bazian conducted its review on behalf of a local health authority. Bazian reported that the 20 studies suffered from numerous flaws, including incorrect data interpretation, "basic errors" and the failure to rule out other factors.

Document D-07: P.V. Williams, letter to the City Council of Port Angeles, Washington, November 18, 2003, http://bit.ly/2F6ZKdN

Summary: Critics of fluoridation sometimes assert that they or a family member is "allergic" to fluoride or fluoridated water. In this letter, Dr. Paul V. Williams, a professor of pediatrics and environmental health at the University of Washington School of Medicine, cites a 1971 position statement adopted by the American Academy of Asthma, Allergy and Immunology. Dr. Williams also adds that there are "no published scientific studies documenting any relationship between fluoride in water systems and allergies."

Document D-06: W.H. Bowen, "Fluorosis: Is it really a problem?" *Journal of the American Dental Association*, October 2002, Vol. 133, https://www.ncbi.nlm.nih.gov/pubmed/12403544

Summary: Bowen, the author, wrote that "over the years almost every enamel defect observed has been attributed to the presence of fluoride" even though a 1992 Irish study showed that changes of enamel opacity are actually less common in areas where the water is fluoridated. Bowen noted that the link between dental fluorosis and the use of fluoridated toothpastes during the first few years of life. He referred to a 2000 study which revealed that most of the fluorosis cases in fluoridated areas could be explained by children having ingested fluoride toothpaste during the first year of life.

Document D-05: Y. Li et al., "Effect of long-term exposure to fluoride in drinking water on risks of bone fractures," *Journal of Bone and Mineral Research,* 2001, Vol. 16, No. 5, https://www.ncbi.nlm.nih.gov/pubmed/11341339

Summary: These researchers examined the rate of bone fractures experienced by six different population samples in China. Drinking water was determined to be the primary source of fluoride exposure among these populations. The findings yielded a U-shaped curve. The prevalence of bone fractures was lowest among those exposed to water fluoride levels (1.00 to 1.06 ppm) that were closest to the U.S. optimal range. The prevalence was significantly higher among those with negligible levels of fluoride ($\leq$ 0.34 ppm) or much higher levels of fluoride ($\geq$ 4.32).

Document D-04: M.E. Suarez-Almazor et al., **"**The Fluoridation of Drinking Water and Hip Fracture Hospitalization Rates in Two Canadian Communities," *American Journal of Public Health,* May 1993, Vol. 83, No. 5, https://ajph.aphapublications.org/doi/10.2105/AJPH.83.5.689

Summary: This study of two Canadian cities examined whether there was any significant correlation between the rate of hip fractures and living in a fluoridated city. The researchers found no correlation between exposure to fluoridated water and hip fractures.

Document D-03: *Fluoridation of Water and Cancer: A Review of the Epidemiological Evidence,* Report of the British Working Party on the Fluoridation of Water and Cancer, (London) 1985, http://bit.ly/2MQfHM1

Summary: A key objective of this report was to examine the conclusions reached by two Americans (John Yiamouyiannis and Dean Burk) who attributed a rise in U.S. cancer mortality to the growth of water fluoridation. The members of this British expert panel

criticized the Burk and Yiamouyiannis studies for various reasons, including the inappropriate use of data, questionable research methods, mistakes in their analysis, and conclusions about one age group that were "distorted by an important error in the data." In a preface to the report, Britain's chief medical officer wrote: "The wealth of evidence which has been gathered and assessed during this period, including that presented in this report, justifies the conclusion that fluoridation is a safe and effective method of reducing dental decay." At the time of this report, approximately 260 million people received drinking water that was fluoridated, and roughly 5 million of them lived in the United Kingdom.

Document D-02: "Fluoridation of water supplies and cancer mortality," *Journal of Epidemiology and Community Health,* 1981, Vol. 35, No. 4, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1052169/pdf/jepicomh00257-0011.pdf

Summary: In 1964, Birmingham became the first city in England to engage in water fluoridation. This study was designed to address concerns that some had expressed about whether fluoridation might be linked to the 6.4% increase in the city's cancer death rate. Researchers examined cancer death rates in seven cities in England and Wales with populations of over 400,000. After reviewing the data, they found that Birmingham's increased cancer death rate was virtually the same as the average increase in the other cities: 6.5%. The study concluded that the data "provides no reason to suppose that any unique factor, such as fluoridation of the water supplies, has affected the death rate for cancer in Birmingham since 1964."

Document D-01: N.C. Leone et al., "Medical Aspects of Excessive Fluoride in a Water Supply," *Public Health Reports*, October 1954, Vol. 69, No. 10, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2024409/pdf/pubhealthreporig00178-0039.pdf

Summary: The initial studies in Michigan, New York and Canada that confirmed fluoridation's effectiveness also examined whether children who consumed fluoridated water experienced any unforeseen health or problems. However, other studies examined whether any unanticipated medical conditions might be linked to higher-than-normal concentrations of fluoride. One such study compared two communities in central Texas—Bartlett, which had elevated levels of naturally occurring fluoride (≥7.6 ppm) in its water supply, and Cameron, whose fluoride concentration was well below the optimal level. Blood tests and medical exams were conducted over a 10-year period. Although (as expected) fluorosis rates in Bartlett were much higher, "no clinically significant" adverse health conditions were found with prolonged consumption of the water in Bartlett.

SECTION E:

The Costs & Savings from Water Fluoridation

Document E-08: D. Moore et al. "The costs and benefits of water fluoridation in NZ," *BMC Oral Health,* 2017, Vol. 17, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5704512/

> **Summary:** This study evaluated the costs and impact of CWF in New Zealand, where fluoridation programs are common. The study found that for communities with a population above 500 people, the net discounted savings over 20 years from adding fluoride to drinking water would exceed $1.4 billion dollars (New Zealand currency).

Document E-07: "Return on Investment (ROI) for each $1 Spent on Health Programs," an analysis by the Children's Dental Health Project, 2017, https://www.cdhp.org/resources/298-lifetime-costs-of-a-cavity-by-delta-dental

> **Summary:** In this comparison, six different public health strategies are compared to assess their Return on Investment (ROI). These strategies include CWF, childhood vaccinations, tobacco prevention programs, asthma disease management, employee wellness programs, and patient navigators in rural areas. Based on peer-reviewed research, CWF provided the greatest ROI. In fact, fluoridation's ROI was more than three times higher than tobacco prevention programs and almost seven times higher than asthma disease management programs.

Document E-06: J. O'Connell et al., "Costs and Savings Associated with Community Water Fluoridation in the United States," *Health Affairs*, 2016, Vol. 35, No. 12, https://www.healthaffairs.org/doi/abs/10.1377/hlthaff.2016.0881

> **Summary:** This study revealed that of the roughly 211 million Americans with access to fluoridated water in 2013, the savings per person was $32.19. The estimated return on investment was $20 for every dollar spent on fluoridation programs.

Document E-05: T. Ran et al., "Economic Evaluation of Community Water Fluoridation: A Community Guide Systematic Review," *American Journal of Preventive Medicine*, 2016, Vol. 50, No. 6, https://www.ncbi.nlm.nih.gov/pubmed/26776927

> **Summary:** The coauthors examined 10 studies and concluded that the research they reviewed "continues to indicate that the economic benefit of CWF exceeds the intervention cost. Further, the benefit-cost ratio increases with the population of the community."

Document E-04: B.L. Edelstein et al., "Reducing early childhood caries in a Medicaid population," *Journal of the American Dental Association,* April 2015, http://bit.ly/2RglEAg

Summary: This system used a process called system dynamics modeling to explore the impact of different ways to reduce tooth decay among preschool-age children (ages 0-5) who are enrolled in Medicaid in New York State. The study determined that "defluoridating the [New York City] water supply would increase reparative dentistry costs by $55.9 million for young children receiving Medicaid alone. The overall effect would be far greater, given that CWF additionally benefits young children in families above Medicaid eligibility as well as the entire state's residents across their life spans." Moreover, the study noted that CWF has "the lowest unit cost" of all fluoride-based strategies and "holds the greatest promise for both disease reduction and cost savings while equitably reaching all young children receiving Medicaid regardless of their caries risk."

Document E-03: S. Glied and M. Neidell, "The Economic Value of Teeth," *The Journal of Human Resources*, 2010, Vol. 45, http://bit.ly/2IhiM3g

Summary: This study by health management experts found that having "access to water fluoridation during childhood increases (lifetime) earnings by roughly 2 percent overall" but the effect was larger (4%) for women. The coauthors explained that their findings held up after controlling for various labor or economic trends, or community-level factors.

Document E-02: "Recommendations for Using Fluoride to Prevent and Control Dental Caries in the United States," *Morbidity and Mortality Weekly Report*, Centers for Disease Control and Prevention, August 17, 2001, Vol. 50, No. RR-1, https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5014a1.htm

Summary: This document was produced by a work group of 11 experts convened by the CDC. The work group pointed out that water fluoridation is "one of the few public health measures that results in true cost savings" (i.e., the money saved from preventing disease is greater than the money spent to carry out the program). Adjusted for 1999 dollars, the CDC Work Group reported (p. 22) that CWF in the United States cost an estimated average of $4.71 for every decayed tooth surface that was prevented. Of course, the cost of treating a one-surface cavity would have been dramatically higher than that figure.

Document E-01: "Water Fluoridation and Costs of Medicaid Treatment for Dental Decay – Louisiana, 1995–1996," *Morbidity & Mortality Weekly Report*, Vol. 48, No. 3, 1999, https://www.cdc.gov/mmwr/preview/mmwrhtml/mm4834a2.htm

Summary: The costs of treating tooth decay in young children can be significant, particularly if treatment requires extensive procedures and general anesthesia in a hospital operating room (OR). In this study, the Louisiana Department of Health and Hospitals (LDHH) and the Centers for Disease Control and Prevention reviewed Medicaid dental claims for a 12-month period (1995-96) for children of ages 1 to 5. Among 3-year-olds, the average dental treatment costs for those in non-fluoridated parishes (counties) were $58.91 higher than those in fluoridated parishes. At all ages, Medicaid treatment costs were higher

in non-fluoridated parishes. The average difference in treatment costs per Medicaid-eligible child over this 12-month period was $36.28.

SECTION F:
The Opponents of Water Fluoridation

Document F-17: Curiel et al. "Referendum opposition to fluoridation and health literacy: a cross-sectional analysis conducted in three large US cities," *British Medical Journal (BMJ Open)*, 2019, Vol. 9, https://bmjopen.bmj.com/content/9/2/e022580

Summary: This study reveals that a community with higher health literacy is more likely to support CWF in a voter initiatives (referenda). The study examined results in more than 900 voter precincts from three large U.S. cities in which CWF initiatives were held between 2000 and 2013. This analysis suggests that an increase in health literacy scores of one standard deviation predicted a 12 percentage-point increase in support for CWF. (For a quick primer on standard deviations, check out this video.) As the coauthors explain, "Health literacy serves as an indicator of voter ability to process health information, including dental information."

Document F-16: "New Fluoride/Brain Study Could End Fluoridation," Fluoride Action Network, Dec. 11, 2015, posted on fluoridealert.org, http://bit.ly/31E1e90

Summary: Soon before researchers with the National Toxicology Program (NTP) formally approved the decision to conduct an animal study of fluoride exposure, the Fluoride Action Network (FAN) posted this article on its website. The purpose of the NTP study was to explore what effect, if any, fluoride might have on cognitive and learning skills. In this article, FAN praises the NTP's "cutting-edge scientific tools" and eagerly awaits such a study. As the headline of the article declared, FAN believed the study might lead to CWF's demise. Yet the NTP study *(see Document D-35)* found no link between fluoride exposure at various concentrations and cognitive/learning skills.

Document F-15: Howat et al., "New international review supports community water fluoridation as an effective and safe dental health promotion measure," *Health Promotion Journal of Australia*, 2015, Vol. 26, https://onlinelibrary.wiley.com/doi/10.1071/HEv26n1_ED

Summary: In this editorial, the coauthors review the diversity of nations where fluoridation program, and they contend that public health professionals have a responsibility to counter" the misinformation that opponents spread about CWF. "The opposition to fluoridation," they write, "is akin to the anti-vaccination movement, with many unsubstantiated arguments and strategies. It is very hard to understand the stance in

light of the weak arguments that do not stand up to scientific scrutiny. It appears that many of the small but vocal group of critics lack relevant health training and fail to use carefully conducted scientific research to support assertions."

Document F-14: M. Foley, "Fluoridation and hypothyroidism – a commentary on Peckham et al," *British Dental Journal*, Vol. 219, No. 9, November 13, 2015, https://www.nature.com/articles/sj.bdj.2015.841

Summary: In 2015, a journal article by British researcher Stephen Peckham, who advised an anti-fluoride group, presented a link between fluoride in drinking water and hypothyroidism in England. In this commentary, Dr. Michael Foley, an Australian researcher criticizes Peckham and his coauthors for presenting a study that "contains serious biases and flaws" and focuses "on a small number of poor quality studies that reinforce their own views, while ignoring contradictory evidence from much stronger studies and reviews." Dr. Foley added that Peckham et al "show little understanding of confounding factors, and have made only a token attempt at considering their impact." Dr. Foley also called to task the Peckham et al article for using citations that were inappropriate or irrelevant. For example, the writer takes Peckham to task for citing the European Union's 2011 SCHER report about fluoride to raise fears about CWF, while ignoring SCHER's conclusion that human studies "do not suggest adverse thyroid effects at realistic human exposures to fluoride."

Document F-13: L.A. Hoaglin-Cooper and W. Maas, "Fluoridation Rollback Surveillance," a poster presented at the National Oral Health Conference," 2014-2018, http://bit.ly/2Zoo6Yh

Summary: The coauthors collected data on so-called "rollbacks," which are efforts by opponents to cease existing CWF programs in the United States. Data is provided on the number of attempted rollbacks and the number in which CWF was maintained and the number of decisions in which CWF was rolled back (ended). Over this five-year-period, 73% of rollback attempts ended with fluoridation being maintained. CWF rollbacks succeeded in only 27% of these instances.

Document F-12: P. & E. Connett, "Major Progress at Eliminating Fluoride in Water Supplies by Fluoride Action Network," June 26, 2012, Mercola.com, http://bit.ly/2XTz8EE

Summary: According to this article, in 2011 the Fluoride Action Network (FAN) joined a coalition that included an anti-vaccine group. The coalition, which is called the Health Liberty Coalition, was promoted in an article by Paul Connett (FAN's founder) and his wife Ellen.

Document F-11: "Not all studies carry equal weight," an issue brief produced by the Pew Center on the States, April 2012, https://tapintohealthyteeth.org/wp-content/uploads/2015/07/Not-All-Studies-Carry-Equal-Weight.pdf

Summary: This issue bulletin by the Pew Center on the States concluded that CWF opponents "often cite studies that had flawed methodologies, were not properly peer-reviewed, or were not relevant to water fluoridation in the United States." In addition, Pew explained that *Fluoride*—a source cited often by anti-fluoride activists—is a publication managed by fluoride critics that "has published a number of flawed or scientifically incomplete studies. The articles in *Fluoride* do not undergo the rigorous level of peer review by independent scientists that is standard protocol for reputable journals." The final section of this bulletin explored how opponents sometimes cite valid research while misrepresenting the findings of such research—one example being the 2006 report of the National Research Council's Committee on Fluoride in Drinking Water.

Document F-10: J.E. Dodes and M.W. Easley, "The Anti-Fluoridationist Threat to Public Health," white paper produced by the Institute for Science in Medicine, April 2012, https://www.scienceinmedicine.org/policy/papers/AntiFluoridationist.pdf

Summary: This white paper examines the primary tactics used by opponents and shares specific examples. A leading way that critics "raise fears about safety is by talking about a condition called dental fluorosis" without mentioning that fluorosis in the U.S. is typically a mild, cosmetic condition that doesn't affect the health or function of the teeth. The authors explain that one anti-fluoride group "cited bizarre case studies of people that are in no way representative of normal behavior or normal conditions."

Document F-09: An open letter from the New Hampshire Oral Health Coalition to the state House Committee on Resources, Recreation and Development, January 2012, https://americanfluoridationsociety.org/wp-content/uploads/2018/04/NH-Reply-to-FAN-50-Reasons.pdf

Summary: This letter was submitted to members of this committee of the New Hampshire House of Representatives. In this letter, the Coalition responds to the various assertions in the Fluoride Action Network's "50 reasons to oppose fluoridation."

Document F-08: L.M. Vance, "The Fluoridation Question Revisited," a guest commentary published by the Future of Freedom Foundation, March 2, 2011, https://www.fff.org/explore-freedom/article/fluoridation-question-revisited/

Summary: Opponents of CWF can be found on both the left and right sides of the political spectrum. Some libertarian groups have expressed hostility toward fluoridation, mostly because of the "personal choice" view. This commentary published by the Future of Freedom Foundation is an example of this perspective. Overlooking or ignoring the scientific evidence, the essayist contended: "It is not teenagers and adults whose teeth supposedly benefit from fluoride, only children." The essay argued that it should not be the job of the government to recommend, provide, require or fund fluoridation programs. "Government has no business in our wallets or our water," the essayist wrote. The writer's extremist views were demonstrated when he continued: "So not only should no fluoride be added to any water supplies in the United States, there should be no data collected by the

National Health and Nutrition Examination Survey and no HHS and EPA standards. Indeed, these departments and agencies shouldn't exist in the first place."

Document F-07: J.M. Armfield, "When public action undermines public health: a critical examination of antifluoridationist literature," *Australia and New Zealand Health Policy,* 2007, Vol. 4, No. 25, https://www.researchgate.net/publication/5780044_When_public_action_undermines_public_health_A_critical_examination_of_antifluoridationist_literature

Summary: The author concludes that critics of fluoridation "make extensive use of fear mongering." In addition, he makes this observation: "Half-truths are presented, fallacious statements reiterated, and attempts are made to bamboozle the public with a large list of claims and quotes often with little scientific basis. Ultimately, attempts are made to discredit and slander scientists and various health organisations that support water fluoridation."

Document F-06: T.W. Cutress, *Response to a list of "50 Reasons to Oppose Fluoridation" compiled by Dr. Connett*, October 25, 2005, https://www.dentalwatch.org/fl/connett/response_to_50_reasons.pdf

Summary: This lengthy document was prepared by Dr. T.W. Cutress as a rebuttal to "50 Reasons to Oppose Fluoridation," a document created by Paul Connett, who was then the leader of the Fluoride Action Network (FAN). Dr. Cutress worked for the Dental Unit of the Medical Research Council of New Zealand. This rebuttal exposes the flawed, emotional and unscientific arguments used by Connett and others. As Dr. Cutress explained, several of FAN's 50 reasons "are not actually reasons but personal subjective viewpoints, some of which lack literal or factual substance." Other public health organizations or researchers have produced rebuttals of FAN's arguments that are similar to Dr. Cutress' document.

Document F-05: J. Seavey, "Water Fluoridation and Crime in America," *Fluoride*, Vol. 38, No. 1, 2005, http://www.fluorideresearch.org/381/files/38111-22.pdf

Summary: This 2005 article offers a good example of how CWF opponents use flawed research practices to raise fears about fluoridation. It was published by *Fluoride*, a journal that several critics of fluoridation started in the 1960s. Many of the articles published by *Fluoride* would be unlikely to remain intact if they had gone through the peer-review process used by the leading health and scientific journals. This article, written by a man with no apparent expertise in criminology, asserts that there is an association between violent crime and water fluoridation—"suggesting the existence of a 'fluoride-related' category of crime." The writer explains that the crime stories on which his article is based "were selected, based on their content and on my intuition, from my routine daily reading, rather than from a methodical or exhaustive search using, for example, keywords or search engines."

Document F-04: *Building Capacity to Fluoridate: Literature Review*, U.S. Department of Health and Human Services (CDC), June 2003, https://mj-others.s3-us-west-2.amazonaws.com/Bldg+Capacity+to+Fluoridate+(2003).pdf

> **Summary:** The purpose of this CDC report is to examine recent local campaigns about CWF and explore the factors that influence communities' decisions to support or oppose fluoridation. The CDC report observes that anti-fluoride activists come from both the right and left ends of the political spectrum. The report studied the tactics used by anti-fluoride groups, noting that they "have often designed their messages to capitalize on prevalent societal fears." In the 1950s, opponents suggested that fluoridation was a communist plot. In the 1960s and '70s, in the early years of the environmental movement, CWF critics began using terms such as "toxic waste" and "pollutant" in hopes of winning support from environmentalists. When the AIDS epidemic emerged, some opponents tried to link the immune disease to fluoride. In the 1990s, as organic and "natural" foods gained popularity, CWF opponents attacked fluoride as an unnatural "chemical" that was harmful. Table 1 of this review provides examples of opponents' campaign and messaging tactics, such as citing a link between fluoride and an adverse health condition "without qualifying the statement to reflect that the link only exists when fluoride is administered at extremely high levels." This review also explores the many variables that can shape the outcomes of a local fluoridation ballot measure.

Document F-03: R.B. Jones et al., "Fluoridation Referendum in La Crosse, Wisconsin: Contributing Factors to Success," commentary published by the *American Journal of Public Health*, 1989, Vol. 79, No. 10, https://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.79.10.1405

> **Summary:** The coauthors offered their observations and insights from the successful voter referendum campaign to initiate a CWF program in the city of La Crosse, Wisconsin. "If fluoridation approval is subject to public referendum," the coauthors wrote, "the timing of the ballot is an important factor for success." The coauthors advised CWF advocates to do their best to ensure that fluoridation referenda coincide with primary or general elections because these typically generate the largest voter turnout. Although chiropractors are often among those opposing CWF policies, the coauthors noted that there were chiropractors are both sides of the issue in La Crosse. A post-election poll in La Crosse revealed that CWF was supported by 71% of college graduates, 62% of those with some college, and 37% of those who never attended college.

Document F-02: L.E. Block, "Antifluoridationists Persist: the Constitutional Basis for Fluoridation," *Journal of Public Health Dentistry,* fall 1986, Vol. 46, No. 4, https://www.ncbi.nlm.nih.gov/pubmed/3465958

> **Summary:** Opponents of fluoridation frequently challenge the right of a state or local government to adopt CWF, asserting that it violates individual rights. The author observes that numerous court rulings have upheld the right of states, cities or communities to adopt fluoridation measures in recognition of government's role "to protect and promote the

health, safety, morals, and general welfare of its citizens as a whole." Likewise, religious objections and other legal challenges have similarly been dismissed by courts.

Document F-01: "Trendley Dean Repudiates Antifluoridationists," News of Dentistry, *Journal of the American Dental Association*, Vol. 61, October 1960, http://bit.ly/2Xc54qz

Summary: CWF opponents have a track record of using false or misleading statements in hopes of raising public fears and advancing their cause. Dr. H. Trendley Dean was one of the early scientific pioneers whose groundbreaking research revealed the decay-prevention benefits of CWF. In 1960, an opponent of fluoridation posted an advertisement in various newspapers alleging that Dr. Dean had repudiated his support for fluoridation. These ads were published under the name of L. S. Stevens, who was identified as the chairman of the Ohio Pure Water Association. On page 16 of this document, Dr. Dean disputes these claims by the Ohio anti-fluoride group. Dr. Dean, who at one time directed the National Institute of Dental Research, wrote a letter to an Ohio newspaper, stating: "There is no legitimate basis for these (advertising) claims. I still strongly urge all communities to fluoridate their water supplies. The procedure is safe and of significant benefit in reducing dental decay."

SECTION G:
The Alternatives to Water Fluoridation

Document G-19: A. Aoun et al., "The Fluoride Debate: The Pros and Cons of Fluoridation," *Preventive Nutrition and Food Science*, 2018, Vol. 23, No. 3, http://bit.ly/2ZqIloa

> **Summary:** This research article reported that milk fluoridation programs for children—many supported by the World Health Organization—are operating in about 15 nations. Estimates of the per-child cost of milk fluoridation are higher than most CWF programs. The coauthors called milk fluoridation "a less efficient method for delivery of fluoride when compared to water fluoridation" because the fluoride added to milk "forms insoluble complexes that make fluoride absorption difficult."

Document G-18: A. Fabruccini et al., **"**Comparative effectiveness of water and salt community-based fluoridation methods in preventing dental caries among schoolchildren**,"** *Community Dental and Oral Epidemiology,* 2016, Vol. 44**,** https://www.ncbi.nlm.nih.gov/pubmed/27467460

> **Summary:** This study reviewed oral health data for children in two cities: Montevideo, Uruguay and Porto Alegre, Brazil. Both cities exceed 1 million in population. Fluoridated salt is widely used in Montevideo, while a water fluoridation program operates in Porto Alegre. Based on an analysis of data from each city, the coauthors found that "schoolchildren exposed to fluoridated salt had a "significantly higher likelihood" of having dental cavities than those served by a water fluoridation program. For this reason, the study concluded: "Fluoridated water appears to provide a better protective effect against dental caries than fluoridated household salt among schoolchildren from developing countries."

Document G-17: V.H. Murthy, "Statement on Community Water Fluoridation," U.S. Surgeon General, U.S. Department of Health and Human Services, March 9, 2016, https://www.cdc.gov/fluoridation/guidelines/surgeons-general-statements.html

> **Summary:** In his March 2016 statement on CWF, Dr. Vivek Murthy—then-Surgeon General—wrote: "Water fluoridation is the best method for delivering fluoride to all members of the community, regardless of age, education, income level or access to routine dental care."

Document G-16: J.C. Barker et al., "Acceptability of Salt Fluoridation in a Rural Latino Community in the United States: An Ethnographic Study," PLOS, 2016, http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0158540

> **Summary:** This study examined whether low-income Latinos—mostly farmworkers and their families—who live in rural areas and experience poor oral health would be receptive to using fluoridated salt. These individuals live in areas where fluoridation of water is generally not feasible, alternatives are being explore. The study found that fluoridated salt would be accepted by Latinos as a way of obtaining fluoride's proven benefits, so long as:

1) Latinos received information about its effectiveness and safety from trusted, authoritative sources;

2) Fluoridated salt was conveniently available at roughly the same cost as non-fluoridated salt; and

3) Fluoridated salt tasted the same as non-fluoridated salt.

Mothers were determined to be the informational "gate keepers" for rural Latino families on issues of food and health.

Document G-15: D.M. O'Mullane et al., "Fluoride and Oral Health," *Community Dental Health*, Vol. 33, 2016, https://www.mah.se/PageFiles/50259/Flouride_and_Oral_Health_pdf.pdf

Summary: Because fluoride is most effective when a low level of this mineral is regularly maintained in the oral cavity, the coauthors reached this conclusion: "Strategies that provide regular, low-level exposure to fluoride in the community such as fluoridated water, salt, milk and fluoride toothpaste *are superior*, in terms of making fluoride widely available in a cost-effective way, compared with professional applications, notably of high-concentration fluoride gels and varnishes" (emphasis added).

Document G-14: *Briefing note: Introduction of dental milk for primary school children*, Blackpool Council (United Kingdom) Department of Public Health, 2015, http://bit.ly/2XeldMn

Summary: In 2015, the city council in Blackpool—a city in northern England—began a school program in which elementary-age children were served milk that was fortified with fluoride. In this fact sheet, the city's Department of Public Health explained the reasons for this program. "The research evidence demonstrates that adding fluoride to the water supply is the most important population health measure for dental public health," the Department reported. "Blackpool Council had previously agreed to support such an action but this is not currently achievable for operational reasons." The Department adds that fluoridated milk programs "are widely accepted as the next best option if water fluoridation cannot be achieved."

Document G-13: "Scottish Government: Creating a Fairer Scotland: What Matters to You" (Social Justice Conversation Paper), British Dental Association's Scotland branch, August 2015.

Summary: A leading spokesperson for the Fluoride Action Network (FAN), the leading group opposing CWF in the U.S., has cited Scotland's Childsmile program for children as a viable cavity-fighting alternative to water fluoridation. However, pitting the two options against each other is a false choice. The British Dental Association's (BDA) Scotland branch supports both Childsmile and CWF. In this 2015 discussion document, BDA-Scotland declared that it "endorses that communities strive to move towards the decision to choose fluoridated water . . . The move would be of benefit to both children and elderly people. It is suggested that water fluoridation would complement the Childsmile Programme which promotes tooth-brushing and the application of topical fluorides in

children but would also reduce the overall burden of tooth decay and reduce dental health inequalities in the elderly." It's also worth noting that Childsmile does not address the oral health needs of adults.

Document G-12: "Dietary Fluoride Supplements: Evidence-based Clinical Recommendations," American Dental Association, 2013, https://www.ada.org/en/~/media/EBD/Files/ADA_Evidence-based_Fluoride_Supplement_Chairside_Guide

Summary: Several factors can create obstacles for securing compliance with the protocol for administering fluoride supplements to children. As this ADA chart reveals, the dosage for supplements varies based on two factors—a child's age range and the background level of fluoride in the drinking water. In addition, when parents are divorced or live apart for other reasons, children may move between these two homes; the CWF status of these homes may differ. This status might not be known by the parent whose home is the child's primary residence. This can complicate dosage recommendations. Moreover, the decision to prescribe supplements requires that a dentist or pediatrician accurately assess a child's risk of tooth decay.

Document G-11: J. Bánóczy et al., "Milk fluoridation for the prevention of dental caries," *Acta Medica Academica*, Vol. 42, No. 2, 2013, https://www.researchgate.net/publication/259204102_Milk_fluoridation_for_the_prevention_of_dental_caries

Summary: This article reviewed the more than 50 years of research into the decay-reducing impact of milk fluoridation. Early studies were conducted during the 1950s in Japan, Switzerland and the U.S. These evaluations "showed clearly that the optimal daily intake of fluoride in milk is effective in preventing dental caries," the coauthors wrote. The early studies revealed that fluoride does not change milk's taste and is absorbed efficiently, although more absorption occurs more slowly than with fluoride in water. The article observed that the concentration of fluoride varies based on the background level of fluoride exposure and the age of the children. The coauthors reported that the average per-child cost of fluoridated milk programs was about €2 to 3 (about $2.50 to $3). The coauthors contended that milk fluoridation "can be recommended as a caries preventive measure where the fluoride concentration in drinking water is suboptimal" or where decay experience among local children is high.

Document G-10: J.M. ten Cate, "Contemporary perspective on the use of fluoride products in caries prevention," *British Dental Journal,* Vol. 214, No. 4, Feb 2013, http://bit.ly/2IgScra

Summary: Critics of fluoridation often suggest that people who want access to the cavity-reducing benefits of fluoride can simply get fluoride treatments at a dental office. However, in this research review, the author explained that "a frequent exposure to fluoride products is more beneficial in caries prevention than the incorporation of fluoride into the dental tissues, such as is achieved by semiannual topical fluoride treatments." He concluded: "Fluoridation of the drinking water is still the optimal method of fluoride delivery but in many parts of the world this is not implemented due to political/emotional reasons."

Document G-09: "Scientific Opinion on the substantiation of health claims related to sugar-free chewing gum with fluoride and maintenance of tooth mineralisation (ID 1154) pursuant to Article 13(1) of Regulation (EC) No 1924/20061," EFSA Panel on Dietetic Products, Nutrition and Allergies, European Food Safety Authority (EFSA), Parma, Italy, *EFSA Journal*, Vol. 9, No. 4, 2011, https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2011.2072

> **Summary:** A panel of the European Food Safety Authority was asked to validate the right of a company to market chewing gum fortified with fluoride by promoting its effect of remineralizing the enamel of teeth, thereby protecting them from tooth decay. The panel approved the marketing claim that fluoridated gum "increases resistance of enamel to acid attacks and rate of remineralisation" in children. The panel added that keeping teeth mineralized "is a beneficial physiological effect."

Document G-08: *A Systematic Review of the Efficacy and Safety of Fluoridation: Part A: Review of Methodology and Results*, National Health and Medical Research Council (Australian Government), 2007, https://www.nhmrc.gov.au/sites/default/files/documents/reports/HR/eh41_1.pdf

> **Summary:** In the Executive Summary and other portions, this review indicates that the evidence behind water fluoridation's effectiveness is stronger than the research about salt and milk fluoridation.

Document G-07: F. Gagnon et al., "Compliance with Fluoride Supplements Provided by a Dental Hygienist in Homes of Low-Income Parents of Preschool Children in Quebec," *Journal of Public Health Dentistry*, Vol. 67, Issue 1, winter 2007, https://www.ncbi.nlm.nih.gov/pubmed/17436981

> **Summary:** Compliance is a challenge when dietary fluoride supplements are prescribed for children in non-fluoridated areas. This study assessed the challenges of getting low-income families to comply with the recommendation of giving fluoride supplements to their preschool-age children. (Most residents of Quebec lack access to drinking water that is fluoridated.) Although compliance improved, this daily compliance rate reached only 48% of the low-income mothers by the end of the one-year study period.

Document G-06: F. Götzfried, "Legal aspects of fluoride in salt, particularly within the EU," *Schweiz Monatsschr Zahnmed*, Vol 116, April 2006, https://www.ncbi.nlm.nih.gov/pubmed/16708523

> **Summary:** This research article identified seven countries in Western and Central Europe where fluoridated salt was available to consumers: Austria, the Czech Republic, France, Germany, Slovakia, Spain and Switzerland. Consumers in these nations also had access to non-fluoridated salt. Market shares of fluoridated salt were highest in Switzerland (88%) and Germany (65%). Fluoridated salt was produced in the Netherlands but only for export.

Document G-05: "Health Claim Notification for Fluoridated Water and Reduced Risk of Dental Caries," Food and Drug Administration (FDA), posted online in 2006, http://bit.ly/2INdXOj

> **Summary:** In 2006, the FDA reviewed and approved a petition allowing bottled drinking water to be labeled with the following claim: "Drinking fluoridated water may reduce the risk of [dental caries or tooth decay]." Before approving the use of this claim on a water bottle, the FDA required the petitioner to submit "an authoritative statement from an appropriate scientific body of the United States Government or the National Academy of Sciences ..." The FDA accepted three statements as authoritative, including the U.S. Surgeon General's 2000 declaration that fluoridated drinking water "is safe and effective in preventing dental caries in both children and adults."

Document G-04: P. Tramini, "Salt fluoridation in France since 1986," *Schweiz Monatsschr Zahnmed*, Vol 115, August 2005, https://www.sso.ch/fileadmin/upload_sso/2_Zahnaerzte/2_SDJ/SMfZ_2005/SMfZ_08_2005/smfz-08-forschung-3.pdf

> **Summary:** As the author explained, CWF in France was never adopted for two reasons: 1) the technical challenges of too many local water authorities (about 8,000, not counting individual wells); and 2) reluctance to adopt a policy that could be seen as counter to freedom of choice. For these reasons, he wrote, fluoridated salt "was really seen as an appropriate alternative for our country." Fluoridated salt entered the market through a national decree by the French government in 1986. This decree included a provision requiring that non-fluoridated salt must be made available for consumers. Packets of fluoridated salt contain this advisory: "Do not consume if drinking water contains more than 0.5 milligrams of fluoride per litre." In France, 3.7% of the population have drinking water with this level of fluoride. The author reported that tooth decay rates fell sharply in France from 1987 to 1993 but not from 1993 to 1998. This lack of progress after 1993, the author contended, could be due to the fact that fluoridated salt's market share did not increase in this second five-year period. A significant number of younger French people do not use fluoridated salt "probably because they are still not aware of its existence," the author wrote.

Document G-03: W.M. Edgar and A.J. Rugg-Gunn, "The biological plausibility for the caries preventive action of fluoride in milk," Borrow Foundation, United Kingdom, 2004, http://www.borrowfoundation.org/assets/uploads/BiologicalPlausibility.pdf

> **Summary:** This research paper explores how milk fortified with fluoride can help prevent tooth decay. "Milk and water have much in common as vehicles for fluoride, in that the concentration of fluoride is low and they are both drunk as part of the diet," the coauthors wrote. They added that "fluoride concentrations in saliva and plaque rise after intake of fluoridated milk, as occurs with fluoridated water."

Document G-02: "Recommendations for Using Fluoride to Prevent and Control Dental Caries in the United States," *Morbidity and Mortality Weekly Report*, Centers for Disease Control and

Prevention, August 17, 2001, Vol. 50, No. RR-1, https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5014a1.htm

> **Summary:** This document was produced by a work group of 11 experts convened by the CDC. The work group assigned letter grades to seven (7) different forms of fluoride, giving higher grades to forms that were beneficial to people of all ages and those with varying levels of risk for tooth decay. CWF and fluoride toothpaste were the only forms of fluoride that received "A" grades from this work group (pp. 24-25).

Document G-01: D.W. Lewis et al., "Periodic Health Examination, 1995 Update: 2. Prevention of Dental Caries," Canadian Task Force on the Periodic Health Examination, *Canadian Medical Association Journal,* Vol. 152, No. 6, March 1995, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1337757/

> **Summary:** The Task Force concluded that fluoride is the most effective preventive measure and that CWF "remains the single most effective, equitable and efficient means of preventing coronal and root dental caries." Although the Task Force did recommend the use of fluoride supplements for children in areas with sub-optimal fluoride concentrations, it noted that "compliance may be difficult to assure."

APPENDIX:
Other Helpful Resources

National Resources:

The **American Dental Association** (ADA) has a "Mouth Healthy" version of its website that is designed to educate consumers about oral health. The ADA's Mouth Healthy home page provides a lot of helpful information and links: https://www.mouthhealthy.org/en/az-topics/f/fluoridation

The **American Fluoridation Society** (AFS) is a 501(c)4 organization led by dental and medical professionals who assist others in educating their communities about the benefits and safety of community water fluoridation. Their fact sheets, press statements and other content can be accessed at https://americanfluoridationsociety.org/

The **Campaign for Dental Health** (CDH) is a project of the American Academy of Pediatrics, the largest organization for pediatricians in the United States. The website has both an English and Spanish version.

English: https://ilikemyteeth.org/

Spanish: https://spanish.ilikemyteeth.org/

The **Centers for Disease Control and Prevention** (CDC) recommends community water fluoridation based on a large body of evidence showing it safely reduces tooth decay for children and adults. CDC's website provides a lot of helpful resources: https://www.cdc.gov/fluoridation/index.html

In 2018, the American Dental Association updated **Fluoridation Facts**. This impressive and encyclopedic document answers every question that typically arises about fluoride and fluoridation. To order a copy of Fluoridation Facts, visit https://www.ada.org/en/public-programs/advocating-for-the-public/fluoride-and-fluoridation/fluoridation-facts

The **Oral Health Section** of the American Public Health Association (APHA) works closely with public health officials and policymakers on oral health issues. APHA is a strong supporter of community water fluoridation. Learn more about the Oral Health Section at https://www.apha.org/apha-communities/member-sections/oral-health

For decades, **U.S. Surgeons General** have issued statements explaining why they strongly support community water fluoridation. To access those statements, visit this web page: https://www.cdc.gov/fluoridation/guidelines/surgeons-general-statements.html

State Resources:

The **New York State Department of Health** has a variety of helpful resources through its Oral Health page. These resources include a link to Oral Health Data & Statistics, demonstrating the significant impact that dental disease has on New Yorkers. These resources can be accessed at https://www.health.ny.gov/prevention/dental/

The **Schuyler Center for Analysis and Advocacy** (SCAA) is a leading statewide policy analysis and advocacy organization working to shape policies to improve health, welfare, and human services for all New Yorkers, especially those who are disenfranchised. SCAA has helped educate key stakeholders in New York State about oral health and, more specifically, about community water fluoridation. SCAA's resources can be accessed at https://www.scaany.org/policy-areas/health/oral-health/