

A Best Practice Approach Report describes a public health strategy, assesses the strength of evidence on the effectiveness of the strategy, and uses practice examples to illustrate successful/innovative implementation.

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Best Practice Approach Community Water Fluoridation

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Summary of Evidence Supporting Community Water Fluoridation

Research	+++
Expert Opinion	+++
Field Lessons	++
Theoretical Rationale	+++

See **Attachment A** for details.

I. Description

A. Current Recommendations for Community Water Fluoridation

Community water fluoridation (CWF) entails the controlled adjustment and monitoring of fluoride in community drinking water to reach recommended fluoride concentrations for preventing tooth decay (caries).^{1,2,3,4,5} Beginning in 1962, the U.S. Public Health Service recommended adjustment of community drinking water contain 0.7 to 1.2 ppm (parts per million) fluoride depending on the annual average maximum daily air temperature of the area. The U.S. Department of Health and Human Services (HHS) and the Environmental Protection Agency (EPA) routinely review, update and adopt standards and guidelines on fluoride in drinking water.⁶ On April 27, 2015, HHS announced the most recent recommendations for adjusting the level of fluoride in drinking water to 0.7mg/L (milligrams per liter, equivalent to ppm) to prevent tooth decay.⁷

The HHS Federal Panel on Community Water Fluoridation offered four reasons for this new recommendation:

1. "Community water fluoridation remains an effective public health strategy for delivering fluoride to prevent tooth decay and is the most feasible and cost-effective strategy for reaching entire communities.
2. In addition to drinking water, other sources of fluoride exposure (toothpastes, supplements, rinses) have contributed to the prevention of dental caries and an increase in dental fluorosis prevalence.
3. Caries preventive benefits can be achieved and the risk of dental fluorosis reduced at 0.7 mg/L.
4. Recent data do not show a convincing relationship between water intake and outdoor air temperature. Thus, recommendations for water fluoride concentrations differ based on outdoor temperature are unnecessary."⁸

Healthy People (HP) 2020 Oral Health Objective OH-13 calls for a 10 percent increase in the proportion of the U.S. population served by community water systems to have the recommended fluoride concentration for caries prevention, bringing that proportion up to 79.6 percent."⁹ The current extent of fluoridation in states can be found in "[My Water's Fluoride](#)" (for participating states) or on the [Centers for Disease Control and Prevention \(CDC\) website](#).

The benefits of community water fluoridation are achieved regardless of age, education, income level or access to routine dental care.^{10,11} Barriers to its implementation include political opposition, technical challenges, and costs involved in fluoridating very small water systems.¹² Given the modest cost per person per year to fluoridate public water systems, community water fluoridation is recommended as the most cost-effective method for preventing caries.¹³

B. Role of State Oral Health Programs

State oral health programs along with the state water quality or drinking water programs, have consistently devoted efforts to delivering the benefits of community water fluoridation to their states' residents. State water fluoridation program activities are described in this section. State practice examples of fluoridation program activities are provided in Section V.

1. Legislation/Policies

Implement and enforce laws and regulations to assure access to drinking water with the recommended fluoride concentration for caries prevention. These activities include:

- Implementing and monitoring state laws and regulations mandating fluoridation of community water systems, ranging from all public water systems in the state to public water systems within cities/counties serving a minimum population threshold.
- Ensuring sufficient sampling and reporting practices and other applicable state level standards for fluoridated drinking water.
- Supporting local administrative actions or public votes (i.e., referenda) in favor of water fluoridation.
- Developing policies and resolutions in support of community water fluoridation.

2. Advocacy, Promotion, and Collaboration

Organize and mobilize community resources (public and private) to promote community water fluoridation. Activities include:

- Enlisting partners such as the state water quality program, state dental and dental hygiene associations, chronic disease programs, Maternal & Child Health (MCH) programs, local health departments, children's advocacy groups, legislators, community leaders, and health providers to support all aspects of community water fluoridation (e.g., legislation, policy development, advocacy, promotion, monitoring, surveillance and reporting).
- Providing a forum for partners to communicate, plan and pool resources for efforts related to community water fluoridation (e.g., establishing a coalition, task force or workgroup.)
- Working with partners to obtain independent foundation funding of new facilities.
- Developing strategies to deal with anti-fluoridation messages.

3. Knowledge on the Benefits, Safety and Status of Water Fluoridation

Improve knowledge on the benefits, safety, and status of community water fluoridation and support actions/behaviors favorable to its implementation by using community-wide health promotion interventions (educational, political, regulatory, and organizational efforts) directed toward the public, practitioners, and policymakers. Provide education and technical assistance to communities, organizations and advocacy groups. This includes informing the public, practitioners, and policymakers about:

- Efficacy, cost-effectiveness and safety of community water fluoridation.
- Fluoridation status of the state.
- Costs to maintain and operate equipment and carry out the program.
- Opportunities to secure additional funding to maintain and update the equipment.
- Legal authority as applicable.

4. Supporting Construction of Fluoridation Systems

Provide or facilitate financial and technical support to communities building and/or maintaining fluoridation systems for optimal fluoridation of public water systems. Key activities reported by states include:

- Funding the purchase of fluoridation equipment for initial installation.
- Providing CDC Engineering and Administrative Recommendations for Water Fluoridation, (EARWF) to those involved with design and maintenance of systems.
- Providing guidance and review of fluoridation equipment design prior to construction.

5. Training, Monitoring, Surveillance, Reporting and Inspection

Comply with current CDC engineering and administrative recommendations for water fluoridation including routine monitoring of fluoride content. Activities include the following:

Training

EARWF recommends the following:

- State Fluoridation Specialists should attend CDC's [Water Fluoridation: Principles and Practices](#) course.
- Fluoridation Specialists are advised to take the CDC course within one year of accepting the position and to repeat the course periodically per CDC recommendations. CDC offers the training annually at two sites, Sacramento, CA and Murfreesboro, TN.
- State personnel should provide training to operators of new systems.
- State personnel should ensure a minimum of one hour of precertification training as part of the basic course for water system personnel.
- Each state should provide an annual fluoridation training course of 6 to 8 hours for water system personnel.

Monitoring, Surveillance and Reporting

- Monitor daily fluoride levels in the water distribution system by water system personnel.
- CDC recommends state and local water system personnel operate a monthly split-sample program. Split samples have one half of the water sample tested on-site, and the second part is sent to a state laboratory or accredited laboratory for verification testing.¹⁴
- Participate fully in CDC's Water Fluoridation Reporting System (WFRS), providing, at a minimum, monthly updates of changes in the fluoridation status of water systems. For those systems adjusting the fluoride content of the water, provide monthly averages of daily testing for each system and documentation of compliance with state testing requirements.
- Ensure adherence to state drinking water regulatory requirements, which mandate submission by public water systems of adequate reporting of compliance testing.
- Provide annual report to Association of State and Territorial Dental Directors (ASTDD) State Synopses. Note: The [Synopses website](#) is a product of a cooperative agreement between the CDC and the ASTDD.

Inspection

- State personnel provide a detailed, onsite inspection of each new fluoridation system before system start-up to ensure construction and installation are in accordance with state-approved plans and specifications.
- State personnel provide a periodic comprehensive inspection of individual water fluoridation systems as part of a Sanitary Survey or separate inspection. Inspections should include a detailed assessment of fluoridation systems sufficient to document operational reliability, system safety and compliance with engineering and administrative recommendations.
- Maintain an inventory of fluoridation equipment needs reflected in reports to policy-makers and or in funding requests.

6. Human Resources to Support Community Water Fluoridation Efforts

Develop human resources to support community water fluoridation efforts. Activities include:

- Establishing a state fluoridation administrator/specialist position who will be responsible for: a) supporting fluoridation programs; b) promoting water fluoridation; c) providing liaison with other federal, state and local agencies, and d) resolution of problems. Ideally, the person with these responsibilities will be administratively located in the state's oral health program or state's drinking water or water quality program.
- Establishing a state fluoridation engineer whose responsibilities include:
 - Site visits
 - Start-up visits
 - Training of water system personnel
 - Monitoring of all fluoridated water systems
 - Resolution of operational problems.
- Establishing trained water system personnel responsible for each fluoridated water system.

7. Financial Resources to Support Community Water Fluoridation Efforts

Secure financial resources to support community water fluoridation efforts. Sources might include:

- State general funds.
- Federal block grants for states.
- Other sources of federal support, which include funding through CDC (e.g., Cooperative Agreements for State-based Oral Disease Prevention Programs) and the Health Resources and Services Administration (HRSA).
- Funds available through local communities, counties, and water districts.
- Private sources at the local, state and national levels such as but not limited to foundations, insurers, dental associations and others.

C. Extent of Use

- Worldwide, approximately 435 million people drink adjusted fluoridated water in more than 60 countries, and at least another 50 million drink water with natural fluoride at or around the recommended level for caries prevention. Countries with water fluoridation include Australia, Brazil, Canada, Chile, Ireland, Malaysia, New Zealand, Singapore, South Korea, Spain, Sweden, United Kingdom, and the United States. In 2014 Israel's Health Minister unilaterally rescinded fluoridation, which was immediately [overturned by the 2015 successor and is to be reinstated in 2016](#). Community water fluoridation has not been permanently banned anywhere.¹⁵
- Communities may choose to provide the benefits of water fluoridation through fluoridated salt or fluoridated milk.¹⁶
 - The World Health Organization recommends that "salt fluoridation should be considered where water fluoridation is not feasible for technical, financial or

sociocultural reasons." In 2011, fluoridated salt reached almost 280 million people, 70-80 million in Europe in addition to nearly 200 million in Latin America.¹⁷ Countries with fluoridation salt programs include Switzerland, France, Germany, Mexico, Columbia, Bolivia, Costa Rica, Cuba, Ecuador, Uruguay, Venezuela, Jamaica and Peru.^{18,19,20}

- Milk fluoridation, when established distribution systems are available, is another alternative to water fluoridation. It has been implemented in Bulgaria, Chile, China, Peru, Russia, Thailand and the UK.²¹

- In the U.S. during 2012, about 210 million people (74.6 percent) of the population served by public water supplies received optimally fluoridated water compared with 144 million (62.1 percent) in 1992. State-specific percentages ranged from 10.8 percent (Hawaii) to 99.9 percent (Kentucky) and 100 percent (District of Columbia). The national objective in HP 2020 calls for 79.6 percent of the population served by community water systems to have optimally fluoridated water, up from the HP 2010 target of 75 percent.²² The baseline for the HP 2010 objective was 65 percent and the target of 75 percent was achieved. In 2012, 21 states and the District of Columbia reached 79.6 percent or more of the population served by community water systems with fluoridated water at the recommended level to reduce caries; 21 have 50.0-79.6 percent; five have 25.0-49.9 percent; and three have less than 25 percent.²³

- In 2012, roughly 18,500 community water systems nationwide provided fluoridated water at the recommended level to reduce caries. To meet the national HP 2020 objective, however, more than 15 million people served by community water systems will need to join those who currently have access to public water systems fluoridated to the recommended level to reduce caries.¹⁵⁻¹⁷

- In 2012, 47 of the 50 largest cities in the United States were fluoridated. Residents of large non-fluoridated cities are among more than 100 million persons in the United States who lack this method of caries prevention.¹⁵

- According to the 2011-2012 Synopses of State Dental Public Health Programs, all 50 states and the District of Columbia have programs to address the fluoridation of community water systems. However, there is wide variation in the human and financial capacity of state oral health and/or drinking water programs to conduct the activities listed above, as well as variation in, state and local demand for and acceptance of fluoridation.²⁴

- As of February 2010, 12 states and the District of Columbia had laws mandating fluoridation.²⁵ In March 2011, Arkansas passed a new law for statewide fluoridation.²⁶ The size of the public water systems or counties/communities affected and exemption provisions vary by state.

- Additional information on local and state policies and laws can be searched through the [Fluoride Legislative User Information Database \(FLUID\)](#). FLUID is a comprehensive database containing legal decisions by U.S. courts and current information on federal, state

and local policies regarding community water fluoridation. A useful summary of legal issues has been produced by Wurzburg and Parver.²⁷

- ASTDD maintains a [Rollback Catalog](#) to monitor and archive successful and unsuccessful efforts defending and supporting community water fluoridation. In 2014, CWF was challenged 88 times and was terminated only 16 times. CWF was affirmed by vote 20 times and was continued 52 times without a formal vote being taken.
- Although the CDC WFRS database contains information for all states and the District of Columbia, as of 2013, 11 states do not allow public access through My Water's Fluoride.^{28,29,30} WFRS data are used to allow the public and health providers to identify the fluoridation status of their water system, as well as to identify recipients of annual awards for fluoridation operational excellence and to determine states' achievement of the Healthy People 2020 water fluoridation objective. As more states routinely participate in WFRS, the reporting system will be an increasingly valuable tool for monitoring state data and annually updating national water fluoridation data.

II. Guidelines & Recommendations from Authoritative Sources

A. [U.S. Public Health Service \(PHS\)](#)

The PHS has updated and replaced its 1962 Drinking Water Standards related to community water fluoridation.³¹ PHS now recommends an optimal fluoride concentration of 0.7 milligrams/liter (mg/L). The optimal concentration of fluoride in drinking water is the concentration providing the best balance of protection from dental caries while limiting the risk of dental fluorosis. The earlier PHS recommendation for fluoride concentrations was based on average outdoor air temperature of geographic areas and ranged from 0.7–1.2 mg/L. The updated guidance is intended to apply to community water systems currently fluoridating, or initiating fluoridation, and is based on considerations including: (a) Scientific evidence related to the effectiveness of water fluoridation in caries prevention and control across all age groups; (b) Fluoride in drinking water as one of several available fluoride sources; (c) Trends in the prevalence and severity of dental fluorosis; and (d) Current evidence on fluid intake of children across various outdoor air temperatures.³²

B. [Healthy People 2020](#)

[Healthy People 2020 Oral Health Objective](#) OH-13 calls for 79.6 percent of the U.S. populations served by community water systems to have optimally fluoridated water.

C. [Centers for Disease Control and Prevention \(CDC\)](#)

CDC has recognized water fluoridation as one of the great public health achievements of the twentieth century.^{33,34} In 1995, CDC issued recommendations related to the technical aspects of water fluoridation, including engineering, administration, monitoring and surveillance, design, and safety procedures for both community and school public water supply systems.³⁵ In 2001, CDC published [Recommendations for Using Fluoride to Prevent and Control Dental Caries in the United States](#).¹ These recommendations promote the continuation and adoption of community water fluoridation in more communities as the foundation for sound caries prevention programs.

D. [Cochrane Database of Systematic Reviews \(Cochrane Review\)](#)

The [Cochrane Collaboration](#) is a global independent network of health practitioners, researchers, patient advocates and others systematically reviewing primary research in human health care and health policy. The [Cochrane Library](#) includes more than 25 reviews of a variety of fluoride modalities.

In 2015 the Cochrane Oral Health Group reviewed the evidence for the effect of water fluoridation for prevention of tooth decay and development of enamel fluorosis.³⁶ They identified 155 studies in which children receiving fluoridated water (either natural or artificial) were compared with those receiving water with very low or no fluoride. Twenty studies examined tooth decay, most of which (71percent) were conducted prior to 1975. For the assessment of fluorosis, 135 studies (published between 1941 and 2014) included populations exposed to different water fluoride concentrations; 73% of the dental fluorosis studies were conducted in places with naturally occurring fluoride, up to 5ppm in their water.

Water fluoridation resulted in a 35 percent reduction in decayed, missing or filled primary teeth (dmft) (mean difference was 1.8 dmft), a 26 percent reduction in decayed, missing or filled permanent teeth (DMFT) (mean difference was 1.2 DMFT), and a 15 percent increase in the percentage of children with no decay.

Increased fluoride exposure results in increased prevalence of fluorosis. The Cochrane group concluded that at a fluoride level of 0.7 ppm in the water, approximately 12% of the people evaluated had fluorosis that could cause concern about their appearance.

Although these results indicate water fluoridation is effective at reducing levels of tooth decay in children's primary and permanent teeth, the applicability of the results to current lifestyles is unclear because the majority of the studies were conducted before fluoride toothpastes, varnish and the other preventive measures were widely used in many communities around the world. However, other Cochrane Reviews conducted between 2003 and 2015 evaluated the effect of topical fluorides for preventing dental caries in children and adolescents.^{37,38} The effect of topical fluoride was not found to be dependent on background exposure to other fluoride sources. The reviewers did find evidence that the relative effect of topical fluoride may be greater in those who have higher baseline levels of caries.

E. National Research Council (NRC)

1. [Report on Fluoride in Drinking Water – A Scientific Review of EPA’s Standards \(2006\)](#)

In 2006, the NRC stated that in developing regulatory standards for high levels of naturally occurring fluoride in drinking water, three adverse health effects warranted consideration: severe enamel fluorosis from exposure to high levels between birth and 8 years of age, risk of bone fractures, and clinical stage II forms of skeletal fluorosis after lifetime exposure (a rare condition in the U.S.) The NRC concluded the Maximum Contaminant Level Goal (MCLG) of 4 mg/L should prevent severe *skeletal* fluorosis. MCLG is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.³⁹

The NRC recommended the U.S. EPA should reduce the MCLG to provide sufficient protection from severe *enamel* exposure.

2. [Report on Earth Materials and Health: Research Priorities for Earth Sciences and Public Health \(2007\)](#)

The National Research Council (NRC) considered research issues related to the connections between earth science and public health, addressing both positive and negative societal impacts. This report identified fluoride as a mineral beneficial for human health, noting that fluoride in drinking water has two beneficial effects: preventing dental caries and contributing to bone

mineralization and bone matrix integrity. Although earlier NRC reports were not conclusive in their opinions, the 2007 report established consensus that fluoride is beneficial based on its role in cellular functions involving metabolic or biochemical processes.⁴⁰

3. National Academy of Sciences (NAS)

In the 2008 NAS booklet [Drinking Water: Understanding the Science and Policy behind a Critical Resource](#), the NAS spotlighted fluoride in drinking water and stated, “In places where fluoride is artificially added to water, the fluoride concentration is kept at a safe level between 0.7 and 1.2 mg/L.”⁴¹

F. [Surgeon General’s Report on Oral Health and National Call to Action to Promote Oral Health](#)

[Oral Health in America: A Report of the Surgeon General](#) recommended community water fluoridation as a very effective and cost-effective method of preventing caries, which benefits all residents served by community water supplies regardless of socioeconomic status.

[A National Call to Action to Promote Oral Health](#), a report released by the Office of the Surgeon General, proposed implementation strategies to overcome barriers in oral health disparities. These strategies include the support and enhancement for adoption and maintenance of community water fluoridation.

G. [U. S. Community Preventive Services Task Force \(The Task Force\)](#)

[The Task Force](#) recommends community water fluoridation based on strong evidence of effectiveness in reducing dental caries across populations. Evidence shows the prevalence of caries is substantially lower in communities with community water fluoridation.

The Task Force updated their evidence review from 1966 to 1999 with evidence from 1999 to 2012. Evidence shows the prevalence of caries is substantially lower across populations in communities with community water fluoridation. The Task Force continues to give community water fluoridation their strongest rating^{8,34,35}

H. [American Dental Association \(ADA\)](#)

Since 1950 the [ADA](#) has endorsed fluoridation of community water supplies as safe and effective for preventing tooth decay. The ADA Statement on Water Fluoridation Efficacy and Safety reports nearly 100 national and international organizations recognize the public health benefits of community water fluoridation for preventing dental decay. These include the World Health Organization, the U.S. Public Health Service, the American Medical Association, and the American Academy of Pediatrics, the American Academy of Family Physicians, the International Association for Dental Research, the National Parent Teacher Association (PTA), and the American Cancer Society. Additional statements reaffirming ADA’s support of community water fluoridation and its effectiveness and safety can be found on the ADA web site [Fluoridation Facts](#). The ADA also supports a National Fluoridation Advisory Committee to assist the Council on Access, Prevention, and Interprofessional Relations (CAPIR) in the promotion of water fluoridation.

I. [American Academy of Pediatric Dentistry \(AAPD\)](#)

The [AAPD Policy Statement on the Use of Fluoride](#) states AAPD “endorses and encourages the adjustment of fluoride content of domestic community water supplies where feasible.”³⁷

J. [American Academy of Pediatrics \(AAP\)](#)

The AAP policy statement on Preventive Oral Health Interventions for Pediatricians is a compilation of current concepts and scientific evidence required to understand and implement practice-based preventive oral health programs designed to improve oral health outcomes for all children, especially

children at significant risk of dental decay. The policy reviews the cause of caries, preventive strategies and caries risk assessment and defines, through available evidence, appropriate recommendations for preventive oral health intervention by primary care pediatric practitioners. Optimal use of fluoride therapies is reviewed, and fluoridated water is recognized as the cheapest and most effective way to deliver anti-caries benefits to communities.^{42,43,44}

K. American Medical Association (AMA)

The AMA House of Delegates has developed the following water fluoridation policies:⁴⁰

H-440.972 Statewide Fluoridation: The AMA (1) urges state health departments to consider the value of required statewide fluoridation (preferably a comprehensive program of fluoridation of all public water supplies, where these are fluoride deficient), and to initiate such action as deemed appropriate and (2) supports the 2011 proposed fluoridation standards as promulgated by HHS and the EPA. (Sub. Res. 9, I-86; Reaffirmed: Sunset Report, I-96; Reaffirmed: CSAPH Rep. 3, A-06; Appended: Res 406, A-11)^{45, 46}

L. American Water Works Association (AWWA)

AWWA publishes a manual for water system personnel called [Water Fluoridation Principles and Practices](#). The publication provides data and guidance on the design, operation, and maintenance of fluoridation systems in water treatment. Covered topics also include the human health effects of fluoride, calculating dosage, feed systems, installation, operation, maintenance, and defluoridation.⁴⁷

The AWWA states it “supports the recommendations of the World Health Organization (WHO), American Medical Association (AMA), Canadian Medical Association (CMA), Centers for Disease Control and Prevention (CDC), American Dental Association (ADA), Canadian Dental Association (CDA), and other professional organizations in the medical community, for the fluoridation of public water supplies as a public health benefit. AWWA supports the application of fluoride in a responsible, effective, and reliable manner including monitoring and control of fluoride levels mandated by provincial, state, and/or federal laws and subject to community acceptance through applicable local decision-making processes. AWWA is committed to regular reviews of the most current research on fluoride and the positions of the medical and dental communities.”

M. American Public Health Association (APHA)

Since 1950, the APHA has supported community water fluoridation as a safe and effective public health measure for the prevention of dental caries (tooth decay), reaffirming this policy position several times since then. The 2008 APHA policy statement is available online through the [APHA Policy Statement Database](#).

N. Association of State and Territorial Dental Directors (ASTDD)

The ASTDD has demonstrated continuous support for community water fluoridation. The [2015 statement](#) supports water fluoridation at the optimal level recommended and “fully supports and endorses community water fluoridation in all public water systems at the optimal level recommended by the US Public Health Service.”

III. Research Evidence

A. Effectiveness for Caries Prevention

Systematic reviews confirm community water fluoridation is effective in decreasing dental caries prevalence in communities.^{48,49,50,51} The U.S. Preventive Service Task Force (The Task Force) found studies measuring decay rates before and after community water fluoridation, the median reduction in tooth decay among children ages 4 – 17 years was 29.1 percent. The Task Force finding is based on 28 studies on the effect of community water fluoridation on caries; 16 about oral health disparities, and 117 about dental fluorosis. Most of these studies were included in a previous systematic review. Based on this updated review, the previous Task Force finding of strong evidence for this intervention remains the same.^{52, 53} Based on strong evidence of effectiveness, the Task Force strongly recommends in the Guide to Community Preventive Services, community water fluoridation be included as part of a comprehensive population-based strategy to prevent or control tooth decay in communities. CDC's recommendations on the use of fluorides, the Surgeon General's Report on Oral Health, the Institute of Medicine, the Canadian Task Force on Preventive Health Care and an Australian Government National Health and Medical Research Council systematic review were in agreement with the Community Guide's strong recommendation for community water fluoridation.^{1,2,51,52,54,55,56,57,58,59,60}

Comparisons of fluoride-deficient and fluoridated communities in the U.S., Australia, Britain, Canada, Ireland, and New Zealand have demonstrated caries reduction ranging from 15-40 percent in fluoridated, as compared with fluoride-deficient, communities.^{61,62,63,64,65} Other evidence of the benefits of fluoridation come from studies of populations where fluoridation has ceased. Examples in the U.S., Germany and Scotland have shown when fluoridation is withdrawn and there are few other fluoride exposures, the prevalence of caries increases.^{66,67,68,69}

B. Cost-effectiveness

The April 2015 [CDC Statement on the Evidence Supporting the Safety and Effectiveness of Community Water Fluoridation](#) highlighted findings that treating all community water with fluoride additives was cost effective relative to other interventions to prevent dental caries.⁷⁰ CDC's conclusions are consistent with The Task Force's systematic review of the economic evaluations reporting fluoridation to be cost saving.

The return on investment (ROI) for community water fluoridation increases as community size increases but, as noted by The Task Force, community water fluoridation is cost saving even for small communities.^{71,72} The estimated ROI for community water fluoridation was \$7 in small communities and \$43 in large communities.

Precise estimates of fluoridation costs to benefits are dependent upon a number of variables: the population served, the incidence and/or prevalence of dental caries, the cost of dental treatment, and the number of water sources and fluoride insertion points, as well as costs of equipment and additives.

Other reports identify similar savings in treatment costs. In Louisiana, a statewide analysis of Medicaid reimbursements for caries-related procedures delivered to children aged 1 to 5 years reported savings of \$67 per child.⁷³ A Texas study confirmed the state saved \$24 per child per year in Medicaid expenditures.⁷¹ A 2010 study in New York showed the state saved \$24 per child per year in Medicaid expenditures.⁷⁴ An economic model used in Colorado comparing fluoridation program costs with treatment savings found one year of exposure to fluoridated water yielded an average savings of \$58 per person when the lifetime costs of maintaining a restoration were included.⁷⁵

Other fluoride-containing products such as toothpaste, mouth rinses, and dietary supplements are available and contribute to the prevention and control of dental caries, yet community water fluoridation is identified as the most cost-effective method of delivering fluoride to all members of the community regardless of age, educational attainment or income level.^{76,77}

IV. Best Practice Criteria

The ASTDD Best Practices Project has selected five best practice criteria to guide state and community oral health programs in developing their best practices. The following **initial review standards** have been proposed for the best practice approach of **Community Water Fluoridation**:

1. Impact/Effectiveness

(Effectiveness of community water fluoridation in preventing dental caries has been established by extensive research – See Section III.)

- Compare percentage of population served by public water systems with fluoride at recommended level to reduce caries (CWF coverage) to HP 2020 objective.
- Document the number of communities or public water systems with fluoride at recommended level to reduce caries.
- Document percentage of fluoridated systems consistently maintaining recommended level of fluoride to reduce caries (documentation of monthly monitoring consistent with CDC's WFRS).

2. Efficiency

- Compare average state cost for fluoridation (cost per person per year) to national estimates. (See **Attachment B**.)

3. Demonstrated Sustainability

- Demonstrate sustainability through the number of years an identifiable water fluoridation program at the state level has operated.
- Demonstrate sustainability through the number of systems initiating, continuing, or discontinuing water fluoridation annually.
- Demonstrate sustainability through reporting percentage of population served by community water fluoridation through annual [ASTDD State Synopsis](#) questionnaire. This information is shared with CDC and posted to the CDC [website](#).
- Demonstrate sustainability through annual monitoring of fluoridation equipment requests.
- Demonstrate sustainability of physical infrastructure and fluoridation equipment through diverse funding mechanisms.

4. Collaboration/Integration

- Demonstrate partnerships/coalitions with key stakeholders and organizations to provide political, financial and scientific expertise to local constituents, for example with:
 - Professional associations
 - Grant makers
 - Health departments
 - Water authorities
 - Universities including schools of dentistry, public health and medicine
 - Dental hygiene programs
 - State environmental protection agencies
 - State departments of education

- Local community leaders
 - School nurses
 - Health advocates
- Demonstrate coordination of fluoridation efforts with other health projects and issues, for example:
 - Water quality associations
 - Maternal and Child Health (MCH) organizations
 - Women, Infants and Children (WIC) agencies/grantees
 - Chronic Disease programs
 - Medicaid
 - Community Health Improvement Plan services (CHIP)

5. Objectives/Rationale

- Link program goals/objectives to HP 2020 objective for fluoridation.
- Link program goals/objectives to the Surgeon General’s Report on Oral Health recommendation for water fluoridation.

V. State Practice Examples

The following practice examples illustrate various elements or dimensions of the best practice approach **Community Water Fluoridation**. These reported success stories should be viewed in the context of the particular state, as well as the program’s environment, infrastructure and resources. Readers are encouraged to review the practice descriptions (click on the links of the practice names) and adapt ideas for a better fit to their states and programs.

A. Summary Listing of Practice Examples

Figure 1 provides a listing of community water fluoridation programs and activities submitted by states. Each practice name is linked to a detailed descriptive report.

Figure 1. State Practice Examples of Community Water Fluoridation

Item	Practice Name	State	Practice #
1	Arkansas Statewide Mandated Community Water Fluoridation	AR	05006
2	Educating Water Plant Operators	GA	12008
3	Fluoridation Surveillance	KY	20001
4	Community Water Fluoridation in Massachusetts	MA	24002
5	Community Water Fluoridation Program	MO	28004
6	Oklahoma Water Fluoridation Program	OK	39001

7	Community Fluoridation Program	VA	53002
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B. Highlights of Practice Examples

Highlights of state practice submissions are listed by the various community water fluoridation program activities.

Legislation/Policies:

- AR [Arkansas Statewide Mandated Community Water Fluoridation](#) (Practice #05006)
Fluoridation law for public water supplies serving more than 5,000 customers.
- KY [Fluoridation Surveillance](#) (Practice #20001)
Fluoridation law for public water supplies serving more than 1,500 individuals.
- MA [Community Water Fluoridation in Massachusetts](#) (Practice #24002)
Local Boards of Health have the authority to order community water fluoridation for their communities.
- OK [Oklahoma Water Fluoridation Program](#) (Practice #39001)
Program collaborated with organizations to develop resolutions and policy statements supporting fluoridation.

Advocacy/Promotion:

- MA [Community Water Fluoridation in Massachusetts](#) (Practice #24002)
Role of the Office of Oral Health is to provide education and technical assistance on fluoridation to local Boards of Health and their community residents, and assists new communities to establish and older communities to maintain fluoridation.
- MO [Community Water Fluoridation Program](#) (Practice #28004)
Program mission includes having new communities fluoridate each year.
- OK [Oklahoma Water Fluoridation Program](#) (Practice #39001)
Developed a coalition of supporters for fluoridation and collaborated with organizations to develop their resolutions and policy statements supporting fluoridation.
- VA [Community Fluoridation Program](#) (Practice #53002)
Program functions include assisting communities to initiate/maintain water fluoridation.

Supporting Communities Starting Fluoridation:

- MA [Community Water Fluoridation in Massachusetts](#) (Practice #24002)
MA Department of Public Health assumes initial costs of fluoridation for the community.
- MO [Community Water Fluoridation Program](#) (Practice #28004)
Program provides fluoridation equipment at no cost to a community starting fluoridation.
- OK [Oklahoma Water Fluoridation Program](#) (Practice #39001)
Provides start-up costs for initiating fluoridation with state-appropriated dollars.

Training, Monitoring, Surveillance, Reporting and Inspection:

- GA [Educating Water Plant Operators](#) (Practice #12008)
Program educates and trains all fluoride operators and monitors fluoride levels.
- MA [Community Water Fluoridation in Massachusetts](#) (Practice #24002)
Program educates and trains all fluoride operators and monitors fluoride levels.
- MO [Community Water Fluoridation Program](#) (Practice #28004)
Program monitors water systems and works with the Drinking Water Program and the state fluoridation engineer.
- KY [Fluoridation Surveillance](#) (Practice #20001)
Surveillance involves water sampling and testing of water companies.
- VA [Community Fluoridation Program](#) (Practice #53002)
Supports attendance of state personnel at CDC fluoridation course and trains local community water systems personnel.

Collaboration with Water Quality & Other Partners:

- MA [Community Water Fluoridation in Massachusetts](#) (Practice #24002)
Collaborates with Board of Health members, water operators, and other community residents and partners with MA Department of Environmental Protection.
- MO [Community Water Fluoridation Program](#) (Practice #28004)
Program collaborates extensively with the Department of Natural Resources, Public Drinking Water Program, where the state fluoridation engineer is located.
- OK [Oklahoma Water Fluoridation Program](#) (Practice #39001)
Developed a coalition of fluoridation supporters.

Human Resources to Support Community Water Fluoridation Efforts:

- KY [Fluoridation Surveillance](#) (Practice #20001)
Fluoridation enforcement staff with 3.5 FTE's stationed in various regions monitors the fluoride levels and provides repairs/maintenance.
- MA [Community Water Fluoridation in Massachusetts](#) (Practice #24002)
State Fluoridation Engineer and Program Coordinator assist communities and local Boards of Health.
- MO [Community Water Fluoridation Program](#) (Practice #28004)
Program collaborates extensively with the Department of Natural Resources, Public Drinking Water Program, where the state fluoridation engineer is located.
- OK [Oklahoma Water Fluoridation Program](#) (Practice #39001)
The state dental director, fluoride consultant, and the epidemiologist work with the Oklahoma Department of Environmental Quality to assist communities with water fluoridation

Financial Resources to Support Community Water Fluoridation Efforts:

- KY [Fluoridation Surveillance](#) (Practice #20001)

As required by statute, program is supported by state general funds.

- MA [Community Water Fluoridation in Massachusetts](#) (Practice #24002)
PHHS Block Grant and state funds support fluoridation activities.
 - OK [Oklahoma Water Fluoridation Program](#) (Practice #39001)
Program supported by state appropriations.
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VI. Acknowledgements

This report is the result of efforts by the ASTDD Best Practices Committee to identify and provide information on developing successful practices promoting community water fluoridation to improve the oral health of children and adults.

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VII. Attachments

ATTACHMENT A

Systematic vs. Narrative Reviews: <http://libguides.mssm.edu/c.php?g=168543&p=1107631>

Accessed: 2/9/15

Systematic Reviews	Narrative Reviews
Investigate a clearly defined topic or question.	Intended to provide an overview of an area.
Literature is gathered using explicit search protocols.	Explicit, systematic literature search protocol not used.
Studies selected for the review using a protocol specifying inclusion, exclusion criteria.	Studies used to support the reviewers' recommendations are not selected according to an explicit, predetermined protocol.
Data from primary study may be synthesized in a meta-analysis. Evidence "grades" may be applied to individual studies.	May use a level of evidence rating system to "grade" the quality and strength of individual studies.
When evidence is lacking, the authors usually recommend further research.	When evidence is lacking, the authors make recommendations based on their opinions and experience. Recommendations may be "graded" based on the consistency and strength of the underlying evidence.

ATTACHMENT B

Strength of Evidence Supporting Best Practice Approaches

The ASTDD Best Practices Committee takes a broad view of evidence to support best practice approaches for building effective state and community oral health programs. The Committee evaluated evidence in four categories: research, expert opinion, field lessons and theoretical rationale. Although all best practice approaches reported have a strong theoretical rationale, the strength of evidence from research, expert opinion and field lessons fall within a spectrum. On one end of the spectrum are promising best practice approaches, which may be supported by little research, a beginning of agreement in expert opinion, and very few field lessons evaluating effectiveness. On the other end of the spectrum are proven best practice approaches, ones that are supported by strong research, extensive expert opinion from multiple authoritative sources, and solid field lessons evaluating effectiveness.

Promising Best Practice Approaches

Research	+
Expert Opinion	+
Field Lessons	+
Theoretical Rationale	+++

Proven Best Practice Approaches

Research	+++
Expert Opinion	+++
Field Lessons	+++
Theoretical Rationale	+++

Research

- + The majority of available studies in dental public health or other disciplines reporting effectiveness.
- ++ The majority of descriptive reviews of scientific literature supporting effectiveness.
- +++ The majority of systematic reviews of scientific literature supporting effectiveness.

Expert Opinion

- + An expert group or general professional opinion supporting the practice.
- ++ One authoritative source (such as a national organization or agency) supporting the practice.
- +++ Multiple authoritative sources (including national organizations, agencies or initiatives) supporting the practice.

Field Lessons

- + Successes in state practices reported without evaluation documenting effectiveness.
- ++ Evaluation by a few states separately documenting effectiveness.
- +++ Cluster evaluation of several states (group evaluation) documenting effectiveness.

Theoretical Rationale

- +++ Only practices which are linked by strong causal reasoning to the desired outcome of improving oral health and total well-being of priority populations will be reported on this website.

ATTACHMENT C

Estimating Annual Per Person Costs of Fluoridating a Water System

To calculate annualized capital costs use two approaches – (a) book value of equipment and (b) replacement value of equipment.

A. Obtain the following information:

- A-1 Obtain the population served by water system.
- A-2 Obtain the initial cost (book value) of the capital equipment and the year it was purchased.²
- A-3 Obtain the replacement cost of the capital equipment in current year dollars.²
- A-4 Obtain the type of chemical used to fluoridate water.
- A-5 Obtain the annual operational costs such as chemicals, human resources,³ maintenance and repair of equipment in current year dollars.

B. Calculate the following costs:⁵

- B-1 Convert the book value of the capital equipment item A-2 to current year dollars using the CPI.
- B-2 Calculate the annual capital costs for the equipment values in items A-2 and A-3 using a 3 percent discount rate and assuming the equipment has a useful life of 15 years.⁴
- B-3 Calculate the total annual direct costs using book value of equipment and replacement value of equipment by summing values in items B-2 and A-5.
- B-4 Calculate annual cost per person by dividing item B-3 by item A-1.

Example: Calculating the annual per person cost of fluoridation in year 2013 dollars:

A. Assume following information obtained:

- A-1 The water system serves 1,400,000 people.
- A-2 The adjusted cost of the equipment purchased in 2013 dollars was \$4,172,000.
- A-3 Replacement cost of purchasing the equipment today would be \$4,259,413.27.
- A-4 The system uses H₂SiF₆.
- A-5 The annual operating costs are \$639,604.

B. Calculations:

- B-1 Convert the book value of the capital equipment cost (item A-2) from 2013 to year 2015 dollars by multiplying \$4,172,000 by 237.83/229.6 (values taken from CPI). Book value of equipment in year 2015 dollars equals $\$4,172,000 * 237.83/229.6 = \$4,259,413.27$
- B-2 (a) Calculate the annual capital costs of the equipment using its book value in year 2013 dollars and using 3 percent discount rate. This value equals $\$4,172,000 * 0.08377 = \$349,488.44$
(b) Calculate the annual capital costs of the equipment using its replacement value and using a 3 percent discount rate. This value equals $\$4,259,413.27 * 0.08377 = \$356,811.05$
- B-3 Calculate the total annual direct cost:
 - (a) Using the book value of the equipment ($\$34,948.44 + \$639,604 = \$989,092.40$).
 - (b) Using the replacement value of the equipment ($\$35,681.05 + \$639,604 = \$996,415.05$).
- B-4 Calculate the annual direct cost per person:
 - (a) Using the book value of equipment ($\$989,092.40 / 1,400,000 = \0.71).
 - (b) Using the replacement value of equipment ($\$996,415.05 / 1,400,000 = \0.71).

Source: ¹Garcia AI, Caries incidence and costs of prevention programs. J Public Health Dent 1989; 49(5):259-71.

² Include installation costs, engineering expenses, and building improvements necessary to initiate fluoridation.

³ Include value of 1) local water system personnel time spent on fluoridation activities and 2) state fluoridation engineer and fluoridation administrator time spent on local water system activities.

⁴ Using a 3 percent discount rate for equipment with a useful life of 15 years multiply the value of the equipment by 0.08377. For example if the book value of the fluoridation equipment equaled \$1,319,296 in current year dollars and you were using a 3 percent discount rate the annual capital cost would be \$110,517.

⁵ Cost information was obtained for pending report *Community Water Fluoridation Cost Analysis*

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