Community water fluoridation is defined as the adjustment of fluoride concentration in drinking water to levels optimal for preventing caries. Since initiation of community water fluoridation in Grand Rapids, Michigan, in 1945, fluoridation of public water supplies has dramatically reduced the prevalence of dental caries in the United States. Scientific evidence compiled over more than six decades demonstrates that fluoridation is a safe, cost-effective, and equitable intervention that benefits everyone in a given community regardless of financial status. The tremendous success of fluoridation has led the Centers for Disease Control to label it one of ten great public health achievements of the 20th century.

Dental professionals need to become better informed about community water fluoridation. Knowing about the history and facts about community water fluoridation enables dentists, hygienists, and assistants to educate and advocate for this valuable dental public health intervention.
Upon completion of this course, participants should be able to:

- Describe the history of water fluoridation
- Discuss the effectiveness and cost savings of community water fluoridation
- List facts to dispel myths about fluoridation
Before beginning the Community Water Fluoridation course, please take the pre-test. The pre-test consists of several questions to survey your knowledge, and to prepare you for topics included in the course.

- Please take a moment to complete the following pre-test.
- This quiz will help assess your knowledge of community water fluoridation prior to taking this course.

Click here to take the pre-test
At the beginning of the 20th century, extensive dental caries was common in the United States and in most developed countries. No effective measures existed for preventing this disease, and the most frequent treatment was tooth extraction. Failure to meet the minimum standard of having six opposing teeth was a leading cause of rejection from military service in both World War I and World War II.
Fluoridation of community drinking water is a major factor responsible for the decline in dental caries during the second half of the 20th century. Although other fluoride-containing products are available, water fluoridation remains the most equitable and cost-effective method of delivering fluoride to all members of most communities, regardless of age, educational attainment, or income level.
The history of water fluoridation is a classic example of clinical observation leading to epidemiologic investigation and community-based public health intervention. Here is what happened.

Soon after establishing his dental practice in Colorado Springs, Colorado, in 1901, Dr. Frederick S. McKay noted an unusual permanent stain or "mottled enamel" (termed "Colorado brown stain" by area residents) on the teeth of many of his patients. After years of personal field investigations, McKay concluded that an agent in the public water supply probably was responsible for mottled enamel. McKay also observed that teeth affected by this condition seemed less susceptible to dental caries.

Dr. F. L. Robertson, a dentist in Bauxite, Arkansas, noted the presence of mottled enamel among children after a deep well was dug in 1909 to provide a local water supply. A hypothesis that something in the water was responsible for mottled enamel led local officials to abandon the well in 1927.

In 1930, H. V. Churchill, a chemist with Aluminum Company of America, an aluminum manufacturing company that had bauxite mines in the town, used a newly available method of spectrographic analysis that identified high concentrations of fluoride (13.7 parts per million) in the water of the abandoned well. Fluoride, the ion of the element fluorine, almost universally is found in soil and water but generally in very low concentrations (less than 1.0 ppm).

On hearing of the new analytic method, Dr. McKay sent water samples to Churchill from areas where mottled enamel was endemic. The samples contained high levels of fluoride (2.0-12.0 ppm).
The identification of a possible etiologic agent for mottled enamel led to the establishment in 1931 of the Dental Hygiene Unit at the National Institute of Health headed by Dr. H. Trendley Dean. Dean's primary responsibility was to investigate the association between fluoride and mottled enamel. Adopting the term "fluorosis" to replace "mottled enamel," Dean conducted extensive observational epidemiologic surveys and by 1942 had documented the prevalence of dental fluorosis for much of the United States.

Dean compared the prevalence of fluorosis with data collected by others on dental caries prevalence among children in 26 states (as measured by DMFT) and noted a strong inverse relation. This cross-sectional relation was confirmed in a study of 21 cities in Colorado, Illinois, Indiana, and Ohio. Caries among children was lower in cities with more fluoride in their community water supplies. At concentrations greater than 1.0 parts per million, this association began to level off. At 1.0 parts per million, the prevalence of dental fluorosis was low and mostly very mild.
Prospective Field Studies, 1945
- Grand Rapids and Muskegon, MI
- Newburg and Kingston, NY
- Evanston and Oak Park, IL
- Brantford and Sarnia, Ontario, Canada

Caries were reduced 50%-70% among children in the communities with fluoridated water

Dental fluorosis was comparable with the 1.0 ppm

The hypothesis that dental caries could be prevented by adjusting the fluoride level of community water supplies from negligible levels to 1.0-1.2 parts per million was tested in a prospective field study conducted in four pairs of cities (intervention and control) starting in 1945: Grand Rapids and Muskegon, Michigan; Newburgh and Kingston, New York; Evanston and Oak Park, Illinois; and Brantford and Sarnia, Ontario, Canada.

After conducting sequential cross-sectional surveys in these communities over 13-15 years, caries was reduced 50%-70% among children who lived in Grand Rapids, Newburg, Evanston, and Brantford, the communities with fluoridated water. The prevalence of dental fluorosis in the these communities was comparable with what had been observed in cities where drinking water contained natural fluoride at 1.0 parts per million.
Results

Mean DMFT (decayed, missing, filled teeth) among 12 year olds declined 68% from 4.0 in 1966-1970 to 1.3 in 1988-1994.

The effectiveness of community water fluoridation in preventing dental caries prompted rapid adoption of this public health measure in cities throughout the United States. As a result, dental caries declined precipitously during the second half of the 20th century. For example, the mean DMFT among persons aged 12 years in the United States declined 68%, from 4.0 in 1966-1970 to 1.3 in 1988-1994.

The American Dental Association, the American Medical Association, the World Health Organization, and other professional and scientific organizations quickly endorsed water fluoridation.
Caries declined in both communities with and without fluoridated water in U.S.

Diffusion of fluoridated water through bottling and processing of foods and beverages

Widespread use of fluoride toothpaste

Since the early days of community water fluoridation, the prevalence of dental caries has declined in both communities with and communities without fluoridated water in the United States. This trend has been attributed largely to the diffusion of fluoridated water to areas without fluoridated water through bottling and processing of foods and beverages in areas with fluoridated water and widespread use of fluoride toothpaste.

Fluoride toothpaste prevents dental caries, but its effectiveness depends on frequency of use by persons or their caregivers. In contrast, water fluoridation reaches all residents of communities and generally is not dependent on individual behavior.
Although early studies focused mostly on children, water fluoridation also is effective in preventing dental caries among adults. Fluoridation reduces enamel caries in adults by 20%-40% and prevents caries on the exposed root surfaces of teeth, a condition that particularly affects older adults.

Water fluoridation is especially beneficial for communities of low socioeconomic status. These communities have a disproportionate burden of dental caries and have less access than higher income communities to dental-care services and other sources of fluoride. Water fluoridation may help reduce such dental health disparities.
Effectiveness of Water Fluoridation

Beneficial for low SES communities

Water fluoridation is especially beneficial for communities of low socioeconomic status. These communities have a disproportionate burden of dental caries and have less access than higher income communities to dental-care services and other sources of fluoride. Water fluoridation may help reduce such dental health disparities.
How does fluoride work?

Fluoride's caries-preventive properties initially were attributed to changes in enamel during tooth development because of the association between fluoride and cosmetic changes in enamel and a belief that fluoride incorporated into enamel during tooth development would result in a more acid-resistant mineral. However, laboratory and epidemiologic research suggests that fluoride prevents dental caries predominately after eruption of the tooth into the mouth, and its actions primarily are topical for both adults and children. These mechanisms include 1) inhibition of demineralization, 2) enhancement of remineralization, and 3) inhibition of bacterial activity in dental plaque.
Inhibition of demineralization

Enamel and dentin are composed of mineral crystals (primarily calcium and phosphate) embedded in an organic protein/lipid matrix. Dental mineral is dissolved readily by acid produced by cariogenic bacteria when they metabolize fermentable carbohydrates. Fluoride present in solution at low levels, which becomes concentrated in dental plaque, can substantially inhibit dissolution of tooth mineral by acid.
Fluoride enhances remineralization by adsorbing to the tooth surface and attracting calcium ions present in saliva. Fluoride also acts to bring the calcium and phosphate ions together and is included in the chemical reaction that takes place, producing a crystal surface that is much less soluble in acid than the original tooth mineral.
Inhibition of bacterial activity in dental plaque

Fluoride from topical sources such as fluoridated drinking water is taken up by cariogenic bacteria when they produce acid. Once inside the cells, fluoride interferes with enzyme activity of the bacteria and the control of intracellular pH. This reduces bacterial acid production, which directly reduces the dissolution rate of tooth mineral.
By the end of 1992, 10,567 public water systems serving 135 million persons in 8,573 U.S. communities had instituted water fluoridation (20). Approximately 70% of all U.S. cities with populations of greater than 100,000 used fluoridated water. In addition, 3784 public water systems serving 10 million persons in 1924 communities had natural fluoride levels greater than or equal to 0.7 ppm. In total, 144 million persons in the United States (56% of the population) were receiving fluoridated water in 1992, including 62% of those served by public water systems. However, approximately 42,000 public water systems and 153 U.S. cities with populations greater than or equal to 50,000 have not instituted fluoridation.
Cost effective

- Costs about 50 cents per person per year to fluoridate

- Cost savings – for every $1 spent, $38 saved

Fluoridation is one of the most cost effective measures in all of public health, and certainly in dentistry. It costs only around 50 cents per person per year to fluoridate community drinking water, depending on the size of the water system and the number of people on the system. One study showed that for every one dollar spent on fluoridating drinking water, $38 was saved by not having to restore teeth in later years.
Fluoridation Facts

- ALL water sources contain some fluoride
  - Fresh surface waters <0.2 ppm
  - Well waters – AZ 29.5 ppm
  - All plants and animals have some F exposure
- Optimal water fluoridation is 0.9 to 1.2 ppm (CDC)
- No difference in effectiveness between naturally occurring and “artificially added” fluoride

It is important to understand that all natural water sources contain some amount of the fluoride ion. Fresh surface waters usually contain less than 0.2 part per million of the fluoride ion, whereas some well waters have even more. A well in Arizona, for example, measured almost 30 part per million of fluoride.

Optimal water fluoridation is not exactly 1 part per million, but is in the range of 0.7 to 1.2 parts per million fluoride. The Centers for Disease Control and Prevention Water Fluoridation Reporting System states that optimal fluoridation is between 0.9 and 1.2 parts per million fluoride.

Studies have shown that there is no difference in the effectiveness of preventing tooth decay in patients exposed to fluoridated water where the fluoride is naturally occurring and those exposed to fluoridated water where the fluoride is artificially added to the community drinking water.
Fluoridation studies have shown a 44-60% reduction in caries prevalence in fluoridated communities.

Fluoride not only protects children from caries, but also adults (including root caries).

Fluoridation studies have shown a 44-60% reduction in caries prevalence in fluoridated communities, using non-fluoridation communities as control groups.

The oldest post-World War II "baby boomers" will reach age 60 years in the first decade of the 21st century, and more of that birth cohort will have a relatively intact dentition at that age than any generation in history. Thus, more teeth than ever will be at risk for caries. In the next century, water fluoridation will continue to help prevent caries among these older persons in the United States.
Fluoridation Facts

“The overwhelming weight of scientific evidence indicates that fluoridation...is both safe and effective.” (ADA)

- No association between fluoride and bone cancer
- Fluoride does not affect human enzyme activity
- No confirmed reports of fluoride allergies
- No relationship between cancer rates and fluoride

Fluoridation and fluorides used in other preventive regimens are not without controversy. Numerous groups have blamed fluoride exposure on many systemic diseases. The American Dental Association states that the overwhelming weight of scientific evidence indicates that fluoridation is both safe and effective.

The ADA goes further by dispelling some of the myths. It is important to advocate for fluoridation of drinking water.

Here are the facts:
(1) there is no association between fluoride and bone cancer;
(2) fluoride does not affect human enzyme activity;
(3) there are no confirmed reports of fluoride allergies;
(4) there is no relationship between cancer rates and fluoride;
Fluoridation Facts

“The overwhelming weight of scientific evidence indicates that fluoridation...is both safe and effective.” (ADA)

- No association between fluoride and neurological problems
- No evidence linking fluoride exposure to AIDS
- Fluoridated drinking water is not a genetic hazard
- No relationship between fluoride and Down’s Syndrome

(5) there is no association between fluoride and neurological problems;
(6) there is no evidence linking fluoride exposure to the Human Immunodeficiency Virus or AIDS;
(7) fluoridated drinking water is not a genetic hazard;
(8) there is no relationship between fluoride and Down’s Syndrome
Fluoridation Facts

“The overwhelming weight of scientific evidence indicates that fluoridation...is both safe and effective.” (ADA)

- No link between fluoride and Alzheimer’s disease
- Fluoridated water does not cause or worsen kidney disease
- Drinking fluoridated water is not a risk factor for heart disease
- Optimal fluoridation does not affect drinking water quality

(9) there is no link between fluoride and Alzheimer’s disease;
(10) fluoridated water does not cause or worsen kidney disease;
(11) drinking fluoridated water is not a risk factor for heart disease;
and (12) optimal fluoridation does not affect the quality of the drinking water.
Among the most striking results of water fluoridation is the change in public attitudes and expectations regarding dental health. Tooth loss is no longer considered inevitable, and increasingly adults in the United States are retaining most of their teeth for a lifetime. For example, the percentage of persons aged 45-54 years who had lost all their permanent teeth decreased from 20.0% in 1960-1962 to 9.1% in 1988-1994.
“Nearly all tooth decay can be prevented when fluoridation is combined with dental sealants and other fluoride products, such as toothpaste.”

(CDC)

The Centers for Disease Control and Prevention has gone so far as to say that nearly all tooth decay can be prevented when fluoridation is combined with dental sealants and other fluoride products such as toothpaste. What an amazing accomplishment this would be!
Things you can do...

- Get the facts
- Know the benefits of community water fluoridation
- Educate patients and community leaders to dispel the myths
- Advocate to prevent dental caries
- Learn more about fluoridation

http://www.cdc.gov/oralhealth

As a dental professional, it is critical to know the benefits and facts about community water fluoridation. Educate patients and community leaders to dispel the myths about fluoridated drinking water. Become an advocate for community water fluoridation. To learn more about fluoridation go to www.cdc.gov/oralhealth.
Final Assessment

- Please take a moment to complete the final assessment.
- Click the button below to begin.

Click here to take the final assessment

Now it’s time to take the final assessment. This assessment is a comprehensive skill check that covers all of the objectives in this course. It consists of multiple choice and true/false questions.

You must score a minimum of 80% to pass this assessment and receive 1 CDE credit.

Directions: Click the Final Assessment button below to take the final assessment.