UPDATING THE WATER FLUORIDATION REPORTING SYSTEM IN TEXAS

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Certificate in Dental Public Health

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LIST OF ABBREVIATIONS

ASTDD	Association of State and Territorial Dental Directors
CDC	Centers for Disease Control and Prevention
CWF	Community water fluoridation
EPA	Environmental Protection Agency
PWS	Public water system
PPM	Parts per million
SES	Socioeconomic status
TDH	Texas Department of Health
U.S.	United States
USDHHS	United States Department of Health and Human Services
USPHS	United States Public Health Service
WFRS	Water Fluoridation Reporting System

A. ABSTRACT

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Objective: To edit and update the Water Fluoridation Reporting System for the state of Texas, allowing for compliance with Centers for Disease Control and Prevention recommendations, resulting in essential fluoride information being posted on line.

Methods: After gaining access to the Water Fluoridation Reporting System, data provided by the Oral Health Division of the Texas Department of Health was accumulated, cleaned, standardized, analyzed, consolidated and entered into the Water Fluoridation Reporting System program.

Results: 75.8 percent of the state public water system population was receiving naturally or adjusted fluoridated water. This level meets the objectives described in *Health People 2010* of 75 percent.

Conclusion: The Water Fluoridation Reporting System is a beneficial mechanism to monitor the fluoridation status of public water systems in this country. Like any surveillance system, it will require continued support from the dental public health community, professional groups, legislators, and the public for its quality assurance and compliance. It is also a useful system for dentists/physicians to help determine if selected children should be prescribed fluoride supplements (tablets).

B. NAME OF PROJECT

UPDATING THE WATER FLUORIDATION REPORTING SYSTEM IN TEXAS

C. APPLICANT'S ROLE IN PROJECT

This project was originated by the applicant Dr. Joseph A. Bartoloni. The applicant, in conjunction with the Oral Health Division of the Texas Department of Health (TDH), was responsible for the planning, data processing, and reporting.

D. STATEMENT OF PURPOSE

The purpose of this project was to edit and update the Water Fluoridation Reporting System (WFRS) for the state of Texas to ensure accuracy and completeness of the data, preparatory to its being placed in the public domain on line. After completion of this project, the residents and health professionals of Texas will be able to access fluoride information on line for their specific location from the Centers for Disease Control and Prevention (CDC) website.

E. BACKGROUND AND REVIEW OF THE LITERATURE

Dental caries is a transmissible, reversible, diet and time-dependent multifactorial disease of the mouth manifested in teeth. It is a pathologic process of localized destruction of tooth tissues by acids produced from microbial metabolism of sugars and starches (1). Dental caries is a lifelong disease that affects individuals of all ages. In the United States (U.S.), it affects 50 percent of children aged 5-9 years, 67 percent of adolescents aged 12-17 years (2), and 94 percent of adults aged 18 and older (3). While the prevalence of dental caries has decreased in the U.S., it still remains the most common chronic childhood disease. Dental caries disproportionately affects low income families, and minority children (4). Dental caries also tends to affect populations characterized by low levels of parental education, individuals who do not seek regular dental care, and those without dental insurance or access to dental services (5).

This disease can be greatly reduced when science-based, preventive measures are applied appropriately. The most cost-effective methods are community- or population-based (6).

In the U.S. and other developed countries, we have seen a dramatic decline in the prevalence, and severity of dental caries in the last half of the twentieth century. This is mainly due to the discovery of fluoride in reducing and preventing dental caries. Today, fluoride offers the best protection against dental caries, and community water fluoridation (CWF) remains the most equitable and efficient means of delivering fluoride to the population (7). CWF safely and inexpensively benefits both children and adults by effectively preventing tooth decay, regardless of health knowledge, attitudes, behaviors, socioeconomic status or access to care. It may contribute to the reduction of disparities in caries risk and experience across subgroups defined by socioeconomic status (SES), race or ethnicity, and other predictors of caries risk (8). CWF has been described in *Healthy People 2010* as an "ideal public health method because it is effective, eminently safe, inexpensive, requires no cooperative effort or direct action, and does not depend on access or availability of professional services. It is equitable because the entire population benefits regardless of financial resources" (9). The CDC noted that CWF was one of the ten most important public health measures of the twentieth century (10). The use of CWF remains the cornerstone in the prevention of dental caries in the U.S. today.

CWF is the deliberate addition of fluoride into the drinking water in accordance with scientific and dental guidelines to promote the communities health through the prevention of dental caries. Fluoride is the ionic form of the element fluorine. It is colorless, tasteless, and odorless. Fluoride is ubiquitous, found in small but varying amounts in soils, water, plants, animals, and is found in most of the calcified tissues of the body (i.e., bones and teeth). All community water supplies in the U.S. contain at least trace amounts of natural fluoride.

What is the history behind CWF? In the early 1900's in Colorado Springs, Colorado, a local dentist named Dr. Frederick S. McKay discovered many of his patients' teeth exhibited tooth discoloration (then called "Colorado Brown Stain," now termed fluorosis or mottled enamel). This condition was first reported in the scientific literature by Dr. J. M. Eager in the teeth of emigrants embarking at Naples, Italy to the U.S. (11). In the 1920's, Dr. McKay concluded that either something in or missing from the drinking water was causing this condition. He also found that teeth with mottled enamel were free of dental caries. He described this condition, and made recommendations on how to prevent its occurrence (12).

In 1931, fluoride was identified as the element in drinking water that caused fluorosis and inhibited dental caries (13). Dr. G. J. Cox first proposed adding fluoride to public water supplies to prevent dental caries (14). During the 1930's Dr. H. Trendley Dean of the United States Public Health Service (USPHS) and Dr. McKay worked together to explore the relationship of naturally occurring fluoride in water, dental caries and fluorosis. Dr. Dean and associates conducted several studies to determine an individual, and a community fluorosis index (15). He then devised studies to test the hypothesis that consumption of fluoridated water was associated with decreased caries (16); followed by studies to define the lowest fluoride level at which caries was inhibited (17). Dean (18) proposed that one part per million (ppm) was the optimal concentration for climates similar to Chicago, Illinois. This concentration was found to dramatically reduce the prevalence of dental caries (50 to 60 percent at that time), with minimal severity and prevalence of enamel fluorosis (8 to 15 percent were of very mild and mild grade fluorosis).

In the mid 1940's four classic prospective implementation studies were begun to evaluate the effects of water fluoridation (19-22). During the 1950's and 1960's, Frank J. Maier and

Ervin Bellack, both with the USPHS, developed the engineering principles of community water fluoridation including: the practicality of fluoride chemicals, the best mechanical equipment to use, and the best process controls.

Over the past fifty years multiple studies have been conducted on fluorides and CWF. Data have consistently shown that CWF is safe, practical, and cost-effective in reducing the incidence of dental caries in a community (23-26). In 1996, the CDC reviewed the U.S. experiences with fluoridation and concluded: 1) fluoridation of community water supplies dramatically reduces the incidence and prevalence of dental caries, 2) the benefits of fluoridation far exceed the risks, and 3) the benefits of fluoridation should be brought to more individuals worldwide (27). Several national, public health and medical agencies have issued guidelines supporting CWF, encouraging further expansion. These agencies include the Task Force on Community Preventive Services (8), the American Dental Association (28), and the American Medical Association (29).

A recent report from the Surgeon General stated, "community water fluoridation continues to be the most cost-effective, practical and safe means for reducing and controlling the occurrence of dental caries in a community" (30). Kargul (31) provided an excellent review of the history of water fluoridation and concluded that CWF provides safe and effective protection from dental caries at a reasonable cost. McDonagh (32) performed an exhaustive systematic review of water fluoridation and concluded that water fluoridation was associated with an increased proportion of children without caries, and a reduction in the number of teeth affected by caries. The authors also found that a fluoride level of one ppm resulted in 12.5 percent of exposed individuals developing fluorosis.

Initial studies of CWF showed decreases in childhood dental caries due to fluoridation were approximately 50-60 percent (33, 34). Murray (35) showed that water fluoridation reduced caries between 40 and 50 percent for primary teeth, and 50 to 60 percent for permanent teeth, after reviewing ninety five studies between 1945 and 1978. Recent estimates have been 18-40 percent reduction (36, 37), confirmed by the U.S. Department of Health and Human Services (USDHHS) (38). This is likely due to the near universal use of fluoride toothpaste, and the halo effect of fluoride in processed foods being distributed to non-fluoridated areas. CWF has also been shown to benefit adults as well as children (39). Hopcraft (40) showed that subjects with a lifetime exposure to fluoridated water reported a 23 percent lower level of caries experience than subjects with no exposure to fluoridated water, while subjects with a partial lifetime exposure to fluoridated water had a reduction of 17 percent. The authors also concluded that the beneficial effects continued throughout adolescence into adult life. Other studies have shown that continual exposure to fluoridated water is required to maintain the benefits of fluoridation after communities discontinued the use of fluoridated drinking water (41, 42). Singh (43) recently found that the maximum caries-preventive effects of fluoridated water were achieved by pre- and post-eruption exposure. The findings from whole population Australian studies in the universal school dental therapy program indicated the importance of a pre-eruptive exposure to fluoridated water without which there was no significant prevention of caries. Preeruptive exposure was required for a caries-preventive effect and that exposure after eruption alone did not lower caries levels significantly. This finding contradicts mainstream thought which indicates that fluoride's predominant effect is posteruptive and topical, and that fluoride works primarily after teeth have erupted, especially when small amounts are maintained and bioavailable in the oral cavity at sites of caries challenge (44). Today, we see smaller differences in the prevalence of dental caries

between fluoridated communities and non-fluoridated communities due to increased fluoride exposures from other sources (e.g., fluoride dentifrices, fluoride mouthrinses and foods and beverages processed using fluoridated water) (45).

Results from a 1989 workshop found that the annual cost of water fluoridation in the U.S. was $0.51 per person (range: $0.12-$5.41), and the participants concluded that water fluoridation was one of the few public health measures that results in true cost savings (46). Griffin (47) determined that the annual per person cost savings resulting from fluoridation ranged from $15.95 in small communities to $18.62 in large communities. In addition, the authors found that the reduction in costs of restorative care due to averted disease exceeded the cost of water fluoridation in communities of any size. In 2000, the TDH in conjunction with the Department of Community Dentistry at the University of Texas Health Science Center in San Antonio conducted a study of the cost of publicly financed dental care in relation to CWF. This study found that for an initial one ppm rise in water fluoride level, the average cost of public dental care (Medicaid, Early and Periodic Screening, Diagnosis, and Treatment) per child declined $24 per year. The wide implementation of CWF in Texas has resulted in substantial savings in publicly financed dental care (48).

In this country, dental caries distribution has become skewed with the majority of disease burden found in low SES levels (4). Burt (49) has contended that continuation of water fluoridation is needed because it is the most effective and practical method of reducing SES-based disparities in the burden of dental caries, and should remain as a public health priority. The CDC has concluded that fluoridation of the public water supply is the most equitable, cost-effective, and cost-saving method of delivering fluoride to the community (5).

The CDC has recommended that frequent exposures to small amounts of fluoride each day are the most appropriate method to reduce the risk for dental caries in all age groups. One technique to accomplish this is through consumption of optimally fluoridated water (5). Current federal fluoridation guidelines state that community drinking water should contain 0.7-1.2 ppm fluoride based on the average maximum daily air temperature of the area (50). The fluoride level must be maintained at or near the optimal level to be effective. This was based on studies conducted during the 1940's and 1950's. The U.S. Environmental Protection Agency (EPA) regulates the addition of fluoride to drinking water, but the EPA's Safe Drinking Water Information System only tracks fluoride concentrations in water systems with naturally occurring fluoride levels above 2.0 ppm (maximum contaminant goal). Four ppm is the maximum contaminant level permitted for a public water system (PWS). The safety of these levels was affirmed in 1993 (26), and is again under required periodic review by the National Science Foundation.

In the U.S., approximately 162 million individuals (65.8 percent of the population served by public water systems) receive optimally fluoridated water compared to 144 million (62.1 percent) in 1992 (51, 52). Recently, the trend to implement water fluoridation has accelerated. The *Healthy People* 2010 health promotion and disease prevention objectives call for increasing the percentage of U.S. residents on public water supplies drinking fluoridated water from 62 to 75 percent. This would equate to adding 30 million individuals served by over 1,000 community water systems (27), and good progress has been made with almost a third of this goal achieved due to implementation in some major cities in California and Texas. A successful fluoridation program requires the proper design/construction of the facilities, and proper operation and monitoring of the systems.

Until recently, water fluoridation quality was monitored through the use of three data systems: the CDC Fluoridation Census, the CDC Proficiency Testing Program, and the Association of State and Territorial Dental Directors (ASTDD) Fluoridation Quarterly Report (53). These systems tended to operate independently, and did not provide the detail necessary to monitor, plan, and effectively implement programmatic changes. Due to these limitations, ASTDD requested assistance from the Division of Oral Health at the CDC to develop a comprehensive fluoridation tracking system for use by states. This request has resulted in the development of the World Wide Web based Water Fluoridation Reporting System (WFRS). WFRS represents a monitoring and surveillance tool developed for use by Tribal, Federal, and State governments to monitor CWF programs, and improve quality control.

The intent of WFRS is: ease of use, minimal hardware and software requirements at user locations, access via the Internet, adaptability to individual user needs, and support of future modifications (53). WFRS was designed to effectively monitor the quality and quantity of water fluoridation, while minimizing the time and resources needed for data collection. WFRS is an Internet-based monitoring and surveillance system that can be used by state and tribal fluoridation managers. WFRS was developed to collect and edit data over the Internet in "real time" (i.e., information supplied by state and tribal fluoridation program managers are entered instantaneously resulting in updated records).

This program was developed by the CDC in collaboration with the ASTDD to monitor fluoridation at the state and local levels in the U.S. WFRS not only tracks which systems are fluoridated, but is also designed as a tool to assist states and tribes in monitoring the quality of fluoridation. Users can enter monthly data, and can indicate whether or not the water system met the daily testing requirements. Based on criteria derived from the state or tribe, WFRS evaluates

the data entered to determine if the water system provided "optimally" (i.e., desired range) fluoridated water for the month. These reports provide essential information to fluoridation managers to aid in improving the quality of fluoridation. Data from WFRS is gathered every 24 hours, and is used to update information and maps on its website.

WFRS has allowed the CDC to expand information to the public regarding CWF, and the CDC launched a new website designed to increase public and professional access to information on fluoride content and fluoridation status of local drinking water supplies. Two new features offered include "My Water's Fluoride," and "Oral Health Maps." "My Water's Fluoride" allows consumers and health professionals in participating states to access basic information about their individual water system, including the population served by the system, and the target fluoridation level. One of the recommendations of the 2001 CDC Fluoride Recommendations was for parents of young children less than six years old, to know the fluoride concentration of their child's drinking water in order to consider whether to alter the child's fluoride intake. "My Water's Fluoride" will aid both patients and oral health professionals in determining the fluoride content of the drinking water, so they can assess whether additional fluoride should be prescribed. "Oral Health Maps," a geographic information system application, provides state or county profiles with selected demographic and water fluoridation information for participating states. To date, participation in WFRS is voluntary.

In 2000, the CDC sent state-specific reports generated from WFRS to each oral health department at each state health agency to ensure accuracy and completeness. In July 2001, each state received preliminary data, and was asked to submit corrections. Eight states including Texas did not update their data.

In 2002, the CDC published state-specific data on populations receiving optimally fluoridated public drinking water (52). The results indicate slow progress up to that time toward increasing access to optimally fluoridated public drinking water. The CDC is optimistic that data from WFRS will increase public awareness of the benefits of community water fluoridation, and can be utilized to identify areas where additional health promotion is needed. It will also be useful for dentists and physicians in determining the dosage of fluoride tablets for children in non-fluoridated areas.

F. DESCRIPTION OF THE PROJECT

The applicant processed information provided by the Fluoridation Engineer, Tom Napier, of the Oral Health Division of TDH to edit and update the WFRS. This resulted in determining the percent of the population served by a PWS having access to fluoride, and allowed the state to comply with recommendations from the CDC.

G. PROCEDURES AND METHODS

The applicant contacted the Oral Health Division of TDH to inquire about updating the WFRS for the State. The dental director of TDH agreed to allow the applicant to work with the fluoride engineer to edit and update the program. The first step required was registering with the CDC and gaining access to a password for authorized use in WFRS. A database of all fluoridated water systems for the state of Texas was then received from TDH to begin updating the records. All these systems were cross-checked with the existing database with the Texas Commission for Environmental Quality, (lead environmental agency responsible for protecting the natural resources for the state of Texas), at http://www3.tceq.state.tx.us/iwud/#pws, to verify type and source of water system. This information was then transferred to WFRS. The next step

involved verifying and updating basic water information for each fluoridated PWS. The following information was updated for each PWS.

UPDATED ENTRY	FUNCTION
PWS Region Identification	Region within the state that the water system is located
Fluoridation status	Used to generate reports and control data input and storage (e.g., adjusted, non-adjusted, natural, defluoridated)
System type	Water system classified by ownership and or intended customer (e.g., community, military, school)
Water source	Allows user to specify the type of source for each water system (e.g., ground, surface, mixed)
Fluoride criteria	To store fluoride readings, and to determine if the water system is in compliance with fluoride regulations and recommendations (e.g., natural fluoride concentration, optimal fluoride concentration, lowest optimal concentration, highest optimal concentration)
Chemical type	Allows user to specify the fluoride chemical for each water system (e.g., sodium fluoride, sodium fluorosilicate, fluorosilicic acid)
Population served	Population served by the public water system

The final step involved verifying and editing the relationships between systems to avoid erroneous readings for consecutive systems (PWS which purchases water from another water system, and does not adjust the fluoride concentration itself). This was accomplished by cross-checking a database of Texas purchased secondary systems provided by TDH and transferring the information into WFRS.

This water system information will then be used directly by WFRS to determine system compliance with Owner (responsible for oversight of a water system) regulations, in report

generation, and in identifying the relationships between systems (i.e., which water systems sell to/purchase water form other systems). After completion of these tasks, the use of WFRS will become a function of entering monthly fluoride data from existing PWS in Texas, printing reports, then using the information to improve the quality of water fluoridation. The WFRS for Texas can then also become publicly available for public and professional information, health promotion and assurance.

H. FINDINGS

After editing and updating the basic information, the TDH verified all changes for accuracy and completeness and processed all updates. Fluoridation percentages were determined by dividing the number of individuals using public water systems with fluoride levels considered optimal (i.e., naturally occurring and adjusted) for the state by the total population of the state served by public water systems. This resulted in a working map of percentage of county PWS population receiving fluoridated water (Figure 1). This map is now available for public viewing and linkage at http://apps.ncdd.cdc.gov/gis/doh. Presently 75.8 percent of Texas residents served by community water systems have access to fluoridated water. This figure meets the *Healthy People 2010* objective (Figure 2).

I. DISCUSSION

WFRS, developed by the CDC, serves as a surveillance database to measure our progress to reaching the goal established in *Health People 2010*. WFRS serves a fundamental role in dental public health by monitoring the fluoride status in community water supplies, and provides decision maker's guidance for developing and implementing the best strategies for prevention of dental caries. This system allows states to develop coordinated public health approaches via

information exchange. For this data to be useful though, it must be accurate, timely, and available in a usable form.

Today, less than half of the states are participating in WFRS. Why? Many state health departments lack an oral health component. Also, those with oral health programs have been weakened due to decreases in resources, with sharp reductions in personnel and program dollars. Barriers to participation include: no perceived benefits by certain states, no lead organizations to handle data collection, and lack of resources, time, personnel and interest. Programs without well-developed constituencies and well-described values tend to be underutilized or curtailed. Poor management can result in under funding of critical programs that are relatively inexpensive and cost-effective. In a time period where groups with multiple needs are competing for available resources, it has become essential that state/local oral health program managers assess the effectiveness and value of all dental public health programs including surveillance of the fluoridation status for all residents. Improved oral health for all U.S. residents depends on stronger leadership by the oral health community to promote a more comprehensive awareness of the benefits of CWF, and to increase active participation in WFRS by all states.

For WFRS to be successful, I would recommend the following: a clearer fluoridation presence in the Oral Health Division at the CDC by providing direction, promotion, and incentives; increased funding from the CDC to states for technical assistance, personnel, training, collaboration with other water agencies; effective communication to the media, public, consumer groups, professional organizations, and legislators of the importance of surveillance; developing a strong set of messages to policy makers that public program dollars can be saved by investing in and monitoring CWF; communicating a sense of common goals to dental professionals in private practice for advocacy and continuation of the program.

As for the state of Texas, the capabilities of WFRS need to be expanded in the future. The Oral Health Division of TDH needs to emphasize the importance of monthly reporting of daily fluoride levels and monthly split samples to operators of all water systems with adjusted fluoride levels. TDH could then analyze the information and input low, high and average values into WFRS. Other considerations for the state should include: additional funding for the Oral Health Division from the state legislature or CDC to further develop an action plan to improve monitoring, surveillance, quality assurance, on-site inspections, and training, and a program to monitor and optimize fluoride levels in communities with water systems containing high natural fluoride levels

J. CONCLUSIONS

Today, patients have higher expectations and greater demands for oral health care, including deriving the most benefits from fluoride exposure. More patients are becoming aware that oral health is a component of overall health. The U.S. population is evolving, with more sophisticated consumers and more aggressive expectations of the dental community. Also, dental care payers want information on outcomes of care that measure the effectiveness of services provided.

WFRS has been shown to be a valuable tool for monitoring and updating national water fluoridation data. Utilizing WFRS, results show that Texas is following national health organizations' recommendations. Approximately 75.8 percent of the population of Texas connected to PWS has access to fluoridation. To date, nationwide results indicate that the U.S. is progressing towards increasing access to optimally fluoridated public drinking water. To reach the *Healthy People 2010* goal in other parts of the country will require local, state and federal

health organizations to coordinate with policymakers to create new funding for promotional efforts to gain support.

The key to establishing CWF is through organized community support, which requires educating the public including community leaders/organizations, health and human services leadership, and our patients. CWF has significantly improved the publics' health in the last 50 years contributing to improved quality of life for many Americans. It is the most cost-effective method of exposing individuals to the benefits of fluoride reaching individuals of all ages and SES levels. Despite these benefits, recent progress has been a challenge due to struggles for public acceptance. Hopefully, data from the WFRS will increase public awareness of the benefits of CWF, and will be used to identify areas where additional health promotion is needed.

Our goal should be to provide the best possible oral health for the American people. We must continue to realize that the interests of the public will be best served by supporting and increasing access to CWF. This can be facilitated by utilizing continuous surveillance provided by WFRS.

K. SUGGESTED CHANGES IF THE PROJECT WAS REPEATED

If I had the opportunity to repeat this project, I would like to have contributed to the follow on efforts needed to maintain and keep this program up to date, and to publicize WFRS in Texas to the public and the dental profession via the TDH website.

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Texas

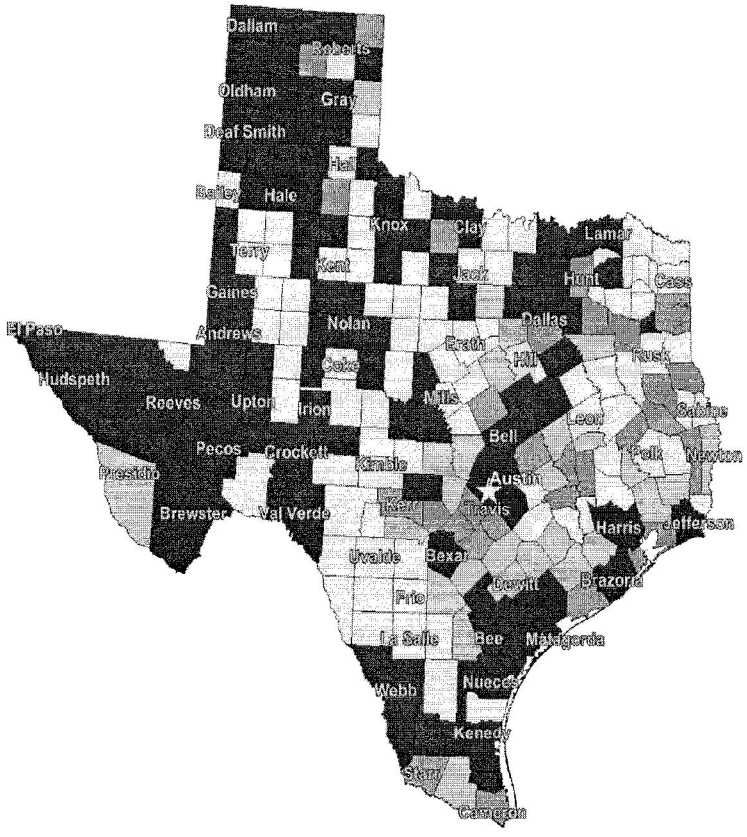
Percentage of county PWS population receiving fluoridated water

Map generated Monday, September 22, 2003

State Capital

Met 2010 Requirements

Fluoridation percentage
- 0 - 24
- 25 - 49
- 50 - 74
- 75 - 100
- >100 (see FAQ's)
- Data Not Available



Source: Centers for Disease Control and Prevention, Division of Oral Health, http://www.cdc.gov/OralHealth

State Info | Charts

Print Page

Texas

State Demographics

Total Population	21,779,893

Counties

Total Number	254
More Than 75% County Population Fluoridated	84
Less Than 75% County Population Fluoridated	170
More Than 75% County PWS Population Fluoridated	107
Less Than 75% County PWS Population Fluoridated	147

Oral Health Indicators

Dentists per 100,000 population	44

Water Fluoridation

State Populations

Served by Public Water Systems (PWS)	21,275,918
Receiving Fluoridated Water	16,133,742
Percent of State Population Receiving Fluoridated Water	74.0%
Percent of State PWS Population Receiving Fluoridated Water	75.8%

Fluoridation Status

Number of Water Systems:

Adjusted Fluoride Content	193
Naturally Fluoridated	450
Purchasing Fluoridated Water	520
Non-fluoridated	3,378

Populations Served:

Adjusted Fluoride Content	13,256,652
Naturally Fluoridated	2,877,090
Non-fluoridated	5,142,176

Adjusted Water Systems, by Chemical Type

Number of Systems

Sodium Fluoride	33
Sodium Fluorosilicate	58
Fluorosilicic Acid	527