Knowledge and Use of Fluoride among Indiana Dental Professionals

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Abstract

***Objectives**: This study assessed the knowledge of Indiana dentists and dental hygienists about fluoride's predominant mode of action and their protocols for the use of fluoride for dental caries prevention. **Methods**: In 2000, questionnaires were mailed to 6,681 Indiana dentists and hygienists prior to the 2001 release of recommendations for the use of fluoride by the US Centers for Disease Control and Prevention. In 2005, the questionnaires were again sent to Indiana dental professionals to assess changes in knowledge and protocols. In addition, a 10 percent sample of Illinois dentists and hygienists were surveyed to determine the similarity of Indiana and Illinois responses. **Results**: Questionnaires were anonymously completed and returned. In 2000, a minority of Indiana health professionals (17 percent) correctly identified that remineralization was fluoride's predominant mode of action. There was a significant increase in Indiana respondents correctly identifying this predominant mode of action between 2000 and 2005 (17 percent versus 25 percent, respectively, $P < 0.0001$). Fourteen percent of Illinois respondents answered correctly in 2005. Preeruptive incorporation of fluoride into enamel was the most frequently cited incorrect response (IN 2000, 79 percent; IN 2005, 71 percent; IL 2005, 82 percent). Some protocols for use of fluoride products reflected inadequate understanding of fluoride's predominant posteruptive mode of action. **Conclusions**: The majority of dental professionals surveyed were unaware of the current understanding of fluoride's predominant posteruptive mode of action through remineralization of incipient carious lesions. Additional research is indicated to assess fluoride knowledge and protocols of dental professionals nationwide. Educational efforts are needed to promote the appropriate use of fluoride.*

Key Words: caries prevention, dental care, fluorosis, fluoride, epidemiology, United States

Introduction

Fluoridation of community water supplies and the use of fluoride technologies in various forms have been credited with significant reductions in the prevalence of dental caries (1). These are important public health achievements and have had a dynamic impact on quality of life. Despite fluoride's widespread use in various modes and concentrations, the United States did not have comprehensive recommendations for caries prevention and control until August 2001, when the US Centers for Disease Control and Prevention (CDC) released *Recommendations for Using Fluoride to Prevent and Control Dental Caries in the United States* (2). These recommendations established guidance for health care providers on the appropriate use of fluoride in dental offices, homes, and in public health.

The recommendations reaffirmed that fluoride's predominant beneficial effect is the result of posteruptive remineralization, rather than the historical belief that fluoride's benefit is the result of fluoride being incorporated into developing dental tissues (3-6). In the CDC's *Recommendations for Using Fluoride to Prevent and Control Dental Caries in the United States*, fluoride's beneficial action is described in this way: "The laboratory and epidemiologic research that has led to the better understanding of how fluoride prevents dental caries indicates that fluoride's predominant effect is posteruptive and topical and that the effect depends on fluoride being in the right amount in the right place at the right time. Fluoride works primarily after teeth have erupted, especially when small amounts are maintained constantly in the mouth, specifically in dental plaque and saliva" (2). This paradigm shift away from the belief that fluoride's predominant beneficial effect is preeruptive and systemic may have a dramatic impact on making treatment decisions and recommendations that will maximize fluoride's preventive capabilities and minimize the potential for dental fluorosis. Because fluoride's predominant effectiveness is now known to be posteruptive and a result of remineralization of incipient lesions, it is clear that adults also benefit from fluoride, rather than only children as was previously believed. Decisions about who should receive professionally applied high-concentration fluoride treatments should be based on caries experience, and individualized, objective appraisals of risk, rather than age.

This study offers results of two cross-sectional surveys conducted to describe Indiana dentists and dental

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hygienists knowledge of fluoride's predominant mode of action and to describe fluoride practice protocols. The first survey was sent prior to the release of the CDC recommendations, and the second was sent 4 years after the release of the document. The purpose in sending the two surveys was to examine the differences in knowledge or practice protocols between the two time points. In order to assess how generalizable the results from the Indiana 2005 survey were, the survey was also distributed to a sample of Illinois dentists and hygienists.

Methods

This study was approved by the Institutional Review Board of Indiana University/Purdue University at Indianapolis. Funding was provided by the Indiana State Department of Health for the purpose of understanding Indiana dental professionals' knowledge about fluoride and to raise awareness of the appropriate use of fluoride in Indiana.

Survey Sample and Procedures. In 2000, prior to the release of the CDC's *Recommendations for Using Fluoride to Prevent and Control Dental Caries in the United States*, a survey questionnaire was designed and mailed with the purpose of determining the fluoride knowledge and protocols of dentists and dental hygienists licensed and practicing in Indiana. In 2005, 4 years following the release of the CDC recommendations, a second round of questionnaires were mailed to assess differences in knowledge and practice.

The cover letters accompanying the questionnaires were signed by the Director of Oral Health of the Indiana State Department of Health. The letters clearly stated that the responses were anonymous, with no means for identifying the source of the reply. The two-page questionnaires were designed to be read by optical scanners, thus eliminating the need for hand entry of the data. The questionnaire was reviewed by experts from the Indiana University School of Dentistry and the Indiana State Department of Health prior to distribution. The 2000 and 2005 questionnaires were identical, with one exception. In the 2005 questionnaire, fluoride varnish was added to the list of types of fluoride used in the office. Addresses of dentists and dental hygienists licensed in Indiana and listing an Indiana mailing address were obtained from the Indiana Professional Licensing Agency. In 2000, 3,492 dentists and 3,189 dental hygienists were mailed a questionnaire; in 2005, questionnaires were mailed to 3,062 dentists and 3,241 dental hygienists.

To estimate if fluoride use and knowledge traits were idiosyncratic to Indiana dental professionals, a 10 percent sample of Illinois dental professionals was surveyed in 2005. The Illinois sample included mailings to 800 dentists and 750 dental hygienists.

Measures. The survey addressed sociodemographic variables, including year of graduation from dental or dental hygiene school, gender, age, solo or group practice, and type of practice (general or specific specialty).

Use of fluoride was assessed by two questions. The first question asked about the types of patients (children or adults with and without active or recent caries) who receive professionally administered topical fluoride applications, with response options including *Always*, *Usually*, *Seldom*, *Never*, *Don't know*, or *N/A*. The second question asked which type of professionally administered fluoride was used most often [choices were *Acidulated phosphate fluoride (APF) or neutral sodium fluoride (NaF) gel in trays*, *Fluoride foam in trays*, *Fluoride rinse*, *Fluoride varnish*, *Don't know,* or *N/A*].

Knowledge of the concentration of fluoride in commonly used dental products was assessed by asking approximately how many parts per million fluoride were in dentifrice and in professionally applied APF gel (choices were *5-100*, *1,000*, *5,000*, *12,000*, *50,000 ppmF*, or *Don't know*).

Two questions related to continuing education – how long it had been since attending continuing education that included information about fluoride (choices were *Within the past year*, *During the past 2-5 years*, *More than 5 years*, *Never*), and through what mode of communication would they prefer to receive new information about the use of fluoride (choices were *Mail new information to my office*, *Publish information in the state dental journal*, *Offer information on a website*, *Offer continuing education classes in Indianapolis*, *Offer presentations at component dental society meetings*).

Finally, because accurate knowledge about fluoride's predominant posteruptive mode of action can be considered the basis for appropriate use of fluoride (7), respondents were asked to rank the importance of the three mechanisms of fluoride in caries prevention. For the Indiana surveys, the order of the three responses to the question about fluoride's mechanism of action was scrambled in order to avoid position bias. Choices were a) *frequent, low concentrations of fluoride in the mouth remineralize incipient lesions*; b) *fluoride ingested by drinking fluoridated water or consuming dietary fluoride supplements, incorporates into, and strengthens enamel while the tooth is developing*; and c) *intraoral fluoride interferes with bacterial metabolism.*

Data Analysis

Returned questionnaires were collected for 3 weeks and were examined for completeness and nonsensical responses. Data were scanned into a computer using TeleForm Workgroup™ version 7.

Chi-square tests were used to compare response rates between the Indiana 2000, 2005, and Illinois 2005 surveys. Chi-square and Fisher's exact tests were used to compare sociodemographic characteristics of dentists and hygienists between the Indiana 2000 and 2005 surveys, and between the 2005 Indiana and Illinois surveys. To assess differences in practice between the 2000 and 2005 Indiana surveys, Chi-square tests were used to compare the percent-

age of respondents who always or usually applied fluoride treatments. To analyze any differences in knowledge between the Indiana 2000 and 2005 surveys, separate univariate logistic regression models were used to test graduation year, professional status (dentist or hygienist), and history of attendance at a continuing education course for significant associations with correctly identifying fluoride's predominant mode of action. A graphical check was used to assure that the logit was linear in graduation year. These three variables were entered into a multivariable logistic regression model for each of the two Indiana surveys. Interactions were tested for inclusion and kept in the model if significant at the 0.05 level. SAS® version 9.1 was used for analyses.

Results

In 2000, 1,435 (41 percent) of Indiana dentists and 1,411 (44 percent) of hygienists completed and returned survey questionnaires. In 2005, 1,200 (39 percent) of Indiana dentists and 1,198 (37 percent) of Indiana dental hygienists responded to the survey (Table 1). The response rate in 2000 was significantly higher than in 2005 ($P \le 0.0001$). Of those responding in 2005, 771 (69 percent) of the Indiana dentists were in solo practice, the remainder were in practice with one or more additional dentists. In 2005, the median number of years Indiana dentists had been in practice was 24 years, whereas the median for Indiana dental hygienists was 17 years. The only demographic characteristic that was significantly different between the two Indiana surveys was the distribution of age ($P < 0.0001$). In the 2005 survey, there were significantly fewer younger dentists (age < 30) than in the 2000 survey. A similar result was found for dental hygienists.

Office Practice of Fluoride Use. Dentists and hygienists reported the frequency with which they apply high-concentration fluoride products to their adult and child patients, with or without recent dental caries. In 2005, (Table 2) 95

Table 1
Sociodemographic Characteristics of Survey Respondents

	2000			2005		
	Dentists $n = 1{,}435$ (%)	Hygienists $n = 1{,}411$ (%)	Combined $n = 2{,}846$ (%)	Dentists $n = 1{,}200$ (%)	Hygienists $n = 1{,}098$ (%)	Combined $n = 2{,}398$ (%)
Age						
<30	6	25	15	2	15	9
31-40	22	33	28	17	32	24
41-50	33	31	32	31	31	31
51-60	24	10	17	31	19	25
61-70	10	1	6	13	3	8
>70	4	0	2	5	0	3
Gender						
Male	85	1	43	83	1	41
Female	15	99	57	17	99	59
Solo or group practice						
Solo	70	59	64	69	63	66
Group	30	41	35	31	37	34
Last attended continuing education including information on fluoride						
<1-1 year	6	7	7	6	4	5
2-5 years	24	29	26	24	39	31
>5 years	47	37	42	50	40	45
Never	23	27	25	21	17	19
Year of graduation from dental/dental hygiene school						
<1950	1	0	0	0	0	0
1950-59	7	1	4	3	1	2
1960-69	15	6	11	12	4	8
1970-79	27	23	25	28	22	24
1980-89	30	29	29	33	26	29
1990-99	20	41	31	27	34	28
2000-05	0	0	0	2	12	8

Table 2
Responses to Questions Related to Knowledge and Use of Fluoride

How often do each of the following types of patients receive professionally applied topical fluoride applications in your office?

	Always (%)	Usually (%)	Seldom (%)	Never (%)	Don't know/ not applicable (%)
2000					
Dentists (n = 1,435)					
Children with active caries or a history of caries	78	11	2	2	7
Children without recent or active caries	57	28	5	3	8
Adults with recent or active caries	25	36	28	4	7
Adults without recent or active caries	11	21	35	26	7
Hygienists (n = 1,411)					
Children with active caries or a history of caries	91	7	0	0	2
Children without recent or active caries	77	18	2	1	2
Adults with recent or active caries	28	37	28	5	2
Adults without recent or active caries	14	23	31	30	3
Combined (n = 2,846)					
Children with active caries or a history of caries	84	9	1	1	5
Children without recent or active caries	67	23	4	2	5
Adults with recent or active caries	27	36	28	4	5
Adults without recent or active caries	12	22	33	28	5
2005					
Dentists (n = 1,200)					
Children with active caries or a history of caries	79	12	1	2	6
Children without recent or active caries	60	27	4	3	6
Adults with recent or active caries	27	34	27	5	7
Adults without recent or active caries	13	20	36	24	7
Hygienists (n = 1,198)					
Children with active caries or a history of caries	92	5	0	1	2
Children without recent or active caries	77	17	3	1	2
Adults with recent or active caries	26	39	28	4	3
Adults without recent or active caries	14	22	35	27	3
Combined (n = 2,398)					
Children with active caries or a history of caries	86	9	1	1	4
Children without recent or active caries	69	22	4	2	4
Adults with recent or active caries	26	36	28	5	5
Adults without recent or active caries	13	21	35	26	5

	2000			2005		
	Dentists n = 1,435 (%)	Hygienists n = 1,411 (%)	Combined n = 2,846 (%)	Dentists n = 1,200 (%)	Hygienists n = 1,198 (%)	Combined n = 2,398 (%)
In your office what type of professionally applied fluoride is used most often?						
Acidulated phosphate fluoride (APF) or neutral sodium fluoride gel in trays	43	36	40	37	34	35
Fluoride foam in trays	34	48	40	44	55	49
Fluoride rinse	16	14	15	11	9	10
Fluoride varnish (2005 only)	NA	NA	NA	2	1	2
Don't know/not applicable	7	3	5	6	1	4
If patients ask approximately how many parts per million fluoride (ppmF) would you say usually is in dentifrice?						
5-100	21	13	17	16	13	14
1,000 (correct)	22	18	20	31	31	31
5,000	2	2	2	3	3	3
12,000	1	1	1	2	1	1
50,000	1	0	0	1	0	0
Don't know	53	65	59	49	51	50

Table 2
Continued

	2000			2005		
	Dentists $n = 1,435$ (%)	Hygienists $n = 1,411$ (%)	Combined $n = 2,846$ (%)	Dentists $n = 1,200$ (%)	Hygienists $n = 1,198$ (%)	Combined $n = 2,398$ (%)
If patients ask approximately how many parts ppmF would you say is in professionally applied APF gel?						
5-100	8	4	6	5	2	3
1,000	9	7	8	7	8	7
5,000	12	7	10	17	14	15
12,000 (correct)	14	14	14	17	19	18
50,000	2	2	2	2	3	2
Don't know	55	65	60	52	55	53
Identify fluoride's most important mode of action in caries prevention. (Only valid responses summarized.)						
	Dentists $n = 1,262$ (%)	Hygienists $n = 1,196$ (%)	Combined $n = 2,461$ (%)	Dentists $n = 1,035$ (%)	Hygienists $n = 1,047$ (%)	Combined $n = 2,082$ (%)
Posteruptive (correct)	17	17	17	22	27	25
Preeruptive	79	80	79	73	68	71
Interferes with glycolysis	4	4	4	5	5	5

percent of Indiana respondents reported *Always* or *Usually* providing fluoride treatments for children with active caries, while 91 percent said they provide fluoride treatments for children without active caries; 62 percent reported they provide treatments for adults with active or recent caries; and 34 percent reported they provide treatments for adults without active or recent caries. The 2000 survey showed no significant difference in practices between 2000 and 2005.

Among 2000 and 2005 Indiana respondents, 79 and 76 percent, respectively, considered "recent caries" to have occurred within the past year; 21 and 23 percent within the past 2-5 years; and <1 percent of both sets of respondents within the past 6-10 years. Respondents were asked what type of professionally applied fluoride was most often used in their offices. In 2000 and 2005, among all Indiana respondents, 40 and 35 percent, respectively, reported using APF or NaF gel in trays; 40 and 49 percent used foam in trays; 15 and 10 percent used high-concentration fluoride rinse; and in 2005 2 percent reported using fluoride varnish. Fluoride varnish was not included as an option in the 2000 survey.

Knowledge of Fluoride Concentrations. In 2000 and 2005, respondents were asked to identify the approximate fluoride concentration of the professionally applied APF used in most offices for topical treatments: In 2000 and 2005, 14 percent versus 17 percent of dentists and 14 percent versus 19 percent of dental hygienists accurately identified the approximate concentration as 12,000 ppmF, with 53 percent of Indiana dental professionals reporting "*I don't know.*" Indiana dentists and dental hygienists were significantly more likely to answer correctly in 2005 than in 2000 ($P = 0.04$ and $P = 0.002$, respectively).

Less than one-third of Indiana dental professionals who responded to the questionnaire could accurately identify the approximate concentration of fluoride in dentifrice. Among all Indiana 2005 respondents, 31 percent correctly chose 1,000 ppmF. Indiana dentists and dental hygienists were significantly more likely to answer correctly in 2005 than in 2000 (20 percent) ($P < 0.0001$ for both comparisons).

Continuing Education. In 2005, 6 percent of Indiana dentists reported attending a preventive dentistry continuing education session within the past year; 24 percent during the past 2-5 years; 50 percent more than 5 years ago; and 21 percent never. The majority of respondents (83 percent) preferred to have new information about fluoride mailed to their offices, rather than published in journals (24 percent), published on the Web (25 percent), or presented at continuing education or dental association meetings (32 percent). There was no significant difference between preferences for receiving information among the 2000 and 2005 respondents.

Knowledge of Predominant Mode of Action of Fluoride. A large percentage of survey respondents in both Indiana surveys were unable to identify the predominant mode of action as "*frequent, low concentrations of fluoride in the mouth, remineralize incipient lesions*" (Table 2). Even though the percentage of respondents who correctly identified the predominant mode of action was significantly greater in the 2005 survey than in the 2000 survey, still only one-fourth of Indiana respondents (25 percent) in 2005 identified the predominant mechanism correctly. The most frequently cited incorrect response was "*strengthening teeth through preeruptive incorporation of fluoride*

Table 3
Odds Ratios for Correctly Identifying Fluoride's Mode of Action

Unadjusted odds ratios (from univariate logistic regression models)		
	OR	95% CI
Indiana 2000		
Graduation year	1.03	1.02, 1.04
DDS versus DH	1.30	0.84, 1.28
Continuing education*		
Within past 5 years	1.27	0.97, 1.66
More than 5 years ago	0.81	0.62, 1.06
Indiana 2005		
Graduation year	1.03	1.02, 1.04
DDS versus DH	0.78	0.64, 0.96
Continuing education*		
Within past 5 years	1.71	1.29, 2.27
More than 5 years ago	0.95	0.71, 1.27
Adjusted odds ratios (from multiple logistic regression models)		
	OR	95% CI
Indiana 2000		
Graduation year	1.03	1.01, 1.04
DDS versus DH	1.22	0.97, 1.53
Continuing education*		
Within the past 5 years	1.38	1.04, 1.82
More than 5 years ago	0.95	0.71, 1.28
Indiana 2005		
Graduation year for DDS	1.01	0.99, 1.03
Graduation year for DH	1.04	1.02, 1.05
Continuing education*		
Within the past 5 years	1.75	1.28, 2.40
More than 5 years ago	1.04	0.76, 1.44

* Never is the reference category.
OR, odds ratio; CI, confidence interval; DDS, Doctor of Dental Surgery (dentist); DH, Dental Hygienist (hygienist).

into enamel" (IN 2000, 79 percent; IN 2005, 71 percent; IL 2005, 82 percent). Few respondents incorrectly identified "*intraoral fluoride interferes with bacterial metabolism*" as the most important mechanism of action (2000, 4 percent; 2005, 5 percent).

Univariate logistic models for both the 2000 and 2005 Indiana surveys showed that the odds of identifying fluorides' predominant mechanism of action increased significantly as year of graduation became more recent (Table 3). The Indiana 2000 survey showed that the odds of identifying fluoride's most important mode of action were no different between dentists and hygienists; however, the Indiana 2005 survey showed that the odds for hygienists answering correctly were significantly greater than those for dentists. The 2000 survey showed that continuing education had no significant effect, while the 2005 survey showed that the odds significantly increased if the subject had attended a continuing education course within the past 5 years.

The multivariable logistic regression model for the 2000 survey showed similar results to the univariate results, except that in this second model, attending a continuing education class within the past 5 years significantly increased the odds of correctly identifying fluoride's most important mode of action. The multivariable model for the 2005 survey revealed that there was a significant interaction between professional status and year of graduation. For example, of respondents who graduated in 1973, dentists were 39 percent more likely than hygienists to correctly prioritize the most important mode of action. Odds ratios for 1983 graduates showed that dentists were 9 percent more likely than hygienists to correctly prioritize the most important mode of action. As graduation year became more recent, the odds ratio of dentists to hygienists became less than one, meaning that more recently graduated dentists are now less likely than hygienists who graduated in the same year to correctly identify fluoride's most important mode of action. It should be noted that conditioned on any particular year of graduation, this difference was not statistically significant. It was striking to note that respondents who correctly identified remineralization as fluoride's predominant mode of action were not significantly more likely to provide fluoride for adults who were at moderate or high risk of dental caries.

Discussion

To estimate if fluoride use and knowledge were idiosyncratic to Indiana dental professionals, a 10 percent sample of Illinois dental professionals ($n = 1{,}550$) was surveyed in 2005. The Illinois response included 460 dentists and dental hygienists (30 percent). The results confirmed that knowledge gaps regarding fluoride are not limited to Indiana dental professionals. Indiana respondents were significantly more likely than Illinois respondents to provide topical fluoride for adults, correctly identify the fluoride concentration of APF and dentifrice and respond that posteruptive remineralization is fluoride's predominant mode of action. There are several important findings in this survey. Our main findings are a) that in 2005, 4 years following the release of the CDC's sentinel recommendations, a considerable proportion of dental professionals in Indiana still did not understand fluoride's predominant mode of action.

Understanding the mechanism of action of therapeutic agents should

be an important component in making informed decisions about treatment modalities. If practitioners believe that the most important mode of action of fluoride is remineralization and prevention of demineralization, it would follow that they would provide high concentration fluoride to the permanent teeth of adults at moderate or high risk of caries. b) This study showed that there was no significant relationship between individual respondents correctly identifying fluoride's predominant mode of action and more frequently providing fluoride for adults at moderate or high risk for dental caries. c) Another important finding was the inability of respondents to correctly identify the concentration of commonly used fluoride products. This result may point to a flaw in the way fluoride products are labeled. Product descriptions such as 0.4 percent SnF_2 gel, 0.2 percent NaF mouthrinse, and 0.76 percent Na_2FPO_3 toothpaste do not clearly notify users that the products actually contain virtually the same concentration of approximately 1,000 ppmF. Labeling fluoride-containing products with the formulation, as well as the ppmF, would encourage broader understanding among dental professionals and the public.

Although the high-concentration fluoride products most commonly used in Indiana dental offices were 1.23 percent APF gel and foam, fluoride varnish is beginning to be used by a small proportion of practitioners. The American Dental Association (ADA) Seal of Approval for caries control and prevention is limited to APF gel and foam. High-concentration fluoride mouthrinse solutions are not only unendorsed, but, because they cannot be used with a saliva ejector, also carry a higher risk of being accidentally swallowed. Fluoride varnish has not yet been approved by the US Food and Drug Administration for use in caries prevention, but the CDC recommendations reference Wakeen (8) stating, "A prescribing practitioner can use fluoride varnish for caries prevention as an 'off-label' use, based on professional judgment," and in May 2006 the ADA released recommendations for professionally applied topical fluoride that endorsed the use of fluoride varnish, especially for children under 6 years of age who are at moderate or high caries risk (9).

Our findings revealed that several variables were associated with knowing the predominant mode of action of fluoride. The likelihood of answering correctly increased with more recent graduation and with recent attendance of continuing education courses focused on appropriate fluoride utilization. In the years between 2001 and 2005, six such continuing education programs were presented at various locations in Indiana; they were attended primarily by dental hygienists. Many dental professionals, as seen in the 2005 survey, preferred mailings as the means of disseminating relevant information (83 percent), while only 6 percent wanted to attend continuing education opportunities. Additional studies to establish the most effective and culturally appropriate means of improving dental professionals' knowledge and office practices are needed. It would be useful to determine where dental professionals learn the majority of their preventive information, to enable targeting information to the most utilized forms of educational opportunities. Additional efforts should be made to recruit responses from younger dentists in order to assess information trends along the continuum of age groups.

Study Limitations

This study represents two cross-sections of dental practice. Because of the anonymous nature of the survey it was not possible to link individual data in a paired design that would allow examining an individual's change in knowledge and its influence on practice. The study also did not allow linking the dentists' responses to knowledge and practice protocols with the dental hygienists who work under their supervision. Additionally, there may be reasons, other than those studied, as to why more adults, especially those at moderate or high risk of dental caries, are not receiving fluoride treatments in dental offices. For example, many dental insurance policies do not cover fluoride treatments for adults, adults may choose to refuse fluoride treatments because of objectionable taste, or dentists may be responding to adults' fluoride needs by prescribing fluoride gels that have higher concentration than over-the-counter dentifrice to be used at home on a daily basis.

Recommendations and Conclusions

Health care workers are expected to be knowledgeable about therapeutic agents that are commonly used in their professions. Fluoride used for the prevention and control of dental caries is one of those agents. Findings from this geographically limited study suggested that steps should be taken to ascertain if there is a lack of understanding among dental professionals throughout the United States about fluoride's predominant mode of action. If so, efforts should be made to enhance practitioners' understanding of fluoride's mechanisms of action and its appropriate use for the prevention of dental caries. The results of this study suggest that certain educational intervention modalities could improve practitioners' knowledge about fluoride and influence their decisions to use fluoride appropriately for adults as well as children. While we may only speculate about strategies to fulfill these research and educational needs, we propose three basic components: a) determine the barriers to using in-office fluoride treatments for moderate and high-risk adults despite the professional's accurate knowledge of fluoride's ability to remineralize incipient lesions; b) promote the concept that the task of continuing education about preventive modalities should be undertaken by bodies that command respect across the professions, such as professional dental and dental hygiene associations, public health agencies,

dental research organizations, and/or dental educational institutions; and c) utilize the preferred dissemination channels, as stated by many of the respondents. Many who responded indicated that they prefer to receive information in the mail: brief, well-targeted updates, periodically mailed to practitioners by public health agencies, may be an effective method for communicating new information about the appropriate use of fluoride and other essential treatment protocols. Taking into consideration the need to emphasize key messages derived from the CDC report, a succinct monograph document mailed to each member of the dental profession could impact practitioners' knowledge base and clinical practices. More accurate understanding of these phenomena will enable dental professionals to make appropriate decisions about the effective use of fluoride based on the risk of dental caries and the risk of enamel fluorosis.

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