ABSTRACT

Title of Thesis: WHAT MARYLAND DENTISTS KNOW AND DO ABOUT PREVENTING DENTAL CARIES

Go Matsuo, MPH, 2013

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Statement of the problem: Dental caries is the most prevalent disease of US children. Yet, we have known for decades how to prevent it and most adults consider dentists their source of dental information. The purpose of this study was to determine dentist's knowledge, opinions and practices regarding caries prevention. **Methods:** A mail survey was used to determine dentists' knowledge, opinions and practices regarding caries prevention. Frequency distributions, bivariate and multivariate analysis were conducted. **Results:** The majority of respondents were white, male in private practice. Their knowledge of caries prevention was modest. Their understanding of how fluoride works, appropriate methods of application of fluorides, and duration of professional fluoride applications was poor. **Conclusions:** Dentists' lack of understanding of dental caries prevention impacts not only their clinical decision-making but also what they tell their patients. These results suggest strongly the need for improved education for dental students and those already in practice.

WHAT MARYLAND DENTISTS KNOW AND DO ABOUT PREVENTING DENTAL CARIES

By

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Chapter 1 Introduction

Problem statement

Dental caries is the most prevalent disease of US children. However, many people especially those with higher rates of dental caries prevalence do not understand the process of dental caries and how to prevent this disease using fluorides and dental sealants. Because most people consider their dentist as their source of dental information (O'Neill, 1984; HHS, 2000; IOM, 2011; Melbye and Armfield, 2013), it is important to know what dentists know and do and how they educate their patients about preventing caries.

Overview of the problem

According to reports, there seems to be a lack of knowledge about fluoride and fluoride use among dentists and dental hygienists. Gaskin, Levy, Guzman-Armstrong, Dawson and Chalmers (2010) investigated the knowledge, attitudes, and behaviors of dentists concerning minimal intervention dentistry. In this study, they reported that most of the dentists (96.7%) believed that fluoride was an effective remineralizing agent. However, when responding to the question “How often do you remineralize noncavitated lesions”, 32.2% of dentists chose “sometimes” and 27.5% of dentists chose “Never or Rarely”. Chan, Warren and Henson (1996) reported that only one of 101 dental offices offered American Dental Association (ADA) approved professional fluoride products and techniques (4 minute application). Other dentists applied fluoride products for less than 4 minutes and/or used the

products with lower concentrations than approved by ADA. According to Warren, Henson and Chan (1998), in their study, only one office out of 38 pediatric dentists used both ADA-approved professional fluoride products and techniques. Narendran, Chan, Turner, and Keene (2006) reported that less than 15% of dentists (general and pediatric dentists) could correctly identify the correct age of beginning (six months) and discontinuing (sixteen years) fluoride supplements.

In a study investigating the knowledge and practices of dental hygienists nationwide, although 95.5% of dental hygienists reported that community water fluoridation was very effective/effective and almost 95% recognized the value of pit and fissure sealant, only 58% of them correctly agreed that remineralization is the most important mechanism of fluoride, and 93% incorrectly believed that the most important mechanism of action of fluoride is to be incorporated into developing teeth to make them more resistant to acid demineralization. Additionally, only 39.5% believed that the dilute frequently administered fluorides are more effective in caries prevention than more concentrated, less frequently administered fluorides. Although most dental hygienists agree that "adults benefit from the use of fluorides", they most often chose "Flossing" as the most effective countermeasure in preventing caries in adults. There is no evidence that flossing prevents tooth decay. Similarly to the previous study, the percentages of dental hygienists who were providing a four-minute fluoride application was very low: 18.3% for APF gel, 10.7% for APF foam, 32.5% for NaF gel, 10.6% for SnF_2 (Forrest, Horowitz and Yochi, 2000).

Yoder, Maupome, Ofner and Swigonski (2007) also investigated the knowledge of dentists and dental hygienists in Indiana in 2000 and 2005, before and

after CDC's *Recommendations for Using Fluoride to Prevent and Control Dental Caries in the United States* published in 2001. According to the outcome, only 25 percent of respondents correctly identified the predominant mode of action of fluoride, even though the percentage was significantly greater in 2005 (17 percent versus 25 percent). Additionally, according to the national survey , dentists in the U.S. still have a preference of treatment approach rather than observational and prevention approach, for non-cavitated carious lesions (Tellez, Lauren Gray, Sarah Gray, Sungwoo and Ismail. 2011).

Autio-Gold and Tomar (2008) investigated third-year and fourth-year dental students' opinions and knowledge about caries management and prevention. In this study, 40% of students were not sure whether fluoride varnishes have no associated dental or medical risks, and 16% of students believed that there were some risks. About one-third (37.6%) students were not sure whether fluoride varnishes stain teeth permanently, and 5% believed it did. Furthermore, 30% of students reported that they would not use fluoride varnishes regularly for pediatric patients younger than 5 years. Many students agreed (29.4%) or were not sure (8.8%) with the statement that "most incipient enamel lesions will progress into cavities".

Clovis, Horowitz, Kleinman, Wang and Massey (2012) investigated the knowledge and practices of dental hygienists in Maryland. About 33% of subjects disagreed or did not know that "the most important mechanism of action of fluoride is the remineralization of incipient decay". Over 70% (71%) disagreed or did not know that "dilute, frequently administered fluorides are more effective in caries prevention than more concentrated, less frequently administered fluorides". Many of them

believed incorrectly that toothbrushing without fluoride dentifrices is either somewhat or very effective for prevention of dental caries. Only about two-thirds (64%) believed that dental sealants were very effective for ages 3 to 6. Additionally, many of them believed that professional prophylaxis (55.5%), routine dental care (73.4%), nutritional counseling (66.2%), and infrequent sugar consumption (75%) were very effective for caries prevention for the children 3 to 6 years. Over half (56%) said they do not provide any fluoride treatments to children aged 6 months to 2 years.

According to the literature, oral health care providers do not understand about preventive methods of dental caries (Gaskin, Levy, Guzman-Armstrong, Dawson and Chalmers, 2010; Chan, Warren and Henson, 1996; Narendran, Chan, Turner, and Keene, 2006; Forrest, Horowitz and Yochi, 2000; Yoder, Maupome, Ofner and Swigonski, 2007; Clovis, Horowitz, Kleinman, Wang and Massey, 2012; Tellez et.al. 2011). Therefore, it is very important to know the preventive knowledge and practices of dentists in Maryland.

Definition of variables and/or terms

Dental caries

Dental caries (tooth decay) is one of the most common diseases in humans. It causes pain and disability and also leads to infection, tooth loss, edentulism and even death (Norman, Franklin, Christine, 2008; Vargas, Casper, Altema-Johnson, and Kolasny, 2012). Dental caries is a multifactorial disease; these factors include a susceptible tooth and host, cariogenic microorganisms, substrate (such as refined carbohydrates), and time. Tooth enamel is constantly

experiencing a process of demineralization and remineralization. Acids produced by cariogenic bacteria cause demineralization（dissolves tooth minerals）. Remineralization is the repair or healing of the enamel. Cavitation can occur when demineralization exceeds remineralization over a period of time (Norman, Franklin, Christine, 2008)

Early Childhood Caries (ECC)

ECC is defined as one or more decayed, missing (due to caries), or filled tooth surfaces in any primary teeth in a pre-school aged child between birth and 71 months of age (Norman, Franklin, Christine, 2008).

Risk Assessment for dental caries

Dentists should conduct a risk assessment for dental caries for each patient. According to the American Academy of Pediatric Dentistry caries risk assessment is "the determination of the likelihood of the incidence of caries during a certain time period or the likelihood that there will be a change in the size or activity of lesions already present" (AAPD, 2011b). Since caries occurs through a complex interaction of multiple factors, caries risk assessment is difficult. Many methods for caries risk assessment exist, and there is no single predominant method at present (CDC, 2001b). A population will be at high risk, for example if they are in a community without water fluoridation, with low socioeconomic status, have low levels of parental education, or don't have dental insurance or access to dental services (CDC, 2001b). Individuals will be at high

risk, for example if they have active dental caries, poor family dental health, high level of infection with cariogenic bacteria, poor oral hygiene reduced salivary flow, restorations with overhangs and open margins, (CDC, 2001b: ADA, 2006). If children and adults are at low risk for dental caries, they can maintain that status through frequent exposure to small amounts of fluoride, such as consuming community water fluoridation and using fluoride toothpaste. However, if children and adults are at high risk, additional exposure to fluoride and dental sealants are needed (CDC, 2001b: Beauchamp et.al, 2008). Because the risk factors and the community of individuals are able to exist on a continuum or change over time due to changes in habits, oral micro flora, or physical condition, caries risk should be re-evaluated periodically (CDC, 2001b; ADA, 2006; AAPD, 2011d).

How fluoride works

"Fluoride protects teeth in two ways: systemically and topically" (American Dental Association, 2005). Systemic fluorides include those intended to be ingested. Those ingested fluorides are incorporated into tooth structures during tooth formation prior to eruption. This fluoride converts hydroxyapatite into fluorapatite and makes the tooth more resistant to decay (ADA, 2005; Norman, Franklin, Christine, 2008). Topical fluoride action is provided by fluoride in the plaque and saliva, which enhances remineralization, besides reformed enamel crystal contains more fluoride and has more acid resistance. Additionally, fluoride in plaque reduces the acid production of dental-plaque

organisms (Norman, Franklin, Christine, 2008). Today, it is accepted that the systemic effect is less effective than the topical effect, however there is evidence of a systemic effect (Norman, Franklin, Christine, 2008; Newbrun, 2004; Singh, Spencer and Armfield, 2003; Singh and Spencer, 2004). Frequent exposure to small amounts of fluoride each day will maximize the effect of caries risk reduction (CDC, 2001b).

Methods of application of fluoride

Sources of systemic fluoride used in the United States include fluoridated water, dietary fluoride supplements in the form of tablets or drops and fluoride present in foods and beverages. Sources of topical fluorides, which are not intended to be ingested, include toothpastes, mouth rinses and professionally applied fluoride foams, gels and varnishes (ADA, 2005).

Community Water Fluoridation

Virtually all water contains some level of fluoride which naturally occurs (Norman, Franklin, Christine, 2008). According to ADA, community water fluoridation is “the adjustment of the natural fluoride concentration in water up to the level recommended for optimal dental health (a range of 0.7 to 1.2ppm).” In 1945 Grand Rapids, Michigan, became the world’s first city of adjusted community water fluoridation (ADA, 2005). According to CDC, in 2010, more than 204 million people in the U.S have access to use community water fluoridation. In Maryland, in 2009, 93.1% of the people who have community

water supplies that are optimally fluoridated (Altema-Johnson, 2010). Community water fluoridation reduces dental caries through two ways: systemically and topically (ADA, 2005; Norman, Franklin, Christine, 2008). Additionally, with the community water fluoridation, teeth are exposed to fluoride throughout the day, not just a couple of the times when people brush their teeth (Norman, Franklin, Christine, 2008), and not just at the times people receive professional topical fluoride application at specific teeth. Therefore, the plaque and saliva receive a replenishing of dilute solutions of fluoride on a regular basis, which contributes to caries prevention (Norman, Franklin, Christine, 2008). Water is an efficient vehicle for delivering a low concentration of fluoride at high frequency; throughout the day (Kumar and Moss, 2008).

Dietary Fluoride Supplement

Dietary fluoride supplements, in the form of tablets or drops, are intended to compensate for fluoride-deficient drinking water. Most supplements contain sodium fluoride (CDC, 2001b). To maximize the topical effect, supplements should be chewed or sucked for 1-2 minutes before being swallowed (CDC, 2001b; Rozier et al, 2010). The systemic effect of fluoride supplements is inconsistent, and research reports indicate that supplements taken after teeth erupt reduce caries experience. Some studies reported a clear association of fluoride supplements used by children age less than 6 years and enamel fluorosis (CDC, 2001b). Because of dental fluorosis, ADA confirmed that fluoride supplements should be prescribed only for children at high risk for dental caries

and whose primary source of drinking water is deficient in fluoride (Rozier et al, 2010; AAPD, 2011a). The balance of risk for dental caries and risk for dental fluorosis should be reasonably judged. The medical provider should evaluate the compliance of parents or caregiver and the patients (Rozier et al, 2010). ADA provided the recommended supplemental dosing schedule for children at high risk for dental caries (Rozier et al, 2010).

Topical Fluoride (fluoride toothpaste, fluoride mouthrinse, fluoride gel and foam, fluoride varnish)

Fluoride toothpaste

Fluoride toothpaste accounted for more than 90% of the toothpaste market in the United States (CDC, 2001b). In the United States, the standard concentration of fluoride in fluoride toothpaste is 1,000-1,100ppm (CDC, 2001b). Brushing twice a day is a reasonable recommendation (CDC, 2001b). Swallowing fluoride toothpaste by young children can put young children at risk for enamel flurorosis. Thus, children less than 6 years of age should be monitored when brushing their teeth with fluoride toothpaste (CDC, 2001b). To help prevent children from swallowing too much fluoride toothpaste, it is recommended that only a “smear”(approximately 0.1mg fluoride) of toothpaste be used for children under 2 years, and a “pea-size”(approximately 0.2mg fluoride) amount of toothpaste for children 2-6 years (MCHB, 2007; AAPD, 2011c).

Fluoride mouthrinse

Fluoride mouthrinse is a concentrated solution for rinsing with daily or weekly. The most common fluoride compound used in mouthrinse is sodium fluoride. Solution of 0.05% sodium fluoride (230 ppm fluoride) for daily rinsing for person aged more than 6 years, or a solution of 0.2% sodium fluoride (920 ppm fluoride) for supervised school-based weekly rinsing program are available (CDC, 2001b). School-based fluoride mouthrinse programs are now targeted to high-risk schools in nonfluoridated areas and not recommended for preschool children in the United States because of children's inability to control the swallowing reflex (Kumar and Moss, 2008; MCHB, 2007).

Fluoride gel and foam

Fluoride gel and foam includes gel of acidulated phosphate fluoride (1.23% [12.300ppm] fluoride), gel or foam of sodium fluoride (0.9%[9,050ppm] fluoride), and self-applied gel of sodium fluoride (0.5%[5,000ppm] fluoride) or stannous fluoride (0.15%[1,000ppm] fluoride) (CDC, 2001b; ADA, 2006). The recommended time for each application is 4 minutes (CDC, 2001b; ADA, 2006；Newbrun, 2001) and the frequency is semiannual (CDC, 2001b). Because the application is infrequent, even among patients less than 6 years, the risk for enamel fluorosis is little (CDC, 2001b), however, ADA and MCHB do not recommend the use of fluoride gel or foam to children under 6 years (ADA, 2006; MCHB, 2007). Foam is commonly used in dental practice, but the evidence of its effectiveness of reducing dental caries is not as strong as that for

fluoride gel and varnish (ADA, 2006).

Fluoride varnish

Fluoride varnish holds a high concentration of fluoride in close contact with the teeth for many hours (CDC, 2001b). Fluoride varnishes are available as sodium fluoride (2.26%[22,600ppm] fluoride) (CDC, 2001b; ADA, 2006). There is no known risk for fluorosis using professionally applied fluoride varnish. (CDC, 2001b). The recommended frequency of application is once per 3 to 6 month (Kumar and Moss, 2008; ADA, 2006; MCHB, 2007). Fluoride varnish application requires less time, creates less patient discomfort and has great acceptability from patients than fluoride gel, especially in infants and preschool-aged children (ADA, 2006). MCHB (2007) recommends applying fluoride varnish every 3 to 6 months for the children at risk of dental caries under 2 years and children 2 to 6 years. ADA (2006) also recommends applying fluoride varnish at 6 months interval if the children under 6 years are at moderate caries risk, and to apply at 3 or 6-month intervals if the children under 6years are at high risk. For the children under 6 years, fluoride mouth rinse, gel or foam is not recommended (ADA, 2006; MCHB, 2007).

Figure 1: Range of therapeutic fluoride concentrations used to prevent caries

Method/vehicle	Fluoride concentration (ppm F)
Water supplies	0.7-1.2
Fluoridated salt	200-250
Mouthrinse, daily	230
Dentifrices, children	250-500
Mouthrinse, weekly	920
Dentifrices, adult	1,000-1,500
Self-applied gels or rinses, prescription	5,000
Professionally applied solutions (NaF)	9,200
Professionally applied solutions, gels, foams (APF)	12,300
Professionally applied solutions (SnF_2)	19,500
Professionally applied varnishes	22,600

(Newbrun, 2001).

Pit-and-fissure sealants

Pit-and-fissure sealants are thin plastic coatings applied to the pits and fissures (tiny grooves) on the chewing surfaces of the posterior (back) teeth (CDC, 2011). Sealants protect the chewing surfaces from decay by “providing a physical barrier that inhibits microorganisms and food particles from collecting in pits and fissure” (Beauchamp et.al, 2008).

Although there is not a single system to detect the caries risk and it is necessary to continue to reevaluate caries risk because of the changeability of risk, American Dental Association strongly recommends the placement of sealant to children’s, adolescent’s and adult’s permanent teeth if they are at risk of developing dental caries (Beauchamp et.al, 2008). CDC also recommended the effectiveness of school-based sealant programs (Gooch, 2009; CDC, 2001a; Truman, 2002). Sealants should be applied soon after eruption for the first permanent molars, 6 to 7 years of age (second grade), and again 11 to 13 (sixth grade) for the second permanent molars and premolars (Norman, Franklin, Christine, 2008). Using dental sealants on non-cavitated caries in permanent teeth is effective in reducing caries progression (Griffin et.al., 2008).

Other strategies (Xylitol, antibacterial agents, Dietary modification, Plaque control)

Xylitol

Xylitol is a sugar substitute. Xylitol has been shown to reduce the levels of *mutans streptococci* (MS) in plaque and saliva, and also reduce the level of acid produced by these bacteria (Ly, Milgrom, and Rothen, 2006). However, not all studies confirm a mutans-reducting effect (Van Loveren, 2004). Because plaque pH will not drop and chewing action stimulates saliva flow, it may enhance the remineralization (Burt, 2006; Van Loveren, 2004). An undesirable side effect (osmotic diarrhea) occurs when it is consumed 4 to 5 times the quantity needed for the prevention of dental caries (Ly, Milgrom, and Rothen, 2006). The effective daily xylitol dose is 6 to 10g, and effective frequency of consumption is 3 to 5 times per day, although the labeling of xylitol products are confusing, which leads consumers to misunderstand the total amount of xylitol they are consuming (Ly, Milgrom, and Rothen, 2006). The restriction of maternal transmission of MS to their infants is well documented (Ly, Milgrom, and Rothen, 2006; Burt, 2006). Although Xylitol has had some positive effects, dentists should stress that it is a supplemental practice, and it is not a substitution for a preventive dental regimes including fluoride (Burt, 2006).

Antibacterial agents

Although Chlorhexidine suppresses the MS, the effect on dental caries

development has generally been scanty for ECC (Twetman, 2008) and moderate for permanent teeth (NIH, 2001). However there is good evidence as an adjunct to self-care of the prevention of gingivitis (Ismail and Lewis, 1993). A solution of 10% povidone iodine is also may have effect to prevent ECC, but the allergy to iodine is not uncommon (Twetman, 2008). More research is needed to support using them at regular practice (Twetman, 2008; NIH, 2001; Milgrom, Zero and Tanzer, 2009).

Dietary modification

Sugar is a favored substrate for the cariogenic bacteria, particularly MS and by-products acid of the metabolic process induces demineralization (early caries) of the enamel surface. However, at a time when fluoride exposure is so widespread, in the form of community water fluoridation, fluoride toothpaste, professional fluoride application, sugar consumption is a moderate-to-mild risk factor for caries in most people and it is not as strong as in the pre-fluoride era (Burt and Pai, 2001). Although it is still one of the important factors to access an individual's risk for dental caries (AAPD, 2011d), unfortunately the effect of dietary modification or behavioral interventions, such as altering the pattern of consumption of sucrose containing foods and drinks, on caries reduction is not clear yet (NIH, 2001; Kay and Locker, 1998; Gussy, Waters, Walsh and Kilpatrick, 2006).

Plaque control

The common sense argument that dental plaque removal lowers caries risk is not supported by clinical trials. Therefore mutans streptococci (MS) may not be able to be controlled by mechanical plaque removal (Hujoel, Cunha-Cruz, Banting and Loesche, 2006; Horowitz et al, 2012). However, there is good evidence to support toothbrushing and flossing to prevent gingivitis in adults and only toothbrushing in children (Ismail and Lewis, 1993).

- *Tooth Brushing*

Although supervised brushing with fluoride toothpaste is effective to prevent ECC (Twetman, 2008), according to Horowitz et.al (1980), in their school-based intervention of children in grade 5-8, the effects of supervised brushing with fluoride-free toothpaste were improvement of oral plaque scores (only girls of intervention group) and gingivitis score (boys and girls of intervention group), but there was no difference between the intervention group and control group regarding dental caries. Tooth brushing programs could reduce dental caries if fluoride toothpaste is used, but evidence is not enough to support that toothbrush itself can prevent or control dental caries (Kay and Locker, 1998).

- *Flossing*

According to the systematic review conducted by Hujoel, Cunha-Cruz, Banting and Loesche (2006), although professional flossing in children with low fluoride exposures is effective on the reduction of interproximal caries risk, self-flossing has failed to show positive effects.

Healthy People 2020

Health People 2020 contains a 10-year national set of objectives for improving the health of all Americans. They have four overarching goals and 38-focus areas (HHS, 2012 a). One of the focus areas is oral health. One of the Objectives is: “Reduce the proportion of children and adolescents who have dental caries experience in their primary or permanent teeth” (OH-1), “Reduce the proportion of children and adolescents with untreated dental decay” (OH-2), “Increase the proportion of low-income children and adolescents who received any preventive dental services during the past year” (OH-8), “increase the proportion of children and adolescents who have received dental sealants on their molar teeth”(OH-12) and “Increase the proportion of the U.S. population served by community water systems with optimally fluoridated water” (OH-13). Health communication and health information technology is another focus area related to this thesis. This objective is: “increase the proportion of patients whose doctor recommends personalized health information resources to help them manage their health” (HC/HIT-3) is one of objects in that area (HHS, 2012 c).

The New Oral Health Initiative (NOHI)

IOM (2011) proposed the New Oral Health Initiative (NOHI) to DHHS for helping to move the nation toward achieving the goals and objectives set by the Healthy People 2020. The committee of the IOM developed seven recommendations, which includes focusing on prevention and improving oral health literacy.

Bottled water

Although the effects of consumption of bottled water (most contain below 0.3ppm of fluoride) is assumed to be negative for fluoride intake, whether this is clinically significant is not known (Newbrun, 2010). However, the ADA has given warning of the possibility of missing the benefit of prevention of dental caries by consuming bottled water (ADA, 2003).

Research Question (RQ)

RQ1: What do dentists know and practice about preventing dental caries?

Fluoride Knowledge

Do dentists have current scientific knowledge about fluoride?

Do dentists have knowledge of fluoride effectiveness for children of each age range?

a. *Knowledge about community water fluoridation, dietary fluoride drops/tablets, fluoride dentifrices and fluoride varnish for the children ages 6 months to 2 years*

b. *Knowledge about community water fluoridation, dietary fluoride drops/tablets, fluoride dentifrices, fluoride varnish, topical fluorides-professional, fluoride rinse-at home, fluoride rinse-at school, brush-on fluoride gels, fluoride gel in mouth tray and fluoride foam for the children ages 3 to 6 years*

c. *Knowledge about community water fluoridation, dietary fluoride*

drops/tablets, fluoride dentifrices, fluoride varnish, topical fluorides-professional, fluoride rinse-at home, fluoride rinse-at school, brush-on fluoride gels, fluoride gel in mouth tray and fluoride foam for the children ages 7 to 20 years.

Do dentists have general knowledge about fluoride?

Fluoride Practice

Do dentists apply fluoride appropriately?

Priority of dental caries prevention methods

What kind of dental caries prevention methods do dentists believe are the most and second most effective for children of each age range?

a. *For children 6 months to 2 years.*
b. *For children 3 to 6 years.*
c. *For children 7 to 20 years.*

Dental Sealant Knowledge

Do dentists have correct knowledge about dental sealants?

Do dentists have knowledge of dental sealant effectiveness for children of each age range?

a. *Knowledge about dental sealants used for children ages 3 to 6 years.*
b. *Knowledge about dental sealants used for the children ages 7 to 20 years.*

Do dentists have general knowledge about dental sealants

Dental Sealants Practice

How many dentists are using dental sealants?

What percent of children under 20 years receive dental sealants?

What is the reason why dentists do not provide dental sealants?

RQ2: Do dentists educate patients about caries prevention?

Are they providing information about fluoride for home use?

Do they provide caries preventive education?

For each age group, are they providing necessary information about fluoride and dental sealants?

a. *Education about fluoride drops/tablets, community water fluoridation, mechanism of fluoride action, use of fluoride dentifrice and home fluoride rinses for children ages 6 months to 2 years.*
b. *Education about home fluoride gels, fluoride drops/tablets, community water fluoridation, mechanism of fluoride action, pit and fissure sealants, use of fluoride dentifrice and home fluoride rinses for children ages 3 to 6 years.*
c. *Education about home fluoride gels, fluoride drops/tablets, community water fluoridation, mechanism of fluoride action, pit and fissure sealants, use of fluoride dentifrice and home fluoride rinses for children ages 7 to 20 years.*

RQ 3: Are dentists' characteristics associated with their knowledge and practices?

Chapter 2 Literature review

Prevalence of dental caries in the United States and Maryland

The prevalence of dental caries (treated and untreated dental decay) in the United States is high (Dye et.al, 2007; Department of Health and Human Services, 2000), although according to Dye et.al (2007), between 1988-1994 and 1999-2004, oral health improved for most Americans. In children and youth (2-11years), the prevalence of dental caries in primary teeth was 42% (the contribution of filled surfaces to the number of decayed and filled surfaces was 52.5%) and in permanent teeth (6-11 years) is 21% (the contribution of filled surfaces to the number of decayed, missing and filled surfaces was 66%). In adolescents (12-19 years), the prevalence in permanent teeth was 59% (the contribution of filled surfaces to the number of decayed, missing and filled surfaces was 75.7%). In adults (20-64 years), the prevalence of dental coronal caries was 92% (the contribution of filled surfaces to the number of decayed and filled surfaces is 86.8%) and root caries was 14%. In seniors (65 years and older), the prevalence of coronal caries was about 93% (the contribution of filled surfaces to the number of decayed and filled surfaces is 91.8%) and root caries was 36% (Dye et.al, 2007).

Additionally the prevalence of dental caries in the primary dentition of children ages 2-5 years increased from 1988-1994 to 1999-2004, although dental caries continued to decrease in the permanent dentition for youths (6-11 years), adolescents (12-19 years). This increase is due to a greater number of dental surface restorations not by untreated decay (Dye et.al, 2007). Dye and Thornton-Evans (2010) also

analyzed the same data by income level and race/ethnicity within *Healthy People's* object age range, and found a different trend. One of their findings was, within the age range of 2-4 years, non-poor (≥200% Federal Poverty Level [FPL]) boys experienced the largest percentage increase of caries prevalence, but not for girls or children living at ≤100% of FPL or near-poor (100%-199% FPL) level. Among non-poor boys of 2-4 years and 6-8 years, untreated caries significantly increased. Further, non-Hispanic white children 2-4 years of age experienced a significant increase of caries prevalence, but non-Hispanic black or Mexican American children did not. These same groups also experienced a significant increase of untreated caries.

According to Tomar and Reeves (2009), there are oral health disparities among certain racial and economic groups of children. For example, among children ages 6-8 years, the prevalence of dental caries among non-Hispanic white children is 49%, unchanged between 1988-1994 and 1999-2004. Among non-Hispanic black children, it increased from 49.9% to 56.1%, and among Mexican American children, it increased from 63.8% to 68.5%. Additionally, children living in or near poverty had more dental caries prevalence than among those living 200% above the federal poverty level.

According to the *Survey of the oral health status of Maryland school children 2005-2006* (Manski, Chen, Chenette, and Coller, 2007) and in The Burden of Oral Diseases in Maryland (Altema-Johonson, 2010), about 31% of public school children in Kindergarden (5 and 6 years) and Grade 3 (8 and 9 years old) had at least one caries lesion. Almost 30% (29.7%) of 3rd graders and 32.6% of Kindergartners had untreated tooth decay. Additionally, there were geographic, racial, and educational

disparities of prevalence of untreated dental caries.

Prevention of dental caries

Dental caries can be prevented and controlled by “altering the bacterial flora in the mouth, modifying the diet, increasing the resistance of teeth to acid attacks, or reversing the demineralization process.” (Kumar, and Moss, 2008). However, only the use of fluorides and sealants has successfully caused a reduction of dental caries (Kumar, and Moss, 2008). Unfortunately, these preventive regimes are not well known or understood by the public (Gift, Corbin, and Nowjack-Raymer, 1994; Watson, Horowitz, Garcia, and Canto, 1999; Scherzer, Barker, Pollick and Weintraub, 2010) or even oral health care providers (Gaskin, Levy, Guzman-Armstrong, Dawson and Chalmers, 2010; Chan, Warren and Henson, 1996; Narendran, Chan, Turner, and Keene, 2006; Forrest, Horowitz and Yochi, 2000; Yoder, Maupome, Ofner and Swigonski, 2007; Clovis, Horowitz, Kleinman, Wang and Massey, 2012).

The public’s knowledge of fluoride, dental sealants

According to the 1990 National Health Interview Survey (NHIS), which is the latest national survey investigating public knowledge of dental caries prevention, only 62% of adults correctly identified the purpose of water fluoridation; young adults (18-24 years) was lower (49%) than 25-64 years of age (67%) or 65 years and older (51%). Whites were more likely to know the purpose of water fluoridation than blacks, as were those with higher levels of education. Only 7 % of adults chose “fluoride” as the most effective way of caries prevention among 6 choices, including:

"Limiting sugary snacks" and "Brushing and flossing teeth", and "Don't know". Only 32% of adults had heard of dental sealants (Gift, Corbin, and Nowjack-Raymer, 1994). Watson, Horowitz, Garcia, and Canto (1999) also reported that only 52% of the subjects of 121 Latino parents could correctly describe the purpose of fluoride, and only 3% of them selected "using a fluoridated toothpaste" for caries prevention as opposed to "just brushing teeth" (55%), "visiting the dentist" (28%), "eating less candy" (11%), and "other" (3%). Additionally, only 7% of them knew the purpose of sealants. These results parallel those of earlier studies. A lower perceived value of fluorides by the public in preventing dental caries also was reported in the 1985 NHIS (HHS, 2000).

It is possible that if the U.S. adult population is presented with conflicting information about the benefit and risk of water fluoridation, they may not be able to make an informed decision (CDC, 1992). In a study using focus groups and in-depth qualitative interviews (Scherzer, Barker, Pollick and Weintraub, 2010), the vast majority of rural Latino participants did not drink the municipal water and believed that drinking unfiltered tap water was unsafe. Most of the participants either "had not heard of fluoride" or "heard of fluoride-unclear about purpose and benefit", and said they would be willing to get their children access to fluoride after receiving an explanation of benefit of fluoride. A number of them said they would prefer to get fluoride through the water supply, although they have deep concern about the safety of unfiltered tap water based on its taste, appearance, and smell. According to Sriraman, Patrick, Hutton, and Edward (2009), 69% parents of children 6 months to 15 years old gave their children bottled water, whether exclusively or in combination

with tap water, 65% of them did not know if their bottled water contained fluoride. Huerta-Saenz, Irigoyen, Benavides and Mendoza (2012), investigated the urban minority caretakers of children. They found that only 17% drank tap water exclusively, 38% bottled water exclusively, and 42% drank both. Additionally, only 24% of their subjects know whether bottled or tap water contains fluoride. Hobson et.al (2007) reported that 41.2% of parents of children never gave their children tap water and 30.1% never drank it themselves. Additionally, immigrant Latinos were even less likely to give tap water to their children or to consume it than non-Latinos.

In Maryland, the parents' and caregivers' knowledge about fluoride and dental sealants is also low. Although 98% of them said that they had heard of fluoride, only 58% of them knew the purpose. Additionally, although 65% had heard of dental sealants, only 46% of them knew their purpose. Parents with high school education or less were significantly less likely to drink tap water, give it to their child, and know if their tap water was fluoridated than those with higher education. Medicaid recipients were less likely to drink tap water than non-Medicaid recipients (Horowitz and Kleinman, 2012).

Oral health literacy

Although having knowledge alone is not sufficient to improve one's own health, without understanding disease etiology and prevention strategies, it is difficult for a person to make informed decisions about appropriate health behavior (Gift, Corbin, and Nowjack-Raymer, 1994). Health literacy is "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services

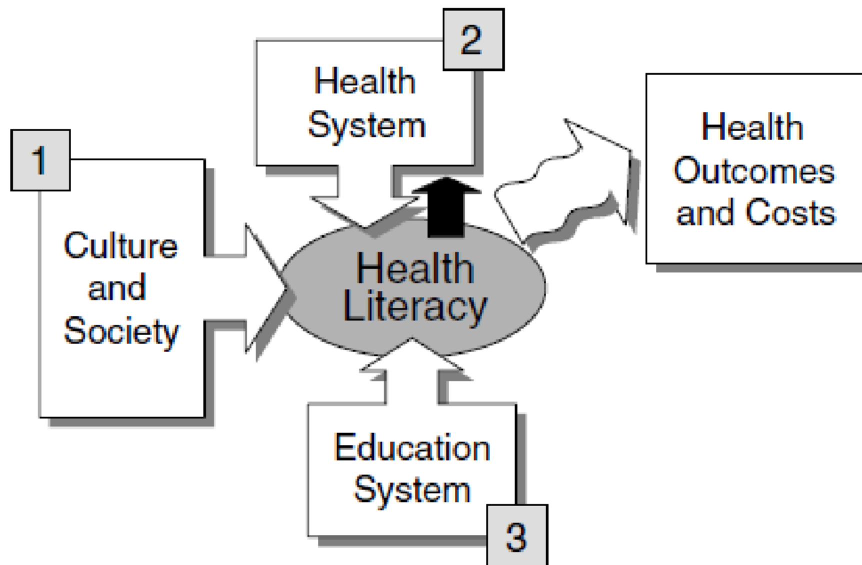
needed to make appropriate health decision"(IOM, 2011; IOM 2004). Similarly, the National Institute of Dental and Craniofacial Research (2005) defined oral health literacy as "the degree to which individuals have the capacity to obtain, process, and understand basic oral and craniofacial health information and services needed to make appropriate health decisions". Although this definition does not specifically identify health provider's and system-level contributions to oral health literacy, they are implicitly included. Literacy is not necessarily the only pathway, but is an important avenue that any effort for improving oral health status of population must take into account (IOM, 2005).

The definition of oral health literacy addresses functional oral health literacy, which includes knowledge, understanding, and the ability to use that knowledge (NIDCR, 2005). According to Baker (2006), a person's ability to maintain "Prior knowledge" is one of the important determinants of health literacy, and prior knowledge is composed of vocabulary and conceptual knowledge. Although the IOM includes conceptual knowledge as a part of health literacy, Baker defines it as a resource to facilitate health literacy and not in itself (Baker, 2006). However, either way, individuals and health care providers need correct and science-based knowledge about health topics to make informed health decisions and recommendations (IOM, 2011).

The IOM report pointed out that there are three potential intervention points we can use to improve health literacy. These include: Culture and Society, the Health Systems and the Education System and are shown in Figure below. The Culture and Society includes such things as race, ethnicity, socioeconomic status, gender, and age,

as well as influences such as media, advertising, marketing, and the Internet. The Health System includes individual practitioners, health organizations and government. The education system includes schools of all levels (IOM, 2011) and continuing education of all levels.

Figure 2: Potential Intervention Points



(IOM, 2004 p34)

Because dentists are a part of the health system and because many people report getting their oral health information from dentists (O'Neill, 1984; HHS, 2000; IOM, 2011; Horowitz and Kleinman, 2012), it is important that they know and practice using current scientific information regarding dental caries prevention. Thus, it is very critical to investigate their knowledge, understanding, and practices regarding fluorides and dental sealants, their comprehension of how to prevent dental caries, and whether or not they are providing education about prevention of dental caries to their patients.

Brief justification or rational for the problem

Dental caries is the most prevalent disease of US children. Many people especially those with higher rates of dental caries prevalence do not understand the process of dental caries and how to prevent this disease using fluorides and dental sealants. Because most people consider their dentist their most important source of dental information (O'Neill, 1984; HHS, 2000; IOM, 2011, Horowitz et.al, 2012), it is important to know what dentists know and do and what they educate their patients about preventing caries.

Chapter 3 Methods

Description of the population studied

Secondary data were used. The data were collected in 2010 using a mail survey which was sent to 1,562 dentists (pedodontists-169 and general practice dentists-1393) who were members of the American Academy of Pediatrics Maryland Chapter or the Maryland State Dental Association (MSDA). Most of the dentists in Maryland are members of MSDA. The Institutional Review Board,University of Maryland approved this study (see Appendix 1).

The response rate was 38% (n=605: pedodontists=80 [response rate was 47%], General practitioner=525 [response rate was 37%]). The majority of respondents were white (89%), 3% were Black and 15% indicated "other", 30% were female and nearly all (93%) were in private practice. The demographic information for the members of MSDA was available. Demographic characteristics of the respondents who were members of the American Academy of Pediatrics Maryland Chapter were not. Therefore, only the characteristics of race, gender, and class year of the subject from MSDA were compared with those of entire membership of MSDA to determine the representativeness of the sample.

Description of the sampling procedure

General dentists who were members of the MSDA were randomly selected from the membership list of practicing providers (n=2472), and pediatric dentists were selected from the entire membership (n=169) of the American Academy of Pediatrics

Maryland Chapter. These lists were obtained from each organization. The selection criteria included was that they were currently practicing dentists in Maryland.

Designation of the validity and reliability of testing device

The questionnaire (see appendix 2) was developed from previous surveys (Forrest, Horowitz and Shmuely, 2000; Loupe, Frazier, Horowitz, Kleinman, Caranicas and Caranicas, 1998). The survey instrument was designed to investigate the dentist's knowledge, attitudes and practices with regard to dental caries prevention. Two pediatric dentists, two public health dentists, and one cariologist reviewed the draft questionnaire to increase content validity. A pilot testing was conducted with dentists to assure the understandability of questions and to gain agreement on the correct responses. The same questionnaire was used to investigate knowledge, opinions and practices regarding caries prevention of Maryland dental hygienists (Clovis, Horowitz, Kleinman, Wang and Massey, 2012).

Procedural outline of steps followed

The completed questionnaires were sent via postal mail with a cover letter signed by the president of Maryland State Dental Association (MSDA) (see Appendix 3). A second mailing was sent to nonresponders with a modified cover letter three weeks after the first mailing. Approximately three weeks after the second mailing, a post card from the president of MSDA was sent to non-responders as a reminder. Finally, email was also sent as a reminder to all subjects to respond to the survey, under the name of Executive Director of MSDA. The responses were collected and

answers were converted to electronic data.

Research question

RQ1: What do dentists know and practice about preventing dental caries?

Fluoride Knowledge

Do dentists have current scientific knowledge about fluoride?

Knowledge of fluoride effectiveness for children of each age range

The frequency distribution and percentage of each item below were examined to see what percent of dentists chose the "correct" answer. The following questions (a-c) are about knowledge of some type of fluoride application for specific age group patients. The numbers of the items (e.g. "Q4a.1") are associated with the questions in the questionnaire (see appendix 2).

a. *Knowledge about community water fluoridation, dietary fluoride drops/tablets, fluoride dentifrices and fluoride varnish for the children ages 6 months to 2 years*

   This was assessed by items Q4a-1, 2, 3 and 4. "Effective" or "very effective" were assigned to "correct", and "not effective" or "somewhat effective" were assigned to "incorrect". "Don't know" was assigned to "don't know".

b. *Knowledge about community water fluoridation, dietary fluoride drops/tablets, fluoride dentifrices, fluoride varnish, topical fluorides-professional, fluoride rinse-at home, fluoride rinse-at school, brush-on fluoride gels, fluoride gel in mouth tray and fluoride foam for the children ages 3 to 6 years*

   This was assessed by items Q5a-1, 2, 3, 4, 6, 7, 8, 9, 10 and 11. "Effective" or

"very effective" were assigned to "correct", and "not effective" or "somewhat effective" were assigned to "incorrect". "Don't know" was assigned to "don't know".

c. *Knowledge about community water fluoridation, dietary fluoride drops/tablets, fluoride dentifrices, fluoride varnish, topical fluorides-professional, fluoride rinse-at home, fluoride rinse-at school, brush-on fluoride gels, fluoride gel in mouth tray and fluoride foam for children ages 7 to 20 years*

This topic was assessed by each item Q6a-1, 2, 3, 4, 6, 7, 8, 9, 10 and 11. "Effective" or "very effective" were assigned to "correct", and "not effective" or "somewhat effective" were assigned to "incorrect". "Don't know" was assigned to "don't know".

General knowledge about fluoride

Dentists' knowledge of the predominant theory of fluoride function, the relation of bottled water to dental caries, fluoride exposure level and dental caries, remineralization of incipient dental caries, and the importance of frequency and concentration of fluoride for caries prevention were assessed by items Q14-6, 7, 8, 11, 13 and 14. For items Q14-6, 11, 13 and 14, "strongly agree" or "agree" were assigned to "correct", "disagree" or "strong disagree" to "incorrect" and "don't know" to "don't know". For item Q14-7, "strongly agree" or "agree" were assigned to "incorrect", "disagree" or "strong disagree" to "correct" and "don't know" to "don't know". For item Q14-8, "strongly agree", "agree", "strongly disagree", "disagree" were assigned to "incorrect", and "don't know" to "correct".

Fluoride Practices

Do dentists apply fluoride appropriately?

The frequency and duration of professional fluoride applications were asked. The frequency distribution and percentage of each item below were examined to see what percent of dentists chose the "correct" answer. Items used were Q7 and Q8. Item Q7 is about the frequency of professional topical fluoride. For Q7, "2× per year" or "more than 2× per year" were considered "correct", and "once a year", "only if they have caries" or "Do not provide" were assigned to "incorrect". Item 8 is about the professional fluoride application time. Items Q8-1, 2, 3, 4 and 5 were used. For Q8-1, 2, 3 and 5, "4 mins" was considered "correct", and "30 secs", "1 min" or "2 mins" were assigned to "incorect". "Do not use " was assigned to "do not use". For Q8-4, "1 min" was assigned to "correct", and "30 secs", "2 min" or "4 mins" were assigned to "incorrect". "Do not use" was assigned to "do not use".

Priority of dental caries prevention methods

What kind of dental caries prevention regimens do dentists believe are the most and second most effective?

a. *For children between 6 months to 2 years*

   Respondents could select their 1st and 2nd priority for this age group among the following: community water fluoridation, dietary fluoride drop/tablets, fluoride dentifrices, fluoride varnish, cleaning infant's mouth, toothbrushing without a fluoride dentifrice, routine dental care, professional prophylaxis,

flossing, nutritional counseling, infrequent sugar consumption, and use of xylitol (Items in Q4a.1-12). The item 4b was used. The frequency distribution of 1st and 2nd selections were examined.

b. *For children 3 to 6 years*

The 1st and 2nd priority for this age group included: community water fluoridation, dietary fluoride drop/tablets, fluoride dentifrices, fluoride varnish, pit and fissure sealants, topical fluoride-professional, fluoride rinse-at home, fluoride rinse –at school, brush-on fluoride gels, fluoride gel in mouth tray, fluoride foam, toothbrushing without a fluoride dentifrice, flossing, professional prophylaxis, routine dental care, nutritional counseling, infrequent sugar consumption and use of xylitol (Items Q5a.1-18). The item 5b was used. The frequency distribution of 1st and 2nd were examined.

c. *For children 7 to 20 years*

The 1st and 2nd priority for this age group were chose among similar procedures as previous (b) (Items Q6a.1-18). Item 6b was used. The frequency distribution of respondents 1st priority and 2nd priority were examined.

Dental Sealants Knowledge

Do dentists have correct knowledge about dental sealants?

Knowledge of dental sealant effectiveness for children of each age range

The frequency distribution and percentage of each item below were examined to see what percent of dentists chose the “correct” answer.

a. *Knowledge about dental sealants used for the children ages 3 to 6 years*

This was assessed by item Q5a-5. The response of "effective" or "very effective" were assigned to "correct", and, "somewhat effective" or "not effective" were assigned to "incorrect". "Don't know" was assigned to "don't know".

b. *Knowledge about dental sealants used for the children ages 7 to 20 years*

This was assessed by item Q6a-5. The responses of "effective" or "very effective" were assigned to "correct", and "not effective" or "somewhat effective" were assigned to "incorrect". "Don't know" was assigned to "don't know".

General knowledge about dental sealant

General knowledge about dental sealants was assessed by items that measure knowledge of when dental sealants should be applied, the evidence of dental sealants and the major reason of loss of dental sealants, using items Q14-1, 2, 3, 4 and 5. For Items Q14-3, 4 "strongly agree" or "agree" were assigned to "correct", "disagree" or "strong disagree" were assigned to "incorrect" and "Don't know" to "don't know". For items Q14-1, 2 and 5, "strongly agree" or "agree" were assigned to "incorrect", "disagree" or "strong disagree" to "correct" and "Don't know" to "don't know".

Dental Sealants Practice

How many dentists are using dental sealants?

The frequency distribution and percentage of item Q10a was examined.

What percent of children whose dentists chose "Yes" to item Q10a do receive dental

sealant?

The frequency distribution and percentage of Q10b was examined.

What is the reason why dentists do not provide dental sealants?

The frequency distribution and percentage of item 11 was examined. The highest, second and third most chosen reasons was reported.

RQ2: Do dentists educate patients about caries prevention?

Are they providing information about fluoride for home use?

The frequency distribution for item Q9a was examined.

Do they provide caries preventive education?

The frequency distribution for item Q13a was examined.

For each age group, are they providing necessary information about fluoride and dental sealants?

The frequency distribution of item Q13b was examined. Only those dentists who chose "yes" for item Q13a were included.

a. *Education about fluoride drops/tablets, community water fluoridation, mechanism of fluoride action, use of fluoride dentifrice and home fluoride rinses for children ages 6 months to 2 years*

   This was assessed by items Q13b-6, 8, 9 and 13. The percentage of dentists

who were providing the information for each item was examined.

b. *Education about fluoride drops/tablets, community water fluoridation, mechanism of fluoride action, and use of fluoride dentifrice and for the children ages 3 to 6 years*

This was assessed by items Q13b-5, 6, 8, 9, 10, 13 and 14. The percentage of dentists who were providing the information for each item was examined.

c. *Education about home fluoride gels, fluoride drops/tablets, community water fluoridation, mechanism of fluoride action, pit and fissure sealants, use of fluoride dentifrice and home fluoride rinses for the children ages 7 to 20 years*

This was assessed by items Q13b-5, 6, 8, 9, 10, 13 and 14. The percentage of dentists who were providing the information for each item was examined.

RQ 3: Are dentists' characteristics associated with their knowledge and practice?

Bivariate Analysis

The characteristics which are collected in this questionnaire are; a) dentists characteristics: their experience of dental caries prevention course excluding their dental school (Q20), their interest in attending a continuing education course on dental caries prevention (Q21), their primary occupation (Q23), their practice setting (Q24), countries they are born (Q25), countries they received dental training (Q26), their graduation year (Q27), their gender (Q28), their race/ethnicity (Q29), their perception of their dental school's training regarding dental caries prevention (Q30), and their specialty (general dentists or pediatric dentists); b) their child patients'

characteristics were also collected: whether or not they have a patients ages 0-20 years (Q1), the distribution of age rage of their child/youth patients (Q2a.1, Q2a.2 and Q2a.3) and the health insurance status of their child/youth patients (Q2b.1, Q2b.2 and Q2b.3).

First, the distribution of Q1, Q2a.1-3, Q2b.1-3, Q20, Q21, Q23, Q24, Q25, Q26, Q27, Q28, Q29, Q30 and their specialty (general dentists or pediatric dentists) were examined to determine whether enough cases were available to analyze for each characteristic. Then a Chi-square test (for discrete data) and t-test (for continuous data) were conducted.

This section addressed the following question; *What dentists' characteristics are related to their knowledge of fluoride? (Q4a.1, Q4a.2, Q4a.3, Q4a.4, Q5a.1, Q5a.2, Q5a.3, Q5a.4, Q5a.6, Q5a.7, Q5a.8, Q5a.9, Q5a.10, Q5a.11, Q6a.1, Q6a.2, Q6a.3, Q6a.4, Q6a.6, Q6a.7, Q6a.8, Q6a.9, Q6a.10, Q6a.11, Q14.6, Q14.7, Q14.8, Q14.11, Q14.13, Q14.14): What dentists' characteristics are related to their fluoride practice? (Q7.1, Q7.2, Q7.3)*: *What dentists' characteristics are related to their knowledge of dental sealants? (Q5a.5, Q6a.5, Q14.1, Q14.2, Q14.3, Q14.3, Q14.4, Q14.5): What dentists' characteristics are related to their practice of dental sealant application? (Q10a)*: *What dentists' characteristics are related to providing fluoride and dental sealants education? (Q9a, Q13a)*

Multivariate analyses

The same characteristics used in the bivariate analysis were used for multivariable analyses, except the characteristics of their patients' age range (Q2a.1, Q2a.2 and

Q2a.3) and insurance status (Q2b.1, Q2b.2 and Q2b.3). Regarding age range, only one related to the dependent variable was entered into the model. For example, for the "*Knowledge of effectiveness of fluoride application for children 6 months to 2 years",* only Q2a.1 (percentage of children ages 6 months to 2 years) was put into the model. Regarding insurance status, only the variable of the percentage of the Medicaid or SCHIP children patients (Q2b.1) was used.

Multiple linear regressions were used when the dependent variable was continuous, and logistic regression was used when the dependent variable was binary.

Knowledge of effectiveness of fluoride application for children 6 months to 2 years

To measure respondents' knowledge of the effectiveness of fluoride application for children 6 months to 2 years, Q4a.1, Q4a.2, Q4a.3, Q4a.4 were used. A knowledge scale was developed. The respondents who selected the correct answer received score 1. The total score ranged from 0 to 4. The score was calculated for each sample. Multiple linear regressions were conducted.

Knowledge of effectiveness of fluoride application for children 3 to 6 years

To measure the knowledge of effectiveness of fluoride application for children 3 to 6 years, Q5a.1, Q5a.2, Q5a.3, Q5a.4, Q5a.6, Q5a.7, Q5a.8, Q5a.9, Q5a.10, Q5a.11 were used. A knowledge scale was developed. The respondents who selected the correct answer received a score of 1. The total score ranged from 0 to 10. The score was calculated for each sample. Multiple linear regressions were conducted.

Knowledge of effectiveness of fluoride application for children 7 to 20 years

To measure the knowledge of effectiveness of fluoride application for children 7 to 20 years, Q6a.1, Q6a.2, Q6a.3, Q6a.4, Q6a.6, Q6a.7, Q6a.8, Q6a.9, Q6a.10, Q6a.11 were used. A knowledge scale was developed. The respondents who selected the correct answer received a score of 1. The total score ranged from 0 to 10. A score was calculated for each sample. Multiple linear regressions were conducted.

General knowledge of fluoride

To measure the general knowledge of fluoride, Q14.6, Q14.7, Q14.8, Q14.11, Q14.13, Q14.14 were used. A knowledge scale was developed. The respondents who selected the correct answer received a score of 1. The total score ranged from 0 to 6. The score was calculated for each sample. Multiple linear regressions were conducted.

The frequency of the topical fluoride application to the children 6 months to 2 years

To measure dentists' use of fluoride for children 6 months to 2 years, Q7.1 was used. Logistic regressions were conducted.

The frequency of the topical fluoride application to children 3 to 6 years

To measure the dentists' use of fluoride for children 3 to 6 years, Q7.2 was used. Logistic regressions were conducted.

The frequency of the topical fluoride application to children 7 to 20 years

To measure the reported use of fluoride for children 7 to 20 years, the Q7.3 was used. Logistic regressions were conducted.

Knowledge of effectiveness of dental sealants for children 3 to 6 years

To measure the knowledge of effectiveness of dental sealants for children 3 to 6 years, the Q5a.5 was used. Logistic regressions were conducted.

Knowledge of effectiveness of dental sealants for children 7 to 20 years

To measure the knowledge of effectiveness of dental sealants for children 7 to 20 years, the Q6a.5 was used. Logistic regressions were conducted.

General knowledge of dental sealants

To measure the general knowledge of dental sealants, Q14.1, Q14.2, Q14.3, Q14.3, Q14.4, Q14.5 were used. A knowledge scale was developed. The respondents who selected the correct answer received a score of 1. The total score ranged from 0 to 5. A score was calculated for each sample. Multiple linear regressions were conducted.

Dental sealants practice

To measure the dental sealants practice, the Q10a was used. Logistic regressions were conducted.

Chapter 4 Results

Sample characteristics

The response rate was 38% (n=605/1562: pediatric dentists n=80/169, general dentists n=525/1393). Because some of the dentists did not provide complete information, the final sample sizes for frequency distributions and analyses vary depending on the variables. The average number of response for each item was about 410 and the valid lowest total was about 280.

The sample characteristics are presented in Table 1. The percentage of males was 70.2% and ; the majority was White (81.6%). Pediatric dentists comprised 13.2% of the sample while general dentists were 86.8%. Most of the dentists were private practitioners (92.8%) and were in solo practice or group private practice (92.8%). They were more likely to have been born (85.7%) and receive their dental training (95.3%) in the U.S. Over sixty percent (63.4%) graduated from dental school before 1990.

Table 1: Characteristics of the samples

Gender	Frequency	Valid Percent
Female	128	29.8
Male	302	70.2
Valid Total	430	100.0
Missing	175	
Total	605	

Race/ethnicity	Frequency	Valid Percent
White	345	81.6
Black	13	3.1
Other	65	12.5
Valid Total	423	100.0
Missing	182	
Total	605	
The specialty	Frequency	Valid Percent
Pediatric dentist	80	13.2
General dentist	525	86.8
Valid Total	605	100.0
Missing	0	
Total	605	
Primary occupation	Frequency	Valid Percent
Private practice	400	92.8
Health professional school faculty/staff member	10	2.3
Armed forces	1	0.2
Public health clinical practitioner	6	1.4
State or local government employee	4	0.9
Hospital staff provider	2	0.5
Graduate student/intern/resident	3	0.7
Health/dental hygiene organization staff member	1	0.2
Other	4	0.9
Valid Total	431	100.0
Missing	174	
Total	605	
Practice setting	Frequency	Valid Percent
Solo practice	232	53.8
Group private practice	168	39.0
Government funded public health practice	12	2.8
Private, non-profit hospital	5	1.2
Other	14	3.2
Valid Total	431	100.0
Missing	174	
Total	605	
Country of origin	Frequency	Valid Percent
USA	361	85.7
Other	60	14.3
Valid Total	421	100.0
Missing	184	
Total	605	

Country received dental training	Frequency	Valid Percent
USA only	410	95.3
USA and other countries	13	3.0
Other countries only	7	1.6
Valid Total	430	100.0
Missing	175	
Total	605	

Year of graduation	Frequency	Valid Percent
1979 or earlier	150	35.6
1980 - 1989	117	27.8
1990 - 1999	83	19.7
2000 or later	71	16.9
Valid Total	421	100.0
Missing	184	
Total	605	

In addition to the demographics, dentists were asked about their patient's age range and insurance status. Although the distributions of age range of their child/youth patients (Q2a.1: approximately what percentage of your child patients are 6 months to 2 year? Q2a.2: approximately what percentage of your child patients are 3 to 6 years? and Q2a.3: approximately what percentage of your child patients are 7 to 20 years?) and the insurance status of their child/youth patients (Q2b.1: approximately what percentage of your child patient Medicaid or SCHIP beneficiaries? , Q2b.2: approximately what percentage of your child patients are members of the commercial/private insurance recipients? and Q2b.3: approximately what percentage of your child patients are out of pocket payers?) were continuous data. Because of the significant skewed data, Q2a.1 and Q2b.1 were converted to categorical data. About 96% of dentists treated children/ youth 0-20 years. About 42% of the dentists saw young child patients 6 months to 2 years of age. Less than 35% of the dentists saw children insured by Medicaid or SCHIP.

Table 2: Demographics of respondents' patients

Whether practice treats children/youth 0-20 years (Q1)	Frequency	Valid Percent
Yes	420	96.1
No	17	3.9
Valid Total	437	100.0
Missing	168	
Total	605	
Approximately what percentage of your child patients are 6 month-2 years? (Q2a-1)	Frequency	Valid Percent
0	167	41.9
any	232	58.1
Valid Total	399	100.0
Missing	206	
Total	605	
Approximately what percentage of your child patients are 3-6 years? (Q2a-2)	Mean (%)	SD
	25.8	17.6
Approximately what percentage of your child patients are 7-20 years? (Q2a-3)	Mean (%)	SD
	67.0	23.9
Approximately what percentage of our child/youth patients are Medicaid or SCHIP beneficiaries? (2b-1)	Frequency	Valid Percent
0	266	66.5
Any	134	33.5
Total	400	100.0
Missing	205	
Total	605	
Approximately what percentage of our child/youth patients are members of the commercial /Private insurance recipients? (2b-2)	Mean (%)	SD
	62.9	26.7
Approximately what percentage of our child/youth patients are out of pocket payers? (2b-3)	Mean (%)	SD
	24.9	21.3

Additionally, dentists were asked if they had taken a dental caries prevention course excluding what they had in dental school, their interest in attending a continuing education course on dental caries prevention, and their level of satisfaction of the course on dental caries prevention provided in their dental school. About 70% of the dentists took additional course of dental caries prevention after their dental school education. About 63% of the dentists indicated they were interests in taking such a course, and around 90% of the dentists rated their dental school training regarding dental caries prevention as "Good".

Table 3: Course of dental caries prevention

Excluding dental school, have you ever taken a course on dental caries prevention?	Frequency	Valid Percent
Yes	297	68.9
No	134	31.1
Valid Total	431	100.0
Missing	174	
Total	605	
Would you be interested in attending a continuing education course on dental caries prevention?	Frequency	Valid Percent
Yes	267	62.5
No	160	37.5
Valid Total	427	100.0
Missing	178	
Total	605	
How would you rate your dental school training regarding dental caries prevention?	Frequency	Valid Percent
Good	395	91.6
Poor and Not sure	36	8.4
Valid Total	431	100.0
Missing	174	
Total	605	

The comparability of this study sample to the members of the Maryland State Dental Association (MSDA) is shown in Table 4. Only general dentists were chosen to be compared with the characteristics of MSDA. The Black population was under sampled, and "other" race was over sampled.

Table 4: Frequency and Percentage of MSDA and sample of race, gender and year of graduation

	MSDA		Sample	
Race	Frequency	%	Frequency	%
White	1709	80.4	290	83.6
Black	165	7.8	11	3.2
Other	251	11.8	46	13.3
Valid Total	2125	100.0	347	100.0
Missing	297		178	
Total	2422		525	
	MSDA		Sample	
Gender	Frequency	%	Frequency	%
Male	1883	78.0	264	75.0
Femail	528	21.9	88	25.0
Valid Total	2411	100.0	352	100.0
Missing	11		173	
Total	2422		525	
	MSDA		Sample	
Graduation	Frequency	%	Frequency	%
1979 or earlier	1070	44.9	130	37.4
1980 - 1989	544	22.8	105	30.2
1990 - 1999	353	14.8	60	17.2
2000 or later	417	17.5	53	15.2
Valid Total	2384	100.0	348	100.0
Missing	38		177	
Total	2422		525	

The majority of both groups were White and Male. Including the graduation year, the percentages of the characteristics were very close. Although there was some over sampling and under sampling, the comparability of our sample is good.

RQ1: What do dentists know and practice about preventing dental caries?

Do dentists have current scientific knowledge about fluoride? (Table 5, Table 6)

<u>*Knowledge of fluoride effectiveness for children of each age range (Table 5)*</u>

Overall

Dentists' understanding of the effectiveness of community water fluoridation was generally higher than for other type of fluoride application. Understanding of the effectiveness of dietary fluoride drops/ tablets decreased from 71.5% for children 6 month to 2years or 78.8% for children 3 to 6 years to 59.3% for children 7 to 20 years. Dentists' knowledge of the effectiveness of fluoride dentifrices was lowest for children 6 months to 2 years (66.4% correct) compared to children 3 to 6 years (84.9%) and 7 to 20 years (85.3%). The use of fluoride rinse - at school got the lowest percentage of correct responses score consistently (50% for the children 3 to 6 years and 51.5% for children 7 to 20 years).

a. Knowledge about community water fluoridation, dietary fluoride drops/tablets, fluoride dentifrices and fluoride varnish for children ages 6 months to 2 years

Dentists' knowledge of the effectiveness of community water fluoridation was the highest (about 90%). The lowest level of understanding was regarding fluoride dentifrices (66.4% correct). Only 71.5% and 69.7% of the dentists know that dietary fluoride drops/tablets and fluoride varnish are effective for children 6 month to 2 years.

b. Knowledge about community water fluoridation, dietary fluoride drops/tablets, fluoride dentifrices, fluoride varnish, topical fluorides-professional, fluoride rinse-at home, fluoride rinse-at school, brush-on fluoride gels, fluoride gel in mouth tray and fluoride foam for children ages 3 to 6 years

Only 50% to less than 75% of the dentists knew that fluoride rinse at home, fluoride rinse at school, brush on fluoride gels, fluoride gel in mouth tray and fluoride foam are effective for 3 to 6 years olds. Knowledge of community water fluoridation was the highest (about 93% correct). The lowest level of knowledge was about the use of fluoride rinse at school only 50% answered correctly.

c. Knowledge about community water fluoridation, dietary fluoride drops/tablets, fluoride dentifrices, fluoride varnish, topical fluorides-professional, fluoride rinse-at home, fluoride rinse-at school, brush-on fluoride gels, fluoride gel in mouth tray and fluoride foam for children ages 7 to 20 years

Only about 50% to less than 75% of the dentists know that dietary fluoride drops, fluoride rinse at home, fluoride rinse at school, brush on fluoride gels, fluoride gel in mouth tray and fluoride foam are effective or very effective for children 7 to 20 years of age. The highest level of knowledge was 85.3% for fluoride dentifrices. The lowest level of knowledge was regarding fluoride rinse at school (51.5%).

Table 5: Knowledge of effectiveness of fluoride application

Knowledge of effectiveness of fluoride	Not Effective	Somewhat Effective	Effective	Very Effective	Do not Know	Valid Total	Correct
Children: 6 mo. – 2 yrs.							
Community water fluoridation (4a.1) (n=)	9	33	99	289	5	435	
%	2.1	7.6	22.8	66.4	1.1	100.0	89.2
Dietary fluoride drops/tablets (4a.2) (n=)	18	80	140	163	23	424	
%	4.25	18.87	33.02	38.44	5.42	100.00	71.5
Fluoride dentifrices (4a.3) (n=)	24	101	154	127	17	423	
%	5.7	23.9	36.4	30.0	4.0	100.0	66.4
Fluoride Varnish (4a.4) (n=)	26	54	131	164	48	423	
%	6.1	12.8	31.0	38.8	11.3	100.0	69.7
Children: 3 – 6 yrs.	Not Effective	Somewhat Effective	Effective	Very Effective	Do not Know	Valid Total	Correct
Community water fluoridation (5a.1) (n=)	2	23	99	307	4	435	
%	.5	5.3	22.8	70.6	.9	100.0	93.3
Dietary fluoride drops/ tablets (5a.2) (n=)	9	64	157	182	18	430	
%	2.1	14.9	36.5	42.3	4.2	100.0	78.8
Fluoride dentifrices (5a.3) (n=)	2	53	177	188	10	430	
%	.5	12.3	41.2	43.7	2.3	100.0	84.9
Fluoride varnish (5a.4) (n=)	7	51	144	193	32	427	
%	1.6	11.9	33.7	45.2	7.5	100.0	78.9
Topical fluorides-professional (5a.6) (n=)	4	57	186	175	8	430	
%	.9	13.3	43.3	40.7	1.9	100.0	84.0
Fluoride rinse-at home (5a.7) (n=)	10	90	203	108	18	429	
%	2.3	21.0	47.3	25.2	4.2	100.0	72.5
Fluoride rinse –at school (5a.8) (n=)	24	123	146	67	66	426	
%	5.6	28.9	34.3	15.7	15.5	100.0	50.0
Brush-on fluoride gels (5a.9) (n=)	9	94	187	108	27	425	
%	2.1	22.1	44.0	25.4	6.4	100.0	69.4
Fluoride gel in mouth tray (5a.10) (n=)	18	85	184	119	18	424	
%	4.2	20.0	43.4	28.1	4.2	100.0	71.5
Fluoride foam (5a.11) (n=)	20	108	180	78	37	423	
%	4.7	25.5	42.6	18.4	8.7	100.0	61.0
Children: 7 – 20 yrs.	Not Effective	Somewhat Effective	Effective	Very Effective	Do not Know	Valid Total	Correct
Community water fluoridation (6a.1) (n=)	12	52	135	227	8	434	
%	2.8	12.0	31.1	52.3	1.8	100.0	83.4
Dietary fluoride drops/ tablets (6a.2) (n=)	48	106	137	118	21	430	
%	11.2	24.7	31.9	27.4	4.9	100.0	59.3
Fluoride dentifrices (6a.3) (n=)	3	52	178	188	8	429	
%	.7	12.1	41.5	43.8	1.9	100.0	85.3
Fluoride varnish (6a.4) (n=)	5	62	166	171	27	431	
%	1.2	14.4	38.5	39.7	6.3	100.0	78.2
Topical fluorides-professional (6a.6) (n=)	4	56	192	173	7	432	
%	.9	13.0	44.4	40.0	1.6	100.0	84.5
Fluoride rinse-at home (6a.7) (n=)	3	103	201	108	15	430	
%	.7	24.0	46.7	25.1	3.5	100.0	71.9
Fluoride rinse –at school (6a.8) (n=)	18	125	153	66	63	425	
%	4.2	29.4	36.0	15.5	14.8	100.0	51.5
Brush-on fluoride gels (6a.9) (n=)	10	88	191	113	27	429	
%	2.3	20.5	44.5	26.3	6.3	100.0	70.9
Fluoride gel in mouth tray (6a.10) (n=)	11	85	194	119	18	427	
%	2.6	19.9	45.4	27.9	4.2	100.0	73.3
Fluoride foam (6a_11) (n=)	15	116	177	75	39	422	
%	3.6	27.5	41.9	17.8	9.2	100.0	59.7

"Correct" = "Very effective" and "Effective"

General knowledge about fluoride (Table 6)

This section addresses dentists' knowledge of the predominant theory of fluoride function, the relation of bottled water to dental caries, fluoride exposure level and dental caries, remineralization of incipient dental caries, and the importance of frequency and concentration of fluoride for caries prevention.

The percentage of general knowledge about fluoride held by dentists varied with the type of question. The highest percentage of correct answers was 90% for the question Q14.6: "It is desirable to use professionally applied fluorides for all children in areas without fluoridated water", and the lowest was 9.2% for the question Q14.7: "The most important mechanism of action of fluoride is that it is incorporated into developing teeth to make them more resistant to acid demineralization." It is notable that the percentage of dentists who were more certain about their answer, that is they strongly disagreed rather than disagreed, was only 3% (Strongly Disagree: 3.0%, Disagree: 6.2%). About 60% of the dentists believed that increasing use of bottled water would increase tooth decay and 26.6% believed that there would be no effect. About 40% correctly understood that dilute frequently administered fluoride is the best method of application, and only 7.4% of dentists strongly agreed with this (Strongly agree: 7.4%, Agree: 33%). About 27% incorrectly believed that more concentrated and less frequently administered fluorides is better. Additionally, about 32% did not know which is better. Only 53% correctly understand that the most important mechanism of action of fluoride is the remineraliation of incipient decay. Only 8.6% of dentists strongly agreed with this statement (Strongly agree: 8.6%, Agree: 44.4%).

About 90% of dentists correctly understand “it is desirable to use professional fluorides for all children in areas without fluoridated water” (Q14.6) and “incipient carious lesions (before cavitation) can be remineralized (healed)” (Q14.11). But their knowledge of the predominant theory of fluoride function (Q14.7 and Q14.14), knowledge of the effect of increasing bottled water use, and knowledge of the superiority of the effectiveness of the dilute and frequently administered fluoride than high concentrate and less frequency administered fluoride (Q14.13) were low.

Table 6: General knowledge of fluoride

General knowledge of fluoride	Strongly Agree	Agree	Disagree	Strongly Disagree	Do not know	Valid Total	Correct
It is desirable to use professionally applied fluorides for all children in areas without fluoridated water(Q14.6) (n=)	198	189	26	10	7	430	
%	46.0	44.0	6.0	2.3	1.6	100.0	90.0
The most important mechanism of action of fluoride is that it is incorporated into developing teeth to make them more resistant to acid demineralization(Q14.7) (n=)	181	207	27	13	7	435	
%	41.6	47.6	6.2	3.0	1.6	100.0	9.2
The increased use of bottled water increases tooth decay among young children(Q14.8) (n=)	59	199	86	30	62	436	
%	13.5	45.6	19.7	6.9	14.2	100.0	14.2
Incipient carious lesions (before cavitation) can be remineralized (healed)(Q14.11) (n=)	88	295	27	2	22	434	
%	20.3	68.0	6.2	.5	5.1	100.0	88.2
Dilute, frequently administered fluorides are more effective in caries prevention than more concentrated, less frequently administered fluorides(Q14.13) (n=)	32	142	94	23	139	430	
%	7.4	33.0	21.9	5.3	32.3	100.0	40.5
The most important mechanism of action of fluoride is the remineralization of incipient decay(Q14.14) (n=)	37	190	148	14	39	428	
%	8.6	44.4	34.6	3.3	9.1	100.0	53.0

"Correct" = "Strongly Agree" and "Agree", "Strongly Disagree" and "Disagree", or "Do not know"

Fluoride Practices

Do dentists apply fluoride appropriately? (Table7)

In the questions about the frequency of fluoride application (Q7), the percentage of correct answers was lowest for children 6 months to 2 years, but, increased as the patients age increased: 44.8% for 6 month to 2years, 76.3% for 3 to 6years, 80.9% for 7 to 20 years. In contrast, the percentage of “Do not use” responses decreased as the patients’ age increased.

In the questions regarding the duration of application time (Q8), as a whole the correct percentage ranged from 14% to 23.8% for the group of “4 mins” was correct (“APF gel”, “APF foam”, “NaF gel” and “SnF_2”) and 57.3% for NaF rinse (“1 mins” was correct). To calculate the percentage of correct answers, the subjects who chose “do not use” were excluded. In every item, the “1min” was the highest percentage among the dentists who use them.

Table 7: Use of fluoride products

Practice of fluoride products	Do not provide	Once a year	2x per year	More than 2x per year	Only if they have caries	Total	Correct
The frequency of topical fluoride treatments provided to child patients							
6 months - 2 years (Q7.1) (n=)	172	32	174	12	25	415	
%	41.4	7.7	41.9	2.9	6.0	100.0	44.8
3 - 6 years (Q7.2) (n=)	52	37	314	12	12	427	
%	12.2	8.7	73.5	2.8	2.8	100.0	76.3
7 - 20 years (Q7.3) (n=)	40	36	343	5	6	430	
%	9.3	8.4	79.8	1.2	1.4	100.0	80.9

"Correct"= "2x per year" and "More than 2x per year"

Type of fluoride and the application time most often used for in-office treatments (% correct in person exclusing do not use)	Do not use	30 secs	1 min	2 mins	4 mins	Total	Correct within use
APF gel (Q8.1) (n=)	165	4	85	23	35	312	
%	52.9	1.3	27.2	7.4	11.2	100.0	23.8
APF foam (Q8.2) (n=)	194	7	76	17	24	318	
%	61.0	2.2	23.9	5.3	7.5	100.0	19.4
NaF gel (Q8.3) (n=)	212	4	43	17	20	296	
%	71.6	1.4	14.5	5.7	6.8	100.0	23.8
NaF rinse (Q8.4) (n=)	221	11	43	18	3	296	
%	74.7	3.7	14.5	6.1	1.0	100.0	57.3
SnF2 (Q8.5) (n=)	237	2	22	13	6	280	
%	84.6	0.7	7.9	4.6	2.1	100.0	14.0

"Correct"= "1 min" for NaF rinse, "4 mins" for the others

Priority of dental caries prevention methods

What kind of dental caries prevention methods do dentists believe are the most and second most effective? (Table 8)

a. For children 6 months to 2 years

“Community water fluoridation” (36%) was the first choice for the first priority to effectively prevent dental caries of 6 months to 2 years. This was followed by “Cleaning infant’s mouth” (19.3%), “Infrequent sugar consumption” (13.4%) and “Nutritional counseling”(10.4%). The highest answer for the 2nd priority was “Nutritional counseling”(15.6%), “infrequent sugar consumption”(15.6%) and “Routine dental care” (15.4%).

b. For children 3 to 6 years

“Community water fluoridation” (36.2%) was the highest for the first priority to effectively prevent dental caries of 3 to 6 years. This was followed by “Routine dental care”(14.9%) and “Infrequent sugar consumption”(12.9%). “Routine dental care” (16.8%) is the highest for the 2nd priority, which was followed by “Infrequent sugar consumption”(14.5%) and “Nutritional counseling”(10.5%).

c. For children 7 to 20 years

“Community water fluoridation” (25.8%) was the most frequent choice for the first priority to effectively prevent dental caries among 7 to 20 year olds. This was followed by “Routine dental care” (18.8%), “Infrequent sugar consumption” (15.3%). “Routine dental care”(17.7%) is the highest for the 2nd priority. This is followed by

“Pit ad fissure sealants”(13.2%), “Infrequent sugar consumption”(11.6%) and “Nutritional counseling”(9.7%).

Overall

Dentists identified “community water fluoridation” as their 1st priority of caries prevention for each age range of children and “Routine dental care” as their second.

Table 8: First and second priority of preventive procedure

Most effective decay preventive measure for children 6 months-2 years - 1st Priority	Frequency	Valid Percent	Most effective decay preventive measure for children 6 months-2 years - 2nd Priority	Frequency	Valid Percent
Community water fluoridation	153	36.0	Nutritional counseling	66	15.6
Cleaning infant's mouth	82	19.3	Infrequent sugar consumption	66	15.6
Infrequent sugar consumption	57	13.4	Routine dental care	65	15.4
Nutritional counseling	44	10.4	Cleaning infant's mouth	52	12.3
Routine dental care	32	7.5	Community water fluoridation	44	10.4
Fluoride dentifrices	18	4.2	Fluoride varnish	41	9.7
Toothbrushing without a fluoride frntifrice	13	3.1	Duetary fkyirude drios/tablets	38	9.0
Fluoride varnish	12	2.8	Toothbrushing without a fluoride frntifrice	21	5.0
Duetary fkyirude drios/tablets	9	2.1	Fluoride dentifrices	18	4.3
Professional prophylaxis	3	.7	Professional prophylaxis	7	1.7
Use of xylitol	2	.5	Flossing	3	.7
Flossing	0	.0	Use of xylitol	2	.5
Total	425	100.0	Total	423	100.0

Most effective decay preventive measure for children 3-6 years - 1st Priority	Frequency	Valid Percent	Most effective decay preventive measure for children 3-6 years - 2nd Priority	Frequency	Valid Percent
Community water fluoridation	146	36.2	Routine dental care	67	16.8
Routine dental care	60	14.9	Infrequent sugar consumption	58	14.5
Infrequent sugar consumption	49	12.2	Nutritional counseling	42	10.5
Fluoride dentifrices	38	9.4	Fluoride dentifrices	36	9.0
Nutritional counseling	30	7.4	Pit and fissure sealants	35	8.8
Pit and fissure sealants	15	3.7	Community water fluoridation	32	8.0
Fluoride varnish	14	3.5	Fluoride varnish	28	7.0
Toothbrushing without a fluoride frntifrice	14	3.5	Duetary fkyirude drios/tablets	25	6.3
Professional prophylaxis	11	2.7	Flossing	18	4.5
Duetary fkyirude drios/tablets	8	2.0	Professional prophylaxis	15	3.8
Fluoride foam	7	1.7	Toothbrushing without a fluoride frntifrice	12	3.0
Fluoride rinse-at home	4	1.0	Fluoride rinse-at home	11	2.8
Topical fluorides-professional	2	.5	Topical fluorides-professional	10	2.5
Fluoride gel in mouth tray	2	.5	Fluoride gel in mouth tray	7	1.8
Flossing	2	.5	Fluoride rinse-at school	1	.3
Brush-on fluoride gels	1	.2	Brush-on fluoride gels	1	.3
Fluoride rinse-at school	0	.0	Fluoride foam	1	.3
Use of xylitol	0	0.0	Use of xylitol	1	.3
Total	403	100.0	Total	400	100.0

Most effective decay preventive measure for children 7-20 years - 1st Priority	Frequency	Valid Percent	Most effective decay preventive measure for children 7-20 years - 2nd Priority	Frequency	Valid Percent
Community water fluoridation	110	25.8	Routine dental care	75	17.7
Routine dental care	80	18.8	Pit and fissure sealants	56	13.2
Infrequent sugar consumption	65	15.3	Infrequent sugar consumption	49	11.6
Fluoride dentifrices	40	9.4	Nutritional counseling	41	9.7
Nutritional counseling	24	5.6	Flossing	36	8.5
Professional prophylaxis	21	4.9	Fluoride dentifrices	35	8.3
Pit and fissure sealants	20	4.7	Fluoride varnish	29	6.9
Fluoride varnish	18	4.2	Professional prophylaxis	23	5.4
Flossing	17	4.0	Community water fluoridation	20	4.7
Toothbrushing without a fluoride frntifrice	16	3.8	Duetary fkyirude drios/tablets	19	4.5
Fluoride rinse-at home	4	.9	Fluoride rinse-at home	15	3.5
Topical fluorides-professional	3	.7	Toothbrushing without a fluoride frntifrice	7	1.7
Use of xylitol	3	.7	Use of xylitol	6	1.4
Duetary fkyirude drios/tablets	2	.5	Topical fluorides-professional	5	1.2
Brush-on fluoride gels	2	.5	Fluoride gel in mouth tray	3	.7
Fluoride foam	1	.2	Brush-on fluoride gels	2	.5
Fluoride rinse-at school	0	.0	Fluoride foam	2	.5
Fluoride gel in mouth tray	0	.0	Fluoride rinse-at school	0	0.0
Total	426	100.0	Total	423	100.0

Dental Sealants Knowledge

Do dentists have correct knowledge about dental sealants? (Table 9)

Knowledge of dental sealant effectiveness for children of each age range

a. The knowledge about dental sealants used for children ages 3 to 6 years.

Most of the dentists (82.8%) knew the effectiveness of dental sealants.

b. The knowledge about dental sealants used for children ages 7 to 20 years.

Most of the dentists (90.1%) knew the effectiveness of dental sealants.

General knowledge about dental sealants

In three items out of five, more than 85% of the dentists answered correctly. However about 30% of dentists incorrectly believed “sealants are somewhat risky because decay may be sealed in the tooth” (Q14.5) and incorrectly believe that loss of sealants is generally attributed to some reasons rather than inappropriate application technique (Q14.4).

Table 9: Knowledge of dental sealants and their effectiveness

Knowledge of effectiveness of Pit & Fissure Sealants	Not Effective	Somewhat Effective	Effective	Very Effective	Do not Know	Valid Total	Correct
children 3 - 6 years of age (Q5a.5) (n=)	9	51	134	223	14	431	
%	2.1	11.8	31.1	51.7	3.2	100.0	82.8
children 7 - 20 years of age (Q6a.5) (n=)	5	32	143	248	6	434	
%	1.2	7.4	32.9	57.1	1.4	100.0	90.1

"Correct" = "Very effective" and "Effective"

General knowledge of the sealants	Strongly Agree	Agree	Disagree	Strongly Disagree	Do not know	Valid Total	Correct
Sealants are not needed if patients receive topical fluorides (Q14.1) (n=)	6	16	194	206	12	434	
%	1.4	3.7	44.7	47.5	2.8	100.0	92.2
Use of sealants is not substantiated by scientific research (Q14.2) (n=)	7	18	168	207	30	430	
%	1.6	4.2	39.1	48.1	7.0	100.0	87.2
Newly erupted permanent molars are the most important candidates for sealants (Q14.3) (n=)	205	165	19	32	13	434	
%	47.2	38.0	4.4	7.4	3.0	100.0	85.3
Loss of sealants is generally attributed to inappropriate application technique (Q14.4) (n=)	83	220	95	8	26	432	
%	19.2	50.9	22.0	1.9	6.0	100.0	70.1
Sealants are somewhat risky because decay may be sealed in the tooth (Q14.5) (n=)	4	126	218	75	13	436	
%	0.9	28.9	50.0	17.2	3.0	100.0	67.2

"Correct" = "Strongly Agree" and "Agree", "Strongly Disagree" and "Disagree", or "Do not know"

Dental Sealants Practice

How many dentists are using dental sealants?

Many dentists (88.4%, N=430) of the dentists report providing dental sealants.

What percent of children under 20 years whose dentists chose "Yes" to item 10a do receive dental sealant?

Many dentists (45.3%) reported providing dental sealants to over 75% of their child patients.

Table 10: Percentage of patients for whom dentists provide dental sealants

	Frequency	Valid Percent
None	1	.3
10% or less	18	4.8
11-25%	29	7.7
26-50%	58	15.5
51-75%	99	26.4
over 75%	170	45.3
Total	375	100.0

Within the dentists who chose "Yes" in Q10a (Whether use dental sealants for child/ youth patients)

What is the reason why they do not provide dental sealant? (Table 11)

The predominant reason for not providing dental sealants was that “Patients are unwilling to pay for them”(45.5%) followed by ”Insurance does not pay for it” (25.5%) and “Parents unfamiliar with the procedure” (7.9%).

Table 11: Reasons for not providing dental sealants

The reason of not providig sealants (Q11)	Frequency	Percent in total (N=605)
Patients are unwilling to pay for them	275	45.5
Insurance does not pay for it	154	25.5
Parents unfamiliar with the procedure	48	7.9
Decay can develop under a sealant	36	6.0
Possible to seal in decay	31	5.1
Other	20	3.3
Sealants do not last very long	11	1.8
I have had poor experience with sealants	11	1.8
It is more economical to place amalgam or composite fillings as needed	9	1.5
Technique is too difficult	7	1.2
Use of sealants are unsubstantiated by research	6	1.0
Too time consuming to apply	5	.8
Office policy does not support use of sealant	1	.2

RQ2: Do dentists educate patients about caries prevention?

Are they providing information about fluoride for home use?

Most dentists (90.3%, N=434) reported providing or recommending fluoride products for child patients for home use.

Do they provide caries preventive education?

Most dentists (92.8%, N=418) reported they provide caries prevention education for children and their parents.

*For each age group, are they providing necessary information about fluoride and dental sealants? (Table 12) (*Among those dentists who chose "Yes" in Q 13a: "Do you or members of your team provide caries preventive education for children and their parents?"*)*

a. *Education about fluoride drops/tablets, community water fluoridation, mechanism of fluoride action, use of fluoride dentifrice and home fluoride rinses for children ages 6 months to 2 years.*

Overall, they were less likely to provide fluoride information to this age group. The highest percentage was for "Community water fluoridation"(60.3%) and only 37.6% of the dentists were educating about "Use of fluoride dentifrice".

b. *Education about home fluoride gels, fluoride drops/tablets, community water fluoridation, mechanism of fluoride action, pit and fissure sealants, use of fluoride dentifrice and home fluoride rinses for children ages 3 to 6 years.*

For this age group dentists were more likely to educate about “Use of fluoride dentifrice”(78.9%), “Community water fluoridation”(72.7%) and “Pit and fissure sealants”(65.7%).

c. *Education about home fluoride gels, fluoride drops/tablets, community water fluoridation, mechanism of fluoride action, pit and fissure sealants, use of fluoride dentifrice and home fluoride rinses for children ages 7 to 20 years.*

For this age group dentists were more likely to educate about “Use of fluoride dentifrice”(87.4%), “Pit and fissure sealants”(85.6%) and “Community water fluoridation”(69.8%). Compared with the age group of 3 to 6 years, dentists were more likely to educate about “Use of fluoride dentifrice” (from 78.9% to 87.4%) and “Pit and fissure sealant”(from 65.7% to 85.6%).

Overall

All of the percentages of correct responses were lower than 95% (22.9% to 87.4%). Dentist were more likely to educate about fluoride dentifrice when children were over 3 years of age but were less likely to educate about the mechanism of fluoride action to any group.

Table 12: Contents of the education provided patients and parents? (N=388)

	Frequency	Valid percent
Children Age 6 months to 2 years		
Fluoride drops/tablets (Q13b.6)	162	41.8
Community water fluoridation (Q13b.8)	234	60.3
Mechanism of fluoride action (Q13b.9)	89	22.9
Use of fluoride dentifrice (Q13b.13)	146	37.6
Children Ages 3 to 6 years		
Home fluoride gels (Q13b.5)	136	35.1
Fluoride drops/tablets (Q13b.6)	217	55.9
Community water fluoridation (Q13b.8)	282	72.7
Mechanism of fluoride action (Q13b.9)	139	35.8
Pit and fissure sealants (Q13b.10)	255	65.7
Use of fluoride dentifrice (Q13b.13)	306	78.9
Home fluoride rinses (Q13b.14)	189	48.7
Youth Ages 7 to 20		
Home fluoride gels (Q13b.5)	189	48.7
Fluoride drops/tablets (Q13b.6)	168	43.3
Community water fluoridation (Q13b.8)	271	69.8
Mechanism of fluoride action (Q13b.9)	171	44.1
Pit and fissure sealants (Q13b.10)	332	85.6
Use of fluoride dentifrice (Q13b.13)	339	87.4
Home fluoride rinses (Q13b.14)	273	70.4

RQ 3: Are dentists' characteristics associated with their knowledge and practice?

Bivariate Analysis

The chi-square test was conducted for the categorical data, and the t-test was conducted for the continuous data. For some characteristics, there were not enough cases for chi-square. These included dentists' primary occupation (Q23), their practice setting (Q24), country of origin (Q25), country they received dental training (Q26) and whether or not they have patients ages 0-20 years (Q1). Therefore they were excluded from the analyses. The analyzed characteristics were a) dentists characteristics: their experience of dental caries prevention course excluding what they learned in dental school (Q20), interest in attending a continuing education course on dental caries prevention (Q21), year of graduation (Q27), gender (Q28), race/ethnicity (Q29), perception of their dental school's training regarding dental caries prevention (Q30), and specialty (general dentists or pediatric dentists), also b) their child patients' characteristics; which included the distribution of ages of their child/youth patients (Q2a.1, Q2a.2 and Q2a.3) and the health insurance status of their child/youth patients (Q2b.1, Q2b.2 and Q2b.3). Although these variables of the child's characteristics are continuous, because of the significant skew of the data distribution, Q2a.1 and Q2b.1 were converted to categorical data. Additionally, Race/ethnicity (Q29) was recorded into "White" or "Not White" and Year of graduation (Q27) was recorded into "Graduate dental school before 1990" or "Graduate 1990 or later".

Dentists' characteristics

Following *a* and *b* sections address the following questions; *What dentists' characteristics are related to their knowledge of fluoride*? : *What dentists' characteristics are related to their fluoride practices?* : *What dentists' characteristics are related to their knowledge of dental sealants?* : *What dentists' characteristics are related to their practice of dental sealant application?* : *What dentists' characteristics are related to providing fluoride and dental sealants education?*

a. Gender (Q28), Specialty (source of data) and Race (Q29) (Table 13)

Gender: Compared to females, males were significantly more likely to understand about the effectiveness of dietary fluoride drops/ tablets for children 6 month to 2 years and for children 3 to 6years and the effectiveness of fluoride gel in mouth trays and fluoride foam for the children of 3 to 6 years.

Females were significantly more likely to understand the effectiveness of the fluoride varnish for children of 3 to 6 years and the effectiveness of fluoride rinse at home for the children 7 to 20 years. Additionally, females were significantly more likely to know the predominant theory of fluoride function and the correct frequency of topical fluoride applications. Furthermore, females were significantly more likely to provide dental sealants and provide and recommend fluoride products for their child patients for home use.

Specialty: Compared to pediatric dentists general dentists were significantly more likely to know correctly the effectiveness of community water fluoridation and dietary fluoride drop/ tablets for children of 6 month to 2 years, the effectiveness of

dietary fluoride drops/ tablets, fluoride rinse at school, fluoride gel in mouth tray and fluoride foam for children 3 years to 6 years of age.

Pediatric dentists were significantly more likely to know about the effectiveness of fluoride varnish for children 6 month to 2 years, 3 to 6 years, and 7 to 20 years. Additionally, pediatric dentists were significantly more likely to have general knowledge and knowledge about the frequency of topical fluoride application compared to general dentists. Furthermore, pediatric dentists understand general knowledge about the dental sealants, and they are significantly more likely to provide dental sealants to their patients (100% compared to 85.8%). Pediatric dentists are also significantly more likely than general dentists to provide prevention education (100% compared to 91.2%).

Race: There were a few items identified as a statistically different between "White" and "Not white". Compared to "Not White", "White" dentists were significantly more likely to know the effectiveness of dietary fluoride drops/ tablets for children 6 months to 2 years and 3 to 6 years.

Summary: Compared to females, males were significantly more likely to understand the effectiveness of fluoride application for dental caries prevention, but females were significantly more likely to know the predominant theory of fluoride function and the correct frequency of topical fluoride application, and more likely to provide dental sealants and recommend the fluoride products for their child patients for home use. General dentists were significantly more likely to understand the effectiveness of fluoride application in some items, but regarding fluoride varnish for all age groups, pediatric dentists were significantly more likely to understand their

effectiveness. Additionally, pediatric dentists were significantly more likely to have general knowledge of fluoride and dental sealants and the recommended frequency of professional fluoride application, and more likely to provide dental sealants and education to their child patients.

Table 13: Knowledge, practices and education of dental caries prevention by Gender, Specialty and Race

Knowledge of effectiveness of fluoride	Gender (Q28)		Specialty (source of data)		Race (Q29)	
	Female	Male	Pediatric	General	White	Not White
Children: 6 mo. – 2 yrs.						
Community water fluoridation (4a.1)	88.1	89.8	82.1	90.8 *	88.1	96.1 *
Dietary fluoride drops/tablets (4a.2)	61.5	75.9 **	53.8	75.4 **	74.3	62.5 *
Fluoride dentifrices (4a.3)	66.1	66.9	74.3	64.8	66.0	71.2
Fluoride Varnish (4a.4)	75.0	67.2	89.5	65.4 **	67.8	78.1
Children: 3 – 6 yrs.						
Community water fluoridation (5a.1)	90.6	94.6	88.5	94.4	94.4	92.1
Dietary fluoride drops/tablets (5a.2)	70.4	82.3 **	66.7	81.5 **	81.3	70.3 *
Fluoride dentifrices (5a.3)	88.0	84.2	87.2	84.4	83.9	94.6 *
Fluoride varnish (5a.4)	85.6	76.8 *	89.6	76.6 *	78.4	84.9
Topical fluorides-professional (5a.6)	87.3	82.8	88.3	83.0	82.7	90.5
Fluoride rinse-at home (5a.7)	73.0	73.1	68.4	73.4	71.9	78.4
Fluoride rinse –at school (5a.8)	43.5	52.9	38.7	52.4 *	48.6	55.6
Brush-on fluoride gels (5a.9)	66.9	71.2	69.7	69.3	69.1	74.6
Fluoride gel in mouth tray (5a.10)	64.5	74.9 *	61.1	73.6 *	71.6	72.6
Fluoride foam (5a_11)	54.0	64.3 *	44.0	64.7 **	62.4	56.9
Children: 7 – 20 yrs.						
Community water fluoridation (6a.1)	80.2	84.7	82.7	83.6	85.2	77.3
Dietary fluoride drops/ tablets (6a.2)	56.5	60.3	58.7	59.4	60.8	54.2
Fluoride dentifrices (6a.3)	87.8	84.6	87.8	84.8	85.3	86.5
Fluoride varnish (6a.4)	82.4	76.1	89.5	75.8 **	77.7	81.3
Topical fluorides-professional (6a.6)	87.9	83.0	89.3	83.5	83.4	90.4
Fluoride rinse-at home (6a.7)	79.8	68.8 *	75.7	71.1	70.1	79.7
Fluoride rinse –at school (6a.8)	54.1	49.8	50.0	51.8	51.7	50.7
Brush-on fluoride gels (6a.9)	75.8	69.1	78.1	69.4	70.4	72.6
Fluoride gel in mouth tray (6a.10)	70.7	74.1	69.0	74.2	73.7	72.2
Fluoride foam (6a_11)	58.5	59.6	53.5	61.0	60.8	54.3

* p<0.05, **p<0.01

Table 13: Knowledge, practices and education of dental caries prevention by Gender, Specialty and Race

General knowledge of fluoride (% correct)	Gender (Q28)			Specialty (source of data)			Race (Q29)		
	Female	Male		Pediatric	General		White	Not White	
It is desirable to use professionally applied fluorides for all children in areas without fluoridated water(Q14.6)	89.8	90.7		92.3	89.5		89.8	92.1	
The most important mechanism of action of fluoride is that it is incorporated into developing teeth to make them more resistant to acid demineralization(Q14.7)	13.4	6.8	*	16.7	7.6	*	9.2	7.9	
The increased use of bottled water increases tooth decay among young children(Q14.8)	10.9	15.3		13.9	14.3		13.0	16.9	
Incipient carious lesions (before cavitation) can be remineralized (healed)(Q14.11)	88.3	88.1		96.2	86.5	*	89.3	81.8	
Dilute, frequently administered fluorides are more effective in caries prevention than more concentrated, less frequently administered fluorides(Q14.13)	35.2	43.3		51.9	37.9	*	40.9	38.2	
The most important mechanism of action of fluoride is the remineralization of incipient decay(Q14.14)	61.7	48.8	*	68.4	49.6	**	49.4	66.7	**

* $p<0.05$, ** $p<0.01$

Table 13: Knowledge, practices and education of dental caries prevention by Gender, Specialty and Race

Practice of fluoride products (% correct)	Gender (Q28)			Specialty (source of data)			Race (Q29)		
	Female	Male		Pediatric	General		White	Not White	
The frequency of topical fluoride treatments provided to child patients									
6 months - 2 years (Q7.1)	55.6	39.6	**	68.4	39.5	**	42.4	52.7	
3 - 6 years (Q7.2)	87.3	72.5	**	96.1	72.1	**	74.2	88.2	**
7 - 20 years (Q7.3)	88.9	78.0	**	94.7	78.0	**	80.2	87.0	
Type of fluoride and the application time most often used for in-office treatments (% correct in person									
APF gel (Q8.1)	27.1	21.4		27.0	22.7		22.3	26.7	
APF foam (Q8.2)	17.6	19.5		9.1	20.4		18.6	14.3	
NaF gel (Q8.3)	15.0	26.6		35.7	21.4		27.4	10.0	
NaF rinse (Q8.4)	43.8	61.0		40.0	58.6		61.4	50.0	
SnF2 (Q8.5)	8.3	16.1		0.0	15.4		13.3	20.0	

* $p<0.05$, ** $p<0.01$

Table 13: Knowledge, practices and education of dental caries prevention by Gender, Specialty and Race

Knowledge of effectiveness of Pit & Fissure Sealants (% correct)	Gender (Q28)		Specialty (source of data)		Race (Q29)	
	Female	Male	Pediatric	General	White	Not White
children 3 - 6 years of age (Q5a.5)	83.2	82.9	87.0	81.9	83.6	85.3
children 7 - 20 years of age (Q6a.5)	92.8	88.8	93.4	89.4	91.4	86.7
General knowledge of the sealants (% correct)						
Sealants are not needed if patients receive topical fluorides (Q14.1)	94.5	90.8	96.2	91.3	91.7	94.7
Use of sealants is not substantiated by scientific research (Q14.2)	89.0	86.0	96.2	85.2 **	87.2	88.3
Newly erupted permanent molars are the most important candidates for sealants (Q14.3)	90.6	83.6	87.2	84.8	84.3	92.1
Loss of sealants is generally attributed to inappropriate application technique (Q14.4)	71.7	69.6	75.9	68.8	69.9	72.4
Sealants are somewhat risky because decay may be sealed in the tooth (Q14.5)	70.3	66.3	81.0	64.1 **	69.5	62.3
Practice of sealants (% "Yes")						
Do you use sealants for your child/youth patients? (Q10a)	93.7	85.5 *	100.0	85.8 **	88.6	89.6

* $p<0.05$, ** $p<0.01$

Table 13: Knowledge, practices and education of dental caries prevention by Gender, Specialty and Race

Education (% "Yes")	Gender (Q28)		Specialty (source of data)		Race (Q29)	
	Female	Male	Pediatric	General	White	Not White
Do you provide/recommend fluoride products (gels, toothpaste, mouthrinses) for child patients for their home use? (Q9a)	94.5	88.1 *	93.7	89.6	90.5	87.0
Do you or members of your team provide caries preventive education for children and their parents? (Q13a)	95.9	91.8	100.0	91.2 **	93.1	93.4

* p<0.05, **p<0.01

b. Experience of additional prevention course excluding dental school (Q20), Interest in taking a prevention course (Q21), Graduation Year (Q27) and Rating on prevention education of their dental school (Q30) (Table 14)

Experience of having an additional prevention course: Dentist who had a caries prevention course excluding those taken in dental school were significantly more likely to understand the effectiveness of fluoride varnish for children 3 to 6 years and 7 to 20 years, correctly understand that making teeth more resistant to acid demineralization is not the most important mechanism of action of fluoride, and they report applying the topical fluoride applications at correct frequencies compared to dentists who never had such a course. Dentists who ever had a caries prevention course were significantly more likely to understand the effectiveness of dental sealants for children 3 to 6 and 7 to 20 years of age, have general knowledge of dental sealants and provide them to children compared to dentists who never had such a course. The dentists with the additional prevention course also were significantly more likely to provide education to their patients and conduct carious risk assessments.

Interest in a future prevention course: Dentists who were interested in attending a continuing education course on dental caries prevention were significantly more likely to know the effectiveness of fluoride varnish for children 6 months to 2 years, the effectiveness of fluoride varnish, fluoride rinse at home and brush on fluoride gel for the children of 3 to 6 years, and the effectiveness of fluoride varnish for the children of the 7 to 20 years compared to those who were not interested. Additionally, dentists who were interested in attending a continuing education course

on dental caries prevention were significantly more likely to know the predominant theory of the mechanism of action of fluoride and significantly more likely to provide topical fluoride applications at the correct frequency compared to dentists who were not interested in such a course. Dentists who were interested in attending a continuing education course on dental caries prevention were significantly more likely to know the effectiveness of dental sealants for children 3 to 6 years of age and significantly more likely to provide dental sealants to their patients. Additionally, they were significantly more likely to provide prevention education and conduct risk assessments compared to those who were not interested in such a course.

Graduation year: Those who graduated from dental school before 1990 were significantly more likely to understand the effectiveness of dietary fluoride drops/tablets for children 6 month to 2 years and 3 to 6 years compared to those who graduated 1990 or later. In contrast, dentists who graduated from dental school in 1990 or later were significantly more likely to know the effectiveness of fluoride varnish for children 6 month to 2 years and 3 to 6 years. Those who graduated in 1990 or later were significantly more likely to know the predominant theory of mechanism of fluoride action, and significantly more likely to provide topical fluoride application at a correct frequency than those who graduated earlier. Dentists who graduated earlier were significantly more likely to know that sealing incipient lesions with dental sealants is not risky.

Rating dental school prevention course: Those who rated their caries prevention education in their dental school as “Good” or “Very Good” were significantly more likely to know the effectiveness of dietary fluoride drop/ tablets,

topical fluoride by professional and fluoride rinse at home for the children of 7 to 20 years compared to those who rated “Poor/ Not Sure”. Those who rated their caries prevention education of their dental school as “Poor/ Not Sure” were significantly more likely to know that dilute frequently applied fluorides are more effective in caries prevention than more concentrated, less frequent applied fluorides and significantly more likely to know the loss of sealants is generally attributed to inappropriate application technique compared to the other group.

Summary: Dentists who graduated in 1990 or later had better knowledge about effectiveness of fluoride varnish, predominant theory of fluoride action, the frequency of professional topical fluoride application. The dentists who took additional dental caries prevention courses or who are interested in taking such a course had better knowledge of dental caries prevention.

Table14: Knowledge, practices and education of dental caries prevention by having a prevention course, interest in taking a prevention course, graduation year and rating of prevention education of their dental school

Knowledge of effectiveness of fluoride	Additional prevention program(Q20)		Prevention course (Q21)		Graduation Year(Q27)		Rating on preventio education(Q30)	
	Yes	No	Yes	No	Before 1990	1990 or later	Good	Poor/Not Sure
Children: 6 mo. – 2 yrs.								
Community water fluoridation (4a.1)	88.9	90.2	90.4	87.8	89.9	88.2	89.6	86.1
Dietary fluoride drops/tablets (4a.2)	70.4	73.4	71.2	71.5	77.4	62.0 **	72.3	63.9
Fluoride dentifrices (4a.3)	67.6	64.3	68.5	62.5	64.3	70.9	66.6	66.7
Fluoride Varnish (4a.4)	72.2	64.3	73.9	62.1 *	64.5	77.1 **	68.7	77.8
Children: 3 – 6 yrs.								
Community water fluoridation (5a.1)	93.9	92.2	95.1	91.0	93.5	93.4	93.3	94.4
Dietary fluoride drops/ tablets (5a.2)	78.8	77.8	77.9	79.5	83.3	69.5 **	79.6	66.7
Fluoride dentifrices (5a.3)	85.9	83.6	85.4	84.3	83.1	87.6	85.3	83.3
Fluoride varnish (5a.4)	81.9	73.2 *	84.2	70.2 **	74.3	86.8 **	78.4	88.6
Topical fluorides-professional (5a.6)	85.5	80.5	86.2	79.7	81.6	86.9	84.3	80.6
Fluoride rinse-at home (5a.7)	74.0	69.8	76.8	66.9 *	70.1	76.5	73.7	63.9
Fluoride rinse –at school (5a.8)	49.7	50.0	51.9	46.7	48.6	51.7	50.9	41.7
Brush-on fluoride gels (5a.9)	71.2	65.6	73.5	63.2 *	69.2	68.6	70.2	63.9
Fluoride gel in mouth tray (5a.10)	71.7	71.3	74.9	66.0	74.8	65.8	72.3	63.9
Fluoride foam (5a_11)	59.5	64.6	63.1	58.6	60.8	61.6	62.0	50.0
Children: 7 – 20 yrs.								
Community water fluoridation (6a.1)	84.8	81.1	84.2	84.1	83.0	83.6	83.9	77.1
Dietary fluoride drops/ tablets (6a.2)	59.2	57.7	56.4	63.5	59.1	58.3	61.0	37.1 **
Fluoride dentifrices (6a.3)	86.0	83.8	86.7	82.7	83.3	87.9	85.3	85.3
Fluoride varnish (6a.4)	82.4	68.5 **	82.2	70.5 **	76.0	81.6	78.1	80.0
Topical fluorides-professional (6a.6)	85.8	81.7	85.7	82.2	83.0	86.1	85.7	71.4 *
Fluoride rinse-at home (6a.7)	73.4	68.7	75.5	66.7	68.5	77.5	73.8	54.3 *
Fluoride rinse –at school (6a.8)	53.7	45.4	54.3	45.8	47.8	56.8	52.3	42.9
Brush-on fluoride gels (6a.9)	72.3	67.9	73.4	66.7	68.9	73.3	71.4	71.4
Fluoride gel in mouth tray (6a.10)	73.9	71.8	75.3	69.0	76.1	68.7	73.9	65.7
Fluoride foam (6a_11)	59.6	58.9	59.7	59.2	59.2	60.7	60.7	45.7

* $p<0.05$, ** $p<0.01$

Table14: Knowledge, practices and education of dental caries prevention by having a prevention course, interest in taking a prevention course, graduation year and rating of prevention education of their dental school

General knowledge of fluoride (% correct)	Additional prevention program(Q20)			Prevention course (Q21)			Graduation Year(Q27)			Rating on preventio education(Q30)		
	Yes	No		Yes	No		Before 1990	1990 or later		Good	Poor/Not Sure	
It is desirable to use professionally applied fluorides for all children in areas without fluoridated water(Q14.6)	91.0	88.4		90.3	89.7		91.1	88.7		90.1	91.2	
The most important mechanism of action of fluoride is that it is incorporated into developing teeth to make them more resistant to acid demineralization(Q14.7)	11.3	3.8	*	9.9	7.1		7.3	12.0		9.3	5.7	
The increased use of bottled water increases tooth decay among young children(Q14.8)	13.0	16.0		11.7	16.7		13.7	13.9		13.9	14.3	
Incipient carious lesions (before cavitation) can be remineralized (healed)(Q14.11)	88.6	87.0		90.1	85.8		86.2	91.4		88.3	82.9	
Dilute, frequently administered fluorides are more effective in caries prevention than more concentrated, less frequently administered fluorides(Q14.13)	43.4	33.6		41.5	38.1		40.3	41.1		39.2	58.8	*
The most important mechanism of action of fluoride is the remineralization of incipient decay(Q14.14)	53.3	51.2		58.3	43.1	**	43.8	66.4	**	52.9	51.4	

* p<0.05, **p<0.01

Table14: Knowledge, practices and education of dental caries prevention by having a prevention course, interest in taking a prevention course, graduation year and rating of prevention education of their dental school

Practice of fluoride products (% correct)	Additional prevention program(Q20)		Prevention course (Q21)		Graduation Year(Q27)		Rating on preventio education(Q30)	
	Yes	No	Yes	No	Before 1990	1990 or later	Good	Poor/Not Sure
The frequency of topical fluoride treatments provided to child patients								
6 months - 2 years (Q7.1)	48.9	34.4 **	49.4	36.9 *	39.1	54.0 **	44.7	40.6
3 - 6 years (Q7.2)	81.0	67.5 **	82.6	66.4 **	72.0	84.0 **	76.7	78.1
7 - 20 years (Q7.3)	84.8	73.8 **	86.2	72.7 **	77.7	86.8 *	81.8	75.8
Type of fluoride and the application time most often used for in-office treatments (% correct in person exclusing do not use)								
APF gel (Q8.1)	23.9	21.2	20.8	29.8	28.2	14.3	23.1	20.0
APF foam (Q8.2)	19.0	18.6	21.0	15.8	21.3	14.0	19.8	10.0
NaF gel (Q8.3)	23.4	26.3	23.7	26.1	29.1	11.5	23.7	14.3
NaF rinse (Q8.4)	57.7	56.5	54.7	61.9	60.4	53.8	56.5	66.7
SnF2 (Q8.5)	11.8	22.2	12.5	18.2	16.0	6.7	12.8	25.0

* $p<0.05$, **$p<0.01$

Table14: Knowledge, practices and education of dental caries prevention by having a prevention course, interest in taking a prevention course, graduation year and rating of prevention education of their dental school

Knowledge of effectiveness of Pit & Fissure Sealants (% correct)	Additional prevention program(Q20) Yes	No		Prevention course (Q21) Yes	No		Graduation Year(Q27) Before 1990	1990 or later		Rating on preventio education(Q30) Good	Poor/Not Sure	
children 3 - 6 years of age (Q5a.5)	86.2	76.0	**	86.6	76.6	**	81.7	84.9		83.5	77.8	
children 7 - 20 years of age (Q6a.5)	93.1	83.2	**	91.9	86.6		88.1	92.8		90.7	82.9	
General knowledge of the sealants (% correct)												
Sealants are not needed if patients receive topical fluorides (Q14.1)	94.5	86.9	**	94.7	88.4	*	90.4	94.7		92.5	85.7	
Use of sealants is not substantiated by scientific research (Q14.2)	90.3	80.2	**	88.1	86.5		85.3	90.1		87.0	85.7	
Newly erupted permanent molars are the most important candidates for sealants (Q14.3)	87.3	80.8		85.2	85.7		84.3	87.3		86.3	77.1	
Loss of sealants is generally attributed to inappropriate application technique (Q14.4)	72.3	64.9		71.0	67.5		68.1	75.3		69.1	85.7	*
Sealants are somewhat risky because decay may be sealed in the tooth (Q14.5)	72.9	55.0	**	68.1	67.3		72.1	59.6	**	68.6	57.1	
Practice of sealants (% "Yes")												
Do you use sealants for your child/youth patients? (Q10a)	94.8	73.1	**	93.1	79.6	**	86.0	90.7		88.8	78.8	

* p<0.05, **p<0.01

Table14: Knowledge, practices and education of dental caries prevention by having a prevention course, interest in taking a prevention course, graduation year and rating of prevention education of their dental school

Education (% "Yes")	Additional prevention program(Q20)		Prevention course (Q21)		Graduation Year(Q27)		Rating on preventio education(Q30)	
	Yes	No	Yes	No	Before 1990	1990 or later	Good	Poor/Not Sure
Do you provide/recommend fluoride products (gels, toothpaste, mouthrinses) for child patients for their home use? (Q9a)	93.2	83.8 **	93.2	85.1 **	87.7	93.3	90.7	81.8
Do you or members of your team provide caries preventive education for children and their parents? (Q13a)	98.9	80.0 **	96.4	87.2 **	93.5	92.5	93.3	90.9

c. Overall Summary of dentists' characteristics

Regarding the effectiveness of fluoride applications, males compared to females, general dentists compared to pediatric dentists, dentists who took additional dental caries prevention course or who are interested in such a course compared to others had better knowledge. But regarding the effectiveness of fluoride varnish for children 6 months to 6 years, pediatric dentists compared to general dentists, those who graduated in 1990 or later compared to those who graduated earlier had better knowledge.

Regarding general knowledge of fluoride, females compared to males, pediatric dentists compared to general dentists had better knowledge. Regarding the frequency of topical fluoride applications, females, pediatric dentists, those who graduated in1990 or later and dentists who took additional dental caries prevention courses or who were interested in such a course had better knowledge.

Regarding knowledge of dental sealants, pediatric dentists, the dentists who took additional dental caries prevention program or who are interested in a course had better knowledge.

Regarding dental sealant practice, females, pediatric dentists, dentists who took additional dental caries prevention program or who are interested in a course were more likely to provide dental sealants than their counter parts.

Regarding education, females, pediatric dentists, dentists who took additional dental caries prevention course or who are interested in doing so were more likely to provide dental caries prevention education than their counter parts.

Child patients' characteristics

Following *d* and *e* sections addresses the following question: *What child patients' characteristics are related to dentists' knowledge of fluoride*? : *What child patients' characteristics are related to their fluoride practices?* : *What child patients' characteristics are related to their knowledge of dental sealants?* : *What child patients' characteristics are related to their practice of dental sealant application?* : *What child patients' characteristics are related to providing fluoride and dental sealants education?*

d. Percentage of Patients 6 month to 2 years (Q2a.1), Percentage of patients 3 to 6 years (Q2a.2) and Percentage of patients 7 to 20 years (Q2a.3) (Table 15)

Although the distribution of the age range of their child/youth patients (Q2a.1, Q2a.2 and Q2a.3) was continuous data, because of the significant data skew, Q2a.1 was converted to categorical data.

6 month to 2 years: The dentists who see patients 6 months to 2 years were significantly more likely to know the effectiveness of fluoride varnish for children 6 months to 2 years, the effectiveness of fluoride rinse at home for children 3 to 6 years, and the effectiveness of fluoride dentifrices for children 7 to 20 years compared with dentists who do not see patients 6 months to 2 years. The dentists who never see children 6 months to 2 years were significantly more likely to know the effectiveness of dietary fluoride drops/ tablets for children 6 months to 2 years. Dentists who see patients 6 months to 2 years were significantly more likely to have general knowledge about fluoride, provide fluoride to their patients at correct frequencies, use dental

sealants, and conduct risk assessments compared to those dentists who do not see any children 6 month to 2 years.

3 to 6 years: Dentists who responded correctly regarding the effectiveness of fluoride dentifrices and fluoride varnish for children 6 months and 2 years, the effectiveness of fluoride dentifrices, fluoride varnish, topical fluoride application by professionals for children 3 years to 6 years, and the effectiveness of fluoride dentifrices, fluoride varnish and topical fluoride application by professional for the children of 7 to 20 years were significantly more likely to see patients 3 to 6 years of age compared to dentists who responded incorrectly. Dentists who answered incorrectly regarding the effectiveness of dietary fluoride drops/ tablets for children 6 months to 2 years were significantly more likely to see children 3 to 6 years compared to those who chose the correct answers.

The dentists with correct knowledge of the predominant theory of fluoride function and the frequency of the topical fluoride treatment were significantly more likely to see patients 3 to 6 years than those who answer incorrectly. Dentists who responded correctly about the effectiveness of dental sealants for children 7 to 20 years and about the general knowledge of dental sealants were significantly more likely to see children 3 to 6 years compared to those who responded incorrectly. Dentists who provide dental sealants and provide prevention education were significantly more likely to see children 3 to 6 years compared to those who do not.

7 to 20 years: Dentists who answered incorrectly about the effectiveness of fluoride varnish for children 6 months to 2 years, fluoride varnish and topical fluoride application by professionals for children 3 to 6 years, the effectiveness of fluoride

varnish and topical fluoride application by providers for children 7 to 20 years were significantly more likely to see patients 7 to 20 years compared with who answered correctly. Dentists who answered correctly about the effectiveness of dietary fluoride drops/ tablets for children 6 month to 2 years and 3 to 6 years were significantly more likely to see patients children 7 to 20 years compared to those who answered incorrectly. Dentists who do not believe that incipient carious lesions can be remineralized and who do not use topical fluoride application at appropriate frequencies were significantly more likely to see patients 7 to 20 years compared to those who believe the primary way fluoride works is that it remineralizes incipient caries lesions and who provide topical fluoride at correct frequencies. The dentists who responded incorrectly about the general knowledge of dental sealants were significantly more likely to see patients 7 to 20 years compared to those who responded correctly. Dentists who do not provide dental sealants and prevention education and do not conduct risk assessments were significantly more likely to see patients 7 to 20 years compared to dentists who do.

Summary: The dentists who see children 6 months to 2 years or who see more children 3 to 6 years were more likely to have correct knowledge of the effectiveness of fluoride application of dental caries prevention, to have general knowledge of fluoride, to know the correct frequency of topical fluoride application, and to know about dental sealants and provide it to their children.

Table 15: Knowledge, practices and education of dental caries prevention by with patients' age range

Knowledge of effectiveness of fluoride	Percentage of dentists of who got correct answer in each group			Mean (standard deviation) percentage of patients treated by Dentists with correct or incorrect knowledge									
	Patients percentage of 6 month-2 years(Q2a-1)			Patients 3 – 6 yrs					Patients 7 – 20 yrs				
	0%	Any		Correct		Not Correct			Correct		Not Correct		
Children: 6 mo. – 2 yrs.				Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Community water fluoridation (4a.1)	91.9	86.4		25.54	(17.54)	30.22	(18.70)		67.06	(23.98)	63.54	(24.27)	
Dietary fluoride drops/tablets (4a.2)	75.9	65.3	*	24.5	(17.17)	29.86	(18.57)	**	68.86	(22.98)	61.32	(25.68)	**
Fluoride dentifrices (4a.3)	62.7	71.0		27.36	(18.48)	23.39	(16.17)	*	65.11	(24.55)	69.52	(23.01)	
Fluoride Varnish (4a.4)	65.4	76.7	*	28.53	(18.66)	19.95	(13.93)	**	62.93	(24.76)	75.09	(20.40)	**
Children: 3 – 6 yrs.													
Community water fluoridation (5a.1)	94.5	91.7		25.80	(17.44)	27.89	(20.69)		67.52	(23.39)	56.93	(29.10)	
Dietary fluoride drops/ tablets (5a.2)	82.5	74.9		25.86	(17.16)	26.99	(19.78)		68.16	(22.53)	60.54	(28.12)	*
Fluoride dentifrices (5a.3)	83.4	87.5		27.22	(17.88)	19.25	(15.34)	**	65.94	(23.68)	70.29	(25.90)	
Fluoride varnish (5a.4)	77.2	83.3		27.63	(17.27)	19.72	(18.33)	**	64.52	(23.42)	75.38	(24.42)	**
Topical fluorides-professional (5a.6)	81.6	87.5		27.07	(17.73)	20.66	(16.74)	**	65.55	(23.84)	72.09	(24.27)	*
Fluoride rinse-at home (5a.7)	67.3	76.3	*	26.18	(17.69)	25.57	(18.00)		66.55	(23.79)	66.86	(24.80)	
Fluoride rinse –at school (5a.8)	50.9	49.5		25.51	(17.15)	26.59	(18.40)		68.89	(22.44)	64.27	(25.36)	
Brush-on fluoride gels (5a.9)	69.8	70.9		26.91	(17.53)	23.86	(18.16)		66.58	(23.14)	66.71	(26.17)	
Fluoride gel in mouth tray (5a.10)	75.8	68.2		25.69	(17.80)	26.26	(17.81)		68.38	(23.18)	63.29	(25.63)	
Fluoride foam (5a_11)	65.6	57.5		25.49	(17.45)	26.51	(18.36)		68.31	(23.27)	64.47	(25.16)	
Children: 7 – 20 yrs.													
Community water fluoridation (6a.1)	80.0	85.7		26.21	(17.71)	24.05	(17.45)		66.88	(23.62)	66.98	(25.91)	
Dietary fluoride drops/ tablets (6a.2)	56.9	62.2		26.28	(17.27)	25.56	(18.28)		67.55	(22.71)	65.38	(25.78)	
Fluoride dentifrices (6a.3)	81.5	89.7	*	26.96	(17.61)	19.70	(16.90)	**	66.22	(23.43)	69.78	(26.81)	
Fluoride varnish (6a.4)	77.8	81.9		27.80	(17.67)	18.66	(15.69)	**	65.21	(23.69)	72.84	(24.16)	**
Topical fluorides-professional (6a.6)	84.7	85.3		27.00	(17.82)	19.97	(15.58)	**	65.74	(24.01)	72.60	(23.16)	*
Fluoride rinse-at home (6a.7)	67.3	75.8		26.79	(17.36)	23.45	(18.32)		65.76	(23.66)	69.61	(24.75)	
Fluoride rinse –at school (6a.8)	50.9	54.1		26.53	(17.39)	25.09	(18.04)		66.93	(23.06)	67.21	(24.97)	
Brush-on fluoride gels (6a.9)	69.8	73.4		26.75	(17.64)	23.45	(17.64)		66.49	(23.61)	68.09	(24.89)	
Fluoride gel in mouth tray (6a.10)	77.8	70.0		25.97	(17.70)	25.32	(17.86)		67.91	(23.53)	64.66	(25.09)	
Fluoride foam (6a_11)	63.4	57.6		27.22	(17.77)	23.95	(17.66)		67.31	(23.31)	66.12	(25.07)	

* $p<0.05$, ** $p<0.01$

Table 15: Knowledge, practices and education of dental caries prevention by with patients' age range

General knowledge of fluoride	Percentage of dentists of who got correct answer in each group			Mean (standard deviation) percentage of patients treated by Dentists with correct or incorrect knowledge								
	Patients percentage of 6 month-2 years(Q2a-1)			Patients 3 – 6 yrs					Patients 7 – 20 yrs				
	0%	Any		Correct		Not Correct			Correct		Not Correct		
				Mean	SD	Mean	SD		Mean	SD	Mean	SD	
It is desirable to use professionally applied fluorides for all children in areas without fluoridated water(Q14.6)	89.4	90.7		25.68	(17.42)	28.37	(19.97)		66.43	(24.25)	68.55	(22.20)	
The most important mechanism of action of fluoride is that it is incorporated into developing teeth to make them more resistant to acid demineralization(Q14.7)	6.7	11.9		32.24	(22.36)	25.17	(17.05)		63.21	(24.37)	67.33	(23.90)	
The increased use of bottled water increases tooth decay among young children(Q14.8)	16.0	13.2		27.11	(20.74)	25.70	(17.18)		67.24	(26.66)	66.66	(23.61)	
Incipient carious lesions (before cavitation) can be remineralized (healed)(Q14.11)	84.7	92.0	*	26.61	(17.81)	21.14	(16.24)	*	65.47	(24.32)	75.71	(19.72)	**
Dilute, frequently administered fluorides are more effective in caries prevention than more concentrated, less frequentl(Q14.13)	39.1	39.8		26.34	(16.24)	25.63	(18.54)		65.75	(22.47)	67.28	(25.04)	
The most important mechanism of action of fluoride is the remineralization of incipient decay(Q14.14)	43.1	60.9	**	28.33	(17.35)	23.28	(17.82)	**	63.43	(23.49)	70.02	(24.31)	**

* p<0.05, **p<0.01

Table 15: Knowledge, practices and education of dental caries prevention by with patients' age range

	Percentage of dentists of who got correct answer in each group			**Mean (standard deviation) percentage of patients treated by Dentists with correct or incorrect knowledge**									
	Patients percentage of 6 month-2 years(Q2a-1)			Patients 3 – 6 yrs					Patients 7 – 20 yrs				
Practice of fluoride products	0%	Any		Correct		Not Correct			Correct		Not Correct		
The frequency of topical fluoride treatments provided to child patients				Mean	SD	Mean	SD		Mean	SD	Mean	SD	
6 months - 2 years (Q7.1)	24.3	61.3	**	30.36	(16.94)	22.47	(16.86)	**	57.33	(23.69)	73.19	(21.64)	**
3 - 6 years (Q7.2)	66.0	86.7	**	29.06	(17.12)	15.64	(14.86)	**	62.39	(23.04)	80.37	(21.11)	**
7 - 20 years (Q7.3)	73.2	88.9	**	28.05	(17.37)	16.41	(15.37)	**	63.85	(23.47)	79.26	(21.78)	**
Type of fluoride and the application time most often used for in-office treatments													
APF gel (Q8.1)	15.0	25.8		27.63	(16.64)	29.28	(17.95)		57.00	(25.25)	62.72	(23.14)	
APF foam (Q8.2)	16.7	19.3		25.71	(15.88)	25.32	(15.73)		69.48	(20.53)	68.88	(20.12)	
NaF gel (Q8.3)	25.9	25.0		26.13	(16.44)	24.68	(15.45)		64.61	(22.40)	68.90	(19.76)	
NaF rinse (Q8.4)	61.3	58.3		23.38	(17.38)	23.91	(13.67)		68.43	(23.39)	71.69	(16.63)	
SnF2 (Q8.5)	11.8	10.0		14.80	(7.26)	22.37	(16.84)		81.00	(13.42)	68.74	(23.74)	

* $p<0.05$, **$p<0.01$

Table 15: Knowledge, practices and education of dental caries prevention by with patients' age range

	Percentage of dentists of who got correct answer in each group			Mean (standard deviation) percentage of patients treated by Dentists with correct or incorrect knowledge									
	Patients percentage of 6 month-2 years(Q2a-1)			Patients 3 – 6 yrs					Patients 7 – 20 yrs				
	0%	Any		Correct		Not Correct			Correct		Not Correct		
Knowledge of effectiveness of Pit & Fissure Sealants				Mean	SD	Mean	SD		Mean	SD	Mean	SD	
children 3 - 6 years of age (Q5a.5)	84.0	83.6		26.63	(17.70)	23.00	(17.59)		66.40	(23.41)	68.05	(26.58)	
children 7 - 20 years of age (Q6a.5)	92.6	89.4		26.50	(17.59)	20.29	(17.23)	*	66.46	(23.70)	70.21	(26.15)	
General knowledge of the sealants													
Sealants are not needed if patients receive topical fluorides (Q14.1)	92.0	93.8		26.68	(17.57)	16.77	(16.47)	**	65.99	(23.88)	75.39	(24.17)	*
Use of sealants is not substantiated by scientific research (Q14.2)	89.4	87.2		26.68	(17.68)	19.76	(17.13)	*	65.88	(24.08)	73.64	(23.03)	*
Newly erupted permanent molars are the most important candidates for sealants (Q14.3)	84.7	85.1		26.38	(17.53)	23.67	(18.37)		66.16	(23.81)	69.36	(24.99)	
Loss of sealants is generally attributed to inappropriate application technique (Q14.4)	65.4	72.6		26.65	(17.62)	24.55	(17.79)		66.44	(23.58)	66.94	(25.08)	
Sealants are somewhat risky because decay may be sealed in the tooth (Q14.5)	64.4	67.5		27.27	(18.12)	23.11	(16.54)	*	64.34	(24.95)	71.59	(21.35)	**
Practice of sealants				Yes		No			Yes		No		
Do you use sealants for your child/youth patients? (Q10a) (Yes)	83.4	93.4	**	27.99	(17.23)	8.94	(11.52)	**	64.04	(23.31)	87.36	(18.82)	**

* p<0.05, **p<0.01

Table 15: Knowledge, practices and education of dental caries prevention by with patients' age range

	Percentage of dentists of who got correct answer in each group		**Mean (standard deviation) percentage of patients treated by Dentists with correct or incorrect knowledge**								
	Patients percentage of 6 month-2 years(Q2a-1)		Patients 3 – 6 yrs					Patients 7 – 20 yrs			
	0%	Any	Yes		No			Yes		No		
Education			Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Do you provide/recommend fluoride products (gels, toothpaste, mouthrinses) for child patients for their home use? (Q9a)	88.3	93.0	26.42	(17.11)	20.35	(22.58)		65.87	(23.37)	74.91	(28.61)	*
Do you or members of your team provide caries preventive education for children and their parents? (Q13a)	91.0	95.5	27.30	(17.45)	9.74	(12.44)	**	64.86	(23.70)	86.25	(18.20)	**

e. Percentage of Patients covered by *Medicaid or SCHIP (2b.1), Percentage of patients with commercial / private insurance (Q2b.2) and Percentage of patients who are out of pocket payers (Q2b.3). (Table 16)*

Although the distribution of the insurance status of their child/youth patients (Q2b.1, Q2b.2 and Q2b.3) was continuous data, because of the significant data skew, Q2b.1 was converted to categorical data.

Medicate or SCHIP: Dentists who do not accept Medicaid or SCHIP children were significantly more likely to know the correct answer about the effectiveness of dietary fluoride drops/ tablets for the children of 6 months to 2 years, the effectiveness of the dietary fluoride drops/ tablet, fluoride rinse at school, fluoride gel in mouth tray and fluoride foam for the children of 3 to 6 years, and the effectiveness of dietary fluoride drop/tablets for children 7 to 20 years compared to dentists who see children with Medicaid or SCHIP. The dentists who see Medicaid or SCHIP children were significantly more likely to know correctly the answer about the effectiveness of the fluoride varnish for children 6 months to 2 years and more likely to provide topical fluoride application at correct frequencies compared to dentists who don't. Dentists who see children with Medicaid or SCHIP were significantly more likely to answer correctly about general knowledge of dental sealants compared to dentists who don't.

Commercial or private insurance: The dentists who knew the correct answer about the effectiveness of community water fluoridation and dietary fluoride drops/ tablets for children of 6 month to 2 years and the effectiveness of dietary fluoride

drops and fluoride rinse at school for children 3 to 6 years were significantly more likely to see children with commercial or private insurance compared to those who chose incorrect answers. The dentists who do not provide caries prevention education were significantly more likely to see the patients with commercial and private insurance than those who do provide education.

Out of pocket: Those who chose the correct answer about the effectiveness of brush-on fluoride gels for children 3 to 6 years and those who provide topical fluoride treatments at an incorrect frequency were more likely to have patients who pay out of pocket compared to those who choose incorrect answer at effectiveness and correct frequency. Those who provide caries prevention education were more likely to see children who pay out of pocket compared to the dentists who don't.

Summary: The dentists who accept Medicaid or SCHIP insured children were less likely to know the effectiveness of fluoride application compared to others, but they have a better understanding about the correct frequency of topical fluoride application and about dental sealants.

Table 16: Knowledge, practices and education of dental caries prevention by type of patients' insurance

Knowledge of effectiveness of fluoride	Percentage of dentists of who got correct answer in each group			Mean (standard deviation) percentage of patients treated by Dentists with correct or incorrect knowledge								
	Percentage of the Medicaid or SCHIP(2b-1)			Commercial/private insurance					Out of pocket payer				
	0%	Any		Correct		Not Correct			Correct		Not Correct		
Children: 6 mo. – 2 yrs.				Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Community water fluoridation (4a.1)	88.5	89.3		64.09	(26.30)	55.36	(27.28)	*	24.18	(20.60)	29.29	(24.46)	
Dietary fluoride drops/tablets (4a.2)	78.0	53.9	**	67.1	(24.22)	53.72	(29.40)	**	25.70	(20.29)	22.53	(23.18)	
Fluoride dentifrices (4a.3)	65.0	72.7		62.86	(26.55)	62.81	(27.47)		24.90	(21.30)	24.43	(21.25)	
Fluoride Varnish (4a.4)	66.7	81.1	**	61.45	(26.92)	66.77	(25.74)		25.80	(21.95)	22.33	(19.19)	
Children: 3 – 6 yrs.													
Community water fluoridation (5a.1)	94.3	90.9		63.46	(26.37)	53.70	(29.96)		24.91	(21.15)	25.86	(24.26)	
Dietary fluoride drops/ tablets (5a.2)	86.5	62.0	**	65.35	(25.38)	53.73	(29.38)	**	25.56	(20.61)	23.19	(24.45)	
Fluoride dentifrices (5a.3)	85.8	86.8		63.26	(26.62)	61.84	(27.22)		24.82	(21.09)	25.85	(23.65)	
Fluoride varnish (5a.4)	79.5	85.2		62.81	(26.79)	64.24	(26.18)		25.00	(21.33)	24.46	(21.43)	
Topical fluorides-professional (5a.6)	85.0	85.3		63.07	(27.27)	62.98	(23.27)		25.44	(21.91)	22.44	(18.71)	
Fluoride rinse-at home (5a.7)	72.6	71.3		64.14	(26.43)	60.03	(27.21)		24.94	(21.14)	25.08	(22.30)	
Fluoride rinse –at school (5a.8)	54.1	40.6	*	66.21	(24.91)	59.21	(27.98)	**	24.61	(20.29)	25.82	(22.79)	
Brush-on fluoride gels (5a.9)	73.4	64.1		64.46	(25.14)	59.20	(29.79)		26.52	(21.32)	21.80	(21.57)	*
Fluoride gel in mouth tray (5a.10)	76.1	62.5	**	63.95	(26.04)	59.77	(28.21)		26.28	(21.36)	22.37	(21.82)	
Fluoride foam (5a_11)	67.6	49.6	**	64.55	(25.68)	60.48	(27.95)		26.27	(21.08)	23.25	(22.20)	
Children: 7 – 20 yrs.													
Community water fluoridation (6a.1)	83.9	83.8		63.80	(26.15)	59.67	(29.86)		24.70	(20.80)	25.19	(24.17)	
Dietary fluoride drops/ tablets (6a.2)	64.6	52.0	*	64.10	(26.30)	61.68	(27.25)		26.65	(22.18)	22.36	(20.03)	
Fluoride dentifrices (6a.3)	84.3	89.7		62.97	(26.46)	64.05	(28.20)		25.13	(21.64)	23.35	(20.13)	
Fluoride varnish (6a.4)	80.1	80.5		63.31	(26.24)	62.37	(28.27)		25.51	(21.68)	22.84	(20.34)	
Topical fluorides-professional (6a.6)	84.7	85.9		63.51	(26.69)	61.14	(26.54)		24.90	(21.27)	25.14	(22.24)	
Fluoride rinse-at home (6a.7)	71.2	74.0		63.19	(26.50)	63.05	(27.37)		24.81	(20.96)	25.15	(22.66)	
Fluoride rinse –at school (6a.8)	53.1	49.6		63.97	(26.16)	62.01	(27.49)		25.02	(20.91)	24.90	(22.21)	
Brush-on fluoride gels (6a.9)	73.5	68.3		63.86	(26.07)	61.49	(28.40)		25.46	(21.26)	23.49	(21.91)	
Fluoride gel in mouth tray (6a.10)	76.4	67.5		63.48	(26.48)	61.87	(27.54)		26.08	(21.40)	21.98	(21.53)	
Fluoride foam (6a_11)	63.0	55.2		62.90	(26.20)	63.23	(27.97)		26.53	(21.37)	22.45	(21.77)	

* $p<0.05$, **$p<0.01$

Table 16: Knowledge, practices and education of dental caries prevention by type of patients' insurance

	Percentage of dentists of who got correct answer in each group		Mean (standard deviation) percentage of patients treated by Dentists with correct or incorrect knowledge							
	Percentage of the Medicaid or SCHIP(2b-1)		Commercial/private insurance				Out of pocket payer			
	0%	Any	Correct		Not Correct		Correct		Not Correct	
General knowledge of fluoride			Mean	SD	Mean	SD	Mean	SD	Mean	SD
It is desirable to use professionally applied fluorides for all children in areas without fluoridated water(Q14.6)	90.4	89.9	62.32	(27.11)	64.43	(24.66)	25.25	(21.80)	22.84	(18.07)
The most important mechanism of action of fluoride is that it is incorporated into developing teeth to make them more resistant to acid demineralization(Q14.7)	7.7	13.0	59.11	(28.21)	63.35	(26.55)	22.62	(21.33)	24.96	(21.41)
The increased use of bottled water increases tooth decay among young children(Q14.8)	13.4	13.6	64.58	(31.13)	62.50	(26.15)	24.80	(26.22)	24.83	(20.60)
Incipient carious lesions (before cavitation) can be remineralized (healed)(Q14.11)	87.3	90.2	62.62	(26.18)	63.41	(31.69)	25.46	(21.65)	20.54	(19.53)
Dilute, frequently administered fluorides are more effective in caries prevention than more concentrated, less frequentl(Q14.13)	37.6	44.3	60.29	(27.87)	64.21	(26.25)	26.39	(23.66)	23.87	(19.98)
The most important mechanism of action of fluoride is the remineralization of incipient decay(Q14.14)	49.2	58.8	60.62	(27.37)	64.52	(26.39)	25.23	(22.50)	24.61	(20.50)

* p<0.05, **p<0.01

Table 16: Knowledge, practices and education of dental caries prevention by type of patients' insurance

	Percentage of dentists of who got correct answer in each group			**Mean (standard deviation) percentage of patients treated by Dentists with correct or incorrect knowledge**										
	Percentage of the Medicaid or SCHIP(2b-1)			Commercial/private insurance					Out of pocket payer					
Practice of fluoride products	0%	Any		Correct		Not Correct			Correct		Not Correct			
The frequency of topical fluoride treatments provided to child patients				Mean	SD	Mean	SD		Mean	SD	Mean	SD		
6 months - 2 years (Q7.1)	34.4	70.3	**	57.57	(28.42)	67.54	(24.12)	**	22.39	(20.42)	26.98	(21.74)	*	
3 - 6 years (Q7.2)	72.7	88.4	**	62.77	(26.22)	64.59	(27.23)		23.21	(19.35)	31.07	(25.64)	**	
7 - 20 years (Q7.3)	79.4	86.9		63.20	(25.93)	62.77	(29.33)		23.76	(19.55)	30.92	(27.53)	*	
Type of fluoride and the application time most often used for in-office treatments														
APF gel (Q8.1)	23.9	22.2		52.48	(30.66)	58.43	(28.73)		31.24	(25.24)	22.31	(21.64)		
APF foam (Q8.2)	21.2	13.3		59.27	(26.29)	62.20	(26.02)		34.27	(22.75)	28.24	(22.87)		
NaF gel (Q8.3)	22.6	31.8		61.21	(30.03)	62.44	(26.23)		28.05	(25.03)	26.82	(22.91)		
NaF rinse (Q8.4)	60.4	46.7		64.10	(22.10)	67.73	(25.74)		30.13	(21.63)	23.26	(19.41)		
SnF2 (Q8.5)	10.3	12.5		55.00	(33.91)	62.32	(25.54)		43.00	(29.92)	27.47	(18.91)		

* $p<0.05$, ** $p<0.01$

Table 16: Knowledge, practices and education of dental caries prevention by type of patients' insurance

	Percentage of dentists of who got correct answer in each group			**Mean (standard deviation) percentage of patients treated by Dentists with correct or incorrect knowledge**							
	Percentage of the Medicaid or SCHIP(2b-1)			Commercial/private insurance				Out of pocket payer			
	0%	Any		Correct		Not Correct		Correct		Not Correct	
Knowledge of effectiveness of Pit & Fissure Sealants				Mean	SD	Mean	SD	Mean	SD	Mean	SD
children 3 - 6 years of age (Q5a.5)	82.9	84.3		63.00	(27.19)	63.03	(23.74)	24.62	(21.01)	27.41	(23.36)
children 7 - 20 years of age (Q6a.5)	90.9	90.6		63.63	(26.53)	59.11	(27.61)	24.62	(21.06)	27.97	(24.46)
General knowledge of the sealants											
Sealants are not needed if patients receive topical fluorides (Q14.1)	92.0	96.9		62.76	(26.83)	63.65	(28.33)	24.54	(21.16)	29.44	(25.46)
Use of sealants is not substantiated by scientific research (Q14.2)	87.6	90.2		62.18	(26.93)	65.17	(25.89)	25.41	(21.88)	21.30	(17.45)
Newly erupted permanent molars are the most important candidates for sealants (Q14.3)	82.0	90.9	*	62.70	(26.80)	65.10	(25.67)	24.29	(20.93)	27.08	(22.72)
Loss of sealants is generally attributed to inappropriate application technique (Q14.4)	65.9	76.9	*	62.24	(27.16)	64.30	(25.82)	24.77	(21.84)	25.25	(20.47)
Sealants are somewhat risky because decay may be sealed in the tooth (Q14.5)	66.0	68.7		62.28	(27.29)	63.68	(25.97)	25.34	(21.34)	24.02	(21.64)
Practice of sealants				Yes		No		Yes		No	
Do you use sealants for your child/youth patients? (Q10a) (Yes)	86.6	92.5		62.07	(27.33)	68.84	(20.93)	24.62	(21.59)	26.57	(19.54)

* p<0.05, **p<0.01

Table 16: Knowledge, practices and education of dental caries prevention by type of patients' insurance

Education	Percentage of dentists of who got correct answer in each group Percentage of the Medicaid or SCHIP(2b-1)		Mean (standard deviation) percentage of patients treated by Dentists with correct or incorrect knowledge Commercial/private insurance					Out of pocket payer				
	0%	Any	Yes		No			Yes		No		
			Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Do you provide/recommend fluoride products (gels, toothpaste, mouthrinses) for child patients for their home use? (Q9a)	90.5	91.7	62.26	(26.69)	67.32	(27.28)		25.22	(21.49)	21.21	(19.94)	
Do you or members of your team provide caries preventive education for children and their parents? (Q13a)	92.5	94.5	61.75	(27.29)	78.80	(13.79)	**	25.23	(21.96)	18.76	(12.88)	*

f. Overall Summary of Child patients' characteristics

Regarding their knowledge of the effectiveness of fluoride, the dentists who see children 6 months to 2 years or who see more children 3 to 6 years, and those who do not see Medicaid or SCHIP children had better knowledge.

Regarding general knowledge of fluoride, the dentists who see children 6 months to 2 years or who see more children 3 to 6 years had better knowledge compared to those who do not see or see fewer.

Regarding the frequency of topical fluoride application, dentists who see children 6 months to 2 years or who see more children 3 to 6 years, and those who see Medicaid or SCHIP children had better knowledge.

Regarding dentists' knowledge of dental sealants, those who see the children 3 to 6 years more compared to those who see fewer children of this age range, and those who see Medicaid or SCHIP children compared to who don't have better knowledge.

Regarding the use of dental sealants, dentists who see children 6 months to 2 years or who see more children 3 to 6 years were more likely to report they provide dental sealant to their child patients.

Multivariate analyses

The findings of bivariate analysis implied that some of the characteristics of dentists were associated with some of the knowledge level, dental practice and/or education of dental caries prevention. The multivariate analyses were also conducted to see whether any characteristics variables predict the dentists' knowledge, practice

and education of dental caries prevention while controlling for other characteristic variables.

The independent variables were "gender (Female vs. Male)", "Race (White vs. Not White)", "Specialty (Pediatric dentists vs. General dentists)", "Children age 6 month to 2 years (0 vs. Any)", "Children age 3-6 years (continuous data)", "Children age 7-20 years (continuous data)", "Percentage of children with Medicaid or SCHIP (0 vs. Any)", "Excluding dental school, have you ever taken a course on dental caries prevention? (Yes vs. No)", "Would you be interested in attending a continuing education course on dental caries prevention? (Yes vs. No)", "Year of graduation (Before 1990 vs. 1990 or later)", "Rate of prevention education of dental school (Good vs. Poor and Not sure)". The groups named first in parentheses were reference group. Among the independent variables of age range of children, only those related to the dependent variable were added in the model, and others were excluded. (e.g. for the "*Knowledge of effectiveness of fluoride application for children 6 months to 2 years*", only "Children age 6 month to 2 years (0, Any)" was added into the model, and "Children age 3-6 years (continuous data)", "Children age 7-20 years (continuous data)" were excluded).

Dependent variables were *Knowledge of effectiveness of fluoride application for children 6 months to 2 years, Knowledge of effectiveness of fluoride application for children 3 to 6 years, Knowledge of effectiveness of fluoride application for children 7 to 20 years, General knowledge of fluoride, The frequency of the topical fluoride application to the children 6 months to 2 years, The frequency of the topical fluoride application to the children 3 to 6 years, The frequency of the*

topical fluoride application to the children 7 to 20 years, Knowledge of effectiveness of dental sealants for children 3 to 6 years, Knowledge of effectiveness of dental sealants for children 7 to 20 years, General knowledge of dental sealants, and *Dental sealants practice*

Knowledge of effectiveness of fluoride application for children 6 months to 2 years

Multivariate linear regression was conducted. There was no statistical significant difference for this regression.

Knowledge of effectiveness of fluoride application for children 3 to 6 years

Multivariate linear regression was conducted. Dentists who see a higher percentage of children 3 to 6 years, were significantly more likely to understand the effectiveness of fluoride application for children 3 to 6 years. However, the dentists who see any Medicaid or SCHIP children were significantly less likely to understand the effectiveness of this method of fluoride application.

Table 17: Knowledge of effectiveness of fluoride application for children 3 to 6 years

	Unstandardized Coefficients		Standardized Coefficients	
Variable	B	Std. Error	Beta	R Square
Gender (Female, Male)	0.613	0.376	0.109	
Race (White, Not White)	0.227	0.388	0.034	
Speciality (Pediatric dentists, General dentists)	0.841	0.459	0.124	
Children ages 3-6 yrs	0.023	0.009	*0.156	
Percentage of children with Medicaid or SCHIP (0, Any)	-0.856	0.356	*-0.156	
Excluding dental school, have you ever taken a course on dental caries prevention? (Yes, No)	-0.067	0.335	-0.012	
Would you be interested in attending a continuing education course on dental caries prevention? (Yes, No)	-0.446	0.313	-0.082	
Year of graduation (Before 1990, 1990 or after)	0.476	0.361	0.090	
Rate of prevetion education of dental school (Good, Poor and Not Sure)	-0.235	0.540	-0.024	
* p<0.05, **p<0.01				*0.058

Knowledge of effectiveness of fluoride application for children 7 to 20 years

Multivariate linear regression was conducted. There was no statistical significance for this regression.

General knowledge of fluoride

Multivariate linear regression was conducted. Pediatric dentists or the dentists who graduate after 1990 were significantly more likely to have general knowledge of fluoride.

Table 18: General knowledge of fluoride

	Unstandardized Coefficients		Standardized Coefficients	
Variable	B	Std. Error	Beta	R Square
Gender (Female, Male)	0.187	0.130	0.090	
Race (White, Not White)	0.177	0.137	0.072	
Speciality (Pediatric dentists, General dentists)	-0.433	0.146	**-0.177	
Percentage of children with Medicaid or SCHIP (0, Any)	-0.017	0.124	-0.008	
Excluding dental school, have you ever taken a course on dental caries prevention? (Yes, No)	-0.139	0.117	-0.067	
Would you be interested in attending a continuing education course on dental caries prevention? (Yes, No)	-0.137	0.110	-0.068	
Year of graduation (Before 1990, 1990 or after)	0.262	0.127	*0.134	
Rate of prevetion education of dental school (Good, Poor and Not Sure)	0.114	0.200	0.030	
* p<0.05, **p<0.01				**0.073

The frequency of the topical fluoride application to the children 6 months to 2 years

Logistic regression was conducted. Dentists who see children 6 months to 2 years or who see the Medicaid or SCHIP children were significantly more likely to choose correct answers.

Table 19: Frequency of topical fluoride application for children 6 months to 2 years

Variable	adj OR	95% CI	
Gender (Female, Male)	0.790	0.428	1.456
Race (White, Not White)	0.766	0.398	1.475
Speciality (Pediatric dentists, General dentists)	0.882	0.435	1.788
Percentave of child patients 6 months to 2 years (0, Any)	**3.235	1.864	5.612
Percentage of children with Medicaid or SCHIP (0, Any)	**3.067	1.715	5.483
Excluding dental school, have you ever taken a course on dental caries prevention? (Yes, No)	0.658	0.369	1.176
Would you be interested in attending a continuing education course on dental caries prevention? (Yes, No)	0.693	0.408	1.178
Year of graduation (Before 1990, 1990 or after)	0.992	0.545	1.806
Rate of prevetion education of dental school (Good, Poor and Not Sure)	0.600	0.230	1.564

* p<0.05, **p<0.01

The frequency of the topical fluoride application to children 3 to 6 years

Logistic regression was conducted. Dentists who see more children 3 to 6 years were significantly more likely to know the correct frequency with which to apply various fluorides. The dentists who reported being interested in attending a continuing education course on caries prevention were significantly more likely to provide topical fluoride at appropriate frequency.

Table 20: Frequency of topical fluoride application for children 3 to 6 years

Variable	adj OR	95% CI	
Gender (Female, Male)	0.845	0.383	1.867
Race (White, Not White)	1.978	0.845	4.626
Speciality (Pediatric dentists, General dentists)	0.597	0.154	2.319
Children ages 3-6 yrs	**1.059	1.033	1.085
Percentage of children with Medicaid or SCHIP (0, Any)	1.114	0.529	2.347
Excluding dental school, have you ever taken a course on dental caries prevention? (Yes, No)	0.933	0.495	1.758
Would you be interested in attending a continuing education course on dental caries prevention? (Yes, No)	*0.468	0.259	0.843
Year of graduation (Before 1990, 1990 or after)	1.335	0.645	2.765
Rate of prevetion education of dental school (Good, Poor and Not Sure)	1.295	0.391	4.286

* p<0.05, **p<0.01

The frequency of the topical fluoride application to the children 7 to 20 years

Logistic regression was conducted. Dentists who see more children 7 to 20 years of age were significantly less likely to know the recommended frequency of topical fluoride applications. Those who are interested in attending a continuing education course were significantly more likely to the recommended frequencies of professionally applied fluorides.

Table 21: Frequency of topical fluoride application for children 7 to 20 years

Variable	adj OR	95% CI	
Gender (Female, Male)	0.861	0.385	1.924
Race (White, Not White)	1.129	0.499	2.551
Speciality (Pediatric dentists, General dentists)	0.655	0.189	2.274
Children ages 7-20 yrs	**0.970	0.953	0.987
Percentage of children with Medicaid or SCHIP (0, Any)	0.658	0.319	1.358
Excluding dental school, have you ever taken a course on dental caries prevention? (Yes, No)	0.877	0.463	1.663
Would you be interested in attending a continuing education course on dental caries prevention? (Yes, No)	**0.417	0.230	0.755
Year of graduation (Before 1990, 1990 or after)	1.559	0.739	3.288
Rate of prevetion education of dental school (Good, Poor and Not Sure)	0.828	0.277	2.473

* p<0.05, **p<0.01

Knowledge of effectiveness of dental sealants for children 3 to 6 years

Logistic regression was conducted; there was no statistically significant differences.

Knowledge of effectiveness of dental sealants for children 7 to 20 years

Logistic regression was conducted. The result was not statistically significant.

General knowledge of dental sealants

Multivariate linear regression was conducted. The dentists who took a

course on dental caries prevention were significantly more likely to have appropriate knowledge about dental sealants.

Table 22: General knowledge of dental sealants

	Unstandardized Coefficients		Standardized Coefficients	
Variable	B	Std. Error	Beta	R Square
Gender (Female, Male)	-0.140	0.141	-0.062	
Race (White, Not White)	0.017	0.149	0.006	
Speciality (Pediatric dentists, General dentists)	-0.156	0.159	-0.059	
Percentage of children with Medicaid or SCHIP (0, Any)	0.116	0.136	0.052	
Excluding dental school, have you ever taken a course on dental caries prevention? (Yes, No)	-0.492	0.128	**-0.217	
Would you be interested in attending a continuing education course on dental caries prevention? (Yes, No)	0.050	0.120	0.023	
Year of graduation (Before 1990, 1990 or after)	0.008	0.138	0.004	
Rate of prevetion education of dental school (Good, Poor and Not Sure)	-0.054	0.212	-0.013	
				**0.067

* p<0.05, **p<0.01

Dental sealants practice

Logistic regression was conducted. Females were significantly more likely to provide dental sealants. The dentists who are interested in attending a continuing education course were more likely to provide dental sealants to their child patients.

Table 23: Whether use dental sealants for child/youth patients

Variable	adj OR	95% CI	
Gender (Female, Male)	*0.297	0.096	0.916
Race (White, Not White)	0.874	0.323	2.366
Speciality (Pediatric dentists, General dentists)	0.000	0.000	
Percentage of children with Medicaid or SCHIP (0, Any)	0.602	0.241	1.504
Excluding dental school, have you ever taken a course on dental caries prevention? (Yes, No)	0.152	0.068	0.343
Would you be interested in attending a continuing education course on dental caries prevention? (Yes, No)	**0.345	0.159	0.748
Year of graduation (Before 1990, 1990 or after)	1.200	0.481	2.993
Rate of prevetion education of dental school (Good, Poor and Not Sure)	0.297	0.074	1.199

* p<0.05, **p<0.01

Summary

Females were significantly more likely to provide dental sealants to their child patients, pediatric dentists were significantly more likely to have general knowledge of fluoride. Dentists who see children 6 months to 2 years were significantly more likely to know the appropriate frequency of professional topical fluoride application to this age group compared to those who do not see children in this age group. Dentists who see a higher percentage of children 3 to 6 years were significantly more likely to know the effectiveness of fluoride application for this age group, and significantly more likely to know the appropriate frequency of professional topical fluoride application to this age group compared to those who see fewer children of this age range. Those who see Medicaid or SCHIP children were significantly less likely to understand the effectiveness of fluoride application for children 3 to 6 years of age, significantly more likely to know the frequency of professional topical fluoride application to children 6 months to 2 years compared to those who do not see this age range. Those dentists who graduated from dental school in 1990 or later were significantly more likely to have a higher level knowledge of fluoride compared to those who graduated earlier. Those who reported interest in attending a continuing education course on dental caries prevention more likely to understand the frequency of topical fluoride application to children 3 to 6 years and 7 to 20 years, and were more likely to provide dental sealants to their child patients than who were not interested in attending such a course.

Chapter 5 Discussion

Dental caries is the single most common chronic childhood disease and remains a common chronic disease across the life span in the United States and around the world (IOM, 2011). Healthy People 2020 (HP2020), national objectives for improving the health of all Americans, include objectives for reducing dental caries among children. Specifically, these objectives state: "Reduce the proportion of children and adolescents who have dental caries experience in their primary or permanent teeth", "Reduce the proportion of children and adolescents with untreated dental decay", "Increase the proportion of low-income children and adolescents who received any preventive dental services during the past year", "Increase the proportion of children and adolescents who received dental sealants on their molar teeth", and "Increase the proportion of the U.S. population served by community water systems with optimally fluoridated water" (HHS, 2012 a). Recognizing the need for change, the Institute of Medicine (IOM, 2011) proposed a New Oral Health Initiative (NOHI) to the United States Department of Health and Human Services (DHHS) to help move the nation toward achieving the goals and objectives set by HP2020.Two of the principles of the NOHI are "Emphasize disease prevention and oral health promotion" and "Improve oral health literacy and cultural competence." To provide appropriate dental caries prevention for the public and to improve oral health literacy, dentists must have current evidence-based information about dental caries prevention. The findings from this study provide the current status of Maryland dentists' understanding, practices and educational efforts regarding dental caries

prevention. In addition, topics for use in educational interventions for dentists are proposed.

In this study dentists had only moderate levels of knowledge about dental caries prevention. Especially lacking was their knowledge of the predominant theory of fluoride action, appropriate methods of application of fluorides (low concentration and high frequency vs. high concentration and low frequency), appropriateness of providing fluoride (fluoride dentifrices and professional application) to young children (especially 6 months to 2 years), frequency and duration of professional topical fluoride applications, and knowledge about the risk of providing dental sealants on noncavitated tooth surfaces.

In multivariate analyses, general dentists were significantly less likely than pediatric dentists to have general knowledge of fluoride. Those who graduated from dental school in 1990 or later were significantly more likely to have general knowledge of fluoride compared to those who graduated earlier. Regarding professionally fluoride application to children 6 month to 2 years, dentists who see children 6 months to 2 years or dentists who see Medicaid or SCHIP children were more likely to understand the frequency of fluoride applications compared to those who do not see children 6 months to 2 years or dentists who do not see Medicaid or SCHIP children. Males were less likely than females to provide dental sealants to teeth of their child patients.

RQ1: What do dentists know and practice about preventing dental caries?

Fluoride Knowledge

Effectiveness of each fluoride application for children of each age range

Overall

Overall, dentists knowledge of the effectiveness of community water fluoridation for each age group: 6 months to 2 years, 3 to 6 years and 7 to 20 years was consistently high (89.2%, 93.3% and 83.4% respectively). Dentists believe that community water fluoridation is effective for children. Their knowledge of the effectiveness of fluoride dentifrices was lowest for children 6 months to 2 years (66.4%) compared to children 3 to 6 years (84.9%) and 7 to 20 years (85.3%). Similar trends were observed in a study of Maryland dental hygienists (Clovis, Horowitz, Kleinman, Wang and Massey, 2012). These findings may be attributed to the fact that there are different recommendations for the use of fluoride dentifrice depending on the child's risk for dental caries or because many dentists do not treat children who are at high risk for caries (low income: 66.5% of the subjects do not accept Medicaid or SCHIP children), or they might be overly concerned about dental fluorosis. However it is recommended using a "smear"(approximately 0.1mg fluoride) of toothpaste for children under 2 years who are at moderate or high risk for dental caries (MCHB, 2007; AAPD, 2011c). Dentists understanding of the effectiveness of dietary fluoride drops/ tablets decreased as the patients' age increased from 71.5% (6 month to 2years) or 78.8% (3 years to 6 years) to 59.3% (7 to 20 years). This outcome might be because most of the dentists believe the more important effect of fluoride drops/ tablets is systemic effect rather than topical effect. In addition, their knowledge might be a result of previous held beliefs that fluoride tablets need to be taken only through age eight. The use of fluoride rinse - at school got the lowest score

consistently (50% for the children age 3 – 6 years and 51.5% for the children 7 – 20 years). Because the prevalence of community water fluoridation in Maryland is one of the highest in the U.S., many dentists may not recognize the need for fluoride rinse programs at school for some students, especially low income who are at high risk for dental caries. Respondents' knowledge regarding the effectiveness of fluorides varied widely and it likely accounted for their variations in reported practices.

For children 6 months to 2 years

Using a "smear" (approximately 0.1mg fluoride) of toothpaste for children under 2 years who are at moderate or high risk for dental caries is recommended (MCHB, 2007; AAPD, 2011c). However, the lowest level of knowledge about the use of fluoride dentifrices was for this age group This lack of understanding may be attributed to the fact that not many dentists treat children who are at high risk for caries (e.g. low income; about 65% of the subjects do not see the Medicaid or SCHIP children). Thus, they might be overly concerned about dental fluorosis rather than preventing dental caries, assuming that the parents are knowledgeable about caries prevention and practice good home care.

Regarding the use of dietary fluoride supplements and of fluoride varnish for this age group, Maryland dental hygienists were more certain about their understanding of the effectiveness of these two regimens. That is they reported, correctly that both were "Very effective" more frequently than did dentists in the current study (Clovis, Horowitz, Kleinman, Wang and Massey, 2012). (Dietary fluoride drops/ tablets: 51.9% of dental hygienists chose "very effective" vs. 38.4% of

dentists "very effective", Fluoride varnish: 51.5% vs. 38.8%). This trend of dental hygienists being more certain about their understanding compared to dentists was observed with many variables. These findings are logical because dental hygienist curricula focus more on prevention and dental students focus more on restorations.

For children 3 to 6 years

Compared to dentists in this study dental hygienists were more likely to chose "Very effective" for fluoride application such as "dietary fluoride drops/ tablets" (dental hygienists: 56.2% vs. Dentists: 42.3%), "Fluoride dentifrices" (52.7% vs. 43.7%), "Fluoride varnish" (65.6% vs. 45.2%) and "Topical fluoride-professional" (50.2% vs. 40.7%) (Clovis, Horowitz, Kleinman, Wang and Massey, 2012).

For children 7 to 20 years

Dentists' understanding of the effectiveness of community water fluoridation was the lowest for this age range (83.4%). Dentists who tend to believe that the systemic effect of community water fluoridation, makes the developing tooth more resistant to decay prior to eruption, is more important than its topical effect, believe that the effect of water fluoridation will be best before the crown part of teeth are fully developed.

General knowledge of fluoride

The percentage of correct answers varied depending on the variable (from 9.2% to 90%). In addition regarding respondents certainty of their response, it is important

to point out that although the percentage was high in two out of six variables, the certainty of their responses “Strongly Agree” or “Strongly Disagree” correctly was very low. For example many dentists (about 90%) believed that carious lesions could be remineralized, but only 20.3% chose “Strongly Agree”. Similarly, many dentists (90%) believed that it is desirable to use professional fluoride application for all children in areas without community water fluoridation, only 46% chose “Strongly Agree”. This suggests that although they have some knowledge, they are somewhat uncertain about it, and this level of understanding should be improved. Additionally the knowledge of the predominant theory of fluoride function (“the most important mechanism of action of fluoride is the remineralization of incipient decay”) was very low (53% of dentists chose “Strongly Agree” or “Agree”). Dentists were more likely to believe incorrectly the old theory: “the most important mechanism of action of fluoride is that it is incorporated into developing teeth to make them more resistant to acid demineralization” (89.2%). This trend of incorrectly believing the old theory about fluoride action was also observed in the study of dental hygienists in Maryland (Clovis, Horowitz, Kleinman, Wang and Massey, 2012), a national study of dental hygienists (Forrest, Horowitz and Yochi, 2000), and the study of Indiana dentists and hygienists (Yoder, Maupome, Ofner and Swigonski, 2007). This suggests that dental and dental hygiene schools still emphasize the old theory of fluoride action more than the current predominant theory.

Frequent exposure to small amounts of fluoride each day, such as drinking fluoridated water, will maximize the effect of caries risk reduction (CDC, 2001b). However relatively few (less than 30%) dentists disagreed and 32.3% did not know

that dilute, frequently administered fluorides are more effective in caries prevention than more concentrated, less frequently applied fluorides. Only 40.5% of the dentists believed that this is the prevailing theory of fluoride application. Similar findings were observed in the dental hygienists' studies (Clovis, Horowitz, Kleinman, Wang and Massey, 2012: Forrest, Horowitz and Yochi, 2000). One explanation for this finding might be because dentists and dental hygienists are taught more about professional topical fluoride application and learn less about public health approaches such as community water fluoridation.

Although it has been assumed that increasing the consumption of bottled water will increase dental caries in children, it has not been proven (Newbrun, 2010). However, about 60% of the dentists believed that it would have a negative effect on oral health, and about 25% believed there would have no effect. The reason for many dentists believing the negative effect of the bottled water on oral health might be from their common sense or because ADA has provided a warning of the negative impact of bottled water (ADA, 2003).

Overall similar levels of knowledge and understanding regarding fluorides were observed among Maryland dentists and dental hygienists.

Fluoride Practices

Dentists were less likely to provide topical fluoride treatments to child patients of 6 months to 2 years. About 40% of them chose "do not provide" for this age range. The percentage of "do not provide" decreased as the age of children increased. Maternal and Child Health Bureau (MCHB) (2007) recommends applying

fluoride varnish for children at risk of dental caries under 2 years of age. ADA (2006) also recommends applying fluoride varnish for children under 6 years of age who are at risk. Because fluoride mouth rinse, gel or foam is not recommended by MCHB or not mentioned in ADA recommendation for children under 6 years, (ADA, 2006; MCHB, 2007), dentists might be reacting to these guidelines or this might be because many dentists of this study indicated they did not see children of this age group or children at high risk (those who with Medicaid or SCHIP), and thus chose "do not provide" (approximately 42% of the sample do not see children 6 months to 2 years, 65% do not see children with Medicaid or SCHIP). Compared to the study of dental hygienists in Maryland, fewer dentists chose "Do not provide" fluoride for children 6 months to 2 years (Dentists "Do not provide": 41.4% vs. Dental hygienists "Do not provide": 56.1%), however, for children 3 to 6 years and 7 to 20 years, the percentage of "Do not provide" was reversed (12.2% vs. 5.6% for 3 to 6 years) and (9.3% vs. 3.4% for 7 to 20 years) (Clovis, Horowitz, Kleinman, Wang and Massey, 2012). According to another study (Autio-Gold and Tomar, 2008), 30% of 3rd and 4th dental school students reported that they would not use fluoride varnishes regularly for pediatric patients younger than 5 years. Dentists, dental hygienists and dental students should be taught that fluoride varnish should be provided to younger children, such as 6 months to 2 years, if they are at risk of dental caries.

The scientifically recommended time for the application of professional fluoride (APF gel, APF foam, NaF gel, SnF_2) is 4 minutes (CDC, 2001b; ADA, 2006；Newbrun, 2001). However, the majority of dentists answered "1min" among those who were using those professionally applied fluoride. Relatively few dentists

were using the correct application time. This trend also was observed among Maryland dental hygienists' study (Clovis, Horowitz, Kleinman, Wang and Massey, 2012), national study (Forrest, Horowitz and Yochi, 2000) and at dental offices in the Great Houston Area (Chan, Warren and Henson, 1996). In one study, the proportion of the dentists who chose the correct time (4 minutes) was also very low (1/101) (Chan, Warren and Henson, 1996). This low rate of correct response might be due to the inability to judge the information provided by sales representatives and advertisements of fluoride products and perhaps even more importantly, the pressure to provide care for more patients (Forrest, Horowitz and Yochi, 2000: Chan, Warren and Henson, 1996). The information provided on fluoride products should be evaluated regarding caries reduction rather than on enamel fluoride uptake (Forrest, Horowitz and Yochi, 2000). In this current study, many dentists chose "Do not use": for "APF gel" (52.9%), "APF foam" (61%), "NaF gel" (71.6%), "NaF rinse" (74.7%) and "SnF_2" (84.6%), but about 80% of the dentists seem to be using "Fluoride Varnish" (data not shown).

Priority of dental caries prevention methods

When asked, of 12 measures (for children 6 months to 2 years) and 18 measures (for children of 3 to 6 years and 7 to 20 years) listed which are the two top priorities to prevent dental caries, community water fluoridation was the first priority identified for every age range of children. However the percentages were low (from 25.8 to 36.2%). "Routine dental care" was most often chosen as the second priority to prevent dental caries (15.4% to 17.7%). Many dental hygienists in Maryland also

believed that routine dental care is very effective, however this is not supported by scientific evidence (Clovis, Horowitz, Kleinman, Wang and Massey, 2012). Only the use of fluorides and sealants has successfully caused a reduction of dental caries (Kumar, and Moss, 2008).

Dental Sealants Knowledge

Most respondents believed that dental sealants were effective (for children 3 to 6 years "Very effective": 51.7%, "Effective": 31.1%) (for children 7 to 20 years "Very effective": 57.1%, "Effective": 32.9%). However, dental hygienists believe the effectiveness for children 3 to 6 years with higher certainty ("Very effective": 64.2% and "Effective": 24.6% for the children 3 to 6 years). (Clovis, Horowitz, Kleinman, Wang and Massey, 2012). The data for 7 to 20 years was not presented in that study. Dental hygienists' were more certain of their knowledge about dental sealants.

Overall, dentists' general knowledge of dental sealants was higher than that of fluorides. This might be because dentists are given more training about dental sealants compared to fluoride or, simply the difficulty of the questions about dental sealants may be easier than those about fluoride. Although using dental sealants on non-cavitated caries in permanent teeth is effective in reducing caries progression (Griffin et.al. 2008), only 67.2% of dentists understand the statement "Sealants are somewhat risky because decay may be sealed in the tooth" is incorrect ("Strongly Disagree": 17.2%, "Disagree": 50%). In a national study of dentists, their preference for restorations rather than prevention (providing dental sealants) or observational approach for the non-cavitated carious lesions was observed (Tellez, Lauren Gray,

Sarah Gray, Sungwoo and Ismail. 2011). These findings might be attributable to the focus on restorative dentistry rather than prevention in dental school education.

Compared to dental hygienists, in three out of five items about their general knowledge of dental sealants, dental hygienists chose the correct answer with greater certainty ("Strongly Agree" or "Strongly Disagree") (Clovis, Horowitz, Kleinman, Wang and Massey, 2012).

Dental Sealants Practice

About 90% of the dentists reported providing dental sealants for their child/youth patients. This percentage is a little lower than dental hygienists in Maryland (dentists: 88.4% vs. dental hygienists: 93%) (Clovis, Horowitz, Kleinman, Wang and Massey, 2012). Less than half (45.3%) of dentists reported they provide sealants to over 75% of their child patients. The main reason for not providing dental sealants to children patients was either "patients are unwilling to pay for them" (45.5%) or "insurance does not pay for it" (25.5%). About 8% of dentists indicated that "parents unfamiliar with the procedure". These trends are similar to the results of the study of dental hygienists in Maryland (Clovis, Horowitz, Kleinman, Wang and Massey, 2012). These findings suggest strongly the need for education for insurance companies and parents about the benefits of dental sealants. Clearly, dentists and their professional organizations should be proactive in advocating for the use of dental sealants, via education about the effectiveness of dental sealants for their patients in daily practice. And dental schools should ensure that dental students have proficiency in applying them on a routine basis.

RQ2: Do dentists educate patients about caries prevention?

The percentage of dentists who report providing information about fluoride for home use, or provide caries preventive education to their patients was high (about 90%).

Dentists were less likely to educate about fluoride to parents of children especially age 6 months to 2 years. Surprisingly, only 37.6 % of dentists educate about the use of fluoride dentifrice to the parents of child patients of this age group, although it is recommended that a "smear"(approximately 0.1mg fluoride) of toothpaste for children under 2 years at risk (MCHB, 2007; AAPD, 2011c). This outcome may be because they are not seeing children at this age range or children at high risk.

RQ3: Are dentists' characteristics associated with their knowledge and practice?

Bivariate Analysis

In general, pediatric dentists, dentists who see children less than 6 years of age, dentists who took continuing education courses about caries prevention after graduation from dental school and those who indicated an interest in attending a course on caries prevention were significantly more likely than their respective counterparts to have better knowledge about dental caries prevention. This outcome is reasonable because pediatric dentists have more training in prevention and when dentists take continuing education courses they should know more than those who did not take such a course. This information is helpful to target populations for educational interventions. For example, general dentists or those who do not see

children less than 6 years should be concerned as high priority target population.

The dentists who accept Medicaid or SCHIP children had significantly less knowledge of the effectiveness of fluoride application than those who do not see these patients. This finding is troubling because children who are Medicaid or SCHIP recipients are at high risk for dental caries and need evidence-based preventive regimens. However, dentists who accept Medicaid or SCHIP children were significantly more likely to know the correct frequency of topical fluoride application and have general knowledge about dental sealants compared to those who do not see those children. These findings suggest that when education is provided to this population, the effectiveness of fluoridation and its mechanism of action should be emphasized.

Dentists who graduated from dental school in 1990 or later were significantly more likely to know that the most important mechanism of action of fluoride is the remineralization of incipient decay and to recognize the correct frequency for topical fluoride application. This finding is logical, because more recently graduated dentists should have more current information.

Pediatric dentists and dentists who graduated in 1990 or later were significantly more likely to understand the effectiveness of fluoride varnish. Apparently because fluoride varnish is relatively new and fluoride varnish is very effective for children under 6 years at risk of dental caries (MCHB, 2007; ADA, 2006), more recent graduates and pediatric dentists should have better knowledge about fluoride varnish use for children.

Multivariate analysis

The characteristics of dentists were not consistently related to the knowledge or practice of fluoride and dental sealants. Dentists who see children 6 months to 2 years or who see children insured by Medicaid or SCHIP were significantly more likely to choose the correct answer for the frequency of topical fluoride application for children 6 months to 2 years compared to who do not.

Pediatric dentists or the dentists who graduate after 1990 were significantly more likely to have general knowledge of fluoride, this might be because they have more current information of dental caries prevention for children. Additionally, the dentists who took a course on dental caries prevention were significantly more likely to have appropriate knowledge about dental sealants and significantly more likely to provide dental sealants. This information suggests that more dentists would have correct information if they took continuing education courses on caries prevention and early detection.

Implication of findings

Although, dentists play an very important role in educating the public to increase oral health literacy, providing appropriate dental caries prevention and advocating for public health policy, such as community water fluoridation (Melbye and Armfield, 2013), the findings of this study imply that many dentists have insufficient knowledge and do not practice caries prevention as well as they should. The "information lag" between practitioner and researcher was pointed out by O'Neill (1984), and unfortunately this information lag still exists. More evidence-based caries

prevention should be provided in dental school and via continuing dental education or dental association meeting for current dentists (Autio-Gold and Tomar, 2008: Garcia and Sohn, 2012: Melbye and Armfield, 2013; Yoder, Maupome, Ofner and Swigonski, 2007; Tellez et.al. 2011). The results of the analysis of this data will be useful in developing courses for dental students and practicing dentists in Maryland. For example, the knowledge of the predominant theory of fluoride action, the knowledge of method of application (low concentrate and high frequency vs. high concentrated and low frequency), knowledge of appropriateness of providing fluoride (fluoride dentifrices and professional application) to young children (especially 6 months to 2 years), knowledge of the appropriate frequency and length of professional topical fluoride application, and knowledge about the risk of providing dental sealants on noncavitated tooth surfaces should be areas of focus in the education intervention.

The need to educate dentists who see Medicaid or SCHIP children about caries prevention and early detection is urgent, because their child patients are usually at very high risk for dental caries. Fluoride varnish is very effective for dental caries prevention and in Maryland Medicaid can be billed for four applications a year, but general dentists and dentists who graduated earlier than 1990 had less knowledge about fluoride varnish than pediatric dentists and dentists who graduated in 1990 or later. This gap also should be improved.

Education in dental school provides the foundation for dentists' knowledge and practices. Evidence-based prevention education should be provided more in the dental school curricula such as through course work, internships, seminars and

mentorships, (Melbye and Armfield, 2013). Although continuing dental education (CDE) improves dental practitioners' knowledge and perhaps performance to some extent, the information about how dentists learn and the methods that are effective to change their practice behaviors is still limited (Melbye and Armfield, 2013). Several studies indicate that change may occur through collegial friendship and dental society meeting, therefore dental societies may be effective in changing current dentists' behavior (Melbye and Armfield, 2013).

Limitations and strengths

The response rate was 38% (n=605: General dentists n=525, pediatric dentists n=80), which is relatively good for a mail survey of health professionals today. However, there was a large number of missing data. Because some of the dentists did not provide complete information, the final sample sizes for frequency distributions and analyses vary depending on the variables. The average number of response for each variable was about 410 and the valid total was from 280 to 436. This fact might limit the generalizability of the findings of this study. Furthermore, because of potential response bias, the dentists who answered the questionnaire might have more interest in prevention and scientific research than non-respondents or believe that they are quite knowledgeable. Therefore, the outcome of this study may be more positive or over represent than the actual knowledge and practice of dental caries prevention of all dentists in Maryland.

On the positive side, the characteristics of the general dentists of the sample (86.8% of the overall sample, n=525) were similar to the overall membership of

Maryland State Dental Association regarding race, gender and year of graduation. This implies that the results of this study are generalizable to the membership of the Maryland State Dental Association. Additionally, according to my literature review, more information about dentists' knowledge and practice of dental caries prevention is needed. This current study provides one aspect of the picture of the dentists in Maryland. The findings of this study also can help shape the contents of the education needed such as the duration of topical fluoride application or the predominant theory of fluoride function action, and the target population of the education. All health care providers, including dentists need to know, understand and practice current methods of prevention to provide their patients with the best care and information. This is especially true with dentists considering the majority of Maryland adults report they get their oral health information from dentists (Horowitz, and Kleinman, 2012).

Directions for future research and intervention

The sample of this study was obtained from the membership list of the Maryland State Dental Association and the American Academy of Pediatrics Maryland Chapter. Maryland has a diverse racial-ethnic population, has both rural and urban areas, is relatively rich and also is a politically sensitive state. The knowledge and practices of dental caries prevention of dentists might vary depending on each state. More research about the topic of current study should be conducted in other states and/or nationwide. Collecting qualitative data by focus groups or in-depth interviews would also provide different and valuable aspects of dentists' knowledge and practices regarding dental caries prevention.

Dentists can and should play very important roles increasing the oral health literacy of their patients and the general population, therefore they should always have up-dated, evidence based knowledge. Based on the results of current this study, educational interventions for dentists are definitely needed. The channels would be continuing dental education and/or dental society meeting for practicing dentists and dental school for future dentists. The best way to provide education and to change dentists' behavior also needs more research. In the current study, dentists prefer "local professional meeting" (41.9%), "State professional meeting"(26.6%), "online" (26.5%) and "JADA/AAPD supplement" (20.2%) (data not shown).

Conclusions

The knowledge of dental caries prevention and early detection of dentists in Maryland is moderate. This issue of an "information lag" has been reported earlier (O'Neill, 1984) and still exists. Dentists' misunderstanding and lack of understanding of dental caries prevention will impede the provision of appropriate caries prevention practices and education to their patients in their practice for improving the oral health status and oral health literacy of their patients. Dental schools should provide up-dated appropriate dental caries prevention curriculum for their students and continuing education also should be provided to current dental practitioners via study groups and local, state and national meetings to ensure dental practitioners know and understand how to prevent dental caries. In turn, more knowledgeable dentists can provide evidence-based prevention education and practice for their patients to improve the oral health literacy and oral health status of their patients.

Appendix1

IRB approval letter

1204 Marie Mount Hall
College Park, MD 20742-5125
TEL 301.405.4212
FAX 301.314.1475
irb@umd.edu
www.umresearch.umd.edu/IRB

DATE: September 7, 2012

TO: Go Matsuo
FROM: University of Maryland College Park (UMCP) IRB

PROJECT TITLE: [372521-1] Knowledge and practice of dental caries prevention of dentists in Maryland

SUBMISSION TYPE: New Project

ACTION: DETERMINATION OF EXEMPT STATUS
DECISION DATE: September 7, 2012

REVIEW CATEGORY: Exemption category # 4

Thank you for your submission of New Project materials for this project. The University of Maryland College Park (UMCP) IRB has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations.

We will retain a copy of this correspondence within our records.

If you have any questions, please contact the IRB Office at 301-405-4212 or irb@umd.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Maryland College Park (UMCP) IRB's records.

- 1 - Generated on IRBNet

Appendix2

Questionnaire

Maryland State Dental Association
6410 Dobbin Road, Suite F
Columbia, MD 21045

University of Maryland, School of Public Health
Herschel S. Horowitz Center for Health Literacy
2367 School of Public Health Bldg., College Park, MD 20742

Maryland Survey of Dental Caries Prevention

(Dentists)

Thank you for taking time to complete this survey. Your confidential answers will be used by the School of Public Health, University of Maryland to develop continuing education and other intervention programs for dentists and dental team members to improve the oral health of the public.

Please circle the number corresponding to the most appropriate response or fill in the box or blank.

TELL US ABOUT THE PRACTICE WHERE YOU WORK

1. Does your practice treat children/youth ages 0-20 years?
   Yes 1
   No (Skip to Question 3) 2

2a. Approximately what percentage of your child patients are the following ages?
   1. Children ages 6 months-2 years ____________ %
   2. Children ages 3-6 years ____________ %
   3. Children/youth 7-20 years ____________ %
   Total (must add to 100%) 100 %

2b. Approximately what percentage of your child/youth patients are members of the following groups?
   1. Medicaid or SCHIP beneficiaries ____________ %
   2. Commercial/ Private insurance recipients ____________ %
   3. Out of pocket payers ____________ %
   Total (must add to 100%) 100 %

2c. In the past year have you had child patients present with early childhood caries (ECC)?
   Yes 1
   No 2

3. In your opinion what is the greatest challenge a practitioner experiences with a child patient who has early childhood caries or ECC? **[Check all that apply]**.
   a. Child is in pain at visit 1
   b. Child has difficult behavioral issues 2
   c. Child does not return for follow-up care 3
   d. Child (parent) is frequently a no-show 4
   e. Parent/caregiver does not follow my instructions 6
   f. Child's teeth always needs cleaning 7
   g. Parent/caregiver does not seem to care about child's oral health ... 8
   h. Parent/caregiver continues to give sweet drinks in child's bottle or tippy cup ... 9
   i. Parent/caregiver will not accept the recommended fluoride regimen ... 10
   j. I don't encounter problems 11
   k. Other, please specify ______________________________ 12

TELL US YOUR OPINIONS

4a. How effective do you think each of the following procedures is for preventing dental caries in children 6 months to 2 years of age? **[Circle only one response for each line]**.

	Effectiveness for Children Ages 6 mos. to 2 years	Not Effective	Somewhat Effective	Effective	Very Effective	Don't Know
1.	Community water fluoridation	1	2	3	4	9
2.	Dietary fluoride drops/tablets	1	2	3	4	9
3.	Fluoride dentifrices	1	2	3	4	9
4.	Fluoride varnish	1	2	3	4	9
5.	Cleaning infant's mouth	1	2	3	4	9
6.	Toothbrushing without a fluoride dentifrice	1	2	3	4	9
7.	Routine dental care	1	2	3	4	9
8.	Professional prophylaxis	1	2	3	4	9
9.	Flossing	1	2	3	4	9
10.	Nutritional counseling	1	2	3	4	9
11.	Infrequent sugar consumption	1	2	3	4	9
12.	Use of xylitol	1	2	3	4	9

4b. Of the above procedures, which two do you consider the **most** effective in preventing caries in children 6 months to 2 years of age? **[Write in number 1-12]**.

1st Priority ______________
2nd Priority ______________

5a. How effective do you think each of the following procedures is for preventing dental caries in children 3 to 6 years of age? **[Circle only one response for each line]**.

	Effectiveness for Children Ages 3 to 6 years	Not Effective	Somewhat Effective	Effective	Very Effective	Don't Know
1.	Community water fluoridation	1	2	3	4	9
2.	Dietary fluoride drops/tablets	1	2	3	4	9
3.	Fluoride dentifrices	1	2	3	4	9
4.	Fluoride varnish	1	2	3	4	9
5.	Pit and fissure sealants	1	2	3	4	9
6.	Topical fluorides-professional	1	2	3	4	9
7.	Fluoride rinse-at home	1	2	3	4	9
8.	Fluoride rinse-at school	1	2	3	4	9
9.	Brush-on fluoride gels	1	2	3	4	9
10.	Fluoride gel in mouth tray	1	2	3	4	9
11.	Fluoride foam	1	2	3	4	9
12.	Toothbrushing without a fluoride dentifrice	1	2	3	4	9
13.	Flossing	1	2	3	4	9
14.	Professional prophylaxis	1	2	3	4	9
15.	Routine dental care	1	2	3	4	9
16.	Nutritional counseling	1	2	3	4	9
17.	Infrequent sugar consumption	1	2	3	4	9
18.	Use of xylitol	1	2	3	4	9

5b. Of the above procedures, which two do you consider the **most** effective in preventing caries in children 3 to 6 years of age? **[Write in number 1-18]**.

1st Priority ______________
2nd Priority ______________

6a. How effective do you think each of the following procedures is for preventing dental caries in youth 7 to 20 years of age? **[Circle only one response for each line]**.

	Effectiveness for Children Ages 7 to 20 years	Not Effective	Somewhat Effective	Effective	Very Effective	Don't Know
1.	Community water fluoridation	1	2	3	4	9
2.	Dietary fluoride drops/tablets	1	2	3	4	9
3.	Fluoride dentifrices	1	2	3	4	9
4.	Fluoride varnish	1	2	3	4	9
5.	Pit and fissure sealants	1	2	3	4	9
6.	Topical fluorides-professional	1	2	3	4	9
7.	Fluoride rinse-at home	1	2	3	4	9
8.	Fluoride rinse-at school	1	2	3	4	9
9.	Brush-on fluoride gels	1	2	3	4	9
10.	Fluoride gel in mouth tray	1	2	3	4	9
11.	Fluoride foam	1	2	3	4	9
12.	Toothbrushing without a fluoride dentifrice	1	2	3	4	9
13.	Flossing	1	2	3	4	9
14.	Professional prophylaxis	1	2	3	4	9
15.	Routine dental care	1	2	3	4	9
16.	Nutritional counseling	1	2	3	4	9
17.	Infrequent sugar consumption	1	2	3	4	9
18.	Use of xylitol	1	2	3	4	9

6b. Of the above procedures, which two do you consider the most effective in preventing caries in children/youth 7 years to 20 years of age? **[Write in number 1-18]**.

1st Priority ______________

2nd Priority ______________

TELL US ABOUT YOUR PREVENTION PRACTICES

7. What is the frequency you or someone in your office provide topical fluoride treatments to your child patients? **[Circle only one response for each age group]**.

		Once a year	2x per year	More than 2x per year	Only if they have caries	Do not provide
1.	Children (6 mos. to 2 years)	1	2	3	4	0
2.	Children (3 to 6 years)	1	2	3	4	0
3.	Youth (7 to 20 years)	1	2	3	4	0

8. Please indicate the type of fluoride and the application time you most often use for in-office treatments. **[Circle only one application time for each type of fluoride]**.

		30 secs.	1 min.	2 mins.	4 mins.	Do not use
1.	APF gel	1	2	3	4	0
2.	APF foam	1	2	3	4	0
3.	NaF gel	1	2	3	4	0
4.	NaF rinse	1	2	3	4	0
5.	SnF_2	1	2	3	4	0
6.	Fluoride varnish	1	2	3	4	0
7.	Fluoride prophy paste	1	2	3	4	0
8.	Other, please specify ___________________________	1	2	3	4	0

9a. Do you provide/recommend fluoride products (gels, toothpaste, mouthrinses) for child patients for their home use?
1. ☐ Yes 2. ☐ No

9b. Do you ask the source of your child patient's drinking water?
1. ☐ Yes 2. ☐ No

10a. Do you use sealants for your child/youth patients?
1. ☐ Yes 2. ☐ No (skip to Question 11)

10b. If Yes, to what percentage of your patients under age 20 do you apply sealants?
1. ☐ None
2. ☐ 10% or less)
3. ☐ 11-25%
4. ☐ 26-50%
5. ☐ 51-75%
6. ☐ Over 75%

11. If your child patients do not receive sealants, which of the following reasons apply? **[Check all that apply]**.
1. ☐ Patients are unwilling to pay for them
2. ☐ Parents unfamiliar with the procedure
3. ☐ Use of sealants are unsubstantiated by research
4. ☐ Sealants do not last very long
5. ☐ Too time consuming to apply
6. ☐ It is more economical to place amalgam or composite fillings as needed
7. ☐ Decay can develop under a sealant
8. ☐ Technique is too difficult
9. ☐ I have had poor experience with sealants
10. ☐ Possible to seal in decay
11. ☐ Office policy does not support use of sealant
12. ☐ Insurance does not pay for it
13. ☐ Other ______________________________

12a. Do you routinely assess dental caries risk factors for your child/youth patients?
1. ☐ Yes 2. ☐ No (If no, skip to Question 13a)

12b. If yes, which of the following caries risk factors do you use for these patients? **[Check ALL that apply]**.
1. ☐ Frequency of dental visits
2. ☐ Child has special health care needs
3. ☐ Child's exposure to fluoride
4. ☐ Child has decay
5. ☐ Times per day child's teeth are brushed
6. ☐ Socioeconomic status of child's parents
7. ☐ Daily between-meal exposures to cavity producing food
8. ☐ Visible plaque
9. ☐ Presence of enamel demineralization
10. ☐ New lesions since last visit
11. ☐ Other, please specify ______________________________

13a. Do you or members of your team provide caries preventive education for children and their parents?
1. ☐ Yes 2. ☐ No (If no, skip to Question 14)

13b. If yes, what topics do you include in caries prevention education for each age group? **[Check all that apply for each group]**.

	Topics	Children Ages 6 mos. to 2 years	Children Ages 3 to 6 years	Youth Ages 7 to 20
1	Toothbrushing instruction	1	2	3
2.	Clean mouth/gums	1	2	3
3.	Flossing instruction	1	2	3
4.	Use of disclosing agents	1	2	3
5.	Home fluoride gels	1	2	3
6.	Fluoride drops/tablets	1	2	3
7.	Prevention of Early Childhood Caries	1	2	3
8.	Community water fluoridation	1	2	3
9.	Mechanism of fluoride action	1	2	3
10.	Pit and fissure sealants	1	2	3
11.	Nutrition/sugar reduction	1	2	3
12.	Use of antimicrobial rinses	1	2	3
13.	Use of fluoride dentifrice	1	2	3
14.	Home fluoride rinses	1	2	3
15.	Use of Xylitol	1	2	3
16.	Other, please specify ______________________________	1	2	3

TELL US YOUR OPINIONS

14. Please indicate the extent to which you personally agree or disagree with each of the following statements. **[Circle only one response on each line]**.

		Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
1.	Sealants are not needed if patients receive topical fluorides	1	2	3	4	9
2.	Use of sealants is not substantiated by scientific research	1	2	3	4	9
3.	Newly erupted permanent molars are the most important candidates for sealants	1	2	3	4	9
4.	Loss of sealants is generally attributed to inappropriate application technique	1	2	3	4	9
5.	Sealants are somewhat risky because decay may be sealed in the tooth	1	2	3	4	9
6.	It is desirable to use professionally applied fluorides for all children in areas without fluoridated water	1	2	3	4	9
7.	The most important mechanism of action of fluoride is that it is incorporated into developing teeth to make them more resistant to acid demineralization	1	2	3	4	9
8.	The increased use of bottled water increases tooth decay among young children	1	2	3	4	9
9.	Levels of salivary micro-organisms may indicate levels of caries risk or activity	1	2	3	4	9
10.	Lactobacilli play a more significant role in the initiation of smooth surface carious lesions than do mutans streptococci	1	2	3	4	9
11.	Incipient carious lesions (before cavitation) can be remineralized (healed)	1	2	3	4	9
12.	Dental caries is a chronic, infectious disease process	1	2	3	4	9
13.	Dilute, frequently administered fluorides are more effective in caries prevention than more concentrated, less frequently administered fluorides	1	2	3	4	9
14.	The most important mechanism of action of fluoride is the remineralization of incipient decay	1	2	3	4	9
15.	Quantity of sugar consumed is more important in causing caries than frequency of sugar consumption	1	2	3	4	9
16.	Fructose, glucose and sucrose are cariogenic	1	2	3	4	9
17.	Decreased salivary flow increases the risk for developing caries	1	2	3	4	9
18.	Removal of plaque is more valuable for maintaining gingival health than for preventing caries	1	2	3	4	9

15. During a typical workweek, how often do you use the following communication techniques?
[Circle one response for the left column and one response for the right column of each line].

		How often do you use it?					Is it effective?		
		Always	Most of the time	Occa-sionally	Rarely	Never	Yes	No	Don't Know
1.	Ask patients to repeat back information or instructions	5	4	3	2	1	1	2	9
2.	Speak slowly	5	4	3	2	1	1	2	9
3.	Limit number of concepts presented at a time to 2-3	5	4	3	2	1	1	2	9
4.	Ask patients to tell you what they will do at home to follow instructions	5	4	3	2	1	1	2	9
5.	Use simple language	5	4	3	2	1	1	2	9
6.	Read instructions out loud	5	4	3	2	1	1	2	9
7.	Hand out printed materials	5	4	3	2	1	1	2	9
8.	Underline key points on print materials	5	4	3	2	1	1	2	9
9.	Write or print out instructions	5	4	3	2	1	1	2	9
10.	Draw pictures or use printed illustrations	5	4	3	2	1	1	2	9
11.	Use models or x-rays to explain	5	4	3	2	1	1	2	9
12.	Refer patients to the Internet or other sources of information	5	4	3	2	1	1	2	9
13.	Ask hygienist, assistant or other office staff to follow-up with patients for post-care instructions	5	4	3	2	1	1	2	9
14.	Use video or DVD	5	4	3	2	1	1	2	9
15.	Follow-up with patients by telephone to check understanding and adherence	5	4	3	2	1	1	2	9
16.	Ask patients whether they would like a family member or friend to accompany them in the discussion	5	4	3	2	1	1	2	9
17.	Use a translator or interpreter when needed	5	4	3	2	1	1	2	9
18.	Ask patients what they can accomplish in connection with their oral hygiene	5	4	3	2	1	1	2	9

16. Have you ever assessed your office/clinic procedures and facility to determine how user-friendly it is for patients?
1. ☐ Yes 2. ☐ No

17. Some clinicians believe that they can do what is necessary to prevent ECC among their Medicaid patients. How sure are you that you can prevent ECC in your patients? **[Circle your response]**.

Very Sure	Somewhat Sure	Somewhat Unsure	Very Unsure	Don't Know
1	2	3	4	9

HELP US PLAN EDUCATIONAL ACTIVITIES

18. Excluding dental school have you ever taken a course on communication skills?
   1. ☐ Yes   2. ☐ No

19. Would you be interested in attending a continuing education course on communication skills?
   1. ☐ Yes   2. ☐ No

20. Excluding dental school, have you ever taken a course on dental caries prevention?
   1. ☐ Yes   2. ☐ No

21. Would you be interested in attending a continuing education course on dental caries prevention?
   1. ☐ Yes   2. ☐ No

22. If yes, where or how would you prefer to receive information and skills about caries prevention and early intervention? [Check all that apply].
   1. ☐ Local professional meeting
   2. ☐ State professional meeting
   3. ☐ National professional annual session
   4. ☐ Local university or college
   5. ☐ Online
   6. ☐ JADA/AAPD Supplement
   7. ☐ In-service training for entire team at the office or clinic where I work
   8. ☐ Grand rounds
   9. ☐ Other, please specify ______________________

TELL US SOMETHING ABOUT YOU

23. What is your primary occupation? [Check only one].
   1. ☐ Private practice
   2. ☐ Health professional school faculty/staff member
   3. ☐ Armed forces
   4. ☐ Federal services
   5. ☐ Public health clinical practitioner
   6. ☐ State or local government employee
   7. ☐ Hospital staff provider
   8. ☐ Graduate student/intern/resident
   9. ☐ Health/dental organization staff member
   10. ☐ Other, please specify ______________________

24. Which of the following best describes your practice setting? [Check only one.]
   1. ☐ Solo practice
   2. ☐ Group private practice
   3. ☐ Government funded public health practice
   4. ☐ Private, non-profit hospital
   5. ☐ Other, please specify ______________________

25. In what country were you born?

   ____

26. In what country did you receive your dental training?

   ____

27. In what year did you graduate from dental school?

   ____

28. What is your gender?
   1. ☐ Female   2. ☐ Male

29. What is your race/ ethnicity?
   1. ☐ White
   2. ☐ Black
   3. ☐ Hispanic
   4. ☐ Asian/Pacific Islander
   5. ☐ American Indian/Native Alaskan
   6. ☐ Other, please specify ______________________

30. How would you rate your dental school training regarding dental caries prevention? [Check only one].
   1. ☐ Very Good
   2. ☐ Good
   3. ☐ Poor
   4. ☐ Very Poor
   5. ☐ Not sure

Thank you for your assistance with this project. Please return this questionnaire by folding and placing tape as indicated. Drop in the mail. Postage is paid.

Appendix3

Attached letter

LOGO of Organization **DRAFT**

Date

Address

Dear Doctor Smith,

As you know, Deamonte Driver's death stimulated a series of major state events starting with a thorough assessment resulting in strong recommendations developed by the Dental Action Committee (DAC) commissioned by Secretary Colmers. While the state has made significant progress in its effort to address caries prevention, there is still more work to be done in providing prevention and early detection and access to care. To develop future interventions, the Maryland State Dental Association and the Herschel S. Horowitz Center for Health Literacy at the University of Maryland, School of Public Health are collaborating on a project to determine dentists' practices and opinions about dental caries prevention and related communication practices.

You can help by completing the enclosed questionnaire, *Maryland Survey of Dental Caries Prevention*. Our pretest showed that the survey could be completed in 15 minutes. **Your assistance is vital to the success of this project.** Help us avoid the expense of follow-up costs by completing this survey today.

Please be aware that your name will not be associated with your answers in any reports. The results from this project will be presented in aggregate form only. Identification numbers linked to your name are used for follow-up purposes so we can send second and third mailings when necessary. No identifying information will be released.

If you have any questions, please call Dr. Alice Horowitz at (301) 405-9797 or Ms. Erika Mabry at 301-405-2356. Thank you in advance for your assistance with this study.

Sincerely,

William F. Martin III, DDS
President, Maryland State Dental Association

6410 Dobbin Road • Suite F • Columbia • Maryland • 21045-4744
(410) 964-2880 • Fax (410) 964-0583 • www.msda.com

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