Maryland Dental Hygienists' Knowledge, Opinions and Practices Regarding Dental Caries Prevention and Early Detection

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Abstract

Purpose: The purpose of this study was to assess Maryland dental hygienists' knowledge, practices and opinions regarding dental caries prevention and early detection.

Methods: A 30 item survey was mailed to 1,258 Maryland dental hygienists. Two follow–up mailings and email reminders were sent.

Results: The response rate was 43% (n=540). Nearly all respondents were female (98%), and 58% practiced in solo settings. Knowledge and certainty of knowledge were moderate: sealants are needed regardless of topical fluoride use (55% certain, 40% less certain), newly erupted permanent molars are the best candidates for sealants (54%, 36%) and professionally applied fluorides are desirable in areas without fluoridated water (55%, 36%). Fewer were certain that incipient lesions can be remineralized before cavitation (23%, 69%), and dilute, frequently administered fluorides are more effective in caries prevention than concentrated, less frequently administered fluorides (6%, 24%). Opinions regarding effectiveness of protocols for 2 age groups from 6 months to 6 years, the challenges of early childhood caries (ECC), prevention practices regarding sealant and topical fluoride applications varied widely. Eighty–nine percent reported routinely assessing dental caries risk factors of child patients and 90% were interested in continuing education courses. There were no significant differences between different types of practice settings, year of graduation, race/ethnicity or gender.

Conclusion: Knowledge of recommended guidelines for fluoride and sealant application support clinical decision–making and self–care counseling. Misinformation and lack of understanding of current research and recommendations identify a need for educational interventions in undergraduate dental hygiene programs and through continuing education for practicing hygienists.

Keywords: Dental caries, dental hygienists, oral health, practice guidelines, clinical practice variations

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Assess the use of evidence–based treatment recommendations in dental hygiene practice.

Introduction

Reduction in the prevalence of dental caries has been a target of concentrated U.S. public health efforts since the mid 20th century, and dental caries has declined dramatically in the last 50 years. The resulting public perception that dental caries is no longer a significant health concern obscures this important public health problem.[1] However, current evidence suggests that prevention efforts must be enhanced for both individuals and the public.[2,3] Dental hygienists, the oral health professionals focused on prevention, should play a pivotal role in this effort.

Data from 2 National Health and Nutrition Examination Surveys (NHANES III, 1988 to 2004 and NHANES 1999 to 2004) show that while oral health among Americans improved over time, dental caries continues to be a concern for all age groups.[1,4,5] Data specifically for the period from 1999 to 2004 show caries prevalence increased among preschool children compared with data from NHANES III. In addition, untreated caries were present for over 25% of adults, aged 20 to 64 years, and more than 20% of adults over age 65 years.[1,4,5] In Maryland, 33% of kindergarten children and 30% of third graders (age 8) had untreated dental caries in 2005 to 2006, and third graders showed almost no change in caries experience and untreated decay since 2000 to 2001.[6]

The Institute of Medicine (IOM) released a report delineating key recommendations for the Health and Human Services Oral Health Initiative, referred to as the U.S. New Oral Health Ini-

tiative (NOHI).[3] The IOM Report provides several recommendations for setting goals and concludes that the Healthy People 2020 goals and objectives should be used as the continuing mission (Table I).[7] The report recommends promoting and monitoring the use of evidence–based preventive services in oral health (both clinical and community based) and counseling across the life span. The domains and significance of prevention are strikingly underscored in this recommendation and they are especially applicable to the primary role of dental hygienists as preventive specialists.[8]

Though the clinical role of dental hygienists varies throughout the U.S. and the world, their primary role has always focused on prevention.[8] Dental hygienists can have a significant impact on prevention of dental caries through preventing the onset of disease, early recognition of disease and patient education that encourages individuals to take an active role in maintaining their oral health.[9,10] The knowledge and understanding of evidence–based preventive regimens and communication approaches that dental hygienists use with their patients is fundamental to their patients adopting recommended oral health practices and procedures.

Table I: Healthy People 2020 Oral Health Objectives Related to Dental Caries*

Oral Health of Children and Adolescents
OH–1 Dental caries experience
• OH–1: Reduce the proportion of children and adolescents who have dental caries experience in their primary or permanent teeth. • OH–1.1 Reduce the proportion of young children aged 3 to 5 years with dental caries experience in their primary teeth. • OH–1.2 Reduce the proportion of children aged 6 to 9 years with dental caries experience in their primary and permanent teeth. • OH–1.3 Reduce the proportion of adolescents aged 13 to 15 years with dental caries experience in their permanent teeth.
OH–2 Untreated dental decay in children and adolescents
• OH–2: Reduce the proportion of children and adolescents with untreated dental decay. • OH–2.1 Reduce the proportion of young children aged 3 to 5 years with untreated dental decay in their primary teeth. • OH–2.2 Reduce the proportion of children aged 6 to 9 years with untreated dental decay in their primary and permanent teeth. • OH–2.3 Reduce the proportion of adolescents aged 13 to 15 years with untreated dental decay in their permanent teeth. • OH–2.3 Reduce the proportion of adolescents aged 13 to 15 years with untreated dental decay in their permanent teeth.
Access to Preventive Services
OH–8 Dental services for low–income children and adolescents
• OH–8: Increase the proportion of low–income children and adolescents who received any preventive dental service during the past year.
OH–9 School–based centers with an oral health component
• OH–9.1 Increase the proportion of school–based health centers with an oral health component that includes dental sealants. • OH–9.2 Increase the proportion of school–based health centers with an oral health component that includes dental care. • OH–9.3 Increase the proportion of school–based health centers with an oral health component that includes topical fluoride.
Oral Health Interventions
OH–12 Dental sealants
• OH–12: Increase the proportion of children and adolescents who have received dental sealants on their molar teeth. • OH–12.1 Increase the proportion of children aged 3 to 5 years who have received dental sealants on one or more of their primary molar teeth. • OH–12.2 Increase the proportion of children aged 6 to 9 years who have received dental sealants on one or more of their permanent first molar teeth. • OH–12.3 Increase the proportion of adolescents aged 13 to 15 years who have received dental sealants on one or more of their permanent molar teeth.
OH–13 Community water fluoridation
• OH–13: Increase the proportion of the U.S. population served by community water systems with optimally fluoridated water.

*U.S. Department of Health and Human Services. Oral Health Objectives. Washington, DC: U.S. Department of Health and Human Services,; 2011 [cited 2011 April 29, 2011]; Available from: http://healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicid=32

Dental hygiene advocates agree that dental hygienists must utilize current methods that have been verified through clinical trials and recommended as best practices.[8,11] A specific recommendation, for example, is the practice of caries management by the CAMBRA risk assessment method that focuses on appropriate prevention and treatment measures for each stage of the dental caries disease process and tailors disease

management to individual risk profiles.[12] While the importance of dental hygienists in education and prevention is generally accepted, there are relatively few studies that investigate hygienists' knowledge, opinions and practice in these areas.

In some studies, a significant proportion of hygienists did not have adequate knowledge of current evidence based recommendations in areas such as fluoride and sealant use and application protocols.[13–15] A study by Forrest et al showed that younger and more recent dental hygienist graduates were more knowledgeable in some topic areas than those who had been practicing longer.[14] However, in a more recent study, Manski et al showed that the more experienced dental hygienists and those who work with Medicaid patients were more likely to understand an appropriate preventive regimen.[15] In these latter 2 studies, those who were members of the American Dental Hygienists Association (ADHA) were more likely to be aware of prevention and treatment recommendations. Even when dental hygienists are aware of current evidence based recommendations, they do not necessarily employ these recommendations consistently.[16]

Current knowledge and understanding of evidence–based interventions are needed to practice effective dental caries prevention and to communicate these messages to patients accurately and effectively. The purpose of this study in Maryland was to explore and determine dental hygienists' knowledge, practices and opinions regarding dental caries prevention and early detection.

Methods and Materials

A cross–sectional survey design was used in this descriptive study of Maryland dental hygienists knowledge, opinions and practices related to dental caries prevention and their use of recommended communication techniques. The findings in this report are limited to the former. The institutional review board at the University of Maryland approved the study.

In May, June and July of 2010, a survey was mailed to 1,258 dental hygienists on a membership list provided by the Maryland Dental Hygienists' Association (MDHA), and data were collected. The 30 item questionnaire was developed from previous surveys[14,17–19] and was designed to elicit what the respondent understands and practices with regard to dental caries prevention and their use of recommended communication techniques. The questions about dental caries were largely drawn from previous surveys,[14,17] while the questions on communications techniques were largely drawn from studies conducted by the American Dental Association and the American Medical Association.[18,19] In addition to the authors of the manuscript, the instrument was reviewed by 2 pediatric dentists, 2 public health dentists and 1 cardiologist for content validity.

For this study, the instrument was then pilot–tested among 6 practicing dental hygienists, revised and printed in a format that could be returned without an envelope. Participation in the study was voluntary and consent to participate was given by completing and returning the survey. The first mailing consisted of the full survey instrument with a cover letter signed by the current president of the MDHA. Approximately 3 weeks after the first mailing, a second complete mailing was sent with a modified cover letter from the president. Approximately 3 weeks after the second mailing, a postal card, also signed by the MDHA president, was mailed as a reminder for the dental hygienist that the survey was not yet received. The MDHA also sent an email reminder to all dental hygienists urging them to respond to the survey as soon as possible.

Statistical analyses included descriptive statistics (frequencies and percentages), cross tabulation and chi–square statistic. For the chi–square test, the associations were examined between all demographic variables and the knowledge and practice variables. All statistical analyses were conducted using SPSS version v18.

Results

A total of 579 surveys were returned for a response rate of 46%. The usable responses were 540 for an effective response rate of 43%. The majority of respondents were female (98%) with 83% Caucasian (Table II). More than half (58%) practiced in a solo practice setting, and 35% were in group practices. Approximately one–fourth of respondents graduated from their dental hygiene education program in each of the previous 3 decades, and 27% graduated before 1980. Eleven percent of dental hygienists treated patients whose oral health care was reimbursed by Medicaid or SCHIP. The majority of respondents' patients (70%) had private insurance.

Knowledge

The findings regarding dental hygienists' knowledge are shown in Table III. For each of the 18 statements regarding the etiology and prevention of dental caries, respondents used a Likert–type scale to indicate their agreement or disagreement

with the statement. Asterisks indicate the correct answers based on current scientific evidence and are identified as strongly agree or strongly disagree. Respondents' preferences regarding caries etiology show correct and incorrect knowledge. One–quarter (25%) correctly strongly agreed that dental caries is a chronic, infectious disease process, but 55% indicated they did not know whether lactobacilli play a more significant role in the initiation of smooth surface carious lesions than do mutans streptococci. Most respondents (62%) correctly identified as strongly agreed that a decreased salivary flow increases the risk for developing caries, 23% indicated that incipient carious lesions before cavitation can be remineralized, 22% responded that levels of salivary micro–organisms may indicate levels of caries risk or activity and 6% indicated that the removal of plaque is more valuable for maintaining gingival health than for preventing caries. Regarding the role of sugars in caries etiology, 44% correctly identified that the quantity of sugar consumed is less important than frequency of consumption, and 29% indicated that fructose, glucose and sucrose are cariogenic.

Responses related to fluoride knowledge reflect variation in the understanding of fluoride's mechanism of action and in the professional application of fluoride. Thirteen percent correctly strongly agreed that the most important mechanism of fluoride action is remineralization of incipient lesions. Although 54% correctly strongly agreed that it is desirable to use professionally applied fluorides for all children in areas without fluoridated water, 6% indicated that dilute, frequently administered fluorides are more effective in caries prevention than more concentrated, less frequently administered fluorides. Regarding whether increased use of bottled water increases tooth decay, 10% correctly identified that they did not know.

Most dental hygienists correctly answered the sealant items recognizing that sealants are needed even if patients receive topical fluorides (55%), newly erupted permanent molars are the most important candidates for sealants (54%) and use of sealants is substantiated by scientific research (45%). Fewer identified that loss of sealants is generally attributed to inappropriate application technique (14%) and sealants are not risky because decay may be sealed in the tooth (11%).

Opinions

Dental hygienists' opinions about the effectiveness of procedures for preventing dental caries are shown in Tables IV and V for ages 6 months to 2 years and 3 to 6 years, respectively. Although there were some variations in respondents' beliefs by age group, for both groups the majority of dental hygienists believed that community water fluoridation is very effective for ages 3 to 6 years of age (73%) and for ages 6 months to 2 years (69%). About half the respondents believed that dietary fluoride drops/tablets are very effective for the younger age group. Fluoride dentifrices were believed by the majority of respondents to be very effective for the older age group, but for ages 6 months to 2 years, beliefs were divided between somewhat and very effective. Fluoride varnishes were believed to be very effective by the majority but less so for ages 6 months to 2 years. About half believed that professionally applied topical fluorides are very effective for both age groups. For ages 3 to 6 years, the greatest proportion of respondents believed that fluoride rinses at home and school, brush–on fluoride gels, fluoride gels in mouth trays and fluoride foam are effective. For both age groups, the greatest proportions of respondents believed that tooth brushing without

Table II: Dental hygienists' characteristics

Characteristic	n	Percentage
Year of Graduation		
1958–1979	144	27.4
1980–1989	131	24.9
1990–1999	116	22.1
2000–2009	135	25.7
Practice Setting		
Solo Practice	306	57.8
Group Practice	189	35.3
All other	34	6.4
Race/Ethnicity		
White	451	83.4
Black	34	6.3
All other	56	10.4
Gender		
Female	521	97.9
Male	11	2.1
Type of dental insurance of child patients		
Medicaid/SCHIP	464	11.0*
Private Insurance	488	70.0*
Out of Pocket	483	21.0*
Ever taken a communication course		
Yes	350	65.8
No	182	34.2

*Average percentage

Table III: Percentages of dental hygienists' knowledge of etiology and prevention of dental caries

Please indicate the extent to which you personally agree or disagree with each of the following statements	SA & A OR (SD & D)	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
Sealants are not needed if patients receive topical fluorides	(94.6)	1.5	2.6	39.6	55.04*	1.3
Use of sealants is not substantiated by scientific research	(86.7)	1.3	2.4	41.2	45.49*	9.6
Newly erupted permanent molars are the most important candidates for sealants	90.4	54.41*	36.0	3.8	4.9	0.9
Loss of sealants is generally attributed to inappropriate application technique	59.9	14.45*	45.4	31.1	2.6	6.4
Sealants are somewhat risky because decay may be sealed in the tooth	(64.2)	2.3	29.1	52.9	11.26*	4.5
It is desirable to use professionally applied fluorides for all children in areas without fluoridated water	90.3	54.49*	35.8	4.1	4.9	0.8
The most important mechanism of action of fluoride is that it is incorporated into developing teeth to make them more resistant to acid demineralization	(8.5)	45.0	44.8	5.5	3.01*	1.7
The most important mechanism of action of fluoride is the remineralization of incipient decay	67.3	12.55*	54.8	24.9	1.7	6.1
Dilute, frequently administered fluorides are more effective in caries prevention than more concentrated, less frequently administered fluorides	29.1	5.51*	23.6	33.3	7.8	29.9
Incipient carious lesions (before cavitation) can be reminearlized (healed)	91.7	23.12*	68.6	3.8	0.6	4.0
The increased use of bottled water increases tooth decay among young children		17.8	48.4	21.1	3.2	9.53*
Dental caries is a chronic, infectious disease process	73.6	25.1*	48.5	21.3	1.9	3.3
Levels of salivary micro–organisms may indicate levels of caries risk or activity	88.7	21.85*	66.9	2.5	0.4	8.5
Lactobacilli play a more significant role in the initiation of smooth surface carious lesions than do mutans streptococci	(17.3)	4.0	23.8	14.2	3.07*	54.9
Fructose, glucose and sucrose are cariogenic	88.4	28.84*	59.6	5.7	2.3	3.6
Quantity of sugar consumed is more important in causing caries than frequency of sugar consumption	(92.7)	2.8	3.0	48.6	44.09*	1.5
Decreased salivary flow increases the risk for developing caries	97.4	61.84*	35.5	0.8	1.9	0.0
Removal of plaque is more valuable for maintaining gingival health than for preventing caries	31.3	6.07*	25.2	52.6	13.7	2.5

*Correct Answers

a fluoride dentifrice is either somewhat or very effective.

Pit and fissure sealants were believed to be very effective for ages 3 to 6 by 64% of respondents. Beliefs regarding flossing as very effective for preventing tooth decay increased with age group: 35% for age 6 months to 2 years and 44% for ages 3 to 6. A large proportion of respondents believed that professional prophylaxis is very effective for both age groups. Nutritional counseling and infrequent sugar consumption were believed to be very effective for both age groups by about two–thirds and three–quarters of respondents, respectively. The use of xylitol was believed to be mostly effective or very effective but large proportions did not know, for 6 months to 2 years, and for 3 to 6 years. For both age groups, routine dental care was believed to be very effective, for ages 6 months to 2 years (63%) and for 3 to 6 years (73%).

Respondents identified a broad range of difficulties with children who have early childhood caries (ECC). Most challenges related to the parent/caregiver (Table VI). Nearly half of all respondents (49%) believed that their greatest challenge with a child patient who has ECC is that the parent/caregiver does not follow their instructions. In addition, the parent/caregiver does not bring the child back for follow–up (45%), continues to give the child sweet drinks (44%), does not seem to care about the child's oral health (26%) and would not accept the recommended fluoride regi-

men (21%). Challenges specific to the child include difficult behavioral issues (37%) and their pain symptoms at the time of the visit (34%). Fewer than half (40%) were somewhat sure they could do what is necessary to prevent ECC, and others (29%) said they didn't know (data not shown).

Practices

Dental hygienists reported their practices regarding risk assessment for dental caries, use of fluorides and sealants, and the topics of education that they provide to children and their parents/caregivers (Table VII). Nearly all (94%) reported that they ask the source of the child patient's drinking water, 79% routinely assessed visible plaque, 77% assessed presence of enamel demineralization and 76% assessed the presence of caries. Frequency of brushing the child's teeth was assessed by 73% and 72% assessed the child's frequency of exposure to fluoride. Less than one–third (30%) reported assessing socioeconomic status of the child's parents as a risk factor.

Nearly all respondents (94%) said they provide/recommend fluoride products for the home use of child patients. Most respondents reported providing topical fluoride

Table IV: Percentages of dental hygienists' beliefs of the effectiveness of the procedures for preventing dental caries in children 6 months to 2 years of age

Effectiveness for Children Ages 6 months to 2 years	Not Effective	Somewhat Effective	Effective	Very Effective	Don't Know
Community water fluoridation	2.6	7.3	20.6	68.6	0.9
Dietary fluoride drops/tablets	3.2	10.7	27.9	51.9	6.4
Fluoride dentifrices	8.8	21.8	32.9	31.2	5.4
Fluoride varnish	7.6	7.6	24.6	51.5	8.7
Cleaning infant's mouth	2.1	8.7	25.6	61.1	2.6
Toothbrushing without a fluoride dentifrice	11.2	30.9	34.7	20.3	3.0
Routine dental care	2.1	9.5	22.5	63.0	3.0
Professional prophylaxis	6.8	16.7	28.0	44.9	3.6
Flossing	11.6	21.1	26.6	34.7	6.1
Nutritional counseling	0.9	8.1	23.0	65.1	2.8
Infrequent sugar consumption	0.6	4.7	21.8	71.7	1.3
Use of xylitol	6.5	19.7	25.6	17.8	30.4

Of the above procedures, which two do you consider most effective in preventing caries in children ages 6 months to 2 years?
- 1st Priority: Community water fluoridation 30.98%
- 2nd Priority: Nutritional counseling 19.16%

Table V: Percentages of dental hygienists' beliefs of the effectiveness of the procedures for preventing dental caries in children 3 to 6 years of age

Effectiveness for Children Ages 3 to 6 years	Not Effective	Somewhat Effective	Effective	Very Effective	Don't Know
Community water fluoridation	0.9	3.9	21.6	73.2	0.4
Dietary fluoride drops/tablets	1.3	10.1	27.7	56.2	4.7
Fluoride dentifrices	0.6	8.9	37.1	52.7	0.8
Fluoride varnish	0.2	5.5	26.5	65.6	2.3
Pit and fissure sealants	2.1	7.9	24.6	64.2	1.3
Topical fluorides–professional	0.9	12.8	34.9	50.2	1.1
Fluoride rinse–at home	2.1	18.6	40.3	37.1	1.9
Fluoride rinse–at school	5.1	23.7	33.2	24.1	13.9
Brush–on fluoride gels	2.7	20.1	42.8	29.6	4.9
Fluoride gel in mouth tray	4.9	25.4	40.1	25.8	3.8
Fluoride foam	5.7	36.6	35.4	20.0	2.3
Toothbrushing without a fluoride dentifrice	17.2	43.7	27.2	10.2	1.7
Flossing	2.1	17.0	36.9	43.7	0.4
Professional prophylaxis	0.6	9.9	33.8	55.5	0.2
Routine dental care	0.0	2.6	23.8	73.4	0.2
Nutritional counseling	0.0	6.4	25.9	66.2	1.5
Infrequent sugar consumption	0.2	3.5	21.1	75.0	0.2
Use of xylitol	1.7	17.2	32.0	26.1	22.7

Of the above procedures, which two do you consider most effective in preventing caries in children ages 3 to 6 years?
- 1st Priority: Community water fluoridation 34.06%
- 2nd Priority: Routine dental care 16.73%

Table VI: Percentages of dental hygienists' beliefs of the greatest challenges with a child patient who has ECC

Item	n	Percentage
Parent/caregiver does not follow my instructions	267	48.8
Child does not return for follow–up care	246	45.1
Parent/caregiver continues to give sweet drinks in child's bottle or tippy cup	247	43.8
Child has difficult behavioral issues	204	36.8
Child is in pain at visit	182	33.6
Child's teeth always needs cleaning	180	33.3
Child (parent) is frequently a no–show	170	31.4
Parent/caregiver does not seem to care about child's oral health	143	26.1
Parent/caregiver will not accept the recommended fluoride regimen	115	21.3
I don't encounter problems	0	0.0
Other: Includes responses from the following categories	–	n/a
• Access to dental healthcare • Education of importance for prevention & treatment • Cost of prevention & treatment • Heredity as a risk factor • Not applicable	2 11 8 1 8	n/a

Table VII: Dental hygienists' risk assessment for dental caries

Question & Item	n	Percentage
Do you routinely assess dental caries risk factors for your child/youth patients?		
• Yes • No	463 59	88.7 11.3
If Yes, which of the following caries risk factors do you use for these patients?*		
• Source of drinking water • Visible plaque • Presence of enamel demineralization • Child has decay • Times per day child's teeth are brushed • Child's exposure to fluoride • New lesions since last visit • Frequency of dental visits • Daily between–meal exposures to cavity producing food • Child has special health care needs • Socioeconomic status of child's parents • Other	494 429 417 412 396 389 382 365 351 312 164 20	93.6 79.3 77.1 76.2 73.2 71.9 70.6 67.5 64.9 57.7 30.3 5.0

*Respondents were asked to "Check ALL that apply"

treatments twice a year for children aged 3 to 6 years (82%) and for those 7 to 20 years (87%, Table VIII). Although 30% said they provide professionally applied fluoride treatments twice per year for children aged 6 months to 2 years, 56% said they do not provide any fluoride treatments. The preferred in–office fluoride treatment was fluoride varnish for 30 seconds (33%) or 1 minute (36%), followed by fluoride prophylaxis paste for 2 minutes (28%). Both APF gel and APF foam were reported by about 25% respondents for a 1 minute application.

Nearly all respondents reported applying sealants (93%) and 46% reported providing sealants for more than 75% of their patients (Table IX). Most respondents reported the reasons that child patients did not receive sealants were financial concerns, including parents being unwilling to pay entirely or to co–pay (62%) and insurance not including sealants as a benefit (46%).

Bivariate analysis did not reveal significant relationships between demographic characteristics and knowledge or practices. There were no significant differences regarding knowledge or practices between different types of practice settings, year of graduation, race/ethnicity or gender.

Discussion

The recommendation of the IOM's Advancing Oral Health in America report to promote and monitor the use of evidence–based preventive services in oral health is particularly relevant to dental hygiene in the state of Maryland.[3] Evidence–based dental hygiene practice in all practice settings can address and help to meet the current Healthy People 2020 objectives related to the prevention and control of dental caries (Table I). In Maryland there is now even greater potential to be effective in caries prevention in multiple settings as a result of recent regulatory change permitting dental hygienists to treat patients in public health facilities without the direct supervision of a dentist. Further, there is new attention to the need for primary prevention of dental caries in Maryland after the death in 2007 of 12–year–old Deamonte Driver.

Grounding dental hygiene practice in current evi-

Table VIII: Professional application of fluorides by dental hygienists

What is the frequency you or someone in your office provide topical fluoride treatments to your child patients?	Responses as percentages					n
	Once a year	2x per year	More than 2x per year	Only if they have caries	Do not provide	
Children (6 mos. to 2 years)	6.4	29.7	1.3	6.4	56.1	519
Children (3 to 6 years)	7.7	82.3	1.7	2.6	5.6	531
Youth (7 to 20 years)	7.2	87.0	1.9	0.6	3.4	531
Please indicate the type of fluoride and the application time you most often use for in–office treatments.	30 secs.	1 min.	2 mins.	4 mins.	Do not use	n
APF gel	0.2	22.9	3.5	11.9	61.4	428
APF foam	0.9	26.9	6.3	7.4	58.6	432
NaF gel	0.5	13.6	3.2	5.7	76.9	403
NaF rinse	1.9	15.7	4.8	1.2	76.3	413
SnF2	1.5	5.9	1.8	2.0	88.8	393
Fluoride varnish	33.0	36.3	12.9	8.9	8.9	482
Fluoride prophy paste	9.0	27.3	28.2	23.1	12.5	433
Other, please specify	36.4	9.1	0	0	0	11

dence has been clearly recognized as an imperative, strongly recommended over several decades[8,11] and is explicit in a number of core competencies defined by the American Dental Education Association.[20] This study suggests that enhancing Maryland dental hygienists' knowledge and practices would help to enable them to make a greater contribution towards achieving the Healthy People 2020 objectives, particularly for the youngest age groups.

Opinions about Practice

Dental hygienists' opinions influence how they practice dental caries prevention and control.[21] To use current best evidence, self–regulatory skills, including self–assessment and self–efficacy, are needed to implement practice change based on evidence.[21] Uncertainty about correct treatment procedures for various ages, such as managing ECC as reported in this study, can lead to selection of ineffective treatments and reduced caries prevention effect. ECC is a form of dental caries that is distinctive in its characteristics. It begins on smooth surfaces, usually in the primary maxillary incisors, then progresses rapidly, and is highly prevalent among very young children of low income families.[22,23] Fluoride interventions, especially fluoride varnishes, are effective in the prevention of ECC.[24]

Respondent opinions regarding the effectiveness of fluorides varied, and likely accounted for their variations in practice, particularly with regard to the time required for the fluoride application protocol (Table VIII). Although most respondents reported that xylitol is beneficial for all age groups, there are no evidence–based clinical guidelines regarding use of xylitol. There is promising evidence for the use of xylitol chewing gum as part of a caries prevention regimen,[25] and an oral xylitol syrup for ages 9 to 15 months to prevent ECC.[26] Nutritional counseling and infrequent sugar consumption were believed by large proportions of respondents to be effective in preventing dental caries for each age group, and this belief is consistent with guidelines for children, adolescents and adults (Table V).[27,28]

Many respondents believed that flossing is very effective for preventing dental caries, but studies have not supported this belief.[29–31] Large proportions of respondents incorrectly held that professional prophylaxis is very effective for caries prevention for all age groups. The public does not understand the difference between strategies for the prevention of dental caries and the prevention of periodontal diseases.[32] Dental hygienists can clarify the difference for individual patients and the public if they are certain about the evidence regarding the effectiveness of different strategies for the prevention of oral diseases. Routine dental care was believed to be very effective in preventing oral disease by at least 60% of respondents, however, this opinion is not supported by evidence. Although routine dental visits are associated with better oral health,[33] and childhood socioeconomic status affects future dental visit patterns,[34] evidence does not support a standardized time interval for dental attendance. It is rec-

ommended that individual patient considerations guide the time intervals for appropriate dental and dental hygiene care and recall schedules.[35] Even in a standardized program for preventive dental care in a population of low risk children, the recall intervals were individualized according to dental health and dental health behavior.[36]

Knowledge–based Practice

Respondents in this study demonstrated moderate knowledge and use of the methods and strategies designed to prevent and control dental caries. A need for continuing education to update knowledge that can be applied in practice was also demonstrated. Those who correctly strongly agreed or strongly disagreed with knowledge items demonstrated certainty regarding their knowledge. Those who responded agreed or disagreed indicated some uncertainty regarding their knowledge. These are reported in parentheses in the following discussion with certain knowledge first, less certain knowledge second. The higher level of knowledge regarding sealants was reflected in respondents' reported practice, with nearly all applying sealants on child patients and over half reporting use for over 75% of their patients. The sealant knowledge was largely consistent with sealant research,[37,38] specifically that sealants are needed regardless of whether patients receive topical fluorides (55%, 40%), newly erupted permanent molars are the best candidates for sealants (54%, 36%) and sealant use is well documented in scientific research (46%, 41%). However, only one–fourth were certain (23%, 69%) that incipient lesions can be remineralized before cavitation, and fewer (11%, 53%) were certain that sealants are not risky because decay may be sealed in the tooth, indicating a need for review of the evidence that sealing non–cavitated caries in permanent teeth is effective in reducing caries progression.[39] The range of responses regarding loss of sealants being attributed to application technique also showed uncertainty regarding the evidence. Clarification is needed for those who are not certain about the reasons for sealant loss (15%, 45%) and for those (10%) who responded they do not know if sealants are supported by research.

The lower level of knowledge of fluorides was remarkable given that the benefits of fluoride in pre-

Table IX: Use of sealants by dental hygienists

Question & Item	n	Percentage
Do you use sealants for your child/youth patients?		
Yes	484	93.1
No	36	6.9
If Yes, to what percentage of your patients under age 20 do you apply sealants?		
None	14	2.9
10% or less	22	4.5
11–25%	29	6.0
26–50%	67	13.8
51–75%	130	26.7
Over 75%	225	46.3
If your child patients do not receive sealants, which of the following reasons apply?*		
Patients are unwilling to pay for them	333	61.6
Insurance does not pay for it	252	46.0
Decay can develop under a sealant	50	9.1
Parents are unfamiliar with the procedure	48	8.9
Possible to seal in decay	35	6.3
Office policy does not support use of sealant	31	5.4
Sealants do not last very long	18	3.3
Use of sealants are unsubstantiated by research	8	1.5
I have had poor experience with sealants	9	1.5
It is more economical to place amalgam or composite fillings as needed	8	1.3
Technique is too difficult	8	1.3
Too time consuming to apply	12	0.7
Other: Includes responses from the following categories	–	n/a
• Tooth anatomy is smooth, low risk • Child cannot tolerate procedure (gags) • Concern about plastic safety • Dentist applies sealant • Office does not offer service	35 3 2 5 4	n/a

*Respondents were asked to "Check ALL that apply."

venting dental caries have been known for more than 75 years, and evidence regarding use of fluorides has received considerable systematic review. Knowing the predominant mechanism of action of fluorides for caries prevention is a prerequisite for the reinforcement of appropriate and routine use in both self and professional care. Over half (55%, 36%) knew that professionally applied fluorides are desirable in areas without fluoridated water,[40] but most (13%, 55%) were not certain that the most important mechanism for fluoride action is by remineralization of incipient lesions.[40,41] Fewer (6%, 24%) understood that dilute, frequently administered fluorides are more effective in caries prevention than more concentrated, less frequently administered fluorides. Knowing the chief mechanism of fluoride action would provide a foundation for dental hygienists to understand the attributes of the various types of topical fluorides and their evidence–based modes of application and effectiveness.[40,42–47] Using current information on fluorides and sealants is especially important because a recent study of Maryland adults showed that they have a low level of understanding about how to prevent dental caries.[48] With regard to the increased use of bottled water increasing dental caries among young children, only 10% correctly answered that they did not know. Evidence regarding bottled water usage is not clear. If bottled water is the main source of water intake, there is likely to be decreased use of community water that is fluoridated. Most bottled water contains fluoride in amounts less than 0.3 ppm.[49,50] Since consumption of bottled drinking water is very high in the U.S.,[51,52] it is generally believed that the decreased fluoride availability will lead to an increase in dental caries prevalence. This might be the reason that two–thirds of respondents (18%, 48%) agreed that increased use of bottled water increases dental caries.

A sound knowledge of dental caries etiology is the foundation needed to understand fluoride mechanisms and how various forms of fluoride function as preventive agents. In the dental caries process, the biofilm on teeth is known to be dominated by acidogenic bacteria, primarily mutans streptococci and lactobacilli. Lactobacilli are not involved in initiation but rather potentially contribute to the demineralization of the teeth once the lesions are established.[53] Knowledge of the critical role of fermentable carbohydrates in the caries process was also low. Although most respondents (45%, 49%) knew that the quantity of fermentable carbohydrates consumed is less important in causing caries than frequency of sugar consumption,[54] less than one–third were certain that fructose, glucose and sucrose are all cariogenic (29%, 60%).[55,56] Most respondents did not know that removal of the biofilm or plaque is not recommended as a caries preventive strategy, but is a focus for maintaining gingival health.[54] Compared with respondents in the national study of 2,000, respondents in this survey demonstrated very similar results on knowledge with minor gains in understanding that caries is a chronic, infectious disease and incipient lesions can be remineralized.[14]

Dental caries risk assessment is strongly recommended for every patient in dental hygiene practice. Clinical guidelines and caries assessment tools are readily available and can be very helpful in daily practice.[28,57] It is noteworthy that most hygienists in this survey reported routine assessment for dental caries risk factors in children and youth, with the exception of the identification of the socioeconomic status of a child's parents. Given U.S. data that show poverty in children and adolescents is still an important risk factor, inclusion of socioeconomic status in risk assessment is advised.[1,5] Current data demonstrating increases in dental caries among non–poor, especially boys ages 6 to 8 years, suggest that assessment of sweetened beverage consumption (juice drinks and sodas) is a vital part of dental caries risk assessment for prevention and control.[1]

The application of fluorides as in–office treatments showed practices inconsistent with evidence. Two–thirds reported using varnishes, although over half reported not applying any topical fluorides for children ages 6 months to 2 years. For this youngest age group, fluoride varnishes have been shown to be very effective when combined with caregiver counseling,[58] and should be applied more often for high risk children.[59] When used, other forms of topical fluoride in this study were applied for 1 minute, even though clinical studies have used only 4 minute protocols. The use of fluoride prophylaxis paste is not recommended as a substitute for fluoride varnish or a 4 minute application of a gel.

Similar to findings by Manski et al, the dental hygienists in this study who provided care for patients with Medicaid were more likely to understand appropriate treatments.[15] The percentage of dental hygienists who treated Medicaid or SCHIP patients was only 11%.

Implications and Recommendations for Practice, Education and Research

As the only oral health professional dedicated to prevention, dental hygienists have an important role to play in meeting the majority of the Healthy People 2020 objectives that are related to the prevention and control of dental caries in all age groups.[7] Knowledge of recommended guidelines for fluoride and sealant application support clinical decision–making and self–care practice counseling. Educational inter-

ventions are needed to advance the knowledge base of dental hygienists. Overall, it appears that a sound grounding in dental caries etiology would be most helpful in laying the foundation for dental hygienists' knowledge of dental caries prevention mechanisms and application strategies. Dental hygiene practice includes an array of preventive therapies designed for dental caries and periodontal disease. Therapeutic strategies for the prevention of dental caries should be separated from those for periodontal diseases to ensure that the etiology, mechanisms of action and application techniques are clearly distinguished and understood. Dental hygiene curricula should be reviewed regularly to ensure consistency with current scientific evidence. Dental hygiene education and post–graduate continuing education courses can be designed to include current evidence, and presented in multiple formats to meet the diverse learning needs of students and graduates.

Self–assessment is the essential component of professional practice that can direct the dental hygienist to review and revise current practices regarding dental caries prevention.[60] Understanding the disease process and the diagnostic and preventive regimens available is essential to oral health promotion and as the foundation for self–assessment of evidence–based dental caries prevention practices. Dental hygiene educators and professional and regulatory agencies can facilitate the development of practice standards and guidelines to support the process of self–assessment and continuing competence in dental hygiene practice.

Intervention education research on dental hygienist practices could help to identify the most effective and efficient strategies for updating and using current evidence regarding the prevention and control of dental caries.

Study Limitations

The generalizability of findings from this study may be limited by several factors. Although the response rate is similar to other studies with health care providers, it is possible that the responses of the survey participants may not reflect the views of nonresponders.[61] Further, because we used the membership list of the MDHA, we did not survey non–member dental hygienists who might be practicing in the state.

Conclusion

Evidence–based knowledge and understanding is essential for both clinical practice with individual patients and for community–based programs. Maryland hygienists were moderately informed about dental caries etiology and prevention. There also was evidence of misinformation and lack of understanding of current research and recommendations. Most dental hygienists (90%) reportedly were interested in continuing education courses in caries prevention. This stated interest is especially positive and will be used to foster implementation of educational interventions. These findings will inform a statewide oral health program to be initiated in 2012.

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