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Survey of Diabetes Knowledge and Practices of Dental Hygienists

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Background. Increasing incidence of diabetes in the United States and risk for more severe periodontal disease in individuals with poorly controlled diabetes make it essential to provide access to education to prepare oral health providers to care for this population.

Objective. The purpose of this survey was to assess the dental hygienist's diabetes knowledge, beliefs concerning the disease, and clinical practices to identify professional continuing education needs. analysis of variance with repeated measures was used to determine if significant differences existed in the amount of muscle activity generated with each fulcrum.

Methods. A 5-part survey was constructed using the American Diabetes Association 2007 Clinical Practice Guidelines and the American Association of Periodontology Commissioned Review of diabetes and periodontal disease. Invitations to participate were disseminated electronically to American Dental Hygienists' Association (ADHA) members. A convenience sample of dental hygienists (n=392) representing 48 states participated.

Results. The majority of the respondents were female (99%), ages 41 to 60 (60.1%), and in practice more than 16 years (58.3%). Major deficits in knowledge were associated with the patient's hemoglobin A1c (HbA1c) value and implications for diabetes control (50%). The survey responses indicated confusion about the current classifications of diabetes with 70% of respondents using classifications that are no longer recognized. Seventy-five to 90% of participants were unfamiliar with the impact of various types of diabetes medications on dental care.

Conclusions. Dental hygienists in this survey demonstrated a need for enhancing knowledge about diabetes as it applies to clinical patient care. The areas of greatest need included the American Diabetes Association Clinical Practice Guidelines for standards of care, diagnosis of diabetes mellitus, medications, and best practices for interacting with other health professionals when caring for people with diabetes.

Keywords: diabetes mellitus, dental hygienist, allied health personnel, continuing education

Introduction

The most recent data from the Centers for Disease Control and Prevention (CDC) indicated that 18.2 million Americans were diagnosed with diabetes in 2002.[1] The CDC estimates that another 5.2 million people have undiagnosed diabetes.[1]

In addition to those with diagnosed and undiagnosed diabetes mellitus, estimates released in June of 2005 by the CDC suggest that an additional 41 million people may have pre-diabetes, which places them at increased risk of developing diabetes.[2]

Given the epidemic proportion of diabetes, it is critical for all health professionals to be well- educated about diabetes.[3] Dental hygienists are well-positioned to provide patients with diabetes prevention information, support the need for good glycemic control, and facilitate referral to other health care providers.

Background

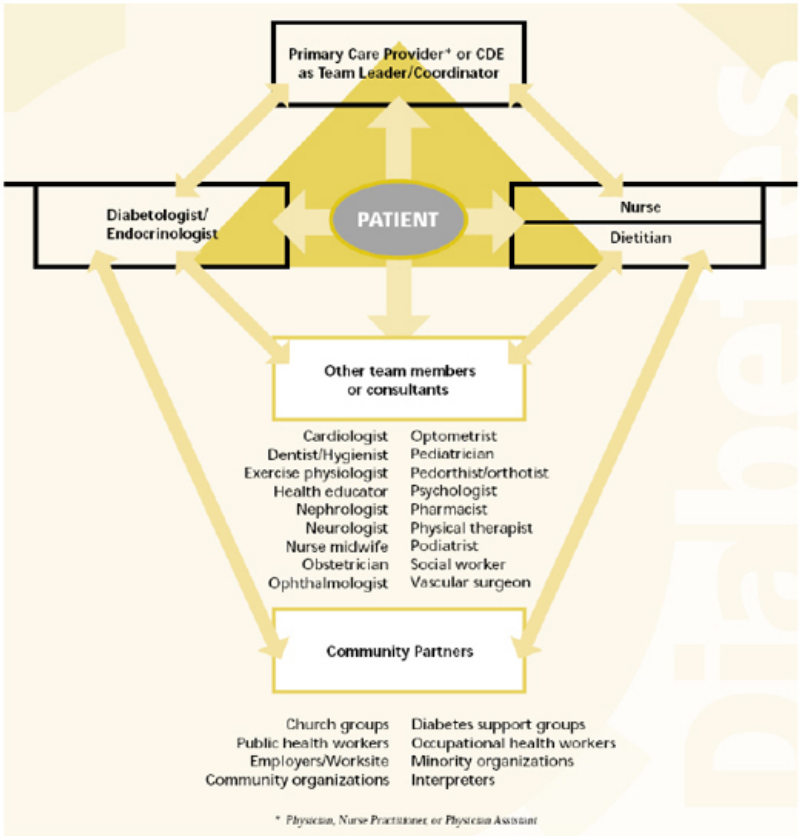
Approximately 70% of the population visit a dental office at least annually, providing an opportunity for dental professionals to assist in diabetes prevention and management.[4] Few studies have been conducted to identify oral health findings predictive of a risk for prediabetes or diabetes. However, a controlled, cross-sectional study of individuals with diabetes and those without found a statistically significant increased severity of periodontal disease (p=0.006), degree of xerostomia (p=0.0003), and presence of white spot carious lesions (p=0.02) in those with diabetes.[5]

Although it seems clear that people with diabetes are at increased risk for periodontal disease, the impact of managing periodontitis on a patient's glycemic control is less clear.6 Research has been done in an attempt to determine if nonsurgical periodontal therapy to treat and manage periodontal disease impacts glycemic control in individuals with diabetes. The results have been inconclusive with some studies demonstrating improvement in glycemic control,[7-9] and others finding no significant difference.[10-13]

Given the increasing prevalence of diabetes it is critical that dental professionals become better prepared to actively work with other health care providers in diabetes prevention and management.[10] Research to investigate the professional education needs of dental practitioners about diabetes is lacking. Nevertheless, the National Diabetes Education Program has developed an educational activity for 4 health care disciplines to facilitate collaboration and ensure that a consistent message is provided to clients with diabetes.[14] The health care providers targeted by the information are optometrists, podiatrists, dental professionals, and pharmacists.[14] This educational activity is a good beginning, but more evidence is needed to identify the educational needs of dental hygienists to ensure adequate support for provision of care for patients with diabetes.

In addition to enhancing education for dental professionals, dental professionals must be incorporated into the multidisciplinary health care team for prevention and management of diabetes for a lifetime, as shown in Figure 1.[15] An interdisciplinary team elevates the role of the dental professional from a peripheral contributor of care to one of greater importance. Dental professionals must become proactive with policy makers and the other members of the health care team to gain support for being an integral member of the team.[15] As a member of a multidisciplinary team, the dental professional should also recommend regular follow up with the primary care provider, annual eye exams and foot exams, as well as flu vaccinations.[14] The purpose of the survey was to assess the dental hygienist's diabetes knowledge, beliefs concerning the disease, and clinical practices of dental hygienists. The information gathered will assist with designing continuing professional education to meet the needs of dental hygienists to enhance their ability to effectively support patients' diabetes prevention and management while achieving and maintaining optimal oral health.

Figure 1. Typical Multidisciplinary Team in Diabetes Care



Centers for Disease Control and Prevention. Team Care: Comprehensive Lifetime Management for Diabetes. Atlanta, Georgia: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 2001.

Methods

Measurements

A 5-part survey was constructed using the American Diabetes Association 2007 Clinical Practice Guidelines for standards of care and diagnosis of diabetes mellitus along with an American Association of Periodontology Commissioned Review of diabetes and periodontal disease.[6,16,17] Survey questions addressed 1) knowledge about oral health and diabetes (58 items); 2) beliefs about addressing diabetes in the dental office (13 items); 3) current practices in providing care to patients with diabetes (18 items); 4) barriers to addressing diabetes in the dental office (10 items); and 5) preferences for topics and modalities for continuing professional education (2 items). The survey ended with a mechanism for respondents to provide open-ended comments.

The survey content was evaluated by diabetes and oral health experts prior to piloting with a small sample of dental hygienists. An initial pilot of the survey (n=36) identified issues with the response options for the questions regarding current practices in reviewing a patient's medical history. This issue was resolved prior to opening the survey to potential respondents nationally.

Participants

An invitation to participate in the survey was disseminated electronically via a mailing list of dental hygienists as well as via a newsletter sent to members of the American Dental Hygienists' Association (ADHA). The mailing list included dental hygienists who contacted Idaho State University for information about the graduate dental hygiene program between August 2005 and October 2007. The electronic newsletter for the ADHA is disseminated nationally. A convenience sample of dental hygienists (n=392) with representation from 48 states completed the survey. Overall 501 potential respondents accessed the electronic survey with a completion rate of 78%.

Results

A summary of demographic characteristics (Table I) indicated the majority of the respondents were female (99%), between the ages of 41 and 60 (60.1%), in a private practice setting (54.6%), and had been in practice more than 16 years (58.3%).

Table I. Characteristics of Survey Respondents

Demographics Variables	Respondents (n)	Respondents (%)
Gender		
Male	4	1
Female	387	99
Age		
<30 yrs	51	13.0
31-40 yrs	75	19.2
41-50 yrs	96	24.6
51-60 yrs	139	35.5
>61 yrs	28	7.2
Missing data	2	.5
Area of Practice(Check all that apply)		
Private practice	256	54.6
Specialty practice	38	8.1
Educator	85	18.1
Public or Community Health	51	10.9
Other	38	8.1
Missing data	1	.2
Yrs in Professional Practice		
<2 yrs	60	15.4
2-5 yrs	34	8.7
6-10 yrs	29	7.4
11-15 yrs	36	9.2
>16 yrs	228	58.3
Missing data	4	1.0

Table II provides an overview of the survey respondents' personal experience with diabetes along with educational preparation for caring for patients with diabetes. Slightly more than one-third of dental hygienists (40%) reported having diabetes themselves or in the immediate family. A majority of respondents spend 10 or fewer hours per week (70%) providing care for patients with diabetes. About 75% of participants had 4 or fewer hours of diabetes education in their entry-level dental hygiene program. The dental hygienists were fairly evenly divided between those who had engaged in 4 or less hours (49.6%) and those who had completed more than 4 hours of continuing professional education related to diabetes since graduation from their professional programs.

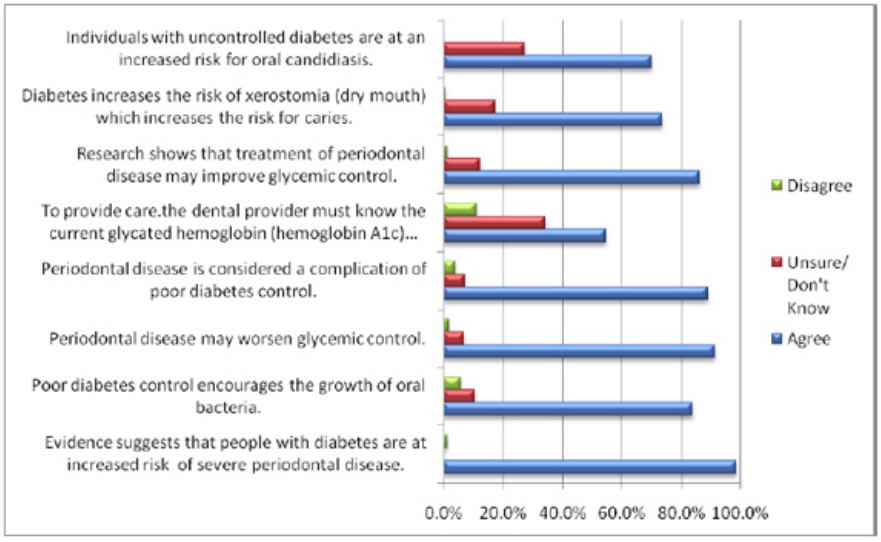
Table II. Previous Diabetes Experience and/or Education of Respondents

	Respondents (n)	Respondents (%)
Do you or someone in your immediate family have diabetes?		
Yes	156	39.9
No	235	60.1
Approximately how many hours/week do you provide care to clients with diabetes?		
<5 hrs	155	39.6
5-10 hrs	119	30.4
11-20 hrs	43	11.0
21-30 hrs	34	8.7
31-40 hrs	29	7.4
Missing data	11	2.8
Approximately how many hours of education about diabetes did you receive during your professional training?		
<1 hr	93	23.8
1-4 hrs	177	45.3
5-10 hrs	68	17.4
>10 hrs	47	12.0
Missing data	6	1.5
Approximately how many hours of continuing education about oral health and diabetes have you had since graduation from your professional program?		
< 1 hr	81	20.7
1-4 hr	113	28.9
5-10 hrs	90	23.0
>10 hrs	104	26.6
Missing data	3	.8

Diabetes and Oral Health Knowledge

A Likert-type scale (strongly agree = 1 and strongly disagree = 5) was used to assess the oral health and diabetes knowledge of the respondents. A majority of respondents agreed (*strongly agree* and *agree* were combined for analysis) with most of the questions related to oral health and diabetes (Figure 2). Dental hygienists responding to the survey tended to be unsure or didn't know about requesting a patient's glycated hemoglobin (hemoglobin A1c) value (34.4%) or risk for candidiasis in the person with uncontrolled diabetes (27.2%).

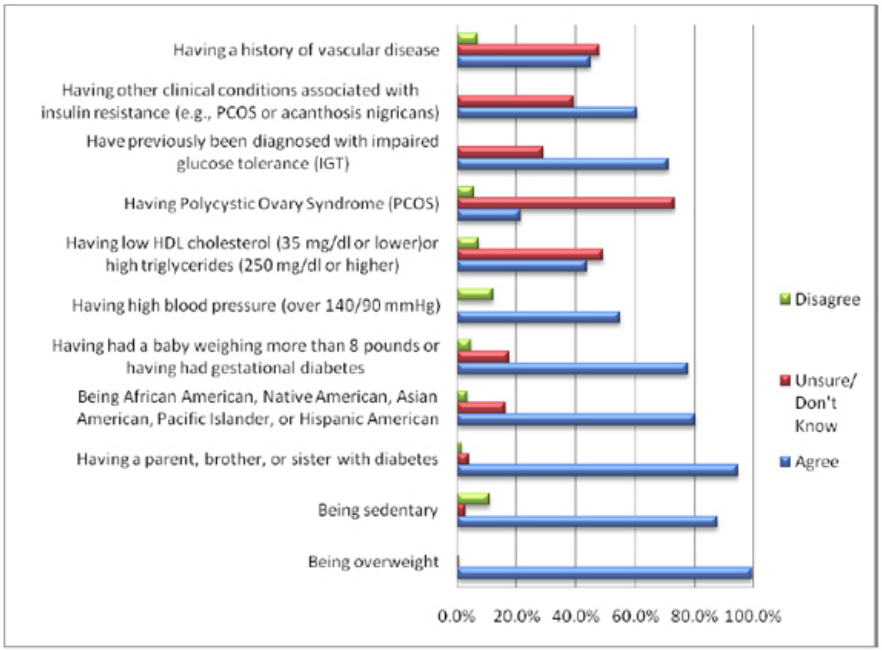
Figure 2. Knowledge about Diabetes and Oral Health



A majority of respondents indicated knowledge (*strongly agree* or *agree*) about the following risk factors for diabetes: being overweight (99.5%), having a family member with diabetes (94.5%), a history of gestational diabetes or giving birth to a baby more than 8 pounds (77.9%), sedentary (76.3%), and previous diagnosis with impaired glucose tolerance (71.1%).

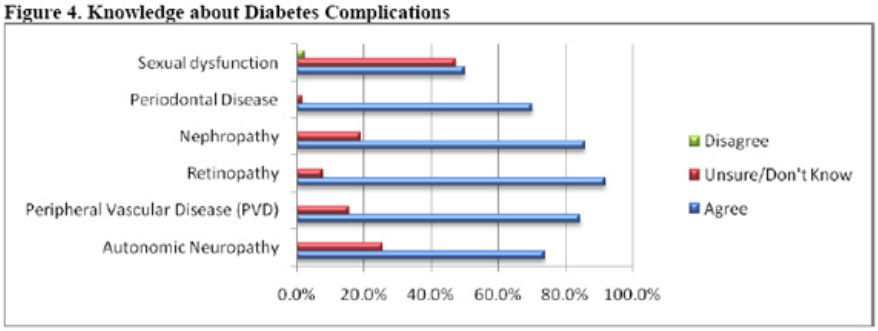
Dental hygienists reported not knowing or being unsure about the following risk factors: polycystic ovary syndrome (PCOS) (73.3%), low HDL cholesterol or high triglycerides (49.1%), and history of vascular disease (47.9%) (Figure 3).

Figure 3. Knowledge about Risk Factors for Diabetes



Respondents to the survey generally knew the complications associated with poorly controlled diabetes (Figure 4). The complications that dental hygienists were most likely to be unsure of were sexual dysfunction (47.6%), autonomic neuropathy (25.8%), and nephropathy (19.1%). When asked about the Expert Committee on Diagnosis and Classification of Diabetes classifications, results indicated that 86% thought Type 1, Type 2, and gestational diabetes were the current classifications, while about 70% thought noninsulin dependent diabetes mellitus (NIDDM) and insulin dependent diabetes mellitus (IDDM) were the current designations. More than 55% of dental hygienists were *unsure* or *didn't know* about the other specific types of diabetes associated with medications, genetics, etc.

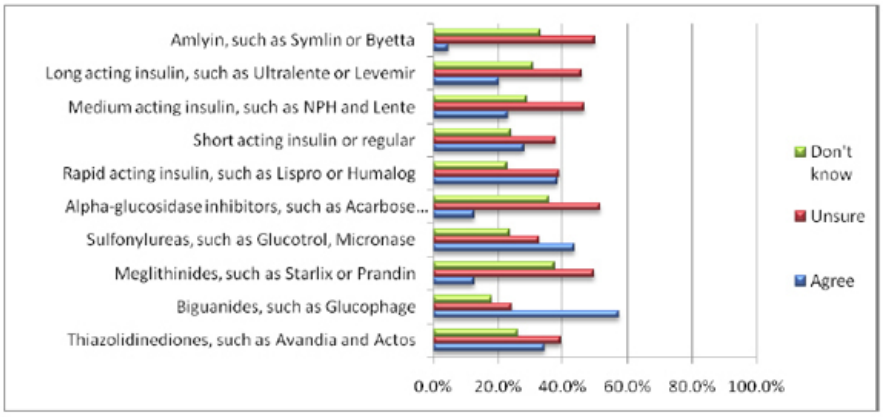
Figure 4. Knowledge about Diabetes Complications



Several questions were asked in regard to knowledge about the standard of care for glycemic control of a person with diabetes. When asked to identify the American Diabetes Association 2007 Clinical Practice Recommendations for fasting blood glucose in those with diabetes, the responses were: 70-110 mg/dl (57.2%), 80-120 mg/dl (36.5%), 90-130 mg/dl (4.8%), and 80-130 mg/dl (1.4%). Responses to the question about the American Diabetes Association recommendation for the number of times a hemoglobin A1C (HbA1c) test should be performed annually in persons who have stable glycemic control were as follows: once per year (45.6%), twice per year (28%), 3 times per year (9.6%), and 4 times per year (45.6%). Respondents indicated the recommendation for the glycated or hemoglobin HbA1c level was less than 6% (26.6%), 7%, (45.5%), 8% (19.2%), 9 (1.3%), and 10 (7.5%).

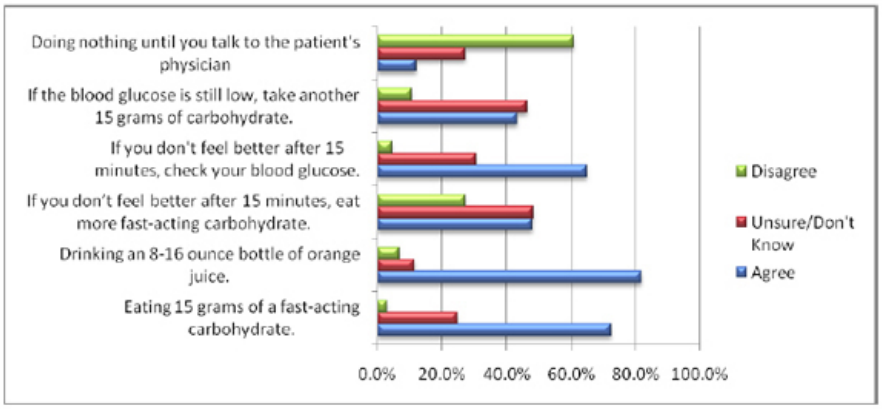
Dental hygienists reported being most familiar with the use of and dental considerations for the following diabetes medications: biguanides, such as Glucophage® or Metformin (57.4%), and sulfonylureas, such as Glucotrol® (44.5%). Over 80% of respondents were not familiar with Meglithinides, such as Starlix® (87.5%), alpha-glucosidase inhibitors, such as Precose® (87.5%), and Amlyin, such as Byetta® (83.1%). Sixty to 76% of participants reported being unfamiliar with the use and dental considerations for the various types of insulin (Figure 5).

Figure 5. Knowledge about Medications Commonly Used to Treat Diabetes



Respondents generally knew that blood glucose levels below 70 mg/dl (67.5%) indicated hypoglycemia. Another 23.3% indicated that blood glucose below 80 mg/dl suggested hypoglycemia. An additional set of questions addressed the American Diabetes Association Clinical Recommendations for treatment of hypoglycemia (Figure 6). Survey results indicated that the best treatment for hypoglycemia was eating 15 grams of a fast-acting carbohydrate (72.5%) and drinking an 8-16 ounce bottle of orange juice (81.9%). Forty-six to 48% of participants were unsure of what to do if the patient didn't feel better or the blood glucose was still low after 15 minutes. Approximately 39% of respondents would do nothing until talking with the patient's physician.

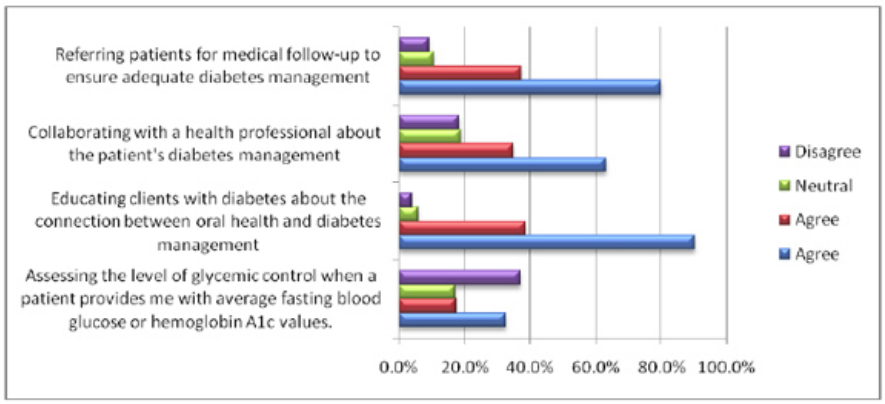
Figure 6. Knowledge about Management of Hypoglycemia



Beliefs about Diabetes in Oral Health Care

Of the questions that addressed the respondents' beliefs about the aspects of education, assessment and referral of patients that were within the dental hygiene scope of practice, 24.8% of dental hygienists felt that all of these things are within the scope of practice (Figure 7). The aspect most frequently reported as not being within the scope of practice was assessing the glycemic control of clients with diabetes through consultation with the patient's medical professional (54.6%).

Figure 7. Competence in Assessment Education and Referring Patients with Diabetes



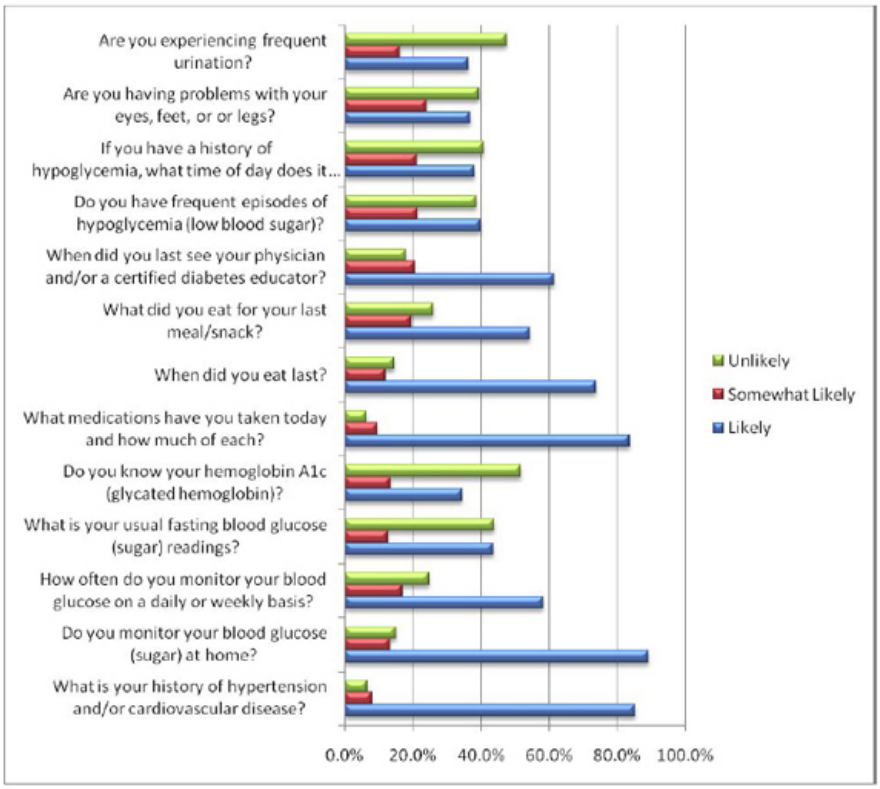
Respondents generally reported feeling competent in educating clients about oral health and diabetes (90.1%), referring patients for medical follow-up (80.1%), and collaborating with a health professional about the patient's diabetes management (63%). Dental hygienists felt least competent in assessing the level of glycemic control when provided with average fasting blood glucose or HbA1c values (50%).

Survey participants agreed that the following should be part of a comprehensive dental examination for patients with diabetes: assessment of diabetes control (83.2%), counseling on prevention of dental disease to enhance diabetes management (97.1%), education about the association between oral infection and glycemic control (97.1%), and referral for medical follow-up as needed (92.1%).

Current Practices for Managing Patients with Diabetes in the Dental Office

Practices when managing patients in the dental office were explored by determining how likely it was for the respondents to ask patient questions about glycemic control, medications, diet, risk factors, and hypoglycemia when reviewing the medical history (Figure 8). The questions that respondents were *extremely likely* or *likely* to ask their patients with diabetes included: Do you monitor your blood glucose at home? (89.1%); What is your history of hypertension and/or cardiovascular disease? (85.2%); What medications have you taken today and how much of each? (83.7%); and When did you eat last? (73.7%). The questions that dental hygienists were *least likely* to ask patients with diabetes were the following: Do you know your hemoglobin A1c (glycated hemoglobin)? (51.7%); Are you experiencing frequent urination? (47.5%), What is your usual fasting blood glucose reading? (43.8%); If you have a history of hypoglycemia, what time of day does it usually occur and how do you manage it? (40.8%); and Do you have frequent episodes of hypoglycemia? (38.7%).

Figure 8. Current Practices in Medical History Review in the Patient with Diabetes



When asked about current practice in assessment, education, and referral of patients with diabetes, respondents were *most likely* to provide referral to a medical professional (54%) and use diabetes patient education materials (46.3%) (Figure 9). The participants were *least likely* to use a glucose monitor to check a patient's blood glucose before or after treatment (82.7%) and have a glucose monitor in the office and know how to use it (75.9%). Only 32% of dental hygienists reported collaboration with medical professionals about a patient's glycemic control. The *strongest barriers* to incorporating diabetes education into patient oral health care included: concerns about using a glucose monitor in the dental office to check blood glucose to prevent or manage hypoglycemia (39.5%) and for identification of patients with hyperglycemia (41.8%) (Figure 10). The items rated as *somewhat of a barrier* were: lack of instructional materials for use during oral health education (49.3%), time to discuss diabetes with clients (46.2%), and lack of culturally appropriate education materials for patients (44.6%).

Figure 9. Current Practice in Assessment, Education and Referring Patients with Diabetes

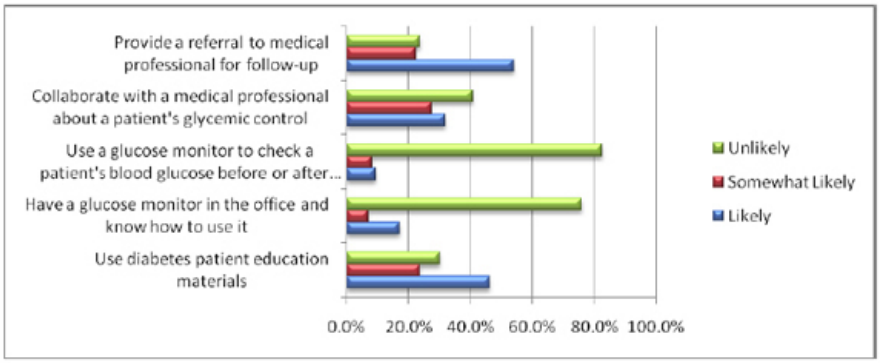
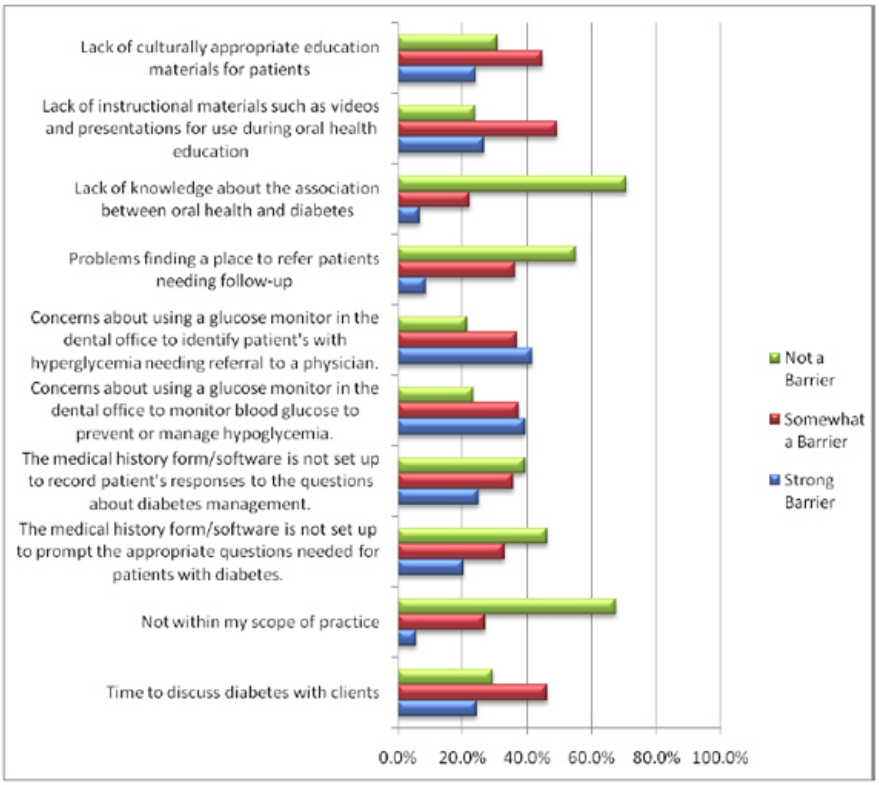


Figure 10. Barriers to Incorporating Diabetes into Oral Health Care



Professional Education Needs of Dental Hygienists

The next group of survey questions addressed the perceived educational needs of dental hygienists about diabetes. The first set of questions covered topics of interest for professional continuing education. The continuing education topics of most interest included: an overview of diabetes medications (91.1%) and an update on diabetes along with the current guidelines for the standard of medical care (83.6%). The responses of the participants can be found in Table III. The next set of survey questions explored the delivery modality dental hygienists preferred for the continuing education. Opinions were varied on this question with the majority of people preferring a half-day lecture/participation workshop or self-paced online course (35.3%), followed by a half-day lecture course (28.3), and an interactive online course (27.8%) (Table IV).

Table III. Continuing Education Needs of Dental Hygienists

What continuing education topics are of interest to you?	Response (n)	Response (%)
Overview of the medications and diabetes management recommendations	350	91.1%
Overview of diabetes and the guidelines for the standard of medical care	321	83.6%
Strategies for collaborating with health professionals caring for patients with diabetes	295	76.8%
Update on the link between oral health and diabetes	263	68.5%
Basic instruction and practice in using a glucose monitor	255	66.4%
Other (please specify)	21	5.5%

Table IV. Mode for Delivery of Professional Continuing Education for Diabetes

If you are interested in continuing education about diabetes, how would you prefer the information be delivered?	Response (n)	Response (%)
1/2 day lecture/participation workshop	136	35.3%
self-paced online course	136	35.3%
1/2 day lecture course	109	28.3%
interactive online course	107	27.8%
full day lecture/participation workshop	79	20.5%
1-2 hour lecture course	67	17.4%
full day lecture course	59	15.3%
Other (please specify)	9	2.3%

Qualitative Data

In addition to the quantitative data gathered by the survey, respondents provided comments that may provide further insight into the survey results. The major themes identified in the qualitative data included the value of the survey in identifying the diabetes education needed, importance of being competent in diabetes prevention and management guidelines as health care providers, and importance of educating employers in order to increase the length of appointments as needed to provide comprehensive care to patients with diabetes. The following paragraphs provide excerpts from the respondents' comments.

A number of comments suggested that taking the survey made them realize how much they did not know about diabetes as it relates to oral health (n=10). Example of these comments included the following:

- "This survey makes me realize there is so much to know and that I don't feel prepared enough at this time to provide all the necessary information to my patients. I definitely need to take a CE course devoted specially to diabetes and patient care."
- "Great survey. It got me thinking!"

Other comments expressed the need for oral health care practitioners to be better prepared to address diabetes and oral health as a component of overall health (n=12).

- "As an oral health care provider, it IS our responsibility to speak to our patients about factors affecting their oral health and to provide information to them that can not only improve oral health, but their overall health. After all, WE ARE HEALTH CARE PROVIDERS!"

And finally there were a number of comments suggesting that the dentist needed to be more supportive of exploring the patient's glycemic control before changes would occur in current practices (n=11).

- "The main issue is the DDS. If they don't have the info, if they don't understand the problem, if they don't see the importance, if they don't educate themselves, if they don't feel the need, and if they think the hygienist is there to buff & puff only, then this issue will not see improvement."
- "How to implement a program in the dental practice that the doctors would allow."

Discussion

Prior to exploration of the findings, it is important to review the limitations of the survey. Lack of random selection of the participants introduces self-selection bias. Those completing the survey may not be representative of all dental hygienists, and, therefore, the results cannot be generalized. Specifically, the demographics of the respondents indicated that the participants had generally been in practice for over 16 years and were in the 41-60 year age range. Therefore, this group of dental hygienists may need more updated information about diabetes prevention and management than more recent graduates of professional programs.

Seventy-five percent of respondents reported 4 or less hours of education about diabetes during their professional career, yet nearly 50% of dental hygienists had pursued 4 or less hours of continuing education about diabetes since graduation. The overall results of the survey seem to suggest that the participants are interested in continuing education on this topic, so increasing the number of diabetes continuing education opportunities as well as variety for the modality of delivery may encourage dental hygienists to increase their diabetes knowledge.

The general diabetes and oral health knowledge of dental hygienists appears to be relatively current based on the survey responses. However, the major deficiency in knowledge for the respondents seemed to be the significance of the patient's glycated hemoglobin (hemoglobin A1c or HbA1c) value. This issue appeared repeatedly in the survey results and is a significant issue since the HbA1c provides information about the patient's long term glycemic control, which in turn may impact the provision of dental care as well as the progression of oral disease. [6,16,17]

Respondents identified a majority of the risk factors (Table V) for diabetes but would benefit from a review of the lesser known risk factors. In particular, 73% of participants did not know polycystic ovary syndrome (PCOS) was a risk factor for diabetes.[17] PCOS is increasingly diagnosed with the current estimates of prevalence being 9-10%.[18,19] PCOS is considered one of the most common endocrine issues in women of child-bearing age with 1 in 15 women being affected.[18,19] Therefore it is incumbent upon dental hygienists to be able to identify PCOS as a possible risk factor for diabetes when reviewing the patient's medical history.

Table V. Risk Factors and Criteria for Testing for Prediabetes and Diabetes[15]

Testing should be considered for all adults who are overweight (BMI $\geq$ 25 kg/m^2) and have any of the following risk factors:
• Physical inactivity • First degree relative with diabetes • Member of high risk ethnic group (e.g. African American, Hispanic/Latino, Native American, Asian American and Pacific Islander) • Women who delivers a baby weighing > 9 lbs. or was diagnosed with gestational diabetes • Hypertension ($\geq$ 140/90 mmHG or receiving therapy for hypertension) • HDL cholesterol <35 mg/dl and/or triglyceride level > 250 mg/dl • History of cardiovascular disease (CVD) • Polycystic ovary syndrome (PCOS) • IGT (Impaired Glucose Tolerance) or IFG (Impaired Fasting Glucose) on a previous OGTT (Oral Glucose Tolerance Test) • Clinical conditions associated with insulin resistance (e.g. severe obesity and acanthosis negricans)
In the absences of risk factors, testing should begin at age 45 years. If results are normal, testing should be repeated at least every 3 years.

The ability of the dental hygienist to effectively interact with the patient about their diabetes condition and to collaborate with other health professionals is dependent on being familiar with the current classifications for diabetes. The survey responses indicated confusion about the current classifications of diabetes (Table VI) by the Expert Committee on Diagnosis and Classification on Diabetes.[16] This was evidenced by approximately 70% of respondents agreeing with the IDDM and NIDDM classifications, which are no longer used. About 86% of participants agreed with the use of the type 1 and type 2 diabetes classifications. This suggests that either dental hygienists think the old and new classifications are interchangeable or are not aware there has been a change in the classification system for diabetes.

Table VI. Current Classification of Diabetes [16]

Classifications	Etiology
Type I Diabetes	B-cell destruction
Type 2 Diabetes	Progressive insulin deficiency often associated with insulin resistance
Other Specific Types of Diabetes	Genetic defects, exocrine defects (such as cystic fibrosis), or drug-induced (e.g. corticosteroids)
Gestational Diabetes	Secondary to pregnancy

In addition to a need for a review of the diabetes classification system, respondents also indicated a need for an update on clinical recommendations for prevention and management of diabetes. Only 18.8% of respondents correctly identified 100-125 mg/dl as being the blood glucose levels used for diagnosis of impaired fasting glucose (IFG).[17] This is of importance for dental health providers because people with IFG and impaired glucose tolerance (IGT) are designated as having prediabetes.[17] Current criteria for diagnosis of prediabetes and diabetes are provided in Table VII. It is not known if people with prediabetes are at increased risk for periodontal disease; however, it is prudent to carefully monitor and maintain oral health to reduce infection and possibly prevent or delay the onset of diabetes.

Table VII. Criteria for Diagnosis of Prediabetes or Diabetes[16]

	Prediabetes	Diabetes
FPG Fasting Plasma Glucose (also referred to as IFG-Impaired Fasting Glucose) (Requires an 8 hr. fast and should be repeated on a different day)	100 – 125 mg/dl	≥ 126 mg/dl
Casual plasma glucose (Casual refers to a random glucose value taken at any time)		≥ 200 mg/dl
IGT Impaired Glucose Tolerance (2 hr plasma glucose during OGTT)	140 – 199 mg/dl	≥ 200 mg/dl

The survey responses suggested that only 5% of respondents knew the current clinical practice recommendations for fasting blood glucose (90-130 mg/dl) levels for good glycemic control in adults with diabetes.[16] It is possible that those responding to the question were indicating the normal blood glucose level for a person without diabetes. Twenty-eight percent of respondents knew the current recommendation that an HbA1C test be performed twice per year in those who have stable glycemic control.[16] About 45% of dental hygienists identified the recommendation for the HbA1c goal (<7%) for persons with diabetes.[16] The results of the questions about glycemic control suggest that dental hygienists do not know the current recommendations. This is a concern because this is information that should be routinely gathered from the patient at each dental appointment in order to assess the patient's level of glycemic control, which can impact the ability to heal as well as the risk of more severe periodontal disease.[20] The clinical recommendations for assessing glycemic control are provided in Table VIII.

Table VIII. Clinical Recommendations for Assessment of Glycemic Control[16]

	Recommendation	Goals
SMBG (Self-monitoring of blood glucose)	• Test 3 or more times/day for those taking multiple insulin injections or using an insulin pump	
○ Pre-prandial or fasting blood glucose	○ Test first thing in the morning and prior to eating	90-130 mg/dl
○ 2 hour post-prandial blood glucose	○ Test 2 hours after a meal	<180 mg/dl
Hemoglobin A1c	• Performed twice annually in those meeting glycemic goals • Performed quarterly in those not meeting glycemic goals	< 7.0% (recommend non-diabetic range of 4.0-6.0)

A majority of respondents stated a need to learn more about the medications currently being used to manage diabetes. This is not surprising given this is a complex and ever-changing area in diabetes management. Another complexity to the use of diabetes medications is that drugs like metformin and rosiglitazone, previously used to manage diabetes, are now also being used in people with prediabetes to prevent the onset of type 2 diabetes.[21,22] Dental professionals need a basic understanding of diabetes medications to anticipate hypoglycemic episodes. If hypoglycemia occurs, the dental hygienist must know how to manage it quickly to prevent it from escalating to an emergency situation. The survey results incorrectly indicated the best treatment for hypoglycemia was drinking an 8-16 ounce bottle of orange juice (81.9%). The American Diabetes Association recommendation is for 15-20 grams of glucose or a quickly absorbed carbohydrate.[16] Fifteen grams of carbohydrate is equal to approximately ½ cup of orange juice.[23] Overtreating hypoglycemia by administering a large carbohydrate load like that found in 8-16 ounces (1-2 cups) of juice may cause high blood glucose and make it more challenging for the patient to stabilize their blood glucose levels.[24,25]

Most dental hygienists responding to the survey believed that educating, assessing, and referring patients with diabetes was within their scope of practice. However, 55% percent of respondents reported that assessing the glycemic control through consultation with the patient's medical professional was not within their scope of practice. In addition, participants felt least competent in assessing the level of glycemic control when provided with average fasting blood glucose or HbA1c values (50%). It is evident that these respondents need additional diabetes education in order to be able to assess the patient's glycemic control when provided with the fasting blood glucose and HbA1c value. Perhaps the most important information a dental provider should gather from the patient is the HbA1c value because it provides an indication of the long term diabetes control.[16] If the patient does not know this information, ask permission to have that information faxed to the dental office from the patient's primary care physician. Glycemic management should be part of the discussion with the patient as it relates to good oral health. With movement to increase access to oral health care, many state practice acts allow dental hygienists to work with general supervision or unsupervised in alternative practice settings making it critical that the dental hygienist be able to interpret the values used to assess glycemic control.

The survey questions addressing current practices when managing patients with diabetes in the dental office revealed that when reviewing the medical history, the respondents were least likely to ask for fasting blood glucose or HbA1c levels and about any history of hypoglycemia. Patients with type 1 diabetes are at higher risk of hypoglycemia and a history of hypoglycemia is a predictor of future episodes.[26] As discussed earlier, questions about glycemic control are essential to prevent a potential emergency situation with hypoglycemia. Seventy-six percent to 83% of survey participants were not likely to have a glucose monitor in their office or know how to use it. This could be a potential issue in an emergency situation with hypoglycemia since 15 minutes after administering 15-20 grams of carbohydrate, the blood glucose needs to be checked to ensure that it is in the normal range.[26] Even if a patient brings their own glucose monitor from home, they may not be able to check their own blood glucose when they are recovering from a hypoglycemic episode. It is therefore suggested that dental offices have a glucose monitor that the staff is proficient in operating (Table IX). In order to use a glucose monitor in the dental office or clinic, the facility must apply for a CLIA (Clinical Laboratory Improvement Amendments) certificate.[27] Since diagnosis of diabetes is not being conducted, glucose monitoring before or after dental

treatment using a glucometer has been granted a waived status under CLIA.[27] However the waived status requires a biennial fee.[28,29] The form is available through the Centers for Medicare and Medicaid Services, Health and Human Services website http://www.cms.hhs.gov/clia/01_overview.asp

Table IX. Glucose Monitors in the Dental Office

Rationale for Glucose Monitoring		
• Prevention of medical emergency (hypoglycemia) • Identification of hyperglycemia that may impact healing which requires medical referral • Monitoring of a patient recovering from a hypoglycemic event		
Options for Glucose Monitoring	***Advantages***	***Disadvantages***
• Patient brings glucose monitor from home	• Patient knows how to use the monitor and can check their own blood glucose. • No need to apply for waived status under CLIA (Clinical Laboratory Improvement Amendment).	• Dental staff may not know how to use the monitor if the patient is not able to do so resulting in failure to appropriately manage hypoglycemia.
• Dental office provides glucose monitor	• Dental staff can be trained to be proficient with using the glucose monitor. • Staff can easily monitor blood glucose before and after treatment to minimize the possibility of hypoglycemia. • Dental staff can monitor recovery from a hypoglycemic event even if patient is not able to assist.	• Must apply and pay a small biennial fee ($150) for waived status under CLIA. ○ CLIA form available from Centers for Medicare and Medicaid Services, Health and Human Services website http://www.cms.hhs.gov/clia/01_overview.asp

The strongest barrier to incorporating diabetes education identified by survey participants was associated with the use of a glucose monitor. A less significant barrier for about 50% of respondents was the time involved in providing education and lack of educational materials. There are many educational resources available to health professionals on the National Diabetes Education Program website http://www.ndep.nih.gov and the American Diabetes Association website http://www.diabetes.org. A list of resources for educational materials could be provided on the AHDA website and during professional education courses to provide easy access to dental professionals.

Dental hygienists responding to the survey demonstrated a strong desire to increase their knowledge of diabetes (84-91%) with additional continuing professional education. Opinions on how this education should be delivered were varied with approximately 35% of respondents expressing a preference for a half-day workshop or a self-paced online course.

Conclusion

Given the increasing incidence of diabetes in the United States and the risk for more severe periodontal disease in individuals with poorly controlled diabetes, it is essential to provide access to regular professional education to prepare oral health providers to care for this population. The sample of dental hygienists in this survey demonstrated a need for enhancing knowledge about diabetes as it applies to clinical patient care. In particular, the areas of greatest need include knowledge about American Diabetes Association Clinical Practice Guidelines for standards of care, diagnosis of diabetes mellitus, and best practices for interacting with other health professionals caring for people with diabetes. As diabetes prevention, diagnosis, management, and treatment continue to advance things like continuous glucose monitoring, insulin pumps, and islet cell transplantation will become more common place and require the dental hygiene educator and clinician to enhance their knowledge about diabetes. Professional education will increase confidence and competence, thereby enhancing the importance of the role of dental hygienists on the multidisciplinary diabetes care team. A variety of educational modalities should be considered to ensure access so that dental hygienists are prepared to support patients with prevention and management of diabetes.

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Notes

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