

## Incorporating Oral–Systemic Evidence into Patient Care: Practice Behaviors and Barriers of North Carolina Dental Hygienists

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### Introduction

The dental hygienist's role as an oral health care provider involves examining patients for signs of oral disease, providing treatment and promoting home care that will help restore patients to a state of health and function. In addition, dental hygienists are often advocates for behavior or life–style changes that will promote total body health and well being. For example, dental hygienists routinely provide nutritional and smoking cessation counseling to help patients in achieving a healthier overall life–style.

Part of the dental hygienist's role as a clinician is identifying and treating periodontal disease. It is estimated that approximately 75% of adults in the United States have gingivitis, and about 35% have periodontitis, making periodontal disease a highly prevalent chronic inflammatory condition.<sup>1</sup>

In recent years, there has been evidence of an association between periodontal disease and several other conditions, such as diabetes,<sup>2–5</sup> cardiovascular disease,<sup>6–11</sup> cerebrovascular accidents (such as stroke),<sup>12,13</sup> respiratory diseases<sup>14–17</sup> and adverse pregnancy outcomes, such as preeclampsia, low birth weight and preterm birth.<sup>18–25</sup> In addition to the conditions listed above, other asso-

### Abstract

**Purpose:** Current research has reported associations between periodontal and systemic health, however, there is little data regarding how dental hygienists are incorporating this evidence into the dental hygiene practice. The purpose of this survey research was to determine what practice behaviors are prevalent among North Carolina dental hygienists regarding the incorporation of oral–systemic evidence into practice as well as perceived barriers to implementation.

**Methods:** A questionnaire was developed, pilot tested, revised and mailed to 1,665 licensed dental hygienists in North Carolina. After 3 mailings the response rate was 62%, with 52% (n=859) of respondents meeting inclusion criteria. Survey data was analyzed using descriptive statistics and Chi–square analysis.

**Results:** Respondents were predominately female (99%) with a 2 year degree (84%). While a minority of dental hygienists (20%) reported measuring blood pressure routinely on all patients, a majority (62%) measure blood pressure in select patients. Oral cancer screenings were performed by 89% of respondents. Eight percent record blood sugar levels, but only 3% record HbA1c values. Fifty percent of dental hygienists are extremely likely to refer patients to a medical provider for follow up assessments. Conditions dental hygienists are likely to discuss with patients include tobacco use (89%), pregnancy (84%) and genetics (79%). Significant barriers to implementing oral–systemic evidence include lack of time (52%), concern over legal risks (44%) and lack of education (27%).

**Conclusion:** North Carolina dental hygienists are implementing some aspects of oral–systemic evidence into practice, but could take a more active role if they had more allotted time, education and training.

**Keywords:** Dental Hygienist, Periodontal Disease, Oral–Systemic Evidence, Oral–Systemic Disease

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ciations are actively under investigation, including obesity,<sup>26,27</sup> kidney disease,<sup>28,29</sup> cancer,<sup>30,31</sup> and metabolic syndrome.<sup>32,33</sup>

According to 2006 data from Centers for Disease Control and Prevention, approximately 70% of the population visit a dental office at least once yearly.<sup>34</sup> The dental hygienist is often the dental team member that provides prevention and intervention services. This may make the dental hygienist a critical health care provider to perform periodontal disease-based risk assessment and interventions to potentially prevent systemic complications and improve overall health. The purpose of this study was to assess practice behaviors and perceived barriers of North Carolina dental hygienists regarding the incorporation of oral-systemic evidence into patient care.

## Review of the Literature

### Health Care Providers' Knowledge, Behaviors and Opinions Regarding Oral-Systemic Disease

In light of the growing evidence regarding oral health and systemic health connections, it is imperative that the roles of the medical provider and oral health care provider are evaluated in terms of risk assessment strategies and practices, opinions regarding the evidence of a connection and practice behaviors concerning patient care. Research has been conducted in this area, and overall findings have indicated low levels of knowledge and formal training.<sup>35-37</sup> In a study conducted by Lewis et al, pediatricians reported that they felt that they had an important role in identifying dental problems and educating families (90%). However, half of the physicians reported they had no training in medical school or residency concerning oral health.<sup>37</sup> Studies conducted by Yuen et al and Vinson et al revealed similar findings, in that the certified diabetes educators polled felt that oral health was important for patient education and care, but that the education practitioners received and their current knowledge levels were lacking.<sup>35,36</sup>

Research investigations have also reported that medical practitioners demonstrate low rates of performing regular oral exams for patients. A study conducted by Wilder et al indicated that if obstetricians perform oral examinations, they happen at the initial pre-natal visit only or if the patient reports a problem.<sup>38</sup> Thomas et al found that, among nurse practitioners, physician assistants and nurse midwives, oral exams were typically performed on pregnant patients at the initial visit, if performed at all, and the majority of practitioners' educational programs did not include oral health education (62%).<sup>39</sup>

Due to reported low knowledge levels and low rates of education regarding oral health in medical programs, it may be the responsibility of oral health care providers to initiate patient awareness of potential oral-systemic connections. Because the dental hygienist may treat the dental patient multiple times during a year, the dental hygienist could play a primary role in performing risk assessment for oral-systemic disease.

### Oral Health Care Practitioners' Knowledge and Practices Regarding Oral-Systemic Disease

Several risk factors for systemic diseases, such as diabetes, cardiovascular disease and cerebrovascular accidents, adverse pregnancy outcomes and others, can be assessed in the dental office. Thorough review of the patient's medical history can provide insight in terms of life style, habits, medications and existing systemic conditions. Assessment of blood pressure, oral cancer screening, periodontal examination, nutritional counseling, tobacco cessation counseling and blood glucose testing can be performed in the dental office.

Two recent studies assessed the curriculum content regarding oral-systemic connections among United States and Canadian dental schools and United States dental hygiene programs.<sup>40,41</sup> Overall, oral-systemic connections are being formally included in the curriculum, and students are being evaluated on their abilities to assess risks and discuss these topics with their patients. Topics allotted the most time (less than or equal to 7 hours) and most emphasized in their curricula were tobacco use, diabetes and cardiovascular disease. Students in dental hygiene programs were evaluated based on their ability to assess risks most often in regards to tobacco use (94%), diabetes (90%), cardiovascular disease (87%) and adverse pregnancy outcomes (79%).<sup>41</sup> Current graduates are being educated regarding oral-systemic disease, and the next logical step is to assess what dental practitioners are doing to incorporate this knowledge into practice.

Overall, it has been found that dentists are more likely to assess for risks and to discuss systemic health issues with their patients, and that they are less likely to actively manage their patients (e.g. perform finger stick test to assess blood glucose levels). Kunzel et al conducted a survey in which they contrasted general dentists and periodontists involvement in 3 areas of managing diabetic patients: assessment of health status, discussion of pertinent issues and active management of patients.<sup>42</sup> In terms of active management, 47% of general dentists and 56% of periodontists were categorized as low performers.<sup>42</sup> Forbes and colleagues

observed similar findings in a 2008 study, in which most dentists polled reported they participated in the assessment and discussion phases of diabetes management, but there was a much lower prevalence of active management.<sup>43</sup>

A national survey conducted by Boyd et al focused on dental hygienists knowledge and practices regarding periodontal disease and diabetes. Participants reported that they were most likely to provide referral services (54%) and use diabetes education materials (46%). They were least likely to use a glucose monitor to check a patients' blood glucose before or after treatment (83%) or have a glucose monitor in the office and know how to use it (76%).<sup>44</sup>

### **Barriers to Implementing Research Evidence into Practice**

For any field to stay current, or to employ evidence-based practice, it is essential that practitioners are familiar with the research evidence and are capable of implementing it routinely. This proves challenging for many reasons, with studies in the field of nursing illuminating some of those challenges. In a study conducted by Schoonover, registered nurses completed a survey regarding barriers to research utilization.<sup>45</sup> Barriers reported among this group were lack of authority to change patient care procedures, lack of time to read research and lack of awareness of research. Hutchinson et al conducted a survey of nurses in Australia to assess barriers to, and facilitators of, research utilization in the practice setting. The barriers reported by participants included time constraints, lack of awareness of available research literature, insufficient authority to change practice, inadequate skills in critical appraisal and lack of support for implementation of research findings.<sup>46</sup> In a more recent study, Chang et al polled nurses in Taiwan regarding barriers to implementing evidenced based practice in nursing homes. The most frequently cited barriers were related to insufficient authority to change practice, difficulty understanding statistical analyses and a perceived isolation from knowledgeable colleagues with whom to discuss the research.<sup>47</sup>

Hughes et al conducted a study to assess how frequently a group of dental hygienists performed screenings for hypertension and barriers to performing the screenings. The results revealed that the majority of respondents were not performing blood pressure screenings, despite the fact that their curricula stressed the importance of this practice for all patients. The most frequently cited barriers were insufficient time in the appointment and minimal value given to the procedure by their employers.<sup>48</sup>

While research provides insight into attitudes, beliefs, knowledge and practice behaviors of medical, nursing and oral health practitioners regarding some specific areas of oral-systemic health, to date there have been no published studies that assess dental hygienists' knowledge, attitudes and practice behaviors regarding oral-systemic health and how they are incorporating evidence into clinical practice. Therefore, the purpose of this study was to assess the practice behaviors and perceived barriers of North Carolina dental hygienists in regards to the implementation of oral-systemic evidence into patient care.

## **Methods and Materials**

A cross-sectional survey of practicing North Carolina dental hygienists was conducted between October 2009 and February 2010. The survey instrument was developed by the research team and pilot tested after approval by the Biomedical Institutional Review Board of the University of North Carolina at Chapel Hill. Pilot testing occurred with 10 dental hygienists, holding various dental hygiene degrees. The survey instrument was revised using feedback from the respondents. The final survey included 39 items and focused on various systemic health issues as they relate to periodontal disease (e.g. diabetes, cardiovascular disease, respiratory disease, etc.). The following sections were included: demographics, practice behaviors, knowledge, attitudes and opinions and barriers. The current paper focuses on the practice behaviors and barriers sections of the survey. The survey instrument, developed in Teleform format, contained Likert-scale questions and close-ended questions. Teleform is a computer program that creates documents which can be scanned into a computer, facilitating speedy and correct data entry.

Names and mailing addresses of the 5,505 licensed dental hygienists in North Carolina were obtained from the North Carolina Board of Dental Examiners. From the original sampling frame, 30% (n=1,665) were randomly selected to receive surveys. The survey instrument, cover letter explaining its purpose and business reply envelopes for return were distributed via mail, utilizing 3 mailings in accordance with the Salant and Dillman methodology.<sup>49</sup> The mailings occurred between October 2009 and January 2010. The cover letter instructed recipients who were unwilling to participate or no longer provided patient care to return their survey blank, thusly alerting us to their status. To maintain confidentiality, the surveys were numerically coded, and participants were not asked to include any personal information on the survey. The research assistant maintained a linkage file to prevent duplicated mail-

ings to respondents. The linkage file was destroyed at the end of the third mailing.

The data was analyzed using SAS version 9.1 (SAS Institute Inc., Cary, North Carolina), using descriptive statistics. Chi-square analyses were performed to assess whether the following categories were associated with the respondent's age, practice type or practice setting: actively engaged in evaluation of periodontal disease, incorporating systemic health management and perceived barriers to incorporation. Level of significance was set at 0.05.

## Results

There were a total of 1,030 surveys returned by recipients (yielding a total response rate of 61.9%). Of these, 859 were completed surveys (yielding a 51.6% usable response rate) and 171 were blank returned surveys. Thirty-two were not deliverable. Respondents were overwhelmingly female (99.5%), with 55% between the ages of 31 and 50. The majority of respondents (84.1%) held a 2 year degree in dental hygiene (associate or certificate). The mean number of years since graduation was 17.7, with a standard deviation of 11.9 (Table I).

Most respondents (84%) indicated that periodontal exams were performed on new patients, and a majority (69.3%) performed periodontal exams at every visit for their periodontal maintenance (D4910) patients. Overall, patients receive periodontal evaluations on a regular basis, ranging from comprehensive full mouth probing to more abbreviated exams, such as periodontal screening and recording and "spot probing" (Table II). The most frequently evaluated indicators of oral health were oral cancer screenings (89.2%), plaque and calculus (91.9%) and gingival appearance (92.%) (Table III).

Sixty-eight percent of respondents reported that the medical history was updated at every visit, and 66% utilized blood pressure cutoffs beyond which no treatment will be provided. Twenty percent of respondents measure blood pressure on all patients, and 62% measure blood pressure on select patients. However, very few (7.6%) record blood

Table I: Demographic and practice characteristics of NC dental hygienists (N=859).

	Respondents	N	%
Age	857		
<30	151	17.6	
31-40	239	27.9	
41-50	235	27.4	
51-59	189	22.1	
≥60	43	5.0	
Dental Hygiene Degree	851		
Certificate/ Associate (2 year)		716	84.1
Bachelors (4 year)		135	15.9
Primary Practice Type	856		
Group private		263	30.7
Solo private		537	62.7
Public health/Other		56	6.6
Primary Practice Setting	817		
Urban		318	38.9
Suburban		335	41.0
Rural		164	20.1
Hrs/week providing patient care	844		
1-10		56	6.6
11-20		116	13.7
21-30		217	25.7
≥31		455	64.7

\*The total number of participants who completed the survey was 859, however some participants skipped questions. The total number of responses per item is indicated in the column marked "Respondents". Percentages may not add up to 100 due to rounding.

sugar levels of diabetic patients, and even fewer (2.8%) record HbA1c values (Table IV). The majority of respondents discuss medications (92.9%) and medical diagnoses (69.6%) with all patients. Blood pressure (62.2%) and stress (64.1%) are discussed with some patients. Bone density (58.9%), physical activity (65.4%), cholesterol (65%) and body mass index (BMI) (79.5%) are typically not discussed (Table V).

Only 34% of respondents reported asking about diabetic patients' blood glucose levels, and only 8% asked about HbA1C values. Eighty-nine percent of respondents reported that they were "extremely unlikely" or "unlikely" to assess patients for diabetes using a glucometer (Table VI). However, 61.7% reported that they are "extremely likely" or "likely" to educate patients about the link between oral infection and glycemic control. Fifty percent reported that they were extremely likely to refer patients to medical providers for follow up for signs and

symptoms detected during a dental hygiene appointment. The survey asked whether or not participants had a role in deciding which patients are referred to a medical doctor or dental specialist, and 79% reported that they do.

The health topics which hygienists most frequently discussed with patients were tobacco use (89%), pregnancy (84.1%), genetic issues (79%), diabetes (75.9%) and stress (66.3%). The conditions for which dental hygiene practitioners were most likely to refer patients to a physician were HIV (35.7%), cardiovascular disease (30.5%), respiratory disease (28.1%), stroke (27.2%) and diabetes (25.5%). Practitioners most often ("always" and "frequently") consult with medical providers regarding need for pre-medication (80.2%), coagulation issues (48.5%) and treatment needs for patients with cardiovascular disease (32.4%) (Table VII).

The most frequently reported "significant" barriers were patients' objection to additional fees for services (68.9%), limitations of time in practice schedule (51.5%) and lack of reimbursement from third party payers (46.4%). Lack of education was perceived by 27.4% of dental hygienists as a "significant barrier" and as "somewhat of a barrier" by 61.3% (Table VIII). For this section, the barrier heading "Patients' objection to additional fees for service" was not qualified in terms of whether or not fees already exist, or if the implication was that the practitioners would begin charging for services rendered (such as glucose testing and counseling). The term "services" was also vague, so these phrases were left to the interpretation of the respondents.

The proportion of dental hygienists who actively participate in evaluating patients for periodontal disease was significantly different among the age groups (Table IX). Younger dental hygienists are more likely to be active in evaluating patients for periodontal disease as well assessing and discussing systemic health

Table II: Practice Behaviors as reported by NC dental hygienists regarding periodontal health examinations.

	Respondents	N	%
Periodontal exams performed on new patients	843		
Always		708	84.0
Often		69	8.2
Sometimes		45	5.3
Infrequently		21	2.5
Who performs new patient perio exams	835		
Dentist		183	21.9
Hygienist		615	73.7
Both		37	4.4
Frequency of periodontal exams for adult prophylaxis patients (D1110)	842		
Every visit		314	37.3
Every 6 mos		169	20.1
Every year		265	31.5
Less frequent than once yearly		94	11.2
Frequency of periodontal exams for perio maintenance patients (D4910)	820		
Every visit		568	69.3
Every 6 mos		119	14.5
Every Year		93	11.3
Less frequent than once yearly		40	4.9
Type of probing for adult prophy patients (D1110)	838		
Full mouth probing		433	51.7
PSR		161	19.2
Spot probing		244	29.1
Type of probing for perio maintenance patients (D4910)	816		
Full mouth probing		677	83.0
PSR		75	9.2
Spot probing		64	7.8
Is the patient informed of perio diagnosis	843		
Always		703	83.4
Frequently		118	14.0
Infrequently		22	2.6

issues. The proportion of dental hygienists who perceived barriers to the incorporation of systemic health management was also significantly different among the age groups (Figure 1). Overall, older respondents and those in solo private practice tend to be more likely to perceive barriers as significant.

Table III: Frequency and for whom NC dental hygienists evaluate oral health indicators to determine oral health status

	All Patients		New/Select Patients		No Patients	
	N	%	N	%	N	%
Gingival Appearance	768	92.8	59	7.1	1	0.1
Plaque/Calculus	763	91.9	62	7.5	5	0.6
Oral Cancer Screening	746	89.2	82	9.8	8	1.0
Probing Depths	561	67.7	263	31.7	5	0.6
Bleeding on Probing	524	65.0	260	32.3	22	2.7
Tooth mobility	439	52.7	390	46.8	4	0.5
Furcations	388	47.3	411	50.1	21	2.6
Clinical Attachment Levels	309	39.9	408	52.6	58	7.5
Mucogingival Relationships	279	38.1	365	49.9	88	12.0

Practice type was significantly associated with engagement in managing systemic health issues (Table X) and perception of barriers (Figure 2). Practitioners in public health settings are more likely to be active in managing systemic health issues and are less likely to perceive barriers to the incorporation of systemic health management practices. Dental hygienists practicing in rural settings were least active regarding periodontal evaluation (Table XI). While Chi-square analyses were used to determine statistically significant differences for many areas, practice setting seemed only to affect periodontal evaluation issues.

## Discussion

The results from this cross-sectional survey of North Carolina dental hygienists indicated that respondents are incorporating some aspects of oral-systemic evidence into patient care. Many respondents indicated they update medical histories at every visit, and evaluate blood pressure prior to treatment. Hygienists are also actively and routinely providing systemic health counseling in some areas, such as tobacco cessation. They reported having a role in deciding who is referred to a medical or dental specialist, and were likely to do so. This speaks to the amount of responsibility that is delegated to dental hygienists and the breadth of

Table IV: Practice Behaviors as reported by NC dental hygienists regarding evaluation of overall/systemic health.

	Respondents	N	%
Medical History (Med Hx) Updated	853		
Every appt.		581	68.1
Every 3–6 mos		94	11.0
Every Year		134	15.7
No regular schedule		44	5.2
Personally Review Med Hx	852		
Always		713	83.7
Often		105	12.3
Sometimes		18	2.1
Infrequently		16	1.9
Blood pressure cutoffs	813		
Yes		533	65.6
No		280	34.4
Diabetic Patients—Blood sugar	858		
Record		65	7.6
Ask About		292	34.0
Not Done		501	58.4
Diabetic Patients—HbA1C	858		
Record		24	2.8
Ask About		71	8.3
Not Done		763	88.9

Table V: Systemic health issues and the patients for whom NC dental hygienists assess or discuss risk.

	All patients		New/Select Patients		No Patients	
	N	%	N	%	N	%
Medications	777	92.9	57	6.8	2	0.2
Medical Diagnosis	584	69.6	238	28.4	17	2.0
Tobacco Use	336	40.2	477	57.1	22	2.6
Alcohol Use	144	17.3	423	50.7	267	32.0
Pulse	101	12.2	326	39.3	403	48.6
Stress	66	6.7	539	64.1	246	29.3
Physical Activity	20	2.4	270	32.3	547	65.4
Body Mass Index (BMI)	19	2.3	152	18.2	663	79.5
Cholesterol	25	3.0	268	32.0	545	65.0
Bone Density	9	1.1	335	40.1	492	58.9

Table VI: Frequency (%) of dental hygienists who are likely to perform/offer oral-systemic services or refer to/contact a medical provider regarding a systemic health issue.

	N	Extremely Likely	Likely	Somewhat Likely	Unlikely	Extremely Unlikely
Refer patients to a medical provider for follow up for signs and symptoms detected during a dental appointment	847	49.8	35.8	9.4	2.7	2.2
Educate patients about the link between oral infection and glycemic control	849	26.7	35.0	20.7	10.6	6.9
Call patient's physician to coordinate treatment	845	23.8	29.9	24.5	12.3	9.5
Offer nutritional counseling to patients	849	20.5	30.5	27.3	13.1	8.6
Offer tobacco cessation counseling	848	20.2	32.4	24.3	12.7	10.4
Refer patients to Quitlines or other cessation services	845	18.0	25.2	27.8	16.4	12.5
Discuss/Counsel obese patients about the risk of systemic disease	850	7.5	13.1	23.2	33.1	23.2
Refer patients to labs/physicians for fasting glucose testing	850	6.6	15.5	18.7	20.8	38.4
Assess patients for diabetes using a glucose monitor	849	1.6	2.6	6.8	33.3	55.6
Perform fasting glucose testing in your office with lab follow up	849	0.1	0.6	1.9	24.7	72.7

Table VII: Frequency (%) with which NC Dental hygienists reported consulting with medical colleagues and/or dental specialists regarding systemic health issues.

	N	Always	Frequently	Occasionally	Rarely	Never
Need for pre-medication	849	45.3	34.9	16.4	2.1	1.3
Coagulation issues	830	26.0	22.5	27.8	13.5	10.1
Patient's medications (e.g. physical/emotional)	830	12.9	19.2	36.5	20.5	11.0
Treatment needs for patients with CVD	828	10.4	22.0	34.5	19.8	13.3
Treatment needs during pregnancy	841	10.3	12.2	25.8	32.7	18.9
High or low blood pressure readings	830	7.2	15.5	32.4	26.5	18.3
Treatment needs for patients with diabetes	828	3.4	10.4	33.5	32.7	20.0
Patient's risk for diabetes	818	2.4	7.2	20.5	38.0	31.8

care rendered in the dental practice setting. If dental hygienists provide regular periodontal exams, and have a role in referring patients, they may be a critical health care provider to assess for oral-systemic risks and managing those risks.

In contrast, the current study found that, while assessment and discussion was ubiquitous among our study population, in-office active management (such as performing a finger stick test to assess for diabetes) was not prevalent. This is similar to the results of studies conducted by Kunzel<sup>42</sup> and Forbes.<sup>43</sup> While a significant portion of the population visits a dental professional regularly,<sup>34</sup> many

people may only visit a physician when experiencing signs and symptoms of problems. In light of this, an argument can be made for more active general health screening and management in the dental office. In a recent study of North Carolina dental hygienists regarding educating and counseling patients about obesity, respondents were willing to discuss obesity with their patients, and 65% reported they were "highly confident" or "confident" about their abilities to discuss specific health risks associated with obesity and the importance of weight loss.<sup>50</sup> In contrast, data from the current study indicated that very few practitioners discuss issues like BMI and physical activity levels

Table VIII: Frequency (%) of NC dental hygienists who reported barriers to incorporation of oral-systemic evidence into practice

	N	Significant Barrier	Somewhat a Barrier	Not a Barrier
Patients' objection to additional fees for services	829	68.9	25.2	5.9
Lack of time in practice schedule	842	51.5	34.3	14.1
Lack of reimbursement from 3rd party payers	796	46.4	37.9	15.7
Concern over legal risks	818	44.1	43.2	12.7
May be perceived by state board as unauthorized practice of medicine	809	39.2	46.0	14.8
Lack of patient acceptance of dental professional providing counseling	839	31.9	54.6	13.5
Lack of education on systemic health	840	27.4	61.3	11.3
Lack of patient education materials	839	21.2	55.9	22.9
Fear of appearing judgmental to the patient/parent	838	21.0	57.3	21.7
Low level of confidence about actively managing patients with systemic health problems	838	15.4	61.1	23.5
Lack of CE opportunities	836	14.5	49.2	36.4
Lack of appropriate referral options within my community	828	12.2	47.2	40.6
Lack of definitive evidence to indicate oral-systemic connections	824	7.5	53.6	38.8

Table IX: The effect of age on practice behaviors.

Practice Behavior	Age				P-Value
	<30 (%)	31-40 (%)	41-50 (%)	>50 (%)	
Ask about blood sugar	46	37	30	26	<0.001
Record Blood sugar	12	8	6	6	0.017
Discuss alcohol use with all patients	20	20	19	12	<0.001
Discuss tobacco use with all patients	45	43	42	32	<0.001
Perform full mouth probing for D4910 patients	88	90	78	78	<0.001
Evaluate probing depths for all patients	74	72	70	56	<0.001
Evaluate bleeding on probing for all patients	72	67	64	59	0.03

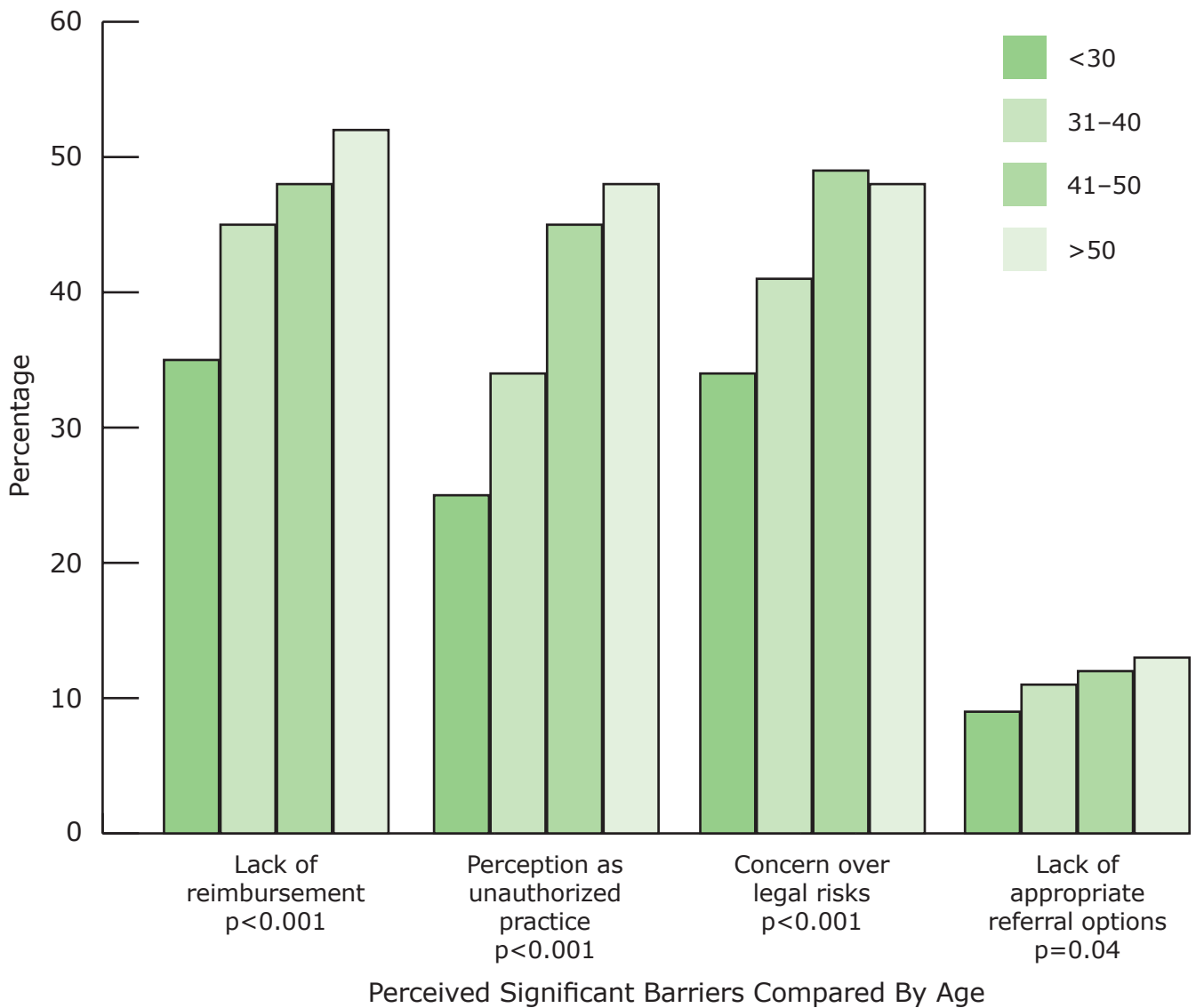
with their patients. Respondents more frequently consult with physicians regarding health issues that directly affect their process of care than active management of systemic health issues (e.g. coagulation issues and pre-medication needs). These are more immediate issues that can influence the safety of providing treatment the day the patient is scheduled rather than long-term oral-systemic health management.

Overall, younger hygienists (40 years old or younger) were more active in implementing oral-systemic evidence into practice. Also, they were significantly less likely than older hygienists to consider "concern over legal risk" and "perception by board as unauthorized practice of medicine" as

significant barriers. This is perhaps due to changes in dental hygiene curricula regarding the oral-systemic link. In our population, age was statistically correlated to number of years since graduation ( $p < 0.001$ ), and was therefore used as a proxy measurement. Esmelli et al conducted a study assessing general dentists' attitudes and practices regarding patients with diabetes. They found that, compared to those with no formal training, those who had formal training were more likely to feel that they knew how to assess for diabetes, to feel well prepared and effective to intervene and to feel that they had appropriate knowledge about related pharmaceutical products. Dentists who had formal training were 4 times more likely to provide services to address diabetes than those who did not have



Figure 1: Comparison of perceived “significant” barriers by age



any formal training.<sup>51</sup> A recent report on curricula in United States dental hygiene programs found that current graduates are receiving formal training concerning oral-systemic disease.<sup>41</sup> Therefore, they should generally feel more comfortable than older practitioners regarding the incorporation of oral-systemic evidence into practice.

Practitioners in public health settings were more active regarding systemic health management (e.g. asking about, recording and discussing systemic health issues), but were least active in performing periodontal examinations when compared to practitioners in group or solo private practices. Public health dentistry in North Carolina is largely centered around children’s oral health. Local health departments and the dental clinics therein serve mostly children, with limited services for adults. Therefore, the lower rate of periodontal examinations is not surprising. The nature of public health

is typically in prevention and overall health management, so it is encouraging that the data supported active management of health.

The 5 most frequently reported “significant” barriers to implementation of oral-systemic evidence into patient care were patients’ objection to fees (69%), lack of time in practice schedule (52%), lack of reimbursement from third party providers (46%), concern over legal risk (44%) and perception by the dental board as the unauthorized practice of medicine (39%). Interestingly, if “significant barrier” and “somewhat a barrier” were combined to get a picture of what may be perceived as any kind of barrier, lack of education emerged as the second most reported barrier. Patients’ objection to fees remained the top reported barrier. These responses indicate an assumption that patients will be charged for additional services. In the study conducted by Esmeli et al, authors evaluated what

Table X: Effect of practice type on practice behaviors.

	Group Private (%)	Solo Private (%)	Public Health/ Other (%)	P-Value
Ask about blood sugar	32	33	52	0.014
Record blood sugar	8	5	27	<0.001
Ask about HbA1c	6	8	18	0.015
Record HbA1c	4	2	7	0.017
Have blood pressure cutoffs	70	62	81	0.006
Perform full mouth probing for D1110 patients	55	51	41	<0.001
Perform full mouth probing for D4910 patients	84	84	67	0.024
Evaluate probing depths	99	99	91	<0.001
Evaluate mobility	98	98	93	0.016
Discuss pulse with all patients	9	12	28	0.003
Discuss medications with all patients	96	92	92	0.04
Discuss medical diagnoses with all patients	77	67	59	0.001
Discuss alcohol use with all patients	18	15	34	0.004
Discuss BMI with new/select patients	19	16	30	0.04
Discuss bone density with new/select patients	43	40	20	0.022

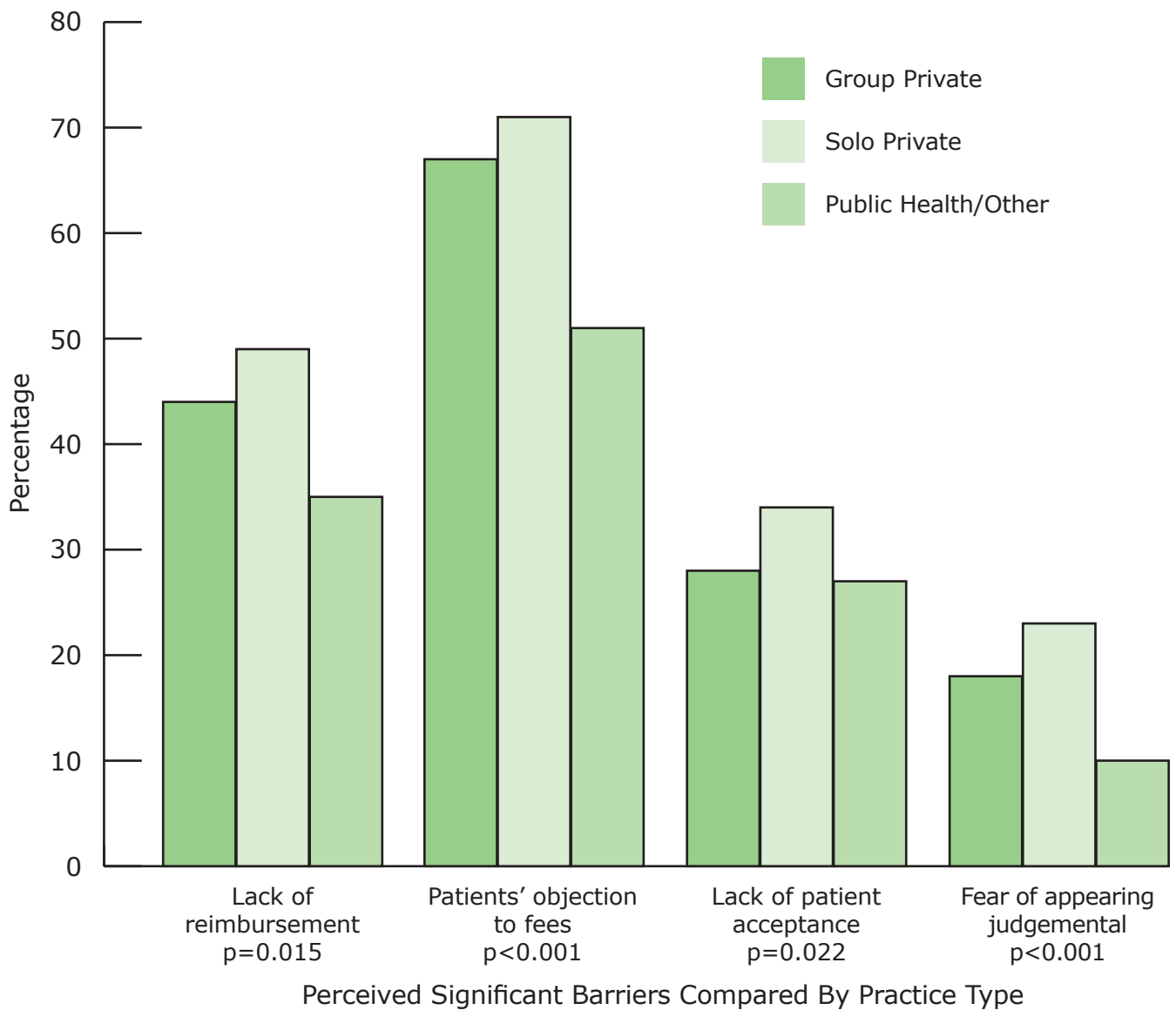
dentists perceived to be barriers to blood glucose measurement. Lack of reimbursement was the most frequently reported barrier (53%).<sup>51</sup> The prevalence of systemic health services and counseling may increase if third party payers provide reimbursement. Another factor that influences dental hygiene care is the hygienist's philosophy of practice. Hygienists' expectations for their own level of professionalism, as well as the expectations of employers and patients, shape the way in which they practice, and what responsibilities they will assume. In striving to achieve "best practices," thorough periodontal evaluation and regular risk assessment through review of patients' medical histories should be a goal for dental hygiene practitioners. Also, if the dental team can collaborate with medical professionals, patients will receive more thorough care. Expectations regarding practices may change as evidence emerges, and perhaps in the future patients will expect more from dental professionals. If this happens, dental care may evolve into a more comprehensive discipline.

Incorporating oral-systemic disease assessment and treatment into patient care will require a level of interprofessional collaboration and education with other health care professionals. Interprofessional education is defined as an educational process that provides health professions students "with experience across professional disciplinary lines as they acquire knowledge and skills in subject areas required in their respective educational programs."<sup>52</sup> For example, in the "seamless care"

model at Dalhousie University in Nova Scotia, Canada, teams comprised of students from medicine, nursing, pharmacy, dentistry and dental hygiene work together to provide collaborative care to patients transitioning from acute care to the community.<sup>53</sup> This learning model utilizes problem-based learning, cooperative learning and opportunities for reflection and integration of learning. Interprofessional education facilitates learning about other professions, as well as attitudes towards implementing a team-based approach.<sup>54,55</sup> However, the history of interprofessional education in dentistry/dental hygiene in the United States has not been progressive, except in a few instances,<sup>56-59</sup> and may take years to achieve. Perhaps oral health care professionals will need to take the lead in educating other health care professionals about the implications of oral disease to systemic health.<sup>60</sup> Also, continuing education is an avenue that may impact the practice of dentistry. As practitioners become more familiar with the link between oral health and systemic health, integration of this knowledge into patient care might become easier as well as more prevalent. Continuing education, in which dental and medical professionals learn together, may be an ideal route to promoting interprofessional collaboration.

There were certain limitations to this study. Generalizability may be limited due to non-response bias. Those who took the time to complete the survey may have higher levels of interest than others, and thus may be more likely to perform in the

Figure 2: Comparison of perceived "significant" barriers by practice type



questioned areas. If respondents were inherently more proactive, then the results may be skewed to reflect more proactive practices. However, the high response rate gives strength to the results and increases generalizability. Another consideration affecting generalizability may also be the distribution of the survey in North Carolina alone. For example, the relatively restrictive practice act in North Carolina may create a tendency for dental hygienists to be reluctant about more active patient management, producing a lower rate of performance than the national average. A national distribution of the survey would lend considerable insight. Conversely, North Carolina is the tenth most populous state and is growing rapidly.<sup>61</sup>

Table XI: Effect of practice setting on practice behaviors

Practice Behavior	Urban (%)	Suburban (%)	Rural (%)	P-Value
Perform periodontal exam at every visit for D1110 patients	40	41	26	0.022
Perform full mouth probing for D1110 patients	50	56	43	0.037
Evaluate probing depths for all patients	70	70	57	0.007
Evaluate mobility for all patients	58	48	52	0.037

North Carolina also ranks tenth in terms of elderly population (65 years and older), with a 2008 estimate of 1,139,052 residents in this category.<sup>62</sup> As the population ages, people tend to have more

systemic health issues. More active care from oral health care providers is important for the overall health of this population. These population characteristics make North Carolina a state that is representative of the population as a whole.

## Conclusion

North Carolina dental hygienists are actively and routinely incorporating some aspects of oral-systemic evidence into patient care. A more active role in patient management would necessitate more time in their practice schedules, and more education and training. Further research in this area is needed. Appropriate next steps may include surveying practitioners on a national level to ascertain practice behaviors and barriers among a more diverse population. Furthermore, entry-level education and continuing education regarding the oral-systemic connection should help ensure incorporation of this evidence into patient care.

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