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Diabetes screening at the periodontal visit: patient and provider experiences with two screening approaches

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Abstract: *Objectives:* This study examined patient and dental provider experiences during the periodontal visit of diabetes screening approaches involving the collection of gingival crevicular blood (GCB) and finger stick blood (FSB) for haemoglobin A1c (HbA1c) testing. *Methods:* At a large, urban, US periodontics and implant clinic, FSB samples from 120 patients and GCB samples from 102 of these patients were collected on special blood collection cards and sent to a laboratory for HbA1c testing, with test results sent to the patients from the laboratory. Quantitative and qualitative data from patients and qualitative data from providers were collected and analysed. *Results:* Quantitative and qualitative data support the feasibility and acceptability of the approaches described. Themes that arose from the interviews with providers and patients include 'a good chance to check', 'patient choice', 'FSB versus GCB testing' and 'a new way of interacting and viewing the dental visit'. *Conclusions:* Periodontal patients and dental providers believe that the dental visit is an opportune site for diabetes screening and generally prefer GCB to FSB collection. HbA1c testing is well tolerated, convenient and acceptable to patients, and GCB testing reduces time and liability obstacles for dental providers to conduct diabetes screening.

Key words: collaborative approach; periodontitis; research; systemic disease

Introduction

The bidirectional relationship between diabetes and periodontal disease has been well documented: diabetes has been shown to be a risk factor for periodontal disease, and the severity of periodontal disease has been associated with glycemic control and the development of complications in patients with diabetes (1). Notably, an analysis of data from the 2003-2004 National Health and Nutrition Examination Survey (NHANES) (2) demonstrated that 93% of patients with moderate or severe periodontal disease would have been recommended for diabetes screening because they met criteria for diabetes risk according to American Diabetes Association (ADA) guidelines (3). Unfortunately, many internists and endocrinologists do not have much familiarity with the relationship between diabetes and periodontal disease (4), and many periodontal patients also have very limited knowledge about this relationship (5). Thus, although at risk, a large number of patients with periodontal disease may not have sought diabetes screening, nor may they have they been encouraged to

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do so by their primary care providers. In fact, many periodontal patients have unrecognized prediabetes and diabetes (1, 6). Importantly, early diagnosis and treatment can prevent or limit complications responsible for considerable morbidity among patients with diabetes and prevent or slow the progression from prediabetes to diabetes (7).

Because a large number of patients with periodontal disease visit a dental provider regularly for periodontal maintenance, the dental office may be an opportune site for systemic health screening. This is especially the case for the many patients with possible systemic disease who have no consistent contact with a primary care provider (8). In fact, some periodontists, general dental providers and dental hygienists have been involved in a variety of activities to support patients' systemic health, especially including performing oral cancer examinations (9), assessing and assisting patients who smoke (10) and supporting diabetic patients with advice on periodontal risks (10–12). Furthermore, analysing data collected in a mail survey of almost 2000 dentists, Greenberg and colleagues (13) report that the majority of respondents thought it important that dentists conduct screening for various systemic health conditions, including diabetes. Most dentists expressed their willingness to collect oral fluids for salivary diagnostics, and about half indicated their readiness to collect blood via finger stick. Reporting on analyses of data collected in a survey administered to 175 New Jersey Dental School clinic patients, Greenberg and colleagues (14) report that almost all patients felt that it was important for dental providers to conduct systemic health screening (including for diabetes), with most patients willing to provide saliva and finger stick samples for such screening. Moreover, the majority of respondents indicated that their opinion of their dentists' competence, compassion, knowledge and professionalism would improve if their dentists were to conduct chairside systemic health screening.

While informative, the studies examining provider and patient attitudes and willingness to participate in chairside diabetes screening involve their anticipated responses and reactions. To our knowledge, no research has examined dental provider and dental patient attitudes and experiences regarding the actual implementation and receipt of diabetes screening at the dental visit. Understanding these attitudes and experiences is vital in informing screening approaches and implementation strategies if diabetes screening in dental offices is to become an accepted practice. In this article, we report periodontal patients' (n = 120) anticipated and actual attitudes and experiences concerning blood collection for chairside diabetes screening. We also report participating dental providers' (n = 7) reactions and reflections on their involvement in diabetes screening activities.

Methods

Overview of the study

Dental providers and patients were involved in a study that aimed to support timely identification of diabetes in adults with periodontal disease at dental visits. The study used materials and an approach to screen for diabetes developed by a high-complexity clinical reference laboratory accredited by the Clinical Laboratory Improvement Amendment of 1988. This approach involves collecting a drop of the patient's finger stick blood (FSB) for haemoglobin A1c (HbA1c) testing, a test approved for diabetes diagnosis in 2010 by the ADA that does not require a fasting blood sample (7). The patient's FSB is collected on a specially prepared blood collection card, and the card with the dried blood sample is enclosed in a sealed, desiccated foil pouch within a waterproof envelope to be sent via a US mail to the laboratory. Upon receipt, the laboratory performs the HbA1c test on this sample and subsequently mails laboratory results with interpretations on their relation to an HbA1c reference range directly to the patient.

While this FSB HbA1c testing approach has generated highly reliable and valid test results, some dental providers and dental patients may be more comfortable with the collection of gingival crevicular blood (GCB) in the mouth (intra-orally) rather than collecting FSB (extra-oral) for diabetes screening (15). Notably, the dental clinician's routine measuring of periodontal pocket depth in patients with periodontal disease typically produces adequate GCB for collection of a blood sample for diabetes screening. We therefore implemented a study involving an innovative, intra-oral diabetes screening approach that could be used with persons with periodontal disease at dental visits. With this approach, the dental clinician uses a blood collection card wand, specially prepared by the collaborating laboratory to collect the periodontal patients' GCB for HbA1c testing. As with the FSB sample, the dental clinician sends the dried blood sample to the laboratory for testing; the laboratory, not the dentist, provides the HbA1c result and its interpretation directly to the patient. In addition to determining the actual GCB and FSB HbA1c results and the number of participants who had FSB HbA1c values in the prediabetes and diabetes ranges, we performed an assessment of the accuracy of the GCB diabetes screening approach. This assessment demonstrated excellent sensitivity (0.933) and specificity (0.900) relative to FSB diabetes criterion values (5). The study also aimed to understand provider and patient views on the acceptability and feasibility of HbA1c testing using both the FSB and GCB diabetes screening approaches.

Study recruitment, participation and data collection took place at the New York University College of Dentistry (NYUCD) Periodontics and Implant Clinic from March through May 2011. To be eligible for the research, periodontal patients needed to be at least 18 years of age and either have diabetes or be at risk of diabetes according to criteria established by the ADA (16). Consistent with NHANES exclusion criteria, patients were ineligible to participate in the research if they required antibiotic premedication before dental treatment or if they had a history of severe cardiovascular, hepatic, immunological, renal, haematological or other organ impairment (17). Details concerning recruitment, patient incentives and attention to the confidentiality of collected data are available elsewhere (6). Individuals were assured that their decision of whether or not to participate would not affect services they

received at the NYUCD. The IRB at the NYU School of Medicine approved all instruments and procedures.

Patient data

After patients had an opportunity to learn about the study, had their study-related questions answered by a research assistant and gave their informed consent for study participation, they completed a 5-min eligibility assessment that determined self-reported diabetes status and elements of diabetes risk according to the ADA (e.g. older age, high body mass index, little daily exercise, diabetes in a first-degree relative, minority ethnicity/race) (16). A total of 120 patients were eligible and agreed to participate in the research. They then completed a 10-min survey before the dental visit at the NYUCD Periodontics and Implant Clinic. The survey gathered socio-demographic information not collected on the eligibility assessment (e.g. sex, education), as well as participants' health-related activities (e.g. regularity of visits with a dental provider, past testing for blood glucose), knowledge about diabetes and its relationship to periodontal disease, and their brief predental visit attitudes about screening for diabetes at chairside.

At the end of the dental visit, during which blood was collected for HbA1c testing, participants completed a 5-min survey on their diabetes screening experience. Patients were asked whether they thought that the dental visit was a good place to have blood collected for this testing and the reason(s) why they felt this way. The 102 patients from whom it was possible to collect both FSB and GCB (there was insufficient bleeding for GCB collection from the remaining 18 patients) were asked whether they preferred FSB or GCB collection and why this was the case. Patients were additionally encouraged to offer their thoughts concerning the collection of blood for glucose testing at their dental visit.

To expand and provide more in-depth information about the patient experience of diabetes screening, we additionally conducted individual interviews with nine participating patients. A qualitative researcher conducted audio-taped interviews that were immediately transcribed verbatim by an experienced transcriptionist. Patients were asked about their experience with the blood glucose testing and prompted to elaborate about how and whether it affected the way they thought about the dental visit and their dentist, and preferences regarding FSB glucose testing compared with GCB glucose testing. Patients participating in these individual interviews were offered a $25 gift card for their participation and provided informed consent for audio-taping of the interviews.

Provider data

A nurse practitioner and eight dental providers participated in the survey, interview and/or blood collection for the study. The dental providers included periodontal residents, a dentist, a dental student, a dental hygienist and dental hygiene students. All but one of the dental providers responded to several open-ended questions regarding their experiences about diabetes screening at the dental visit. Providers were prompted to discuss their confidence in collecting the blood samples, feelings about the time and effort required to collect and prepare specimens, and views on the appropriateness of diabetes screening at the dental visit and their interactions with patients. Finally, they were asked about anticipated barriers in implementing either FSB or GCB diabetes screening in community-based dental practices.

Data analyses

To analyse the quantitative data, we used descriptive statistics (i.e. means, standard deviations, proportions) to report participants' socio-demographic characteristics and health-related factors, their knowledge of their diabetes status, their view of the dental visit as a good place to have blood collected for glucose testing and their preference for FSB or GCB blood collection. All analyses were conducted using PASW version 18.0 (SPSS Inc., Chicago, IL, USA).

To analyse the qualitative patient data, we used constant comparative analysis to generate themes that encompassed and explained as much variation as possible (18). To assure accuracy of patient transcripts from in-depth interviews, the researchers replayed audiotapes and reviewed each transcription, making changes and clarifications as needed. Moreover, we examined open-ended survey responses pre- and post-dental visit and systematically identified significant content and illustrating statements from surveys and transcripts. Preliminary codes and emerging themes were recorded as they occurred. Ongoing discussions about observations and insights relevant to understanding the experience of FSB versus GCB glucose screening were conducted. ATLAS.TI 6.0 (ATLAS.ti Scientific Software Development GmbH, Berlin, Germany) facilitated data analysis.

To elucidate dental provider themes, we likewise used constant comparative analysis to establish preliminary codes and themes (18). Through discovery of recurring themes and remaining close to the data, we compared codes, challenged each others' interpretations and participated in a dialogue to assure fuller description of how dental providers perceived FSB versus GCB glucose screening for patients in a dental clinic. Peer debriefing and review of the systematic processes of data collection and data analysis were used to strengthen rigour and facilitate trustworthiness of qualitative findings.

Results

Patient characteristics

Data concerning socio-demographic information and descriptive information about health-related status and activities are summarized in Table 1.

Patients' anticipated views of blood glucose screening

Data from the predental surveys (n = 120) that described how patients anticipated they would feel about having blood sugar

Table 1. **Characteristics of participants (n = 120)**

Characteristic	Number of those responding	Percent of those responding
Men	50/120	41.7
Latino	25/119	21.0
Race*		
Black/African American/Caribbean	45/119	37.8
White	48/119	40.3
Asian	7/119	5.9
Native American/American Indian	1/119	0.8
Pacific Islander	1/119	0.8
Other race†	22/119	18.5
Between 45 and 65 years old	70/119	58.8
65 years old or older	32/120	26.7
Education: highest grade completed		
Some high school	3/117	2.6
High school graduate or GED	20/117	17.1
Technical school	6/117	5.1
Some college	27/117	23.1
College graduate	39/117	33.3
Post-graduate or professional degree	22/117	18.8
BMI ≥ 25 kg m^{-2}	69/120	57.5
Get little/no exercise each day	57/118	48.3
Have been told have diabetes by health provider	23/120	19.2
Have sibling with diabetes	27/119	22.7
Have parent with diabetes	43/120	35.8
Get at least annual checkups with a dental provider	90/116	77.6
Have a primary care provider	106/119	89.1
Ever had a test for blood sugar?	94/117	80.3

*Five people responded to both 'other race' and a specific race category.
†17/22 people who responded to 'other race' indicated that they were Latino/Latina/Hispanic/Puerto Rican/Spanish/pure Hispanic descent.

tested generally reflected a lack of concern. Indeed, of the 93 patients who responded to how they felt about having their blood glucose tested in the dental visit, the vast majority reported feeling 'fine or okay' (n = 40), 'good or great' (n = 23) or 'having no problem' (n = 17). Of the remaining respondents, seven felt 'indifferent', three were 'interested or curious' and three reported feeling 'nervous'.

Patient experiences of blood glucose screening

In-depth qualitative interviews with patients revealed four essential themes that described the experience of blood glucose screening at a dental office. These included a good chance to check, patient choice, FSB versus GCB testing and a new way of interacting and viewing the dental visit. Themes are elaborated below both with direct patient quotes provided from both the in-depth patient interviews and with open-ended responses to the brief post-dental visit survey with all participating patients to exemplify and illuminate patient experiences.

A good chance to check

None of the patient respondents in the in-depth qualitative surveys had previously considered the idea of diabetes screening when receiving oral health care. In the words of one respondent, 'This is new to me. I never thought of having a diabetes test at a dental office'. Consistent with 90% of the 120 survey respondents who thought that the dental visit was a good place to have blood collected for glucose testing (the remaining survey respondents were unsure), most of the patients participating in the in-depth interviews thought that the diabetes screening was a very good idea. One of the most appealing features of the diabetes screening is that it saved patients' time and gave them an opportunity for screening when they had already committed to a dental appointment (and did not need to wait for an additional medical appointment). Illustrating this, one of the patients indicated, 'Today, I have time and am relaxed. I go to the doctor maybe once a year for a routine check but why wait? It's more [of a] chance to find these things at the dentist. I checked 8 months ago at the doctor but if I go to the dentist, maybe it's a good time to check'. Another respondent said that having diabetes screening in the dental office felt like a 'surprise' or 'bonus' offered by the dental provider and would be a motivating factor for keeping future dental appointments. Expressing the sentiment of many, a respondent indicated, 'I look forward to getting the results'.

Patient choice

Some respondents indicated that to their knowledge, they had never before been screened for diabetes (even though they had periodontal disease) and appreciated that it was being offered. One patient said, 'I was very happy that you asked me if I wanted the test'. Noting that most doctors do not explain the connection between periodontal disease and diabetes, and the importance of screening, another person said, 'I am going to get a letter in the mail to find out what's wrong with me or if nothing is - I'm winning both ways'. Another patient spoke poignantly about the importance of diabetes screening for medically uninsured patients. While he personally preferred his own diabetes screening in a primary care provider's office, he emphasized that the dental office could be a vital site for those who lacked insurance coverage or access to primary care providers.

Repeatedly, patients indicated that if diabetes screening were to be conducted in a dental office, it should be the patient's choice. Illustrating a sentiment shared by all, one patient said, 'If I had diabetes, I would like to know, but it should be the patient's choice', While all the respondents in this sample consented to FSB and GCB testing, they underscored that some people do not want to know whether they are at risk of diabetes, would choose not to be screened and would not want to deal with the consequences of at-risk screening. They emphasized, however, that the dental setting could provide an ideal venue for teaching patients about the

connection between periodontal disease and diabetes and helping patients see peers who were tested. They suggested that these measures could enhance motivation and potentially overcome objections to screening. Several patients said that seeing peers participate in screening could help other patients overcome their concerns.

FSB versus GCB testing

Post-dental visit survey responses from the 102 patients who had both FSB and GCB collection indicated that 51.0% preferred the GCB collection, 31.4% preferred the collection of FSB and the remainder did not express a preference. These preferences were reflected in the in-depth interviews, with most of the respondents indicating that the collection of the GCB sample felt like a routine dental cleaning. One patient said, 'With my gum condition, I naturally bleed so it was nothing special. It was the same feeling as having a cleaning', while another indicated, 'I was not aware when the sample was taken orally but I felt [the] finger prick'. However, for patients who did not have spontaneous bleeding on periodontal probing or whose gums were especially sensitive, the GCB sample collection could sometimes feel more painful than FSB collection.

Some of the respondents worked with their hands and indicated that GCB was preferable to FSB testing. The FSB collection increased concerns about potential infection and the finger prick sensitivity or a band-aid interfered with cooking, sculpting, etc. Others viewed GCB collection as 'easy' or 'less invasive'. A participant indicated, 'I'm used to dental probing while here at the dental clinic'. In contrast, other patients indicated a preference for FSB testing even when GCB sample collections were less painful. These patients viewed FSB collection as 'easier', 'simpler' or 'less invasive'.

Some respondents believed that where blood was drawn (from mouth versus finger) would affect test readings. Several indicated that because FSB testing for diabetes was more familiar, it was always a more valid practice for diabetes screening. Others thought that the GCB screening method would be more sensitive and accurate or would measure 'different blood' from that of the finger surface that is important for diabetes testing, expressing their belief that contaminants were less likely inside the mouth.

A new way of interacting and viewing the dental visit

For some respondents, participating in diabetes screening prompted a new way of interacting with a dental provider, viewing the dental visit and thinking about their health care. They reported that gaining more knowledge about their health, the increased risk of diabetes among patients with periodontal disease and the opportunity to improve personal care were benefits of the dental visit screening. One respondent (previously diagnosed with diabetes) said that screening in the dental office would help him monitor and regulate his blood sugar. He reported that he saw his diabetes provider every 3 months and his dental provider monthly and that the close monitoring prodded him to practise better self-care health practices.

For some, receipt of laboratory test results was another benefit of the diabetes screening at the dental visit. Referring to the written report, respondents suggested that it provided concrete material that the patient could bring to his or her primary care provider to facilitate communication. Illustrating this point, a person remarked, 'They have the paper in the mail and they can call up and say: ''Excuse me, what does this mean? I do not understand what is on the paper'''. One respondent indicated that receiving the laboratory result in the mail meant that another member of the household could potentially open and read the laboratory finding, thus compromising confidentiality. For him, this was a minor concern, and no other patients in our sample expressed apprehension over laboratory correspondence by mail.

Although blood glucose screening did not specifically affect the way patients thought about their dental providers (e.g. feeling more cared about by dental providers as a result of the screening), several noted the benefits of interacting with a dental provider. Many suggested that the dental visit could be a venue for additional illness screenings (i.e. such as cancers) and discussions about medical conditions and medications. They pointed out that knowing more about a patient's health could help both dentists and patients integrate medical findings toward improved health outcomes. Exemplifying this, a diabetic patient who reported learning that her increased blood sugar was a side effect of a new medication was able to follow up with her prescribing rheumatologist. Another patient who was rationing her diabetes medication to contain costs learned that this was an ineffective approach and was ultimately able to secure assistance with prescription costs. A number of patients reported that when they had problems, they were more likely to see a dental provider and more amenable to change following a dental visit. One person summed it up this way: 'When you get a dental problem you have pain or cannot eat. You get more alarmed and become a better patient'. Some patients remarked that it was easier to talk with dental providers than with medical providers, and thus, education about periodontal disease and diabetic risk in the dental office was invaluable. Illustrating this, one respondent indicated, 'Talking to people and giving them papers to read will change their minds and help them find out about their health. There is no downside to that'.

Provider's experiences of blood glucose testing

Participating dental provider responses also addressed the four essential themes that described the experience of blood glucose screening for diabetes at a dental office. These included a good chance to check, patient choice, FSB versus GCB testing and a new way of interacting and viewing the dental visit. Themes are elaborated below with direct provider quotes to exemplify and illuminate patient experiences.

A good chance to check

Consistent with the experiences revealed by patients, all of the participating providers agreed that blood screening for diabetes was appropriate for dental providers. Echoing the patients' description of the dental office as a 'good place to check', the dental hygienist explained that blood collection for diabetes screening was an important role within the purview of dental hygienists. She pointed out, 'Blood collection for diabetes screening is well within our scope of practice. We see blood almost every day with our patients, especially periodontal patients. For many patients, this will be an addition to the preventive work already provided by the dental professional. Many patients are unaware [of the relationship between periodontal disease and diabetes], and [with the diabetes screening] it is a rewarding, 2-in-1 packaged deal when they visit the dental clinic'.

Patient choice

Whereas patients reiterated that diabetes screening should be the patient's choice, dental providers emphasized that patients need to be convinced of the need for screening and educated about the role of dental providers in this process. Most dental providers described that patients were surprised to be offered an opportunity for diabetes screening and needed to be given a rationale for this screening. Shedding light on this, a dental hygiene student explained, 'Some patients didn't see where a dental professional would fit in with a diabetes screening. After thoroughly explaining to them how research studies have concluded a connection, not necessarily causal relationship but close correlation between periodontal disease and diabetes, they saw the need for such a screening. The screening approach wasn't intimidating to the patient and actually was very pleasant... according to most of the patients. Most of the patients were used to sitting in the dental chair and getting a cleaning, so the collection of oral blood wasn't a problem. Many patients stated how much they hated finger sticks because of the pain and this made potential subjects hesitant to participate [in the research]'.

Framing expectations and the rationale for the screening was identified as important. One dental provider explained, '[FSB and GCB collection] methods needed explanation to the patient so that they (patients) knew what to expect from the procedure, and reassurance as far as anticipated discomfort and time needed to collect the blood'.

Consistent with the qualitative patient data, dental providers indicated that 'not all patients wanted to know their diabetes status'. While reporting that patients were 'generally happy to be receiving screening for their diabetes', they indicated that some patients were reluctant to incorporate medical screening into a dental visit and did not wish to learn about their diabetes risk. A periodontal resident elaborated on the difficulties: 'I found that [with] patients, it was not always easy to integrate the approach into the dental visit. Sometimes patients were resistant to involving something presumably medical into their dental visit. There are patients who simply do not wish to know the information, even if it were made readily available and was not necessarily diagnostic, as it was in this case'.

Providers identified lack of patient motivation as a vital obstacle to overcome if diabetes screening were to be implemented in community-based dental practices. To address this concern, one periodontal resident described the need to provide educational literature and scholarly articles to patients. She said, 'I would think that the obstacle would be to motivate patients to participate, and making the connection between diabetes and periodontal disease clear to them and thereby validating the need for the screening. To make this process easier, perhaps there could be readily available, easy to understand literature for patients to read, cited from various reputable journals, which would help drive the point home'.

FSB versus GCB testing

Dental providers in our study generally believed that GCB collection was a more appropriate blood glucose screening approach, but most reported that both methods were feasible. They reiterated that dental providers routinely see blood related to periodontal procedures and that obvious bleeding facilitated GCB collection. However, the dental student noted that routine probing and measuring of periodontal pocket depth did not always produce adequate gingival crevicular bleeding for a diabetes screening sample. While indicating that for patients with periodontal disease, there was no problem with blood collection, she added, 'I felt more confident with finger stick only because we were able to procure a sample 100% of the time'. In contrast, a periodontal resident found the GCB collection to be more expedient.

Time efficiency for specimen collection was a key consideration for providers. Providers had differing thoughts concerning the time needed for sample collection. A periodontal resident reported, 'I found that it usually took a bit longer to collect the finger samples than the oral samples, because most patients had abundant oral blood, but not all patients bled readily from the finger'. In contrast, one of the dental hygiene students reported the FSB collection was quicker than the GCB collection. She said, 'the finger stick blood samples took less time because blood appeared immediately. Oral blood samples took a little more time because it took more concentration to get oral blood that was not contaminated with saliva so our sample was not diluted'. Most believed that the time needed for the sample collection and mailing preparations were comparable for the FSB and GCB samples. Reflecting the views of most participating dental providers, a dental hygiene student indicated, 'Packaging of both the finger and oral blood samples wasn't difficult and required the same amount of time'.

Notably, as this was a research study requiring patients' informed consent, there was a considerable amount of paperwork that took some time. A dental hygiene student elaborated on this: 'The preparation process as well as the whole blood collection process did not take a lot of time. Paperwork

was the main time consumer. As soon as the patient was done with signing all the paperwork, the procedure went very smooth and fast. Preparation of both of the materials for the oral sample and finger stick was pretty much the same and did not cause any difficulties at all'.

Several providers expressed their belief that many patients would ultimately choose not to participate in FSB screening at a dental office. A dental hygiene student indicated, 'In my opinion a very small percent of the patients would agree to take finger stick on a regular dental visit since most people do it in a physician's office anyway.... a lot of people are terrified by needles and pinches and the physician's office atmosphere overall, so [GCB collection] would suit them perfectly'. The dental hygienist agreed and noted, 'I think the biggest obstacle would be finger nick collection.... I do not see obstacles with the oral blood collection. It is fast, easy and relatively painless'.

Importantly, scope of practice issues influenced blood sample collection. A dental hygienist pointed out that because of various state licensing restrictions, some hygienists could collect GCB but not FSB samples. In contrast, a foreign-trained dentist specified that she could only collect FSB specimens.

Regardless of method, some providers mentioned that cost might be a barrier for patients and suggested that selected populations, sites or screening approaches specific to dental or medical offices might be important to consider. A dental student noted, 'The screening would most likely be an additional charge. To make it easier to implement, the costs of the screening would have to be reasonable for the selected population or maybe the community health center could hold free screening periodically throughout the year. Patients would most likely be more comfortable with dental professionals doing oral blood samples and leaving the finger sticks to their physician based on what they know and have experienced prior'.

Another potential obstacle identified by several providers was the manner in which the test results would be communicated to patients. A dental hygiene student stated, 'I think the greatest obstacle would be the way the results would be distributed to the patients. Even though the results could be distributed directly from the lab by mail to the patients, some patients might not want their results to be mailed'. A dentist further expressed concerns about communication of diagnosis and the dentist's role, saying, 'I think the biggest obstacle would be to be able to let the patient know about their results. If there is a diagnosis of the patient being diabetic or in a pre diabetic range, then the dentist [would have] a limitation of not being able to... diagnose the condition and would need the assistance of the patient's family doctor or a nurse practitioner to help let the patient know about his diagnosis'.

A new way of interacting and viewing the dental visit

Just as patients described a new way of interacting and viewing the dental visit, for dental providers, it meant being able to address patients' systemic health needs when they are so closely connected to their oral health. Illustrating this, one dental hygiene student enthusiastically said, 'I have been working with patients for 2 years and have seen a lot of patients with diabetes as well as periodontal disease. It is a great idea to implement any methods and strategies to address this correlation and take advantage of the knowledge in order to fight the consequences of these diseases. The dental office is a great place to make this kind of test and examination possible'.

Dental providers remarked that many patients thought they only needed to see a dentist when they were in pain, and patients needed to be educated about the dental visit and the broader role of dental providers. Most described that patients were very receptive to thinking about the dental visit as an opportunity for screening and providing health education and for expanding their view of dental roles in the healthcare continuum. Expressing enthusiasm about this prospect, one respondent emphasized, 'Once the importance is fully understood by this particular population, utilization of such a vital asset to their healthcare services will reach its maximum potential'.

Discussion

Results of our study indicate that both periodontal patients and dental providers believe that the dental visit is a good site for diabetes screening. Reinforcing the potential for the dental visit to serve as 'a good place to check' for diabetes, patients showed little apprehension and considerable appreciation for the time-saving manner in which they were being provided with diabetes screening, while dental providers were amenable to taking the blood samples. Both patients and dental providers emphasized the importance of patient education about the bidirectional relationship between diabetes and periodontal disease as supporting the implementation of diabetes screening at the dental visit. Dental providers viewed this education as an opportunity to motivate the screening, while patients viewed the education they would receive from trusted oral healthcare professionals as an additional benefit. Based on some respondents' understanding about 'different blood' in the mouth and in the finger, such education would be helpful in clarifying the meaning of blood glucose test results. For other patients, the opportunity to monitor blood sugar levels, discuss the effects of medications prescribed by other care providers and resolve access to care and prescription/visit cost issues was uniquely met in the dental visit.

Both patients and dental providers tended to prefer GCB to FSB collection for this screening. Especially for periodontal patients with considerable bleeding on probing, the collection of the blood sample was generally viewed as simpler and less invasive and eliminated concerns about sensitivity at the site of the finger prick. Participating dental providers generally viewed the obvious bleeding when probing in patients with moderate or severe periodontal disease as facilitating blood collection, enabling both US dentists and dental hygienists to do so within their scope of practice and taking little time. For patients with more limited bleeding on probing, both patients and providers acknowledged that blood collection from the finger would be a preferred approach.

Notably, whether using FSB or GCB collection, the diabetes screening approaches described in the current research have a variety of advantages that make them especially suitable at the dental visit. As reflected in the provider interviews, these approaches are not time intensive. They require only a single drop of blood to be collected by the dental provider, applied to a card and mailed to the laboratory for HbA1c testing. In addition, blood collection at the point-of-care using the described method does not require a certificate of waiver from the Clinical Laboratory Improvement Amendment (CLIA) as analysis of HbA1c levels is conducted by a CLIA-accredited laboratory rather than by the dental provider. In the laboratory, analyses of blood specimens use technology that is widely regarded as the reference method of the National Glycohemoglobin Standardization Program (NGSP), as advocated by the American Diabetes Association. In addition, these approaches do not require the dentist to make a diabetes diagnosis, a medical decision with which the dentist may be especially uncomfortable as it is outside of her/his scope of practice. Thus, potential obstacles of providers' time and liability in chairside screening (13) are minimized with our diabetes screening approaches.

There are also potential limitations in various approaches involving diabetes screening at the dental visit. Regarding the FSB and GCB diabetes screening approaches, some participating patients and providers described concerns about possible loss of patient confidentiality in their receiving diabetes screening results by mail. However, others viewed receipt of the written report as helpful in facilitating subsequent conversations with their primary care providers. Whether using the FSB or GCB approaches described in the present study or other diabetes screening approaches, it is likely that most periodontal patients will wish to participate in diabetes screening conducted at the dental visit. However, as some patients will not want to know their diabetes status, respondents emphasized the importance of patient choice in whether or not to participate. Other limitations of all diabetes screening approaches involve the cost of the screening and the need for patient follow-up of out-of-range test values with primary care providers. The extent to which patients with test values in the diabetes range seek further work up with their primary care providers is an important issue in need of future research.

Finally, findings of our study are limited because they represent the views of a purposive sample of patients and providers. Sample selection from an urban periodontics and implant clinic may not represent the views of all patients and providers. Importantly, however, qualitative research does not seek statistical representativeness (18). Rather, purposive sampling is used to capture the experience of persons who have direct 'lived' knowledge of a particular experience, and this permits researchers to conduct in-depth data collection and analysis (19). Consistent with a qualitative approach, we selected patients and providers with experience of diabetes testing in two different ways (e.g. GCB and FSB) at a dental visit and for the purpose of sharing that knowledge.

For the most comprehensive examination of the subject matter as possible, we analysed both quantitative and qualitative data. Quantitative data provide some basic information on both the appropriateness of the dental venue for diabetes screening and patients' preference for GCB collection to FSB collection. Qualitative data illuminate and contextualize how patients see diabetes screening in general, testing in a dental office and the larger and the more complicated process of changing healthcare roles and responsibilities.

Conclusion

Both periodontal patients and dental providers believe that the dental visit is an opportune site for diabetes screening and generally prefer GCB to FSB collection. By examining patient and provider experience, we report on a novel diabetes screening approach that is well tolerated, convenient and acceptable to patients and reduces time and liability obstacles for dental providers conducting diabetes screening.

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