Evidence to support a bidirectional relationship between diabetes and periodontal disease has been emerging for more than 15 years. In 1993, Löe\textsuperscript{1} proposed that severe periodontitis was the sixth complication of diabetes; in 1996, Taylor and colleagues\textsuperscript{2} reported other compelling findings that severe periodontitis at baseline is associated with worsening glycemic control over time in a population-based study of Pima Indians with diabetes who were noninsulin dependent.

Casey Hein, BSDH, MBA

Scottsdale Revisited: The Role of Dental Practitioners in Screening for Undiagnosed Diabetes and the Medical Co-Management of Patients with Diabetes or Those at Risk for Diabetes
In spite of the fact that these findings have been reproduced and validated in countless studies reported during the past decade, these important discoveries have yet to be translated into everyday patient care in medical and dental practices. In her expose on the mysteries surrounding the relationship between diabetes and periodontal disease, Lalla was more eloquent in her challenge to the healthcare professions: “We now have evidence that although growing understanding of the diabetes-oral link supports an increased primary and preventive role for dentists in diabetes, this knowledge has not translated to real changes in clinical practice…There is clearly room for improvement in clinical practice, and looking ahead, research towards developing clinical support systems for dentists [author (CH) suggests this should also include dental hygienists, physicians, nurses, diabetes educators, dietitians] and also programs that facilitate the interaction and synergy among all healthcare providers involved in the care of diabetic individuals is of essence.”

This kind of change may actually be underway. With a landmark report entitled the Report of the Independent Panel of Experts of ‘The Scottsdale Project’ (also known as The Scottsdale Report), the significance of oral health in promoting whole body health in individuals with diabetes was brought to the forefront of the healthcare arena.

The intent of The Scottsdale Project, which convened from April 11-13, 2007, was to bring together, for the first time, a wide range of medical and dental experts* to dialogue about the quality of evidence related to the association between diabetes, periodontal disease, and cardiovascular disease. Furthermore, the independent panel of experts was tasked with defining whether the current data is meaningful and useful enough to justify the development of guidelines for clinical decisions and patient management. Citing the potential threat that periodontal disease may pose to systemic health, specifically related to the increased risk for complications of diabetes, the experts discussed whether current evidence is strong enough to support the adoption of periodontal disease as a modifiable risk factor in decreasing the risk for diabetic complications and the development of heart disease and stroke.

*Charles Cobb, DDS, PhD; D. Walter Cohen, DDS; Môise Desvarieux, MD, PhD; Sheila Garris, MD, FACCP; Casey Heim, BSDH, MBA; Anthony Iacopino, DMD, PhD; Evanthia Lalla, DDS, MS; Brian Mealey, DDS, MS; Lynnae Millar, MD; Steven Offenbacher, DDS, PhD, MMSc; Robert Ostfeld, MD, MS; David Paquette, DDS, MPH, DMSc; Shailesh Patel, BM, ChB, DPhil, FRCP; Louis F. Rose, DDS, MD; Maria Ryan, DDS, PhD; Souvik Sen, MD, MS, FAHA; Maurizio Trevisan, MD, MS; Karen Williams, RDH, PhD

The Scottsdale Report also spawned awareness of the importance of medical-dental collaboration in the co-management of patients who have increased risk for diabetes, or who have already been diagnosed with diabetes who also may have periodontal disease. In addition, the report proposed a transdisciplinary model of care that relies on bilateral point-of-care screening from medical and dental providers to identify and cross-refer patients who either are at risk for or who have undiagnosed periodontal disease, diabetes, and cardiovascular disease (CVD) (ie, medical providers screening for periodontal disease and dental providers screening for diabetes and CVD).

There were two overarching, key issues that The Scottsdale Report sought to address:

**Key Issue I:** Is it appropriate to develop guidelines that assist dental providers in identifying patients who have or who are at risk for diabetes and/or CVD, or screening patients for undiagnosed diabetes and/or CVD who need to be referred to physicians?

**Key Issue II:** Is it appropriate to develop guidelines that assist medical providers in identifying patients who have or who are at risk for periodontal disease, or screening patients who may have undiagnosed periodontal disease who need to be referred to dentists?

The Scottsdale Report reviewed evidence of the relationship between periodontal disease and CVD, and made specific recommendations related to this area of investigation. This article discusses the report’s findings related to diabetes and periodontal disease only. This article also explores more current studies and literature reviews related to this subject matter, selected for their relevance, including literature published after the consensus conference and not contained in the body of evidence considered by panel experts in their findings during the Scottsdale Conference. The article concludes by promoting the role of dentists and dental hygienists in screening and co-management of patients with diabetes or those who are at risk for diabetes, and offers recommendations for how the findings of The Scottsdale Report and more recent research can be incorporated into dental practice settings.

**THE SCOTTSDALE CONCLUSIONS**

In reference to Key Issue I, it was the consensus of the panel of experts that it is appropriate to develop guidelines to assist dental providers in identifying patients who...
are at risk for diabetes. The experts concluded that a thorough search for patient-provided information that may lead to a diagnosis to improve oral and systemic health should be conducted by dental providers. The panel recommended the following protocols for dental providers to screen patients for diabetes:

1. Patients at risk for diabetes (information obtained from thorough family and personal medical history), regardless of oral presentation, should be referred by dentists to laboratories to have their fasting blood glucose levels checked and/or referred to their physician for further diagnostic evaluation.

2. Patients with severe periodontitis (severe for age, failure to respond to treatment, abscesses) or fungal infection should be considered for referral to their physician for screening for diabetes.

3. If laboratory testing for diabetes is performed in a dental care setting, it should be done in accordance with American Diabetes Association screening guidelines (fasting blood glucose) with appropriate follow-up of laboratory data and communication with the physician.

4. For the patient who has been diagnosed with diabetes (and/or CVD), dentists should work collaboratively with physicians to achieve the best possible patient care outcomes. A set of guidelines should be developed to define what is important for bidirectional interprofessional communication.

5. Patients already diagnosed with diabetes who do not have a treating physician are at high risk for cardiovascular events and should be seen by a physician.

In reference to Key Issue II, the panel of experts determined that it is appropriate to develop guidelines that assist medical providers in identifying patients who are at risk for periodontal disease or screening patients who may have undiagnosed periodontal disease who need to be referred to dentists. Furthermore, they noted, medical providers’ recognition of the signs and symptoms associated with periodontal disease may identify patients who are either at risk or who are undiagnosed who should be referred to the dental provider. They concluded that physicians can screen for signs and symptoms associated with periodontal disease based on patient history, symptoms, and a visual assessment of the patient’s teeth and gums.

Accordingly, the expert panel of The Scottsdale Project recommended that medical providers screen and refer all patients suspected of having periodontal disease, as well as the following management plan for patients with diabetes.

1. Patients with diabetes should be managed medically as recommended by the American Diabetes Association.

2. Patients with diabetes should have a dental examination at a minimum of twice a year, or more frequently if advised by the dental provider, and receive appropriate dental/periodontal care.

3. There should be close communication between the primary care physician and the dentist.

4. Medical providers should advise the patient with periodontal disease that this is a chronic infection of the gums and an important complication of diabetes.

5. Medical providers also should advise patients that periodontal disease has been associated with significant health problems, including worsening metabolic control and other complications of diabetes, coronary artery disease, and stroke.

6. Medical providers should advise the patient that periodontal disease can be treated by the dentist and dental hygienist.

7. If the patient has not seen a dentist within the last year or if there are signs of periodontal disease, the patient should be advised to make an appointment to see a dental provider right away.

It is important to note that the expert panel’s recommendations for clinical guidelines should not be interpreted to mean that the scientific evidence is fully adequate. In formulating its recommendations, the expert panel assessed only the evidence available at the time of the consensus meeting.

THE NEXT CHAPTERS: ADDRESSING THE UNKNOWNS

Although much has been achieved in the investigation of the relationship between diabetes and periodontal disease, there are still many unanswered questions including the following:

1. What exactly are the biologic mechanisms involved in the pathogenesis of periodontal disease in individuals with diabetes?

2. Does periodontal disease have an effect on glycemic control and increase the risk for complications of diabetes? Does treatment of periodontal disease affect a decrease in insulin requirements of patients with poorly controlled diabetes?
3. For children and adolescents with diabetes, what is their increased risk for oral diseases?

4. What are the inflammatory pathways that link obesity, metabolic syndrome (MetS), and periodontal diseases?

MORE RECENT VALIDATION OF THE DIABETES-PERIODONTAL DISEASE RELATIONSHIP

A number of articles published since the consensus proceedings of The Scottsdale Project are noteworthy. The findings of various studies underscore the importance of increasing awareness of the bidirectional relationship of diabetes and periodontal diseases within the medical community.

In a 2008 review of evidence published since year 2000, Taylor and Borgnakke validated previously reported conclusions that diabetes is associated with increased occurrence and progression of periodontitis and, further, that periodontal infection is associated with poorer glycemic control in individuals with diabetes. The authors reviewed 17 cross-sectional studies and concluded that the adverse effect of diabetes on the periodontium are consistent with the meta-analyses conducted by Papapanou, published in 1996, and Khader and colleagues, published in 2006.

In addition, this literature review provided supplemental evidence to suggest a dose response relationship between diabetes and periodontal diseases. More specifically, as glycemic control deteriorates, the negative effect of diabetes on the health of the periodontium appears to be enhanced. In examining the evidence related to the effect of the degree of glycemic control on periodontal status, the authors reviewed 11 cross-sectional studies and one prospective study. In examining the evidence related to the effects of periodontal disease and its treatment on glycemic control, the authors reviewed 22 publications with various study designs. They concluded that the evidence under review suggested that infection from periodontal origin may contribute to poorer glycemic control and the risk of diabetic complications. The authors further proposed that these findings must be validated by rigorous, controlled trials in diverse populations.

NEW FINDINGS ON THE DENTAL CARE OF ADOLESCENTS AND CHILDREN WITH DIABETES

More recently, Lalla and colleagues reported findings from a number of studies related to the increased risk of oral complications in childhood and adolescent diabetes. In one study, which examined the periodontal integrity of 350 children with diabetes and 350 non-diabetic controls between 6 and 18 years of age, the investigators found that young subjects with diabetes had a statistically significant increase in gingival inflammation (mean gingival index = 1.14 vs 1.08, respectively, unadjusted \( P = .006 \); the percentage of sites that bled on examination was 19% vs 13.6%, respectively, unadjusted \( P < .001 \)). Attachment loss, calculated as the percentage of sites > 2 mm, was also significantly higher in subjects with diabetes compared to non-diabetic controls. When the subgroups, 6 to 11 years of age and 12 to 18 years of age, were analyzed separately, the negative effect diabetes had on the integrity of the periodontium remained significant. These findings led the researchers to conclude that there is an association between diabetes and an increased risk for periodontal destruction and that this relationship may be initiated very early in the lives of children and adolescents with diabetes. It was concluded that diabetes, as an important risk factor for periodontitis, may have greater significance sooner in life than previously recognized by earlier research.

In a parallel study, Lalla and colleagues investigated diabetes-related parameters that might be associated with the accelerated destruction of the periodontium during childhood and adolescence. Periodontal examinations were performed on 350 6- to 18-year-old subjects with diabetes, and data on important diabetes-related variables (ie, type and duration of diabetes, age at diagnosis, mode of insulin therapy, mean glycated hemoglobin [Hb A1c] over the past 2 years, body mass index [BMI]) were collected. Of these subjects, 93% had type 1 diabetes and were treated with insulin only. The case definition used to define periodontitis included both gingival bleeding and attachment loss. After adjusting for several relevant variables, investigators found a strong positive association between mean Hb A1c (a measure of the cumulative blood sugar level over the patient’s recent history, usually about 3 months; correlates with risk for diabetic complications) and periodontitis (odds ratio = 1.31, \( P = .030 \)). Within the whole study population, Hb A1c significantly correlated with gingival bleeding; however, attachment loss alone was not correlated significantly. The researchers concluded that these findings provide evidence that in young individuals with diabetes, changes in the microvasculature of the periodontium may be related to metabolic control. To that end,
Lalla and colleagues\textsuperscript{11} proposed that good glycemic control is essential in the prevention of periodontal complications in young patients with diabetes.

In studies conducted over the past 35 years, there are conflicting reports of how diabetes may influence patterns of tooth eruption in children. In the largest cohort study to date (ie, 270 children with diabetes and 320 children without diabetes) Lal and colleagues\textsuperscript{12} found that children with diabetes, aged 10 to 14 years (late mixed dentition stage) had a higher propensity for advanced tooth eruption than the control group without diabetes. The authors appropriately noted that this stage of dental development corresponds with puberty and growth spurts, and consequently, adolescents with diabetes may be at greater risk for accelerated dental development as a result of the systemic effects of diabetes. As further noted by the authors, many orofacial complications, such as malocclusion, crowding, impaired oral hygiene, periodontal disease, and the need for orthodontic correction, are correlated with disturbances in the timing or sequence of tooth eruption.\textsuperscript{12}

**EMERGING EVIDENCE ON THE INTERRELATIONSHIP BETWEEN OBESITY, METABOLIC SYNDROME, AND PERIODONTAL DISEASE**

In a recent survey of the literature, Pischon and colleagues\textsuperscript{13} reviewed mounting evidence that suggests that obesity is associated with oral diseases, particularly periodontal disease. The authors noted that although the underlying biologic mechanisms between obesity and periodontal disease have yet to be established, what is conclusive is the role of adipose tissue in actively secreting a variety of cytokines and hormones that are recognized etiologically in the inflammatory process. The authors theorized that similar pathways are involved in the pathophysiology of obesity, periodontitis, and related inflammatory diseases. Also cited is evidence to support that obesity is second only to smoking as the strongest risk factor for inflammatory periodontal tissue destruction.\textsuperscript{13} Obesity, now considered a systemic disease, is a known risk factor for several chronic diseases such as hypertension, type 2 diabetes, dyslipidemia, and coronary heart disease (CHD) and as such should be recognized as a multiple-risk-factor syndrome for overall and oral health. Pischon and colleagues put forward a model that links periodontitis and obesity with inflammatory related chronic disease states (Figure 1).

The authors also proposed that given the prevalence of obesity (more than 60% of the US population is overweight or obese), treating overweight individuals in the dental care setting will become the norm. Furthermore, the authors suggested that measurement of BMI and waist circumference as part of periodontal risk assessment should be performed on a routine basis.\textsuperscript{13}

In describing the role of obesity and insulin resistance as a biologic mechanism common to both periodontal
infection and systemic complications, such as type 2 diabetes and CVD, Mealey and Rose\textsuperscript{14} offered another model to explain the biologic plausibility of these interrelationships (Figure 2).

Engebretson and colleagues\textsuperscript{15} recently reported a study of 46 patients with type 2 diabetes and chronic periodontitis designed to determine to what extent periodontitis influences circulating tumor necrosis factor-alpha (TNF-\(\alpha\)) levels in subjects with diabetes. TNF-\(\alpha\) is a cytokine known to play an important role in mediating the insulin resistance of obesity through its overexpression in fat tissue.\textsuperscript{16} The investigators hypothesized that periodontal infection and inflammation influence TNF-\(\alpha\) levels in the circulation of patients with diabetes, playing an important role in insulin resistance. Findings included a significant positive correlation between TNF-\(\alpha\) and attachment loss, plasma endotoxin, and gingival crevicular fluid levels of interleukin-1 beta (IL-1\(\beta\)), but not probing depth, bleeding on probing, plaque index, serum glucose, Hb A\textsubscript{1c}. A dose response relationship between the severity of periodontitis and TNF-\(\alpha\) was observed. Engebretson and colleagues concluded that chronic periodontitis may influence levels of circulating TNF-\(\alpha\) in individuals with diabetes and periodontal infection, and inflammation may contribute to insulin resistance.

Recently, there have been a number of papers written in support of more active involvement of dental practitioners in the identification and treatment of obesity-related conditions. One of these conditions, the MetS, is characterized by obesity, dyslipidemia, insulin resistance, high blood pressure, and a proinflammatory and prothrombotic state.\textsuperscript{17}

Friedlander and colleagues\textsuperscript{18} published a recent literature review pertaining to the dental implications of MetS. The authors concluded that “given the prevalence and adverse cardiovascular outcomes of MetS, dentists [author (CH) suggests this should extend to dental hygienists also] need to consider MetS when formulating risk assessments for middle-aged and older patients…” In their literature review, Friedlander and colleagues also emphasized the importance of developing treatment plans that preserve the natural dentition, thereby providing for optimal masticatory efficiency and the greatest potential to ensure that patients at risk for MetS are able to eat foods that do not contribute to atherogenesis (ie, fruits and vegetables).

Conducted by Nibali and colleagues,\textsuperscript{19} another study investigated whether periodontitis, as a chronic infection with low-grade systemic inflammatory properties, might represent one of the etiologic factors contributing to MetS and subsequently increased risk for diabetes and CHD. Subjects (302 patients with severe periodontitis and 183 healthy controls) were examined periodontally and blood samples were obtained to ascertain levels of inflammatory and metabolic factors in healthy and periodontitis patients. The authors concluded that within the limitations of a case-control design, their findings suggested that patients with untreated severe periodontitis may be predisposed to increased risk of MetS and, therefore, CVDs. These findings provided further evidence of the interrelationships of inflammatory driven disease states and make a compelling case for the cumulative burden of inflammation associated with multiple-risk-factor disease states.

### AGGRESSIVE MANAGEMENT OF PERIODONTAL DISEASE AND ITS POTENTIAL TO REDUCE COMPLICATIONS OF DIABETES

Lifestyle interventions, such as modification of diet and exercise, are the first line of defense in preventing and managing diabetes.\textsuperscript{20} Clearly there is a role for dentists and dental hygienists in these types of interventions and monitoring patient outcomes in the care of patients with diabetes, those who are at risk for diabetes, or those who were diagnosed with prediabetes. Glycemic control and blood pressure and cholesterol management affect a reduction in microvascular and macrovascular complications of diabetes and subsequently decrease the risk for cardiovascular events.\textsuperscript{20} So “tight control” of blood glucose levels has become the key to reducing the risk of diabetic complications. In a 2008 review on the prevention and treatment of diabetes and its association with oral diseases, Skamagas and colleagues\textsuperscript{20} discussed the contribution of severe periodontal disease to systemic inflammation and its potential to increase insulin resistance. The authors proposed that aggressive management of periodontal disease in diabetes case management has the potential to reduce the “inflammatory milieu’s” detrimental effects on diabetes control and subsequently decrease the risk for a cardiovascular event.

In her comprehensive paper on “Diagnostic and Therapeutic Strategies and the Management of the Diabetic Patient,” Ryan discussed the importance of periodontal health for people with diabetes.\textsuperscript{21} The author cited a well recognized clinical trial, The Diabetes Control and Complications Trial (DCCT),\textsuperscript{22} which offered compelling evidence.
that improved control of blood glucose reduces the risk of a number of long-term complications of diabetes, especially retinopathy, nephropathy, and neuropathy. As a result of these findings, the major objective of diabetes management is to reduce and then maintain low Hb A1c levels (4% to 6%). Ryan described the sequelae of untreated periodontal disease as a chronic inflammatory state that leads to increased insulin resistance, reduced glucose tolerance, and increased risk of diabetic complications. Three studies cited by Ryan demonstrated that diabetic subjects with severe periodontitis are at greater risk for developing nephropathy and cardiovascular disease, thereby having an impact on mortality.

Other investigators are exploring how the inflammatory state of periodontal disease can contribute to acceleration of cardiovascular disease (CVD), the No. 1 cause of death from diabetes. More recently, Lalla and colleagues published a small pilot study that explored the effects of anti-infective periodontal treatment in patients with diabetes and whether this therapeutic intervention influenced alterations in the proinflammatory potential of peripheral blood mononuclear cells. These pro-inflammatory components are known to contribute to the development and/or progression of atherosclerosis-related diseases. The study included 10 subjects with diabetes and moderate to severe periodontitis who received full-mouth subgingival debridement, and in whom blood samples were drawn to observe changes in levels of various serum markers before treatment and 4 weeks after therapy. Findings, 4 weeks after treatment, included:

- Clinically and statistically significant improvements in periodontal parameters (i.e., percentage of sites that bled on probing, the number and percentage of pockets ≥ 5 mm, the number and percentage of sites with attachment loss of ≥ 5 mm)
- Only a modest reduction in the levels of subgingival bacteria and a marginal effect in serum immunoglobulin G titers to periodontal bacteria
- Significant suppression of serum C-reactive protein and sE-selectin, but no change in plasma fibrinogen

Percentage of mononuclear cells with proinflammatory properties significantly decreased

These findings led the researchers to conclude that macrophages, derived from peripheral blood, have the capability to produce TNF-α in diabetes-associated periodontitis, and furthermore, periodontal therapy may effect a reduction in the production of TNF-α and the number of circulating monocytes. As noted by the authors, further studies with a larger cohort are required to fully understand this relationship; however, the finding that periodontal therapy may have an effect on the production of TNF-α has important implications in addressing the inflammatory complications of diabetes, specifically atherosclerosis, in which TNF-α may play a role in pathogenesis.

Recent research by Lim and colleagues provided further evidence of the importance of “tight” glycemic control in ensuring periodontal health in people with diabetes. The study was comprised of 181 adult patients with either type 1 or type 2 diabetes. Other inclusion criteria included at least 8 natural teeth and no known major medical complications. Subjects received full-mouth periodontal assessment, which included the presence of bleeding on probing (BOP) and probing depth measurements. Smoking status was recorded. Blood samples were collected on all subjects and analyzed for markers of metabolic control and inflammation including Hb A1c, high sensitivity C-reactive protein (hsCRP) and lipid profile (i.e., triglycerides, low-density lipoprotein [LDL], and high-density lipoprotein [HDL]). In this study population Hb A1c emerged as the single significant predictor of BOP (P = .05), and both Hb A1c and hsCRP emerged as significant predictors of percentage of probing depths ≥ 5 mm (P = .05). As a marker of metabolic control of diabetes, Hb A1c was correlated positively with LDL, triglycerides, and total cholesterol. The finding that there is a correlation between glycemic control and the severity of periodontal disease concurred with previous studies. The authors concluded that this study confirmed that poor glycemic control is the most significant risk factor associated with periodontal status; furthermore, that these findings underscore the importance of promoting oral health as a component of total patient care in patients with diabetes.

**THE ROLE OF DENTAL PRACTITIONERS IN SCREENING AND CO-MANAGEMENT**

Evidence suggests that dental providers may not recognize or embrace a role in screening for undiagnosed diabetes
and in the co-management of patients with diabetes or those at risk for diabetes. A survey of general dentists published in 2006 indicated that only 7% of respondents screen for diabetes, and only 26% take an active role in the management of patients with diabetes.29

The pandemic of diabetes demands that the responsibility for screening and co-management be incorporated throughout healthcare, including all point-of-care providers, such as dentists and dental hygienists. With each new year, statistics on the prevalence of diabetes are revised upward; there seems no end in sight to this mounting pandemic. Today there are 23.6 million people in the United States, or 8% of the population, who have diabetes. This includes 17.9 million people who have been diagnosed and another 5.7 million who are undiagnosed.30,31 The total prevalence of diabetes increased 13.5% from 2005 to 2007. It is estimated that 57 million people have prediabetes.30,31 Future projections of diabetes are even more dismal. Figure 3 provides projections of the future prevalence of diabetes through year 2050.32 It is important to note that the current prevalence of diabetes in the United States is 8%, which already has exceeded previous forecasts of 6.8% in year 2010.

Given the frequency of patients’ visits to the dental office (more than 60% of Americans visit the dental office at least once a year and most of the visits are for routine, non-emergent care33), dentists and dental hygienists are uniquely positioned to intercept undiagnosed diabetes. In a general dental practice with 2,000 adult patients, statistically it is reasonable to assume that about 40 patients will have diabetes which has not been diagnosed. Borrell and colleagues34 developed a predictive model that would assist dental providers in identifying undiagnosed diabetes in their patient base by using self-reported data commonly queried in a medical history questionnaire and data recorded in periodontal examinations, both of which are routinely conducted in dental practice settings.

Analysis33 of data from the Third National Health and Nutrition Examination Survey (NHANES III) and periodontal examinations provided compelling evidence that subjects with a self-reported family history of diabetes, hypertension, and high cholesterol, along with clinical evidence of periodontal disease (defined as at least 2 sites with clinical attachment level of ≥ 6 mm and at least one site with a pocket depth of ≥ 5 mm) had a 27% to 53% probability of having undiagnosed diabetes. Mexican-American men had the highest probability and white women the lowest probability. The researchers34 also found that as the presence of reported risk factors (for diabetes) increased, the probability of having undiagnosed diabetes increased, conveying a synergistic effect of a relatively small number of risk factors. The authors concluded by appropriately noting that dental providers’ screening for undiagnosed diabetes carries with it the responsibility for medical follow-up in terms of referral for blood glucose testing to establish a diagnosis.

Given their professional calling, dentists and dental hygienists are also well positioned to promote important lifestyle
modifications for patients at risk for diabetes, and collaborate with physicians, nurses, diabetes educators, and dietitians (among others) in progressive co-management of patients with diabetes. In the same scenario of 2,000 adult patient base, it is reasonable to expect that about 160 patients have been diagnosed with diabetes, many of whom will require progressive case management for their oral health and collaborative interventions with other healthcare providers to ensure optimal metabolic control of diabetes and reduced risk or delay of complications of diabetes. Accordingly, “physicians should expect increased interaction with oral health professionals in the future, as evidence continues to accumulate that inflammatory periodontal diseases and diabetes are closely linked together.”

The American Diabetes Association has made some rather bold statements, which call into question the ability of the current healthcare delivery system to implement these standards of care for diabetes. Some of these statements follow.

- The implementation of the standards of care for diabetes has been suboptimal in most clinical settings.
- A major contributor to suboptimal care is a delivery system that too often is fragmented, lacks clinical information capabilities, often duplicates services, and is poorly designed for the delivery of chronic care.

Indeed, dentistry and dental hygiene have the opportunity to become part of a greater solution to challenges associated with the implementation of standards of care for diabetes and to remedy a delivery system that is fragmented and not able to address the chronic nature of diabetes.

**CLINICAL IMPLICATIONS TO THE PRACTICE OF DENTISTRY AND DENTAL HYGIENE**

Dental practitioners are well positioned to actualize the recommendations embodied within *The Scottsdale Report* and incorporate into everyday practice the findings of relevant research on the inflammatory driven interrelationships of diabetes, obesity, and periodontal disease that continue to emerge. Listed are a number of suggestions for implementation.

1. Screen adult, adolescent, and child patients for undiagnosed diabetes. Criteria for referring individuals for blood glucose testing to establish a diagnosis of diabetes are listed in Table 1 and Table 2. These guidelines are updated by the American Diabetes Association on an annual basis and published in *Diabetes Care* at the beginning of each year.

2. Counsel patients with diabetes about the possible perioral complications of diabetes, including gingivitis, periodontitis, xerostomia, candidiasis, oral lichen planus, leukoplakia, and oral cancer. Various studies have found that the majority of individuals with diabetes are unaware of the link between diabetes and periodontal disease and that in comparison with their knowledge of other complications of diabetes, their knowledge of increased risk for periodontal disease is low.

3. Counsel patients with diabetes about the potential effect of periodontitis on glycemic control. The presence of periodontitis increases the risk of worsening glycemic control (perhaps six-fold increased risk of worsening glycemic control over time). Some studies show that diabetic patients with periodontitis require

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### Table 1:

Criteria for Testing for Prediabetes and Diabetes in Asymptomatic Adult Individuals

<table>
<thead>
<tr>
<th>1. Testing should be considered in all adults who are overweight (BMI = 25 kg/m²) and have additional risk factors:</th>
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<tr>
<td>- Physical inactivity</td>
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<tr>
<td>- First-degree relative with diabetes</td>
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<tr>
<td>- Member of a high-risk ethnic population (eg, African American, Latino, Native American, Asian American, and Pacific Islander)</td>
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<td>- Delivered a baby weighing 9 lb or were diagnosed with gestational diabetes mellitus (GDM)</td>
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<td>- Hypertension (140/90 mm Hg or on therapy for hypertension)</td>
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<tr>
<td>- HDL cholesterol level 35 mg/dL (0.90 mmol/L) and/or a triglyceride level 250 mg/dL (2.82 mmol/L)</td>
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<td>- Polycystic ovarian syndrome (PCOS)</td>
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<td>- Impaired glucose tolerance or impaired fasting glucose on previous testing</td>
</tr>
<tr>
<td>- Other clinical conditions associated with insulin resistance (eg, severe obesity and acanthosis nigricans)</td>
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<td>- History of CVD</td>
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<table>
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<th>2. In the absence of the above criteria, testing for prediabetes and diabetes should begin at 45 years of age.</th>
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<tr>
<td>- If results are normal, testing should be repeated at least at 3-year intervals, with consideration of more frequent testing depending on initial results and risk status.</td>
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less insulin after treatment for periodontal disease. Studies that have measured the difference in Hb A1c after treatment for periodontal disease reported improvements in Hb A1c ranging from 0 to 2 percentage points in Hb A1c levels; however, studies are inconclusive. Patients with poorer glycemic control may have more rapid recurrence of deep pockets and less favorable long-term response to treatment.

4. For children and adolescents who are diagnosed with diabetes or those who are at risk for diabetes, carefully screen for accelerated tooth eruption, caries, and inflammation of soft tissues. In these patients (Table 2), early identification of individuals susceptible to periodontal diseases and/or caries may allow for more aggressive therapies, more frequent care, and interventions that could help prevent or minimize the destruction of hard and soft tissues of the oral cavity later in life. In their challenge to healthcare providers, Lalla and colleagues wrote, “In consideration of the present findings [the bidirectional relationship between diabetes and periodontal disease], oral screenings and periodontal prevention/treatment programs should be considered as a standard of care for young patients with diabetes.”

5. Help educate other healthcare providers in the importance of oral screening of young patients with diabetes. Collaboration with other healthcare providers is key in providing optimal care for both oral and systemic health in patients with diabetes. The American Diabetes Association recommends an oral examination as one of the components of the initial visit of children and adolescents with diabetes. However, helping nondental care providers understand the significance of the bidirectional relationship between diabetes and periodontal disease may promote the provision for oral screenings in young people with diabetes as a standard of care for children and adolescents. Programs to address periodontal needs should be the standard of care for diabetic youth. Kapp and colleagues observed that people with diabetes may be 1.46 times as likely (95% confidence interval [CI], 1.30 to 1.64) to have at least one tooth removed than nondiabetic individuals are, and that the association between diabetes and tooth loss was stronger among younger subjects (aged 18 to 44 years). These findings led the researchers to conclude that, “multidisciplinary efforts are needed to raise awareness of the risk of tooth loss among younger people with diabetes.”

6. Monitor clinical outcomes of periodontal treatment and the glycemic control of patients. This includes routine periodontal examinations that are comprehensive (including evaluation and recording of BOP, pocket depth, recession, attachment loss, plaque index, inflammation) in addition to requesting patients’ laboratory records of Hb A1c. “Given the potential link between periodontal disease, diabetes, and cardiovascular disease, aggressive management of oral health and regular follow-up seems a reasonable approach.”

Table 2: Criteria for Testing for Type 2 Diabetes in Asymptomatic Children

<table>
<thead>
<tr>
<th>Overweight (BMI = 85th percentile for age and sex, weight for height 85th percentile, or weight 120% of ideal for height). Plus any two of the following risk factors:</th>
<th></th>
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<tbody>
<tr>
<td>Family history of type 2 diabetes in first or second-degree relative</td>
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<tr>
<td>Race/ethnicity (eg, Native American, African American, Latino, Asian American, and Pacific Islander)</td>
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<tr>
<td>Signs of insulin resistance or conditions associated with insulin resistance (eg, acanthosis nigricans, hypertension, dyslipidemia, or PCOS)</td>
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<tr>
<td>Maternal history of diabetes or GDM</td>
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<tr>
<td><strong>Age of initiation:</strong> 10 years or at onset of puberty, if puberty occurs at a younger age</td>
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<tr>
<td><strong>Frequency:</strong> every 2 years</td>
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<tr>
<td><strong>Test:</strong> fasting plasma glucose preferred</td>
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Table 3: Criteria for the Definition of Metabolic Syndrome

<table>
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<th>Individuals having three or more of the following criteria were defined as having the metabolic syndrome:</th>
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<tr>
<td>Abdominal obesity: waist circumference &gt; 102 cm in men and &gt; 88 cm in women</td>
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<td>Hypertriglyceridemia: 150 mg/dL (1.69 mmol/L)</td>
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<tr>
<td>Low high-density lipoprotein (HDL) cholesterol: &lt; 40 mg/dL (1.04 mmol/L) in men; &lt; 50 mg/dL (1.29 mmol/L) in women</td>
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<tr>
<td>High blood pressure: 130/85 mm Hg</td>
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<td>High fasting glucose: 110 mg/dL (6.1 mmol/L)</td>
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7. Stay current in the latest advances in the diagnosis, prevention, and treatment of diabetes. This “will assist oral health professionals in providing better quality of care for people with diabetes.”20 One of the best sources for this information is Diabetes Care.

8. Counsel obese patients about the possible oral complications of obesity. Dental hygienists are uniquely positioned to screen and counsel obese patients regarding the influence of obesity on oral and systemic health. It should be mentioned that this type of therapeutic intervention is particularly relevant in younger populations. “With obesity increasingly affecting young people, the onset of type 2 diabetes is also shifting to younger ages, leading to the earlier appearance of diabetic complications.”43

9. Screen patients for MetS. In caring for patients who present with medical histories and physical signs indicating possible metabolic disorder, dental practitioners should ask the patient whether he or she has been evaluated for MetS or its component risk factors (Table 3).44

10. For patients with diabetes, take the lead in developing treatment plans that integrate strategies for risk reduction such as smoking cessation and promotion of a healthy lifestyle, such as advising about the ABCs of diabetes care: Attention to Hb A1c, Blood pressure, and Cholesterol.

11. For patients with diabetes and diseases of hard and soft tissue of the oral cavity, inform the treating physician of a patient with diabetes of the dental diagnosis, treatment plan, and any concerns about the patient’s ability to undergo treatment, such as the potential impact of long and/or complicated dental procedures. A template for this type of dentist-to-physician communication can be developed. Research related to the relationship between diabetes and periodontal disease is published in a number of highly reputable medical journals. Attaching copies of the original research to the communication is an effective way to educate physicians and other healthcare providers on the bidirectional relationship between diabetes and periodontal disease.

12. Train nondental care providers to screen for signs and symptoms associated with periodontal disease based on patient history, symptoms, and/or visual assessment of the patient’s teeth and gums. Nondental providers can reinforce the importance of oral health by recommending biannual dental examinations for those with diabetes or at risk for diabetes, in addition to encouraging strict compliance to patient self care/oral hygiene.

**CONCLUSION**

Recognition of the mounting evidence of relationships between oral and systemic health will confront dental hygienists, dentists, physicians, nurses, and other healthcare providers to the importance of working together. No where is this more important than in the early identification of individuals with undiagnosed diabetes and the co-management of the oral and overall health of patients with diabetes.

There is sufficient evidence of a bidirectional relationship between diabetes and periodontal disease to formulate guidelines for screening for undiagnosed diabetes and the co-management of patients with diabetes in the clinical practice of dentistry and dental hygiene. There also exists sufficient evidence on the role periodontal disease plays in increasing systemic inflammation to suggest that nondental care providers should screen patients for periodontal disease. For those dental and nondental practitioners who embrace the opportunity to become more actively involved in this important arena of healthcare, this new and exciting level of clinical practice is certain to benefit patients and be professionally rewarding.

**ABOUT THE AUTHOR**

Casey Hein, BSDH, MBA, is the Director for Interprofessional Oral-Systemic Curriculum Development; Assistant Clinical Professor in the Department of Periodontics, the University of Manitoba, in Winnipeg, Canada. In this position, Hein is developing the first curriculum specifically related to oral-systemic relationships for medical, nursing, pharmacy and dietitian students. She also has a joint appointment at the University of Colorado School Of Dental Medicine as an assistant professor in Craniofacial Biology and associate professor in Dental Hygiene. Hein's passion is in translating credible findings of oral-systemic research and she frequently speaks and writes on the topic. Casey can be contacted at caseyheinrdh@comcast.net.
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REFERENCES


