

# COMBATING DIABETES, OBESITY, PERIODONTAL DISEASE AND INTERRELATED INFLAMMATORY CONDITIONS WITH A SYNDEMIC APPROACH

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## Abstract

This article discusses the standard of care-practice gap in diabetes care and makes a compelling case for why dental and medical professionals need to collaborate in integrating oral care in diabetes management. Epidemiologic trends and the etiological rationale for adopting a syndemic orientation to the epidemic of obesity, insulin resistance, diabetes and related inflammatory conditions are presented. The term “syndemic” describes a set of 2 or more linked health problems that interact synergistically to contribute to the excess burden of disease in a population with a specific focus on the forces that bind the problems together. The authors suggest that instead of approaching prevention and treatment of chronic disease states as discrete, individual problems, a syndemic perspective would allow healthcare providers to view chronic inflammatory diseases or conditions such as diabetes, obesity, insulin resistance, hypertension, hyperlipidemia, and infections like periodontal disease as an interrelated cluster of maladies with specific focus on the ties or forces (acquired and environmental risk factors) that bind these conditions together. The article also discusses possibilities for large scale population based intervention strategies and micro-systems of collaboration targeting obesity, diabetes, and periodontal disease through health promotion in childhood and adolescent populations. Also included are aggressive screening and risk reduction strategies targeting patients with risk factors for diabetes and patients who have undetected diabetes.

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**Key words:** Diabetes, obesity, syndemic, periodontal disease, collaborative treatment, prevention

## Introduction

It is staggering to consider the threat that diabetes and obesity pose to our current healthcare system. The growing population of aging Americans with diabetes or unattended risk factors related to diabetes and the growing segment of the youth population that is overweight and already manifesting signs and symptoms of insulin resistance has begun to drain our economy of the resources needed to preventively avert this epidemic in younger generations. More disturbing is the realization that even the best attempts by healthcare providers to follow guidelines for diabetes care have fallen short. We are now at the tipping point where the unrestrained epidemics of obesity and other unattended risk factors for inflammatory conditions such as diabetes have outpaced the intervention strategies currently in practice. This places right at our doorsteps an unprecedented opportunity to change what has clearly become an obsolete model of healthcare delivery. Accordingly, the responsibility to prevent and treat obesity and diabetes can no longer fall solely to an overburdened medical community. The expectation that the medical profession can unilaterally implement wellness-promotion and risk-reduction strategies without enlisting the cooperation of other healthcare professionals is unrealistic. Indeed, referring to the increasing incidence of diabetes, a think tank recently concluded, “No single

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individual or group can meet these challenges alone.”<sup>1</sup>

It is widely recognized that the development of type 2 diabetes and its complications is highly correlated with being overweight or obese. Obesity is also an independent risk factor for hypertension and dyslipidemia in addition to cardiovascular disease (CVD)<sup>1</sup>. Added to this cluster of obesity-related conditions is a newcomer: periodontal disease. Growing evidence suggests that obesity is a significant predictor of periodontal disease, which reflects yet another cascade of inflammatory events.<sup>2,3</sup> It is theorized that chronic stimulation and secretion of proinflammatory cytokines associated with periodontal infection contribute to insulin resistance, which may further increase diabetes risk. Obesity appears to be a precipitating factor in this cascade.

### *The Obesity Pandemic*

According to the Department of Health and Human Services, “Calling obesity in the U.S. an epidemic or pandemic is more than rhetorical.”<sup>1</sup> Five years ago, when the National Institutes of Health published clinical guidelines to identify, evaluate, and treat adult obesity, an estimated 97 million American adults were overweight or obese.<sup>2</sup> The classification of overweight and obesity now applies to more than 60% of American adults and nearly 80% of some high-risk subgroups, such as African-American women,<sup>1</sup> placing these individuals at greater risk for diabetes and subsequent CVD. Some authorities estimate that 2 out of 3 Americans are overweight or obese.<sup>1</sup> Obesity, which is now considered a chronic disease, substantially increases the risk of morbidity from hypertension; dyslipidemia; type 2 diabetes; coronary heart disease; stroke; gall bladder disease; osteoarthritis; sleep apnea and respiratory problems; and endometrial, breast, prostate, and colon cancers.<sup>5</sup>

The number of overweight children has more than doubled among 2- to 5-year-olds and more than tripled among 6- to 11-year-olds.<sup>1</sup> Approximately 10.4% of children 2- to 5-years-old and 15.3% of children 6- to 11-years-old are overweight.<sup>6</sup> It is generally known that childhood adiposity tracks into adulthood and significantly influences adult mortality and morbidity.<sup>6</sup> Some investigators note a “gap between current dietary practices and recommended diets for infants, children, and adolescents.”<sup>3</sup> For instance, the American Dietetic Association states that the percentage of diets that “need improvement” among children 2 to 3, 4 to 6, and 7 to 9 is 60%, 76%, and 80%, respectively.<sup>6</sup> Furthermore, the diets of most American children do

not meet the Food Guide Pyramid recommendations for fruit, grain, and dairy groups or the Dietary Guidelines for Americans recommendations for total and saturated fats. Both guidelines should be achievable for all American children over the age of 2.<sup>6</sup> Thus, there is a pressing need to target young children for primordial obesity prevention. Given that dietary patterns and physical activity are largely established and weight gain and adiposity entrained by parents and guardians, this goal cannot be accomplished without targeting whole families.

A study of 1,740 students in 12 middle schools reported a high incidence of risk factors for diabetes, including impaired fasting glucose, hyperinsulinism suggestive of insulin resistance, and body mass index (BMI)  $\geq$  85th percentile.<sup>3</sup> Another nationwide epidemiologic study found that obese children were more than twice as likely to develop diabetes as normal weight children.<sup>3</sup> These findings suggest the overwhelming need for population-based efforts to decrease overweight/obesity and diabetes risk in childhood and adolescence.

After almost 25 years of research, the conditions known collectively as the metabolic syndrome (MSyn), also referred to as “syndrome X,” have become accepted as a leading cause of death for the obese, diabetics, and other subpopulations.<sup>3</sup> Alarming, an estimated 24% of adult Americans have MSyn. This syndrome was derived from investigators’ recognition that complications of obesity, such as diabetes, hypertension, insulin resistance and heart disease may be more related to central adiposity (waist circumference) than overall obesity. Also included in MSyn are hyperinsulinemia, abnormal blood lipids (dyslipidemia), a procoagulant state, vascular abnormalities, inflammatory markers, and hyperuricemia.<sup>10</sup> Genetic predisposition may underlie susceptibility to MSyn.<sup>10</sup> Central adiposity is associated with insulin resistance, and both are important predisposing risk factors for MSyn and are related to diabetes, high-fat diet, aging, certain medications, physical inactivity, polycystic ovary syndrome, and low birth weight with imprinting of the brain. Because of its association with insulin resistance, inflammatory markers, and the procoagulant state, MSyn is considered a major risk factor for CVD.<sup>10</sup> With a quarter of the U.S. population with MSyn, it appears that a large number of individuals may not be aware of their increased risk for CVD.

The increase in diabetes rates in the overall population translates into higher rates of pregestational diabetes and a shift toward increased prevalence of diabetes at

younger ages.<sup>3</sup> This trickle-down effect places more women and fetuses at risk, resulting in a greater need for prenatal services.<sup>11</sup> What is also emerging is that the risk of death associated with diabetes may be correlated with abnormal birth weight (low birth weight defined as < 6.5 lbs. and high birth weight defined as ≥ 8.5 lbs.)<sup>3</sup> Lower birth weight is associated with postnatal rapid weight gain and central adiposity, MSyn, diabetes, and CVD in adulthood.<sup>7</sup> This population may represent a subset of at-risk diabetic individuals.<sup>12</sup> Babies who are large for gestational age because of consequences of maternal insulin resistance and glucose intolerance are at high risk for future obesity.<sup>7</sup> Without intervention strategies targeting women of child-bearing age, particularly those in subgroups at greater risk for diabetes, an increase in gestation-related complications can be expected that may place future generations at greater risk for diabetes.

As if the present day epidemic is not devastating enough, current predictions suggest that by 2030 there will be 23 million individuals with diagnosed and 7 million with undiagnosed diabetes, with another estimated 70 million with impaired fasting or postprandial glucose.<sup>3</sup> Direct costs of diabetes could be close to \$175 billion/year, with an additional \$75 billion/year in indirect costs.<sup>13</sup> In reference to a potential pandemic, Bloomgarden recently wrote, "The economic and personal burden of diabetes will be almost overwhelming" and suggested the following measures to avert the pandemic:<sup>13</sup>

1. Continue to invest in research.
2. Abandon an acute-care model and adopt a chronic-care model.
3. Focus on early treatment and prevention.
4. Find a way to limit obesity.

Collectively, the previous statistics present a strong argument for multiple levels of preventive care. This is a departure from our current healthcare system which focuses on treatment of diabetes and other chronic diseases in an attempt to minimize related disability or loss of function. Implementing preventive strategies before risk factors develop in children and adolescents by promoting lifestyle changes that emphasize exercise, proper diet, weight loss, and the importance of being tobacco-free (primordial prevention) is key. Strategies aimed at reducing risk factors in individuals who are already insulin resistant (secondary prevention) is also essential. These preventive strategies cannot be realized as a population-based strategy without expanding the responsibility to

prevent obesity and diabetes to all healthcare providers. Prevention holds the greatest promise in curbing the projections of diabetes and the chronic inflammatory conditions that parallel its etiology.

Efforts to curb the epidemic of chronic conditions associated with these disease trends can no longer rely primarily on treatment; rather, our efforts must be concentrated on helping young people grow up with healthy lifestyles. This shift in healthcare priorities will provide interventions that liberate future generations from the harmful lifestyles that became the inevitable by-product of the detrimental environmental and societal influences of the 20th century. This shift in priorities requires cooperation of all healthcare providers and calibrated health promotion messages. Given the association of obesity-related conditions with periodontal disease, the dental profession must willingly play a role in such health-promotion and disease-intervention strategies. A key question is whether the dental profession is educationally prepared to expand its responsibility for diabetes prevention and treatment.

It is time for a new model of care which is grounded in promotion of healthy lifestyle before risk factors develop, as well as risk elimination or modification for insulin-resistant or pre-diabetic individuals. Mobilizing dental professionals to embrace this challenge could positively impact diabetes trends. Yet, can this level of care happen in real world practice?

#### ***Guidelines Meet Real World Practice***

The American Diabetes Association (ADA) recently published revised standards of medical care for diabetes (January 2006).<sup>2</sup> Throughout the guidelines there is a range of interventions to improve diabetes outcomes, including screening of asymptomatic adults and children who may be at risk, progressive strategies to prevent and delay diabetes, and care of patients with diagnosed diabetes.<sup>2</sup> Nowhere in the guidelines does the ADA specify that its recommendations are the sole responsibility of the medical community. The guidelines state that the standards of care are intended for clinicians, without specific reference to any one healthcare profession.

In these revised standards, the ADA also made rather bold statements that question the ability of the current healthcare-delivery system to implement such standards of care for diabetes. Several statements are included below.

- "The implementation of the standards of care for diabetes has been suboptimal in most clinical settings."

- “... the challenge of providing uniformly effective diabetes care has thus far defied a simple solution.”
- “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.”

Despite efforts to translate research on diabetes care into primary medical care, it is increasingly apparent that there is a large gap between what is known about diabetes care and what is practiced.<sup>3</sup>

### *The Standards of Care-Practice Gap*

Empirical evidence for a gap in standards of care and practice in treating diabetes has been cited in numerous professional journals. Some state that the level of diabetes care provided in primary care medical practices, where most patients are seen, consistently falls short of what is recommended.<sup>14</sup> Even ordering blood tests or regularly checking HbA1c is performed less frequently than recommended.<sup>14</sup> Saydah and colleagues reported other evidence of suboptimal diabetes care, as follows:<sup>3</sup>

- Only 37% of adults with diagnosed diabetes achieved an HbA1c of < 7% (goal).
- Only 36% of adult diabetics had a blood pressure < 130/80 mmHg (goal).
- Only 48% of adult diabetics had a cholesterol < 200mg/dL (goal).
- Fewer than 7.3% of diabetics achieved all 3 goals.

Other standards of care-practice gaps emerge when examining national diabetes-related objectives for year 2010. Three of the national objectives related to diabetes care include: increasing to 75% the proportion of adults with diabetes who undergo an annual dilated eye exam; increasing to 50% those who have an annual foot exam; and increasing to 50% those adults who have HbA1c measurements at least twice a year.<sup>3</sup> To determine the percentage of adults with diabetes who received 1 or all 3 of these services, the Centers for Disease Control and Prevention (CDC) analyzed data from surveillance surveys collected from 2002 through 2004.<sup>16</sup> Their findings indicate that only 4 out of 10 diabetic adults received all 3 preventive care services, and they concluded that continued interventions to ensure delivery of diabetes care are necessary.<sup>16</sup> An even more startling finding is that of the estimated 7% of the U.S. population with diabetes, only 70% has been diagnosed.<sup>16</sup>

The standards of care-practice gaps cited above result

from overwhelming demands for diabetes treatment. Until complications develop clinically, diabetes is mostly asymptomatic, and medical providers' attempts to fully implement guidelines for diabetes care often take a back seat to immediate concerns of diabetic patients. Before we take aim at the medical profession, we must consider the magnitude of the challenges inherent in reversing the trends in obesity and diabetes.

### *Dentistry's Current Capacity to Impact the Diabetes Epidemic*

Managing diabetic patients' special needs is not new to dentistry. Oral manifestations of diabetes, treatment guidelines, and emergency protocols have been taught in dental schools and dental hygiene programs for decades. What also has been taught and extensively discussed in professional literature is that diabetic patients are at 2-4 times greater risk of developing periodontal disease than non-diabetic patients,<sup>3</sup> and once periodontitis is established in a diabetic host, metabolic control of diabetes is complicated from the constant reservoir of periodontal pathogens responsible for infection.<sup>3</sup> Thus, assessment and treatment of periodontal disease are essential for diabetic patients,<sup>18</sup> and dental providers who treat diabetic patients with periodontitis should monitor serum glucose or HbA1c as part of patient management.<sup>3</sup> Over the last decade, the American Academy of Periodontology has addressed appropriate care of the diabetic patient with periodontal disease in numerous position statements and parameters of care.<sup>3-7</sup> However, the number of dental providers who incorporate these guidelines into everyday patient care has never been quantified. A well designed study that captures data on how diabetic patients are managed in dental practices may determine whether there is a standards of care-practice gap in diabetic patient management in the dental profession that parallels that within the medical profession.

What is less well understood by dental and medical professionals alike is the concept of the risk continuum of periodontal disease, namely, the risk periodontal infection poses to systemic health. Recent research<sup>3</sup> suggests that obesity, mediated by insulin resistance, may increase the risk for periodontal disease; however, this risk continuum does not end here. Although traditional thinking within the broader healthcare arena is that periodontitis is an oral disease with tissue destruction which remains localized, the sequelae of periodontal disease appears significantly more threatening than simply a localized infection. Escalating evidence over 20 years of research suggests

various inflammatory pathways that link oral infections such as periodontitis to systemic damage. These etiological mechanisms include metastatic spread of gram-negative bacteria that gain access to the vasculature through a breach of the compromised epithelial lining of periodontal pockets and metastatic injury from the effects of the circulating toxins of periodontal pathogens.<sup>25</sup> The result is metastatic inflammation caused by immunologic response to the pathogens and their toxins.<sup>25</sup> Infection within the periodontium may be the origin of vascular dissemination of large numbers of virulent pathogenic bacteria to distant sites in the body,<sup>26</sup> thereby increasing the burden of systemic inflammation seen in several chronic disease states, including diabetes.

Another pathobiological concept that may be unfamiliar to many within the dental and medical communities is the relationship between infection seen in periodontal disease, insulin resistance, and the risk of chronic inflammatory conditions. This relationship is best described by a conceptual model proposed by Donahue and Wu,<sup>27</sup> who theorized that there is a pathobiological mechanism to support a role for periodontitis and insulin resistance in increasing risk for diabetes and coronary heart disease (CHD). Simplified, oral infections such as chronic periodontitis could trigger low-level inflammation leading to increased cytokine production and enhanced insulin resistance.<sup>27</sup> Insulin resistance increases the risk for both type 2 diabetes and CHD.<sup>27</sup> Once established, diabetes and CHD may subsequently induce feedback which amplifies the immune and inflammatory responses.<sup>27</sup> If this hypothesis is proven, such a cycle of immuno-inflammatory events would provide multiple opportunities for interventions potentially mitigating the risk for diabetes and CHD.

The overarching precept is that medical and dental professionals have common goals: preventing chronic inflammation and enabling interventions that disrupt the cycle of immuno-inflammatory events. All healthcare providers need to understand the role of inflammation in the link between periodontal disease and systemic diseases such as diabetes and CVD. It is essential that medical providers recognize infections of oral origin as significant risk factors for systemic inflammation.

#### ***Utilizing a Syndemic Orientation to Devise Health-Promotion and Risk-Modification Strategies***

Decades of research related to the sequelae of chronic inflammatory conditions such as diabetes and periodontal

disease have provided significant evidence of interrelated etiological pathways. When carefully examined, these pathways yield multiple opportunities for preventive or early therapeutic intervention of a cluster of multifactorial chronic diseases like diabetes, atherosclerosis-induced diseases, and periodontitis. Adopting a syndemic orientation to the epidemic of obesity, insulin resistance, diabetes and related inflammatory conditions may provide the best blueprint for health-promotion and risk-modification strategies that disrupt the cycle of immuno-inflammatory events. These types of interventions hold the greatest promise for sustainable healthcare.

*Syndemic* is a relatively new term introduced in 1994 by Singer<sup>28</sup> to describe a set of 2 or more linked health problems acting synergistically to contribute to the excess burden of disease in a population.<sup>28</sup> Although the term is generally used in a public healthcare context to describe intertwined and mutually enhancing health and social problems, Singer used it to describe mutually reinforcing connections between substance abuse, violence, and AIDS.<sup>29</sup> A syndemic orientation is primarily distinguished from other healthcare perspectives by its explicit emphasis on examining the connections between health-related problems.<sup>29</sup>

Traditionally, research, disease prevention, public health practices, and healthcare policy have focused on a single disease, even when evidence suggested interrelationships.<sup>29</sup> The term syndemic may aptly apply to the interrelated cluster of chronic inflammatory disease states that may amplify one another and to the forces (environmental and acquired risk factors) linking those disease states together.<sup>29</sup> Diabetes, obesity, insulin resistance, hypertension, hyperlipidemia, and genetically-encoded hyperinflammatory response to infection (i.e., periodontal infection) are part of this cluster of diseases brought on by chronic inflammation. These syndemic relationships are represented in Figure 1.

A syndemic orientation has the potential to provide a framework that can guide initiatives of greater efficiencies and effectiveness because healthcare providers will no longer approach chronic diseases as discrete problems. Instead, diseases will be viewed as a cluster of chronic diseases resulting from multiple forces (environmental and acquired risk factors) that bind the conditions together. As long as outcomes are measured as reductions in specific diseases rather than as a cluster of interrelated chronic conditions, there will be no incen-

tive to collaborate across professional boundaries and patients will be deprived of the creative energy unleashed through collaboration.<sup>29</sup> Such a focus will also fuel inefficiency.<sup>29</sup> A syndemic orientation provides a clearer picture of what forces cause chronic conditions to cluster together.<sup>29</sup> Because medical and dental providers are finally looking at disease relationships the same way, a syndemic perspective provides a catalyst for collaboration.<sup>29</sup> A syndemic orientation also promotes effective collaboration at a scale that better matches the complexity of multi-factorial chronic disease states.<sup>29</sup> As Donahue and Wu's<sup>27</sup> model suggests, there are multiple opportunities for intervention by disrupting the forces that link these conditions, and no single profession can tackle the cluster of the interrelated chronic conditions.

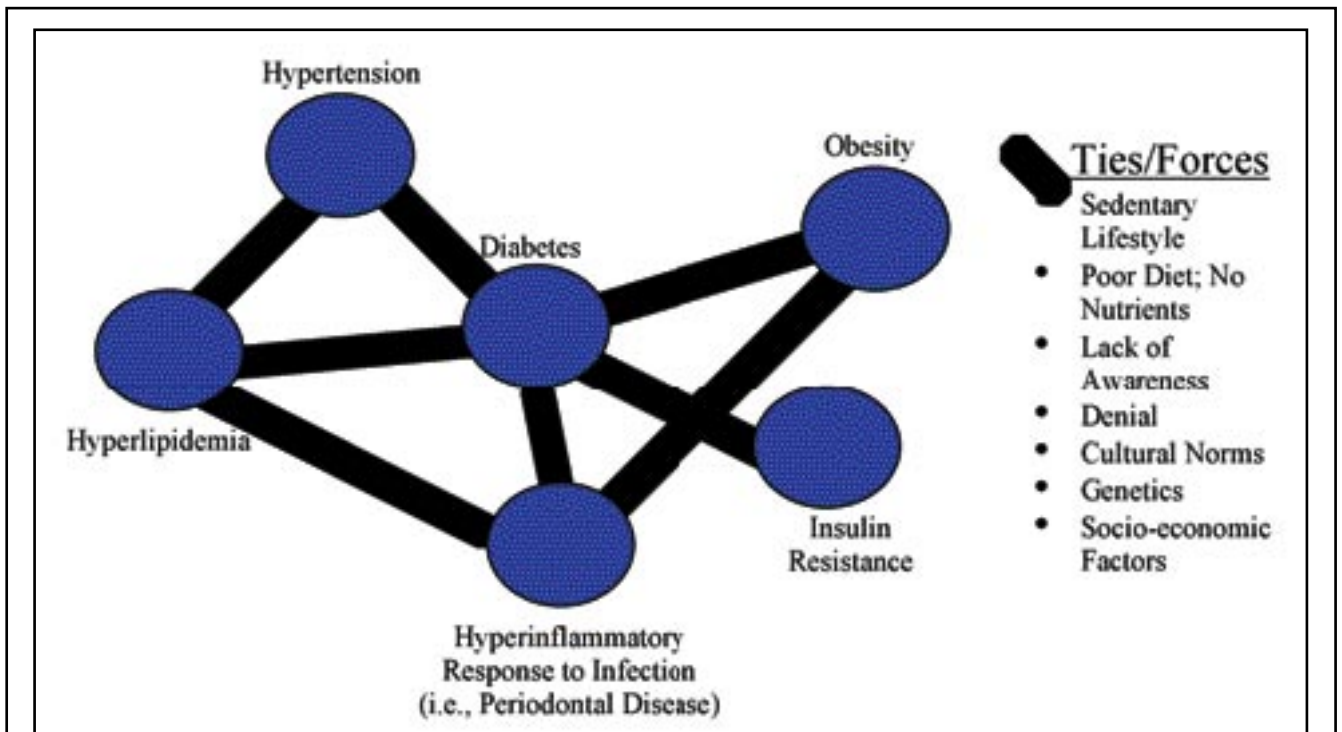
Some may question a syndemic approach, but their objections must be weighed against the known limitations of maintaining the status quo.<sup>29</sup> Specifically, preoccupation with a single disease, like diabetes or periodontal disease, rather than focusing on multiple forces that bind chronic inflammatory conditions together will handicap attempts

to develop effective health-promotion and risk-modification strategies. Because a syndemic orientation has not been a model in this area of healthcare and professional boundaries still are fairly engrained, it is not yet known how powerful interventions can be if they are focused on disrupting forces that unite these chronic disease states.<sup>29</sup>

The challenge of controlling diabetes can best be addressed by adopting a syndemic orientation and implementing a transdisciplinary approach combating diabetes. The term *transdisciplinary* is used to describe the importance of going across and beyond professional boundaries looking at these interrelated inflammatory events as a whole instead of discreet disease entities.

**Prerequisites for Transdisciplinary Intervention**

Before an intervention can occur, practitioners must decide whether they are willing to become involved in combating diabetes. In the concluding statements made by the ADA in Standards of Medical Care in Diabetes (2006), the authors wrote, "Evidence suggests that individual initiatives work best when provided as components of a multi-



**Figure 1 — Syndemic relationships of the interrelated cluster of chronic inflammatory disease states**

The blue nodes represent diseases or conditions, and the ties represent forces (environmental and acquired risk factors) that cause the diseases or conditions and bind them together. Healthcare providers have been trained to focus mainly on the nodes, i.e., obesity, diabetes, hypertension, periodontal disease. These forces (ties) are as much of a problem as the diseases themselves, and the prevalence of chronic diseases may persist unless the connecting forces are addressed. To affect change, intervention strategies that disrupt these ties must be developed and implemented.

factorial intervention...it is clear that optimal diabetes management requires an organized, systematic approach and involvement of a coordinated team of healthcare professionals.”<sup>2</sup> Optimal diabetes management also requires a commitment by both dental and medical providers. For large scale change in the delivery of diabetes care to take place, there are certain things that are a prerequisite, most importantly the factors necessary for dental and medical providers to become involved in health promotion and risk reduction of diabetes:

1. Adequate recognition that the role obesity, and other inflammatory conditions such as periodontal disease, may have in amplifying the risk for diabetes
2. A willingness to provide intervention
3. Adequate skills and resources to do so.

Most troubling is the speculation that this level of commitment may be lacking among dental providers.<sup>30</sup> If statistics from smoking cessation interventions by dental practitioners can be considered a measure of provider willingness to offer health promotion and risk reduction interventions for diabetes, it appears that dentists’ and dental hygienists’ willingness to provide interventions may be wanting.<sup>30</sup> National surveys suggest that only 30-50% of U.S. dentists and 25% of dental hygienists ask patients about smoking, and smoking cessation advice provided in dental offices has been described as “rather ad hoc and somewhat superficial.”<sup>30</sup> Fewer than 20% of dentists used a system to identify patients who smoked, and fewer than 5% provided follow-up services to help patients quit.<sup>30</sup> One study concluded that among physicians, dentists, mental health counselors, and social workers, cessation interventions by dental providers ranked lowest in terms of both quantity and quality.<sup>30</sup> Lack of training and incentives were most often cited to explain the reluctance of dentists and hygienists to provide tobacco-cessation interventions.<sup>30</sup> If these findings hold true for dental practitioners’ willingness to provide diabetes intervention, dentistry’s impact on the pandemic of diabetes will be disappointingly small.

Rather than adding additional interventions to the workload of already overwhelmed medical providers, there are complementary roles and aspects of prevention and treatment that can be delegated to other healthcare professionals. Preventive care increasingly is being delivered by non-physician and non-dentist clinicians.<sup>31</sup> In fact, nurse-led interventions to treat conditions such as diabetes-related hypertension and hyperlipidemia in clini-

cal settings adjunctive to hospitals have been very successful,<sup>32-34</sup> leading some to speculate that if standards of medical care in diabetes “are to be achieved, then such proven methods of delivery care must be adopted.”<sup>34</sup>

For large-scale population-based intervention strategies, the goal should be to develop highly-coordinated and well-trained provider teams that function as case-management teams to provide transdisciplinary care to diabetic patients. These teams could include nurses and dental hygienists along with other allied healthcare providers, such as diabetes educators, nutritionists, exercise physiologists, sports medicine professionals, pharmacists, and social workers, (among others). Such teams also could function as delegations of educators by presenting panel discussions on prevention and treatment of diabetes and periodontal disease. Target audiences could include citizen groups, PTAs, self-help/support groups, pre-kindergarten, elementary, middle, high schools, colleges and universities, hospitals, specialty care facilities, churches, nonprofit groups involved with health and human welfare, chambers of commerce, Rotary clubs, and the like. The same teams also could function as “swat teams” for conducting large-scale screenings for diabetes and periodontal disease at malls, transportation hubs, grocery stores, and community fairs. For an excellent template for organizing community-based initiatives that target obesity, readers should contact the National Heart, Lung, and Blood Institute to request *We Can! Ways to Enhance Children’s Activity and Nutrition; Energize our Community: Toolkit for Action*, online at <http://emall.nhlbihin.net> or by phoning (301) 592-8573.

These kinds of intervention strategies take root in healthcare communities where the philosophy of care is grounded in wellness over repair. Putting this collaborative model of care into practice will require “thought leaders” in dentistry and medicine who are willing to collaborate, and develop a plan for transdisciplinary team training, and assign responsibility for coordination. As momentum builds, other healthcare professionals will become willing partners. Teams can expand their reach by enlisting media support of local newspaper columnists, extending invitations to media representatives to cover an event such as a diabetes and periodontal disease screening day at a mall, or through interviews and discussions on local talk radio. Another valuable collaborative opportunity is to partner with state or local professional organizations, e.g., associations of nurses, diabetes educators, dental hygienists, and dieticians.

On a private practice level, dental professionals who are interested in collaborating with medical providers on diabetes care, building a micro-system of collaboration between a general dental practice and a primary care medical practice will provide the framework for cross referral of patients. To assist dental providers in developing micro-systems of collaboration with primary care medical providers, a questionnaire designed to help identify gaps in knowledge of evidence based research, training, equipment and supplies, and weaknesses in protocols related to prevention and treatment of diabetes in the dental practice is provided. The questionnaire, entitled *Needs Assessment for Implementation of Appropriate Prevention, Screening and Treatment of Diabetes in Dental Practice Settings* may be accessed and downloaded from the *Clinical Decision-Making Tools* section at [www.thesystemiclink.com](http://www.thesystemiclink.com). In addition, the National Diabetes Education Program recently launched an on-line resource at [www.betterdiabetescare.nih.gov](http://www.betterdiabetescare.nih.gov) to help healthcare professionals better organize their diabetes care and help users design and implement more effective healthcare delivery systems for those with diabetes.<sup>2</sup>

#### ***Transdisciplinary Intervention Opportunities for Dental and Medical Providers***

Opportunities for transdisciplinary intervention of diabetes for dental and medical providers exist at all levels of prevention (i.e., primordial, primary, and secondary).

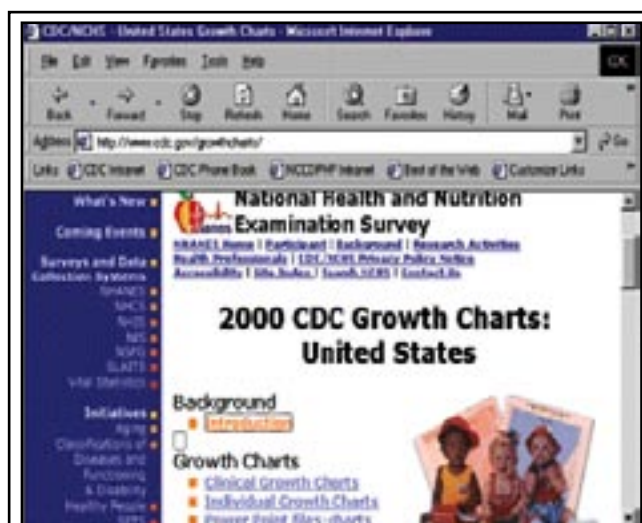
#### **Primordial Prevention**

Primordial prevention of diabetes includes targeting the prenatal state, childhood, and adolescence to promote healthy lifestyles before risk factors are acquired. Today, it is known that the atherosclerotic process begins in youth, culminating in the risk factor-related development of vascular plaque in the third and fourth decades of life.<sup>7</sup> Good nutrition, a physically active lifestyle, and absence of tobacco use contribute to lower risk prevalence and either delay or prevent the onset of cardiovascular disease.<sup>7</sup>

Central to these measures is education about the benefits of optimal nutrition and physical activity.<sup>7</sup> According to the American Heart Association (AHA), "To be sedentary, have a nutritionally adequate diet, and to avoid excessive caloric intake in contemporary society is difficult."<sup>7</sup> To address the crisis associated with the obesity epidemic, the AHA formulated the concept of energy balance. The concept of energy balance has simplified the science of matching appropriate energy intake to energy expenditure. For example, new dietary guidelines for popula-

tions between the ages of 3 and 18 have adjusted daily calorie requirements downward to reflect the prevalence of a sedentary lifestyle. Those children and adolescents who have increased physical activity will require more calories.<sup>7</sup> Health promotion today that addresses the dangers associated with children's over-consumption of energy-dense, nutrient-poor foods and beverages and physical activity patterns will help reduce the risks for future chronic degenerative diseases such as CVD, type 2 diabetes, cancer, obesity, and osteoporosis.<sup>34</sup> Patient education material that helped parents understand the risks of childhood and adolescent obesity and the suspected link to gum disease is located in the *Patient Education Material* section which can be accessed and downloaded from [www.thesystemiclink.com](http://www.thesystemiclink.com).

Healthcare providers must provide useful advice about diet to parents but are often constrained by time to provide that level of care. However, information on caloric/energy values of food can be provided through literature and referral to the abundance of consumer-oriented websites. Parental participation in plotting a child's BMI percentile followed by clinical assessment of those results against standard growth curves allows parent/clinician coassessment of a child's weight gain in a given time period. Healthcare providers are urged to access the CDC's website at [www.cdc.gov/growthcharts](http://www.cdc.gov/growthcharts) (Figure 2), which contains important information and detailed steps to plot BMI-for-age for pediatric patients. Dental providers have a joint responsibility with members of the medi-



**Figure 2**

The [www.cdc.gov/growthcharts](http://www.cdc.gov/growthcharts) website contains detailed information to plot BMI-for-age for pediatric patients.



cal community to develop and implement these types of interventions that begin prevention of chronic diseases early in life. Yet, unless healthcare providers believe that certain dietary practices are harmful and start to understand that inaction may endanger their patients, motivation to change will be very limited.

Primordial prevention of periodontal disease includes targeting women of child-bearing years to ensure periodontal wellness before pregnancy, and education of children and adults regarding the importance of oral health in ensuring systemic health.

### **Primary Prevention**

Primary prevention of diabetes includes aggressive screening and risk-reduction strategies targeting patients with risk factors for diabetes and patients with undetected diabetes. Approximately one-third of all diabetics may be undiagnosed,<sup>2</sup> and dental providers are uniquely positioned to identify these undetected cases. Insurance utilization patterns indicate that individuals tend to seek routine and preventive oral healthcare on a more frequent and regular basis than routine and preventive medical care.<sup>35</sup> placing dentists and dental hygienists at the front line of screening interventions. In the 2006 Standards of Medical Care in Diabetes, the ADA has established criteria for screening for diabetes in asymptomatic adults and children.<sup>2</sup> *ADA Criteria for testing for diabetes in asymptomatic adults* and *ADA criteria for testing for type 2 diabetes in children* may be accessed in the *Clinical Decision-Making Tools* section at [www.thesystemiclink.com](http://www.thesystemiclink.com). These screening criteria can be easily incorporated into new patient as well as periodic dental examinations.

Besides screening for diabetes utilizing the criteria recommended by the ADA guidelines, astute clinicians also will be aware of any oral conditions that may be a manifestation of diabetes. Some of these include xerostomia, which may be related to thirst (a symptom of diabetes), oral mucosal diseases such as lichen planus, recurrent aphthous stomatitis and oral fungal infections, the presence of opportunistic infections like candidiasis, disturbances in taste, and neurosensory disorders such as burning mouth syndrome.<sup>36</sup> Gingivitis is almost twice as prevalent in populations of diabetic children and adolescents as it is in age-matched cohort groups without diabetes.<sup>37</sup> For those children who present with gingivitis, looking for less obvious signs of diabetes or unattended risk factors may help identify undetected cases, which can then be

referred to a physician for diabetes testing.

Several interventions targeting risk reduction should be noted. Moderate weight loss improves glycemic control, reduces CVD risk, and may prevent the development of type 2 diabetes in pre-diabetic individuals.<sup>2</sup> There is a significant body of evidence that suggests that being overweight in childhood and adolescence is associated with insulin resistance, dyslipidemia, and elevated blood pressure in young adulthood.<sup>38</sup> It is also known that weight loss in obese children and adolescents improves insulin sensitivity. The components of the insulin-resistance syndrome (obesity, hypertension, dyslipidemia, and hyperinsulinemia) track from childhood to adulthood, supporting the conclusion that the precursors of CVD are present early in life. Lifestyle modification and weight control in overweight children and adolescents reduce the risk of developing insulin resistance, type 2 diabetes, and CVD.<sup>38</sup> According to the AHA, once a child or adolescent is identified as obese, vigorous clinical efforts should be directed at treatment.<sup>38</sup> Currently, these interventions target behavior modification; however, pharmacological approaches are being considered for the future.<sup>38</sup> Clinicians are cautioned to look for subtle signs indicating that children or adolescents are developing insulin resistance. According to the AHA, "The best approach to prevention of future cardiovascular disease in these young patients is early recognition and aggressive therapy."<sup>38</sup> Without this, it is likely that this patient population is destined to develop cardiovascular complications and require substantial resources for future management.<sup>38</sup>

The distribution of fat tissue is an independent predictor of diabetes. Abdominal obesity, defined as waist circumference of > 40 inches in men and > 35 inches in women, increases the risk of developing diabetes by 3.5 fold after adjusting for BMI.<sup>39</sup> Identifying individuals at risk for MSyn and modifying their risk factors may prevent the progression to MSyn. (*Criteria used to establish the presence of the Metabolic Syndrome* may be accessed and downloaded from the *Clinical Decision-Making Tools* section at [www.thesystemiclink.com](http://www.thesystemiclink.com).) For individuals diagnosed with MSyn, modifications of diet, exercise, and other lifestyle factors may help reduce detrimental health consequences.<sup>10</sup>

On the dental side, obesity is a significant predictor of periodontal disease independent of age, gender, race and ethnicity, and smoking.<sup>3</sup> Evidence suggests that insulin resistance mediates the relationship between obesity

and periodontal disease.<sup>3</sup> In addition, BMI is positively and significantly related to the severity of attachment loss after adjusting for age, gender, income, education, race and ethnicity, and smoking.<sup>3</sup> This increased risk does not vary after adjusting for cholesterol, triglycerides, and CRP.<sup>3</sup> An analysis of NHANES III data indicated that waist-to-hip ratio, BMI, fat-free mass, and subcutaneous fat (central adiposity) were significantly correlated with periodontal disease, suggesting that abnormal fat metabolism plays a role in the pathogenesis of periodontal disease.<sup>3</sup> Additional research mirrors these risk relationships. Al-Zahrani<sup>4</sup> and colleagues found that young individuals (18-34 years old) with abdominal obesity (high waist circumference) had an adjusted odds ratio of 2.27 for having periodontal disease. This suggests that obesity could be a potential risk factor for periodontal disease, especially in younger individuals.<sup>4</sup> Saito<sup>40</sup> and colleagues found that individuals with upper body obesity (i.e., high waist-to-hip ratios) are at increased risk for periodontal disease. Clearly, promoting healthy nutrition and appropriate physical activity may prevent or decrease the rate of progression of periodontal disease. Patient education material that alerts patients about the role of obesity in increasing the risk for gum disease may be accessed and downloaded from the *Clinical Decision-Making Tools* section at [www.thesystemiclink.com](http://www.thesystemiclink.com).

### **Secondary Prevention**

Secondary prevention of diabetes is aimed at minimizing the risk diabetic patients have for macro- and microvascular complications. Interventions focus primarily on gaining and sustaining glycemic control to the same level as a healthy, non-diabetic individual.<sup>41</sup> Recognizing the less obvious signs of uncontrolled glucose levels, such as poor healing and unresolved infection, and correlating these findings with classic signs and symptoms of uncontrolled diabetes can enable dental providers to identify patients with previously undetected diabetes.

Metabolic control appears to be an important factor in the development and progression of gingivitis.<sup>37</sup> For this reason, it is important that children with diabetes be monitored carefully for glycemic control. In a study group of 182 children and adolescents with diabetes and 160 non-diabetic control subjects, Lalla<sup>42</sup> and colleagues found that diabetes remained highly correlated with periodontitis, especially in 12- to 18-year-olds, and BMI was significantly correlated with destruction of the periodontium. These observations suggest that periodontal destruction may start very early in life for diabetics and become more ad-

vanced as children become adolescents, exposing young patients to greater risk for periodontal disease, which in turn complicates glycemic control and increases risk for systemic injury. Programs to promote periodontal disease prevention and treatment should be provided to young diabetic patients.<sup>42</sup>

Certain subgroups of diabetic people are at higher risk for developing periodontal disease. These include patients with poor oral hygiene, patients with a long history of diabetes, patients with complications of diabetes (i.e., retinopathy, angiopathy, nephropathy, neuropathy, delayed wound healing), patients with poorly controlled diabetes, teenagers, and pregnant women.<sup>37</sup>

In diabetic patients, the risk of infection may be directly related to fasting blood glucose levels. One study found that patients with fasting blood glucose levels below 206 mg/dL had no increased risk, and patients above 230 mg/dL had an 80% increased risk of developing infection.<sup>43</sup> Intensive glycemic control can prevent or delay the onset and slow the progression of microvascular complications associated with both types 1 and 2 diabetes.<sup>44</sup> Likewise, good glycemic control is associated with improved periodontal status.<sup>19</sup> Insulin-dependent diabetics may also be genetically predisposed to an exaggerated inflammatory response to gram-negative bacterial infections.<sup>17</sup> Compared with non-diabetic individuals, insulin-dependent diabetic patients exhibit this hyperinflammatory response when challenged with an equivalent bacterial burden.<sup>17</sup> There is also evidence suggesting that chronic periodontal infection contributes to the state of insulin resistance.<sup>45,46</sup> Accordingly, medical providers need to identify patients at risk for periodontitis and incorporate referral protocols into routine practice. Physician recognition that periodontal disease is a chronic gram-negative infection with a direct impact on glycemic control is the first step in developing important collaboration with dental providers.

To provide a more graphic description of the opportunity for systemic seeding of periodontal bacteria throughout the vasculature, it has been estimated that the epithelial surface area potentially exposed to virulent, gram-negative bacteria associated with chronic periodontitis ranges in size from 8 cm<sup>2</sup> to 20 cm<sup>2</sup> (ref<sup>47</sup>) roughly the average size of an adult palm. For diabetics with poor glycemic control, exposure to a gram-negative infection of this size would pose an obvious threat to systemic health. For this reason, healthcare providers from both medicine and dentistry must be familiar with the glycemic control (HbA1c)

of patients so that they can formulate specific preventive or treatment plans to mitigate diabetic complications. For example, dental providers may prescribe more aggressive treatment of periodontal disease or increased frequency of maintenance care, and medical providers may be more vigilant in identifying patients with poor glycemic control who are at risk for infection, including periodontal disease. Accordingly, medical providers should update dentists on a patient's glycemic control, and dental providers should apprise physicians of a diabetic patient's oral status to help regulate their blood glucose levels.<sup>36</sup>

### **Conclusion**

A shift to preventive medicine may very well be on the way. In the past few years, insurers have begun adding preventive-care benefits to many plans, and some insurers are paying for preventive care, regardless of whether deductibles have been satisfied.<sup>48</sup> Yet, there is still convincing to be done — financial models which demonstrate that expenditures made for prevention and wellness promotion will translate into cost savings in the not-so-distant future. The dream case for demonstrating that investment in prevention reduces morbidity and related costs in the long-term is calculating the return on investment for tobacco-cessation services.<sup>49</sup> Over the last 10 years, there has been a dramatic increase in benefits for tobacco-cessation interventions. Research has shown that investing \$.18-\$.79 per member per month to offer a tobacco use-treatment program involving the “5 A's” plus “Quitline” support and nicotine-replacement therapy generated a positive net return on investment of over \$1.70-\$2.20 per member per month after 5 years.<sup>50</sup> Some authorities suggest that the framework now in place for treatment of tobacco use could be adapted to address obesity.<sup>50</sup>

Equally exciting is that some insurers are starting to look at chronic conditions associated with periodontal disease. One recently reported study sought to quantify the effect of periodontal treatment on the reduction of overall risk and medical expenditures for diabetes, coronary artery disease, and cerebrovascular disease (CVD) in a large population of patients with both dental and medical benefits from one company.<sup>50</sup> The conclusions were that earlier periodontal treatment resulted in lower medical costs for diabetes, CAD, and CVD.<sup>50</sup>

Consider the case of an obese, 57-year-old white male with type 2 diabetes, with his last three HbA1c values over 8.0%, advancing retinopathy, and recently diagnosed periodontal disease. This patient just experienced his first

non-fatal myocardial infarction (MI). His familial history of diabetes has been known for over 40 years, and hyperlipidemia and hypertension were diagnosed over 25 years ago. Given what we now know, what interventions could we have employed 40, 30, 20, or even 10 years ago that may have prevented this outcome? Diabetes, heart damage and periodontal disease cannot be reversed to a state of biological health even with the most progressive medical and dental care. At best, our current healthcare system can only offer this man treatment aimed at minimizing the risk for future MIs, and delaying the advance of retinopathy and tooth loss. What can be said about the missed opportunities for prevention earlier in his life? What's more, if this patient does not control his blood sugars, he is at significantly greater risk for a second MI which is likely to be fatal.

It is time to take a fresh look at the pandemic of diabetes, a tidal wave that threatens to engulf our current healthcare system. The responsibility for diabetes prevention, diagnosis, and treatment cannot rest primarily on the shoulders of medical providers. The problem is just too big. Mobilizing the dental profession is critical for large-scale intervention of diabetes. Dental professionals who fully understand the immuno-inflammatory relationship between diabetes and other chronic disease states, and adopt a syndemic orientation, will make the greatest contribution to preventive interventions. Their commitment and cooperation must be enlisted to implement prevention strategies that reinforce and complement the recommendations embodied within the most recent standards of medical care for diabetes (2006).<sup>2</sup> Ultimately, the medical and dental professions' level of commitment will be decided by individual practitioners. For those who decide to “dig in,” rewarding patient interventions are just around the corner, as are new opportunities for collaboration in transdisciplinary care.

*Note from Co-Author Doreen Small, RN, MA, CDE: As a clinical nurse specialist in diabetes for more than 31 years, I have had the opportunity to observe the evolution of both the profession of nursing and the management of diabetes. Nursing has evolved into a diversified profession with nurses not only providing bedside but ambulatory care. Nurses in private practice settings, those in education, and those in research are eager to solve the many still-unanswered questions about diabetes and its management. Nurses also have expanded their focus to include prevention. I see the role of the dental hygienist undergoing a similar transformation, with both nurses and hygienists expanding their focus and practicing in a more holistic, syndemic manner.*

As a result of research, we know that complications of diabetes can be avoided. Individuals with diabetes no longer have to anticipate experiencing the loss of vision or kidney function experienced by parents, aunts, and uncles. We have blood-glucose monitors to measure control, and patients are taught how to manage their own disease by adjusting exercise and food intake on the basis of blood-glucose results. Likewise, knowledge of the relationship between chronic inflammatory conditions such as diabetes and oral health is evolving. This creates a need to modify the delivery of care in medical and dental settings. Working in a transdisciplinary manner, we can triple our successes in combating the epidemic of diabetes.

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