Examining Opportunity in the Dental Community to Identify Prediabetes

Kirsten S. Carew

University of Connecticut, kirsten.carew@uconn.edu

Follow this and additional works at: https://opencommons.uconn.edu/gs_theses

Recommended Citation
https://opencommons.uconn.edu/gs_theses/1469

This work is brought to you for free and open access by the University of Connecticut Graduate School at OpenCommons@UConn. It has been accepted for inclusion in Master's Theses by an authorized administrator of OpenCommons@UConn. For more information, please contact opencommons@uconn.edu.
Examining Opportunity in the Dental Community to Identify Prediabetes

Kirsten Saeger Carew

B.S.B.A, Boston University, 1989

A Thesis
Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Public Health
At the
University of Connecticut
2020
Master of Public Health Thesis
Examining Opportunity in the Dental Community to Identify Prediabetes

Presented by
Kirsten Saeger Carew, B.S.

Major Advisor _______________________________
Helen Swede, Ph.D., M.Sci., P*Stat

Associate Advisor _______________________________
Angela Bermúdez-Millán, Ph.D., M.P.H.

Associate Advisor _______________________________
Sharon M. Gordon, DDS, MPH, PhD

University of Connecticut
2020
Acknowledgements

This thesis is the product of research that was conceived from a class project in SAS Programming and later developed in Public Health Research Methods. This thesis would not have been possible without the support and commitment of my incredible advisory committee and professors in the MPH Program. I would first like to thank Dr. Helen Swede for her enthusiasm and genuine interest in my research proposal. Her constant support, suggestions and guidance helped me over the finish line, and I am forever grateful to her for this experience. I would also like to thank Dr. Angela Bermúdez-Millán for agreeing to be on my committee. Her support was never ending, and her suggestions were invaluable to understanding this topic and how it affects different populations. My sincere thanks also go to Dr. Sharon Gordon for her participation as a member of my advisory committee and as an external reader. She provided professional insight on the dental components that were critical to the accuracy of the paper. I appreciate her time and effort towards the completion of the final project.

Thank you to my sister and my dad who provided encouragement to pursue an MPH and were always excited to hear about my thesis project.

Finally, words cannot express how thankful I am for my husband and kids. This thesis and MPH degree would not have been possible without your support, love and encouragement. John, Jack, James and Riley - I am so grateful to have you in my life and hope that I can use this experience to “be the change.”
Table of Contents

I. Introduction
   A. Research Significance 1
   B. Definitions and scope 3
   C. Prior Research 5
   D. Gap in the Literature 7
   E. Theoretical Framework 9

II. Specific Aims
   A. Research Objectives 9
   B. Hypothesis 10

III. Methods and Materials
   A. Study Design 11
   B. Survey Distribution 12
   C. Survey Instrument
   D. Variables and Data Analysis 14
   E. Confidentiality 15

IV. Results
   A. Response Rates 15
   B. Characteristics of Study Sample 17
   C. Role of Dentists in Screening

V. Discussion
   A. Willingness to Adopt Testing and Risk Assessment 20
   B. Cost Considerations 21
   C. Limitations 22

VI. Conclusions and Recommendations 23

VII. References 25

VIII. Table 1 28

IX. Appendices 29
   A. Public Act No. 19-72 “AN ACT CONCERNING DENTAL PRACTITIONERS” 30
   B. Code D0411 34
   C. Prediabetes Risk Test 35
   D. Recruitment Flyer 36
   E. A1C test kit example 36
Abstract

BACKGROUND: In response to the growing epidemic of prediabetes and diabetes (type 2), the State of Connecticut passed Public Act 19-72 “An Act Concerning Dental Practitioners” effective July 1, 2019 allowing licensed dentists to administer an in-office blood screening test to consenting patients identified as having an increased risk for diabetes. The intent of this law is to expand the venues to screen, identify and inform those at-risk for disease.

METHODS: An anonymous online cross-sectional pilot study was conducted utilizing membership of major statewide dental societies to recruit licensed practicing dentists in the state of Connecticut. Participants completed a 17-item survey that assessed knowledge of the law and the Prediabetes Risk Test, perceptions pertaining to prediabetes and willingness to administer the in-office blood test.

RESULTS: Participants were 23 licensed dentists in Connecticut. The majority are males (n=16, 69.6%) with 20 years plus of experience specializing in a private or group General Dentistry practice. Awareness of the law is low (22%), yet the majority agree it is important to collaborate with primary care providers to prevent disease (90%), screen patients identified at-risk for prediabetes (85%) and inform patients of a prediabetic condition (85%).

CONCLUSION: Lack of awareness of the new law supports the need for increased communication and educational efforts to the dental community. Additional research is recommended to explore factors related to incorporating testing in order to better frame messaging to this population and ensure adoption of a new point of care to combat the diabetes epidemic.
Foundational Competencies

<table>
<thead>
<tr>
<th>Task</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select quantitative and qualitative data collection methods</td>
<td>Original anonymous 17 question quantitative survey created utilizing</td>
</tr>
<tr>
<td>appropriate for a given public health context</td>
<td>Qualtrics. Developed multiple choice and 5-point Likert scale questions</td>
</tr>
<tr>
<td></td>
<td>found in the literature as well as novel items.</td>
</tr>
<tr>
<td>Analyze quantitative and qualitative data using biostatistics,</td>
<td>Utilized IBM SPSS 26 software to analyze quantitative data collected.</td>
</tr>
<tr>
<td>informatics, computer-based programming and software, as appropriate</td>
<td>Performed frequency analysis and chi-square tests to analyze associations.</td>
</tr>
<tr>
<td>Interpreting results of data analysis for public health research,</td>
<td>Summarized variables using descriptive statistics and interpreted data</td>
</tr>
<tr>
<td>policy or practice</td>
<td>for associations.</td>
</tr>
<tr>
<td>Design a population-based policy, program, project or intervention</td>
<td>Data collected could lead to further advocacy to promote awareness of</td>
</tr>
<tr>
<td></td>
<td>new law and promote the incorporation of Prediabetes Risk Test to</td>
</tr>
<tr>
<td></td>
<td>increase awareness among patient population.</td>
</tr>
<tr>
<td>Propose strategies to identify stakeholders and build</td>
<td>Proposed increased collaboration between dental community and</td>
</tr>
<tr>
<td>coalitions and partnerships for influencing public health outcomes</td>
<td>primary care providers to increase identification of prediabetes</td>
</tr>
<tr>
<td></td>
<td>among at-risk patients and improve overall health of patient.</td>
</tr>
<tr>
<td>Apply systems thinking tools to a public health issue</td>
<td>Developed a Systems thinking map to identify all stakeholders involved</td>
</tr>
<tr>
<td></td>
<td>in this public health issue of the increasing epidemic of prediabetes</td>
</tr>
</tbody>
</table>

Concentration Competencies

<table>
<thead>
<tr>
<th>Task</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstrate use of Systems Thinking (ST) in promoting effective</td>
<td>Developed a Systems thinking map to identify a process by which this</td>
</tr>
<tr>
<td>public health programs and policies.</td>
<td>at-risk population of dental patients could be identified. The map</td>
</tr>
<tr>
<td></td>
<td>also shows the importance of collaboration between the dental</td>
</tr>
<tr>
<td>Project summary:</td>
<td>community and the medical community and how all stakeholders are</td>
</tr>
<tr>
<td>To address the fact that one in three adults in the United States</td>
<td>involved in this public health issue.</td>
</tr>
<tr>
<td>is prediabetic and 90% are unaware of their condition, with input</td>
<td>The following stakeholders were involved in the development and</td>
</tr>
<tr>
<td>from my committee as well as from members of the dental community,</td>
<td>distribution of the survey:</td>
</tr>
<tr>
<td>an anonymous survey was developed. The primary goal of the survey</td>
<td>• Connecticut State Dental Association (CSDA)</td>
</tr>
<tr>
<td>was to examine knowledge of a new law passed in Connecticut in July</td>
<td>• Hartford Dental Society</td>
</tr>
<tr>
<td>2019 pertaining to in-office testing of HbA1c in patients and</td>
<td>• Connecticut Oral Health Initiative (COHI)</td>
</tr>
<tr>
<td>willingness to administer the test. We also examined knowledge of</td>
<td>• Licensed practicing dentists</td>
</tr>
<tr>
<td>the “7 Question Prediabetes Risk Test” and the likelihood of</td>
<td></td>
</tr>
<tr>
<td>incorporating this screening tool into their patient information</td>
<td>The following stakeholders would be potential consumers of the</td>
</tr>
<tr>
<td>forms. Through contacts I made at the Connecticut State Dental</td>
<td>findings:</td>
</tr>
<tr>
<td>Association, Connecticut Oral Health Initiative and the Hartford</td>
<td>• Licensed practicing dentists in CT</td>
</tr>
<tr>
<td>Dental Society, the survey was distributed to licensed practicing</td>
<td>• CSDA and Component Societies</td>
</tr>
<tr>
<td>dentists in Connecticut utilizing their member lists and social</td>
<td>• COHI</td>
</tr>
<tr>
<td>media platforms. I also attended a meeting held by the Hartford</td>
<td>• CT Department of Public Health</td>
</tr>
<tr>
<td>Dental Society to speak about the project. Further research is</td>
<td>• CT Legislature including PH committee</td>
</tr>
<tr>
<td>needed in this area and additional distribution channels will be</td>
<td>• American Diabetes Association</td>
</tr>
<tr>
<td>explored to increase participation among the dental community.</td>
<td>• American Dental Association</td>
</tr>
<tr>
<td></td>
<td>• Local Health Departments</td>
</tr>
<tr>
<td></td>
<td>• American Heart Association</td>
</tr>
</tbody>
</table>
Systems Thinking Framework

**Systems Thinking Approach to Identifying Prediabetes in the Dental Setting**

**Patient**
- Post-office visit with dentist and PCP
  - Patient identified at risk for prediabetes or diabetes from Prediabetes Risk Test or in-office HbA1c test
  - Patient referred to PCP for follow-up
  - Patient is confirmed as prediabetic, diabetic or neither.
  - Patient is given informational materials on lifestyle changes to improve health outcomes.

**Front office staff**

**Primary Care Provider (PCP)**
- With patient consent, PCP confirms prediabetic or diabetic diagnosis and provides counseling appropriate to the condition.
- Primary care provider collaborates with dental community providers to address overall health of the patient.

**Indirect Stakeholder**
- Department of Public Health
  - Improving health of residents of Connecticut

**Indirect Stakeholder**
- Insurance companies
  - Insurance covering/out of pocket costs
  - Coverage for this procedure is inconsistent
  - Billing code 00411 HbA1c in-office point of service testing was effective January 1, 2010
  - If test is not covered, patients may not pay out of pocket for the procedure

**Indirect Stakeholder**
- Lawmakers/Policy Makers
  - Posing and advocating legislation
  - “An Act Concerning Dental Practitioners”

**Indirect Stakeholder**
- Medical Equipment and Testing Providers
  - Equipment needed to administer HbA1c test

**Indirect Stakeholder**
- American Dental Association/CT State Dental Association/American Diabetes Association/American Heart Association

**Collaboration among all stakeholders is the key to increasing awareness of prediabetes among at-risk individuals. With increased awareness, the option to improve health becomes a choice.**

**Systems approach to collaborative care**
- Patient starts and follows up with dental on the recommended schedule for oral care and glucose measurements if necessary.

**With over 84 million adults in the United States are identified as prediabetic and 90% are unaware of their condition.**

**A systems thinking approach is critical to understanding why this level of awareness is so low, incorporating diagnostic tools into at-risk patient visits, collaborating between medical professions which in turn will improve the percentage of Americans that are aware of this chronic life altering condition before it develops into type 2 diabetes.**

**Dental Hygienist/Dentist**
- Dental hygienist consults with patient regarding Risk Test Score. This is within their scope of work
- If patient is determined at-risk for prediabetes or diabetes or complications from planned oral care treatment, dental hygienist recommends in-office HbA1c test to measure glucose level.
- HbA1c measurement determines referral to PCP.
- >5.7% = referral to PCP
- Dental and dental hygienist consult patient on the impact of glucose levels on oral health, specifically periodontitis.
Introduction

A. Research Significance

Prediabetes is an epidemic that affects 84.1 million adults in the United States. This is not only a public health problem in the United States, but prevalence estimates of prediabetes worldwide are projected to be over 470 million people by 2030 (Tabak, Herder, Rathmann, Brunner, & Kivimaki, 2012). Prediabetes is a serious preventable health condition in which an individual has blood sugar levels that are higher than normal but not yet high enough to be diagnosed as diabetes (Centers for Disease Control and Prevention, n.d.). It has been estimated that one in three adults in the United States has prediabetes, yet reports have shown that up to 90% are unaware they have this condition (National Diabetes Statistics Report, 2017). This undiagnosed population has a risk four to twelve time greater than those with normal glucose tolerance of developing type 2 diabetes (Albright & Gregg, 2013) and also has an increased risk of cardiovascular disease, stroke and all-cause mortality (Tseng, et al., 2019; Zand, Ibrahim, & Patham, 2018). Studies show that for those individuals diagnosed with prediabetes that make lifestyle changes, they can lower their risk of developing type 2 diabetes by as much as 71 percent depending on their age (Centers for Disease Control and Prevention, n.d.).

The annual incidence of type 2 diabetes is 5%-10% in people with prediabetes compared to approximately 1% in the population with normal glucose tolerance (Albright & Gregg, 2013). If prediabetes is left undiagnosed and therefore untreated, potentially 30% of people will develop type 2 diabetes within five years (Estrich, Araujo, & Lipman, 2019). The implications of developing type 2 diabetes are staggering and include vision loss, amputation, kidney issues, disability and death (Albright & Gregg, 2013). Not only do these conditions present a substantial
burden to the individual, but also annual costs associated with diabetes were estimated to be $327 billion in the United States (Estrich, Araujo, & Lipman, 2019).

In order to treat prediabetes, which is a preventable, reversible condition, this undiagnosed population must first be properly identified and made aware they are prediabetic. There is an opportunity to reach a large number of individuals that visit a dentist but do not visit a medical doctor (Estrich, Araujo, & Lipman, 2019). This distinction is important, as diabetes is also a major risk factor for periodontitis with the risk being three times that among non-diabetic individuals (Preshaw, et al., 2012). Periodontitis is a chronic inflammatory condition that if not controlled can ultimately lead to tooth loss. There is evidence of a bi-directional relationship between diabetes increasing the risk for periodontitis and those with periodontitis controlling their blood sugar (Preshaw, et al., 2012).

Given the relationship between diabetes and periodontitis coupled with the national goals to reduce the prevalence of diabetes, Connecticut and other states have passed legislation to enable dentists to screen for prediabetes and diabetes to enlarge the possibility of identifying people at risk. Specifically in Connecticut, Public Act No. 19-72 AN ACT CONCERNING DENTAL PRACTITIONERS effective July 1, 2019 allows licensed practicing dentists “during an office visit or prior to a procedure and with the patient’s consent to administer an in-office point-of-service test to the patient to measure the patient’s HbA1c percentage utilizing a finger-stick measurement tool if such patient is at an increased risk of diabetes and does not have a previous diagnosis of diabetes” (An Act Concerning Dental Practitioners, 2019). Given the recency of this legislation, it remains unknown the degree to which dentists are willing to incorporate this testing during normal office visits, and what factors might drive their decisions.
B. Definitions and scope

Prediabetes is an epidemic of global proportions. In 2015, an estimated 33.9% of adults in the United States aged 18 years and older had prediabetes identified using plasma fasting glucose (PFG) or glycohemoglobin (HbA1c) levels. Prediabetes affects nearly half of adults age 65 years or older (48.3%) and more men (36.6%) than women (29.3%). Among racial groups, the prevalence of prediabetes was highest among the Asian, non-Hispanic (35.7%) and the Black, non-Hispanic (36.3%) populations. Among adults aged 18 years and older, only 11.6% reported awareness of prediabetes which was identified from the Diabetes Questionnaire in the 2015-2016 National Health and Nutrition Examination Survey (NHANES 2015-2016), “{Have you/Has SP} ever been told by a doctor or other health professional that {you have/SP has} any of the following: prediabetes, impaired fasting glucose, impaired glucose tolerance, borderline diabetes or that {your/her/his} blood sugar is higher than normal but not high enough to be called diabetes or sugar diabetes?”

The lowest levels of awareness of this preventable disease were identified in adults ages 18 to 44 (8.2%), men (9.4%) and Hispanics (7.5%) (National Diabetes Statistics Report, 2017). If left undiagnosed and untreated, 30% of this population will develop type 2 diabetes within five years which overall is the seventh leading cause of death in the United States (Estrich, Araujo, & Lipman, 2019) (Heron, 2019).

Prediabetes can be identified from bloodwork in which there is an impaired fasting plasma fasting glucose (FPG) value or an elevated HbA1c value not high enough to be diagnosed as type 2 diabetes. A prediabetic impaired fasting glucose is defined by the American Diabetes Association (ADA) as a range between 100mg/dL and 125mg/dL. A prediabetic HbA1c level is defined by the ADA as a lab value ranging between 5.7% and 6.4% (Zand, Ibrahim, & Patham,
An oral glucose tolerance test (OGTT) can also be a tool to identify prediabetes but is not commonly used in the general population because it is expensive and impractical to use within the routine setting of a doctor’s visit (Fagg & Valabhji, 2019). Examining laboratory results of fasting plasma glucose values from NHANES 2005-2006 compared to results from NHANES 2015-2016 to identify prediabetes in the survey population measured, prevalence has more than doubled from 8.8% to 18.2% in that ten-year period. Laboratory results of HbA1c values from NHANES 2005-2006 compared to results from NHANES 2015-2016 prevalence has increased from 9.1% to 24.2% in that ten-year period. It can be inferred that because almost 90% of American adults are unaware of their prediabetic condition, the prevalence of diabetes identified using these same NHANES datasets and the definition set by the ADA of a fasting plasma glucose value greater than 125mg/dL has also increased from 3.3% to 5.8%. In addition, those with an HbA1c value greater than 6.4%, defined as diabetes by the ADA has also increased from 6.1% (NHANES 2005-2006) to 10.4% (NHANES, 2015-2016).

Prediabetes is typically asymptomatic. Therefore, it is unlikely to be detected until serious health problems arise, making earlier diagnosis a healthcare priority. It is important to screen for prediabetes if the following risk factors are present: being overweight, age 40 years or older, having a family member with type 2 diabetes, low physical activity (<3 times/week), females that have had gestational diabetes or a baby that weighed 9 pounds or more or having polycystic ovary syndrome. African Americans, Hispanic/Latino Americans, American Indians and some Asian Americans may have a higher risk as well (What is Prediabetes?, 2019). Type 2 diabetes is preventable and can be delayed through methods such as healthy eating, weight loss and increasing physical activity (Gruss, et al., 2019).
Current knowledge/Gaps in Literature

A common theme in the literature addresses the growing epidemic of diabetes concurrent with a lack of knowledge of prediabetes. Several factors contribute to this increase in prevalence starting with approximately 90% of American adults lacking awareness of this disease as a result of under diagnosis (Tseng et al., 2019). The role of a healthcare professional such as a primary care provider or dental provider is key to identifying the need for an initial screening using known risk factors and a concurrent diagnosis of prediabetes if identified through confirmatory laboratory values. By examining the existing knowledge within the dental community, the results may provide additional evidence and support for further research into why 90% of the population identified as prediabetic remains unaware of their condition.

C. Prior Research

In a study performed by Tseng et al. (2019), there are significant gaps in knowledge of prediabetes by primary care physicians (PCP) as well as an underutilization of behavioral programs focused on weight loss and lifestyle modifications. Only 38% of PCP identified Latino ethnicity as a risk factor and only 27% identified Asian race that would prompt prediabetes screening. As mentioned earlier, these groups are at higher risk for prediabetes and should prompt screening if appropriate, especially if other risk factors are present. Awareness of prediabetes is 7.5% in the Hispanic population and 9% in the Asian population (National Diabetes Statistics Report, 2017) which could be attributed to these lower levels of identification among PCP’s (Tseng et al., 2019). Physician knowledge of the correct laboratory criteria for diagnosing prediabetes as defined by ADA was 42% for fasting glucose and 31% for HbA1c which could also be a factor in underdiagnosing this condition. Physician knowledge of recommendations for the management of prediabetes was relatively low with 25% answering
“Do not know” and only 8% reporting the correct goal of a minimum of 7% for weight loss recommended by the ADA. Knowledge of recommended activity levels used for prediabetes management was also low with 13% reporting “Do not know” and 41% reporting the correct level defined by the ADA of 150 minutes per week (Tseng et al., 2019).

Although lifestyle modification programs have proven to be very effective with evidence that shows a 40% to 70% relative-risk reduction in preventing the development of type 2 diabetes from a prediabetic state (Tabak, Herder, Rathmann, Brunner, & Kivimaki, 2012), only 36% of primary care physicians surveyed reported referring patients to a diabetes prevention lifestyle program (Tseng et al., 2019). PCP’s lack of knowledge of risk factors, laboratory criteria and effective evidence-based prediabetes management recommendations likely contributes to the increasing prevalence of type 2 diabetes. This is compounded by delayed diagnosis by healthcare professionals even after an initial elevated HbA1c value has been documented.

In a study by Gopalan et al., (2018), the prevalence of undiagnosed Type 2 diabetes one year following an elevated HbA1c was examined using electronic health records from a cohort of Kaiser Permanente Northern California members. The study population included adults 21 years and older with no evidence of prior diabetes with an HbA1c reading 6.5% or greater between January 1, 2014 and December 31, 2015. Individuals were classified as undiagnosed with Type 2 diabetes if they had no associated ICD-9/10 diagnostic code for diabetes and did not have diabetes added to their record in the year following the first elevated HbA1c value. Of the 18,356 patients that had an elevated HbA1c and identified as meeting the level for type 2 diabetes, 12,804 (69.8%) were clinically diagnosed with type 2 diabetes and 5,552 (30.2%) were not clinically diagnosed within the one year. Of those 5,552 undiagnosed, 26% were adults aged
70 and older, Asian, Latino and Black comprised 57.1% and 92.2% had HbA1c levels between 6.5% and 6.9%. Most notably, among those not clinically diagnosed with type 2 diabetes, 65.2% had a previous diagnosis of prediabetes, 30.8% were identified as overweight and 53.7% were identified as obese. These are well known risk factors for type 2 diabetes and along with an elevated HbA1c should have provided enough evidence to prompt a clinical diagnosis of type 2 diabetes, yet only 40.5% of undiagnosed individuals had follow-up testing and of those only 12.1% had a confirmatory HbA1c value (Gopalan et al., 2018). The low percentage of follow-up testing could be a factor in lack of awareness as no diagnosis could be made based on a confirmatory HbA1c value. Consistent with PCP behaviors in the study done by Tseng et al. (2019), the percentage of clinically undiagnosed individuals can likely be attributed to provider’s misinterpretation of diagnostic guidelines and knowledge of risk factors such as overweight and obesity, previous diagnosis of prediabetes and certain race/ethnicities. Ensuring follow-up on individuals that present with multiple risk factors and an elevated HbA1c will enable a timelier diagnosis and may help to prevent the development of type 2 diabetes and decrease the risk of its associated diseases.

D. Gap in the Literature

While there is literature that examines the physician’s knowledge of risk factors prompting screening, knowledge of the prediabetic ranges for bloodwork laboratory values, and recommended treatment options for those diagnosed as prediabetic, there is a gap in understanding the role and current knowledge within the dental community. The new legislation in Connecticut presents a unique time to assess awareness and utilization, and, determine if improved messaging is required to the dental care community from professional societies and the Department of Public Health.
Prior research by Estrich, Araujo and Lipman (2019) regarding prediabetes and diabetes screening in dental care settings, estimated the number of people who are likely unaware of their prediabetes risk status. Using NHANES data from 2013 to 2014 and 2015 to 2016 that included 10,472 adults, associations among prediabetes and diabetes risk factors, usage of health care and HbA1c levels were analyzed (Estrich, Araujo, & Lipman, 2019). The impact of this study on an important public health issue is evident in the findings estimating that 22.36 million adults could be made aware of their risk for prediabetes or diabetes by providing this assessment in a dental setting because 7.73% of adults had visited the dentist in the last year but not a medical provider (Estrich, Araujo, & Lipman, 2019). The results of this study show that screening in a dental setting would have the highest odds of identifying undiagnosed individuals who are at greater risk due to their race, weight status and age (Estrich, Araujo, & Lipman, 2019). These results support an additional opportunity to augment the primary care doctor-patient relationship as it introduces a novel way to increase awareness among this population. Through increased screening, identification and diagnosis in the early stages becomes possible. Only through awareness is choice an option. By promoting prediabetes screenings in dental care settings, a collaboration can be formed between the medical provider, dental care provider and patient which may likely lead to improved health outcomes.

Prediabetes is a preventable chronic disease and the early diagnosis and treatment should be a focus of healthcare professionals as it is well documented in the evidence that it can be reversed. By understanding if the same gaps in knowledge are present among dental providers and addressing these areas for improvement, there is a great opportunity to increase awareness in this population with the ultimate goal of reducing the prevalence of prediabetes and the incidence of type 2 diabetes.
E. Theoretical Framework

The theoretical framework for this project is based on the concepts of planned behavior and reasoned action. One fundamental aspect of these theories is that knowledge, attitudes and beliefs are strong predictors of intentions and intention predicts behaviors (Greenberg, Glick, Frantsve-Hawley, & Kantor, 2010). This research project sought to understand the level of knowledge of the new law in Connecticut, the billing code associated with in-office point of service testing as well as perceptions of patients and prediabetes. This data could be used as a starting point to develop a plan to increase adoption of administering the in-office point-of-service testing used to measure HbA1c levels and to increase identifying patients at risk of prediabetes. Along with other important health screenings currently performed by dentists such as those for smoking-cessation and oral cancer, screening for prediabetes could present an opportunity not only for identification but also as a channel to disseminate treatment information. There is emerging evidence that periodontitis is associated with higher levels of HbA1c, fasting glucose and the prevalence of prediabetes which contributes additional reasoning as to why it is important to diagnose early in those individuals that are at risk (Preshaw & Bissett, 2019). If these conditions can be identified and treated in individuals that are at risk, the benefits far outweigh any inconveniences this additional screening may cause.

II. Specific Aims

A. Research Objectives

To examine the current level of awareness among dentists of the following: 1.) the law passed in Connecticut in July 2019 (Appendix A) allowing dentists to test blood sugar in office, 2.) the current billing code D0411 (Appendix B) related to HbA1c in-office point-of-service testing in dental office and 3.) the 7 Question Prediabetes Risk Test (Appendix C) provided by
the American Diabetes Association (ADA) and the Centers for Disease Control and Prevention (CDC). By assessing this knowledge base, we can begin to understand if there is an opportunity to increase awareness within this community. The dental community may play an important role in conjunction with medical providers towards empowering this population identified as prediabetic to choose lifestyle modifications that have been proven to reverse this condition to a state of normal glucose tolerance, thereby not developing type 2 diabetes and other costly life altering conditions including periodontitis. In a study by Greenberg et al. (2010) regarding dentists’ attitudes toward chairside screening, the authors discuss the factors that are important in disease prevention. These factors can be applied to this research project in the following manner. An integrated healthcare approach such as the collaboration between the dental community and the medical community. A disease with modifiable risk factors such as prediabetes has been proven with lifestyle modifications such as loss of weight and exercise to either reverse the diagnosis or slow the progression of developing type 2 diabetes. A simple safe screening tool such as the Prediabetes Risk Test and the in-office point of service HbA1c test to identify those at greatest risk. The final factor of effective disease prevention is having the population that would benefit from this screening and identification process. Based on the increasing prevalence of both prediabetes and type 2 diabetes along with their associated diseases in the United States, there is an immense benefit for improving health outcomes for this population (Greenberg, Glick, Frantsve-Hawley, & Kantor, 2010).

B. Hypothesis

It is hypothesized that a greater level of awareness of the new law, the billing code and the Prediabetes Risk Test will be associated with a greater likelihood of administering the in-office point-of-service HbA1c test to patients. In order to assess this opportunity within the
dental community, an exploratory research study was conducted to inform an understanding between the knowledge of billing codes, knowledge of a new law passed in Connecticut effective July 1, 2019, knowledge of the 7 Question Prediabetes Risk Test and the likelihood of administering an in-office blood sugar test among their patient population. The awareness levels will serve as the independent variables and the likelihood to administer the in-office point-of-service HbA1c test as the law is currently written and the likelihood to offer the test if a dental hygienist could perform the test will function as the dependent variables.

III. Methods and Materials

A. Study Design

The anonymous seventeen question cross-sectional online survey was developed utilizing feedback from an advisory committee as well as suggestions from the local dental community. The questions were phrased to reduce any biases pertaining to knowledge or perceptions. The survey was distributed to licensed practicing dentists utilizing e-newsletters and social media platforms of major dental organizations based in Connecticut. These organizations include the Connecticut State Dental Association, Connecticut Oral Health Initiative and the Hartford Dental Society. The membership of these organizations determined the number of potential survey participants. The target population for survey distribution was licensed practicing dentists in the state of Connecticut. This target population was chosen because the law is specifically written to allow “a dentist licensed under chapter 379 of the general statutes may, during an office visit or prior to a procedure and with a patient’s consent, administer an in-office point-of-service test to the patient to measure the patient’s HbA1c percentage utilizing a finger-stick measurement tool” (An Act Concerning Dental Practitioners of 2019).
B. Survey Distribution

This anonymous survey was distributed utilizing the Connecticut State Dental Association (CSDA), Connecticut Oral Health Initiative (COHI) and Hartford Dental Society member email lists and their associated social media platforms. The recruitment flyer (Appendix D) which includes a link and a QR code to access the anonymous survey was distributed by the Connecticut State Dental Association (CSDA) using e-newsletters sent to their members on February 21, 2020 and March 6, 2020 and posted on their Facebook page on February 27, 2020 which is followed by 600 people. The recruitment flyer was also included in the Connecticut Oral Health Initiative e-newsletters sent to their members in February and March and posted on their Facebook page on March 10, 2020 which is followed by 288 people. Additional methods of distribution included emails sent to each contact for the twenty-two local component societies within Connecticut that are an important part of organized dentistry in the state and serve the needs of member dentists at the local level. (Component Societies, 2020). Additional emails were sent to a random sample of eight individual practices in Connecticut using a list of licensed practicing dentists provided by the Department of Public Health. This approach to data collection uses the method of convenience sampling and is useful for this project to gain an understanding within the dental community of Connecticut. This is a non-probability sample because the survey was only distributed to those members that receive the e-newsletters from CSDA and COHI or subscribe to their Facebook pages, are a member of the component societies or are currently licensed in the state of Connecticut.

C. Survey Instrument

Knowledge within the dental community was measured using a descriptive cross-sectional anonymous survey developed in Qualtrics. The cross-sectional anonymous survey is
based on an instrument used by Tseng et al. (2019) in a study assessing knowledge, practices and perception of prediabetes among primary care physicians. The questions in our survey were modified and tailored by myself and my advisory committee to gain an understanding of the knowledge within the dental community. An introduction is included describing the purpose of the survey and that completion of the survey is indicative of their consent to participate. The information sheet also included contact information for study personnel.

The survey collected quantitative data to evaluate the following: 1) perceptions regarding prediabetes, 2) knowledge of ADA billing codes that correspond to in-office monitoring of patient’s blood sugar, 3) knowledge of the “Act Concerning Dental Practitioners”, and 4) knowledge of 7 Question Prediabetes Risk Test.

The first section of the survey included questions related to the participant’s awareness of the 7 Question Prediabetes Risk Test, their willingness to incorporate this test into their patient information forms, the current data collected on their patient information forms, their awareness of the law passed in Connecticut in July 2019, “An Act Concerning Dental Practitioners” and their knowledge of the reimbursable quality of CDT Code D0411 (HbA1c in office point-of-service testing in dental office). The other questions in this section pertain to the likelihood of administering the in-office point-of-service test. The language of the current law states that the test can only be performed by a licensed practicing dentist. These questions ask if the participant is currently administering the in-office point-of-service test. If the participant answered no to this question, to examine the feasibility of increasing the number of tests administered in the dental office, the question was asked how likely they would be to offer the test if it could be performed by a dental hygienist. The last two questions in this section pertain to the likelihood of offering the in-office point-of-service test if it is not reimbursable and how likely a patient would be to
pay out of pocket if this test is not reimbursable. These questions attempt to examine the feasibility of offering the test if it not reimbursable.

In the final section of the survey, the participants are asked questions that will provide demographic information pertaining to their gender, number of years practicing dentistry, specialty, type of practice, and insurance status of patients that can be compared to the total sampling frame of licensed practicing dentists in Connecticut. The data provided by these answers are reported using descriptive statistics. These findings may potentially be utilized in further analyses to understand the differences based on employment status.

D. Variables and Data Analysis

IBM SPSS Statistics 26 software was utilized to analyze the collected data. Descriptive statistics were calculated to examine the distribution of scores on each of the survey questions. Frequencies and chi-square tests were run to evaluate associations between the independent and dependent variables.

In the first section of the survey, a 5-point Likert scale (strongly agree to strongly disagree) was used to evaluate the perceived relationship between prediabetes and periodontal disease, perceptions of the importance to collaborate with the medical community to prevent disease, perceptions of the importance of screening for prediabetes, perceptions of the importance of informing patients of prediabetes, as well as perceptions by the dental community of patient behaviors. The answers to these questions were dichotomized by combining agree and strongly agree versus neutral, disagree and strongly disagree (Tseng et al., 2019).

The answers to questions related to perceptions of prediabetes, awareness of the new law, awareness of the billing code, awareness of the Prediabetes Risk Test and the likelihood of
administering the test were compared for associations. This analysis informs the findings related to the hypotheses.

**E. Confidentiality**

The UConn Institutional Review Board (IRB) approved this study on February 13, 2020 under Exemption Category 2 - Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observations of public behavior (including visual or auditory recording). There is minimal risk posed to the subjects due to the anonymous nature of the survey. There is minimal risk to breach of confidentiality because it is an anonymous survey. The Principal Investigator, Co-Investigators, and Study Coordinator had access only to the data. All key study personnel completed the Collaborative Institutional Training Initiative (CITI).

**IV. Results**

**A. Response Rates**

As shown in Figure 1, approximately 6,269 individuals in the dental community received an e-newsletter from CSDA (3769) and COHI (2500). On February 21, 2020, CSDA sent their e-newsletter to 1,892 dental professional members and it was opened by 631 (33.4%). Of those 631 who opened the e-newsletter, 6 (0.95%) individuals opened the anonymous survey link. On March 6, 2020, CSDA sent their e-newsletter to 1,877 dental professional members and it was opened was by 748 (39.9%). Of those 748 who opened the newsletter, 3 (0.4%) individuals opened the anonymous survey link. On March 4, 2020, COHI sent their e-newsletter to approximately 2,500 dental professionals and was opened by 508 (20.3%). Among those 508 who opened the COHI e-newsletter, 4 (0.79%) individuals opened the anonymous survey link. Based on the total number of e-newsletters sent out in February and March of 6269 with an
average open rate of 31.2% it can be estimated that 1956 e-newsletters would be opened. Using 0.71% as the average standard open rate for the anonymous survey, it can be estimated that the anonymous survey link would receive approximately 14 clicks. With additional distribution through the Hartford Dental Society member email lists and postings on social media platforms, we received 23 completed surveys in the time period from February 21, 2020 through March 20, 2020.

Survey Distribution and Response Rates

Figure 1 Distribution and Response Rates for anonymous survey
B. Characteristics of Study Sample

Table 1 includes the demographics of the study sample. Among those who completed the survey, 69.6 percent were male; 66.7 percent listed their specialty as General Dentistry; 69.6 percent had practiced more than 20 years; 95.6 percent were in a private or group practice and on average 62.1 percent of their patients had employer-based plans for insurance. Compared with the target population for the state of Connecticut, the pilot study sample had similar demographics in gender, those practicing less than 20 years and those practicing General Dentistry, Oral and Maxillofacial Surgery and Oral and Dentofacial Orthopedics. Type of practice and insurance breakdown was not available for the total population of licensed practicing dentists in Connecticut.

C. Role of Dentists in Screening

Figure 2 shows the distribution of responses for the five-point Likert scale questions. Over 90 percent of survey respondents indicated that they “agreed” (“strongly agree” or “somewhat agree”) that it is important to collaborate with primary care providers to prevent disease. Over 85 percent “agreed” that it is both important to screen patients identified at risk for prediabetes as well as important for the dental community to inform patients of a prediabetic condition. Over 20 percent of respondents “did not agree” (“somewhat disagree” or “strongly disagree”) and more than 30 percent “neither agreed nor disagreed” that patients would make lifestyle changes if given informational material on prediabetes.
Figure 2 – Distribution of responses to Question 1 using five-point Likert scale

Awareness of 7-Question Prediabetes Risk Test and Willingness to Adopt. As shown in Figure 3, 78 percent of respondents answered “no” or “not sure” regarding their awareness of this test. The following question asked how likely you would be to incorporate the Prediabetes Risk Test into your patient information forms. Nearly three quarters of the respondents answered that they would “possibly”, “probably” and “definitely” incorporate the risk test.

Figure 3 – Responses to Question 2 “Are you aware of the 7-Question Prediabetes Risk Test”
Awareness of New Law and Willingness to Adopt HbA1c Testing. As shown in Figure 4, only 22 percent of respondents are aware of “An Act Concerning Dental Practitioners”. 96 percent of respondents are not currently administering the test. Among those not currently testing, nearly three quarters responded that they would “possibly”, “probably” or “definitely” administer the test. While this total percentage remains the same when asked in question 8 of the likelihood to offer the test if it could be administered by a dental hygienist under their supervision, there was an increase in those answering “definitely” or “probably” from 27 percent to 50 percent.

![Figure 4 - Responses to Question 5 “Are you aware of “An Act Concerning Dental Practitioners”

V. Discussion

This pilot study is the first known attempt to assess the awareness and utilization of Sec. 11. Public Act 19-72 “An Act Concerning Dental Practitioners” effective July 1, 2019 in
Connecticut. This law was proposed and passed to remove barriers to screening an at-risk population primarily for early detection of disease. This legislation also allows dentists to play an important role in collaborating with the medical community to impact the overall health of the patient.

**A. Willingness to Adopt Testing and Risk Assessment.**

Although our study yielded a small sample size, our results are encouraging regarding the willingness to adopt this testing. For example, the vast majority (91.3%) “strongly agreed” or “somewhat agreed” that it is important for the dental community to collaborate with primary care providers to prevent disease. Additionally, the majority (86.9%) also “strongly agreed” or “somewhat agreed” that it is important to screen patients identified at risk for prediabetes as well as to inform patients of a prediabetic condition. There was a moderate difference in the numbers that “strongly agreed” to inform (65.2%) compared to screen (47.8%). These results suggest that participants may have defined screening as the HbA1c test and not the risk test. Clarification on this question is recommended for future surveys. While these results imply that the majority of respondents believes these are important, the current utilization of screening either with the Prediabetes Risk Test and/or the HbA1c in-office point of service test is near nonexistent with only one respondent currently administering the test. One reason for this may lie in the fact that only 47.8% of respondents answered “strongly agree” or “somewhat agree” that patients would make lifestyle changes if given informational material on prediabetes compared to the other questions related to perceptions.

An opportunity exists to include the Prediabetes Risk Test as a standard routine patient form as the majority (73.8%) answered they would be likely to incorporate the Prediabetes Risk Test into their patient forms even though the majority (65.2%) were not aware of this screening
tool. This single screening tool could be the simplest and easiest option to implement and have the greatest impact on raising awareness of prediabetes risk among this patient population and allow a choice to be made regarding treatment options.

The following results in conjunction with perceptions of importance to screen patients, inform patients and collaborate with medical providers imply that testing patients chairside has the potential to be implemented on a larger scale. The majority (72.7%) are “definitely”, “probably” or “possibly” likely to administer the in-office point-of-service test to patients and the same is true of offering the test if it could be administered by a dental hygienist under the dentist’s supervision regardless of only 21.7% having awareness of the law.

Additional factors also impact the decision to administer the HbA1c test such as the availability and cost of the equipment needed to run the tests, CLIA waivers necessary to run the tests in the office, insurance coverage and out of pocket costs for the patients. As of January 1, 2018, Code D0411 “HbA1c in-office point of service testing” has been effective as a billing code for this procedure pertinent to in-office monitoring of patient blood glucose levels yet only 34.8% were aware if this code is reimbursable.

**B. Cost Considerations**

Of concern is that 60.8% responded that patients would “probably not” or “definitely not” pay for the HbA1c test if it is not reimbursable. The current cost of twenty CLIA waived A1CNow test kits is approximately $182.00, less than $10/test (Appendix E). There is the possibility that the HbA1c test could follow a similar model to that of fluoride varnish in adults, which is typically not covered by insurance. In this scenario, the patient pays out of pocket if financially able and they decide it is an important procedure to maintain good oral health. Based on the approximate cost per test of less than ten dollars, the test could be offered to the patient
for a fee determined by the dentist and based on income level. The cost of the test to the patient will likely be significantly less than the cost of treating type 2 diabetes, assuming treatment and change of behaviors follows. While cost may still present a barrier due to a patient’s income level, partnerships could be developed with organizations to cover the cost of the test for these individuals. Additional factors such as time allotted to each patient visit and the availability of the dentist also affect the rates of administering the tests. One suggestion that may address time constraints of dentists is to amend the law to include dental hygienists as professionals allowed to administer the blood test. Not only is this in line with the scope of practice of a dental hygienist but could increase the capacity to test at-risk patients.

C. Limitations

There may be other factors outside the scope of this study that would limit or advance the likelihood of administering the in-office point-of-service HbA1c test. Another limitation of this study which might affects internal validity is non-response bias, which is common in survey research. An average response rate to an online survey is 30% (Lindemann, 2020). The response rate for this small pilot study did not achieve this response rate, therefore, we have not drawn major inferences. An additional limitation may exist in the delivery method for our survey. The link to the anonymous survey was included as the last item in the e-newsletter. Therefore, a limited amount of time to spend online as well as a limited attention span may have impacted our results. In our small sample, the majority practiced 20 years or more and practiced in a private or group setting. The demographics of our study sample pose a limitation as they are not representative of the group of licensed practicing dentists in Connecticut. There is also the potential for social desirability bias (Bhattacherjee, 2012). Dental providers responding to this survey may give answers that portray themselves in a more positive light rather than what they
truly believe. Although we cannot evaluate the responses in this manner due to the online nature of the survey, the questions were constructed to minimize biased responses. For example, we chose to use the word “aware” versus “knowledge” when asking about the law to minimize the perception of the question feeling like a challenge to the participant.

VI. Conclusions and Recommendations

This pilot study provides early insight into the need to promote the new legislation and promising indications about willingness to adopt testing. The results have informed a greater understanding of the important role the dental community has in conjunction with the medical community to increase screening and testing of the at-risk population as a tool in the primary prevention of prediabetes. The results of this study have also informed an understanding of the awareness among the dental community of a new law passed in Connecticut in July 2019 regarding the ability of dental providers to administer testing of blood sugar. Further research is needed to examine these results in a larger sample.

A possible venue to increase the sample size is to administer this survey at the annual meeting for the Connecticut State Dental Association to present the initial findings and recruit additional participants. The average survey response rate for an in-person survey is 57% (Lindemann, 2020). Therefore, a potentially large number of surveys that may be representative of dentists in Connecticut could be secured by recruiting survey participants at this annual meeting. The next highest average response rate (50%) is to mailed surveys (Lindemann, 2020). Therefore, an additional recommendation would be to secure funding to perform a mailing of the survey to all of the licensed practicing dentists in Connecticut.

Future studies examining awareness and factors associated with implementation of testing in the dental setting may also be structured as in-depth interviews with a representative
sample of licensed practicing dentists and dental hygienists. To augment these results, additional interviews and research could be performed with patients identified as at-risk to examine their understanding of prediabetes, HbA1c measures and the in-office point-of-service blood test. One final suggestion for future research is to examine similar laws and current utilization of the HbA1c blood test in the dental setting in other states. The importance of identifying potential solutions that may have a positive impact on the growing epidemic of prediabetes is critical and needs to be further explored. By encouraging this practice among the dental community, there is an opportunity to identify, inform and educate those at risk which offers this at-risk population a life-saving choice of better health.
References


An Act Concerning Dental Practitioners, Public Act 19-72 (July 1, 2019).


Fagg, J., & Valabhji, J. (2019). How do we identify people at high risk of Type 2 diabetes and help prevent the condition from developing? *Diabetic Medicine, 36*, 316-325.


# TABLE 1

Demographic characteristics of pilot study sample (n=23)

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>Pilot Study Sample No. (%)</th>
<th>Total Target Population No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td>N = 2449</td>
</tr>
<tr>
<td>Male</td>
<td>16 (69.6)</td>
<td>1581 (64.6)</td>
</tr>
<tr>
<td>Female</td>
<td>6 (26.1)</td>
<td>796 (32.5)</td>
</tr>
<tr>
<td>Prefer not to say</td>
<td>1 (4.3)</td>
<td>72 (2.9)</td>
</tr>
<tr>
<td>Type of practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private or group practice</td>
<td>22 (95.6)</td>
<td>Information not available</td>
</tr>
<tr>
<td>Practice affiliated with hospital or large health entity</td>
<td>1 (4.4)</td>
<td></td>
</tr>
<tr>
<td>Years in Practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 20 years</td>
<td>7 (30.4)</td>
<td>697 (28.5)</td>
</tr>
<tr>
<td>&gt;20 years</td>
<td>16 (69.6)</td>
<td>554 (22.6)</td>
</tr>
<tr>
<td>Not listed</td>
<td></td>
<td>1198 (48.9)</td>
</tr>
<tr>
<td>Specialty (could select more than one)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 specialties were included in the survey question based on those recognized by the National Commission on Recognition of Dental Specialties and Certifying Boards. 5 specialties received responses and are listed below:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Dentistry</td>
<td>16 (66.7)</td>
<td>1787 (73)</td>
</tr>
<tr>
<td>Endodontics</td>
<td>2 (8.3)</td>
<td>69 (2.8)</td>
</tr>
<tr>
<td>Oral and Maxillofacial Surgery</td>
<td>1 (4.2)</td>
<td>115 (4.7)</td>
</tr>
<tr>
<td>Oral and Dentofacial Orthopedics</td>
<td>1 (4.2)</td>
<td>145 (5.9)</td>
</tr>
<tr>
<td>Periodontics</td>
<td>4 (16.7)</td>
<td>87 (3.6)</td>
</tr>
<tr>
<td>Insurance breakdown of patients avg.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employer-based plans</td>
<td>62.1%</td>
<td>Information not available</td>
</tr>
<tr>
<td>Medicaid or other state-based program</td>
<td>6.2%</td>
<td></td>
</tr>
<tr>
<td>Self-pay</td>
<td>29.8%</td>
<td></td>
</tr>
<tr>
<td>No charge/Charity</td>
<td>1.9%</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX A: Public Act No. 19-72 “AN ACT CONCERNING DENTAL PRACTITIONERS”

Substitute House Bill No. 7303

Public Act No. 19-72

AN ACT CONCERNING DENTAL PRACTITIONERS.

Sec. 11. (NEW) (Effective July 1, 2019) (a) As used in this section:

(1) "Point-of-service test" means diagnostic testing performed at the site where patients will receive care or treatment; and

(2) "HbA1c percentage" means the proportion of hemoglobin to which glucose is attached and measures the average circulating blood glucose level over the previous two to three-month period.

(b) A dentist licensed under chapter 379 of the general statutes may, during an office visit or prior to a procedure and with a patient's consent, administer an in-office point-of-service test to the patient to measure the patient's HbA1c percentage utilizing a finger-stick measurement tool if such patient is at an increased risk of diabetes and does not have a previous diagnosis of diabetes. A dentist who does not administer such test pursuant to this section shall not be deemed to have violated the standard of care for a dentist. The Commissioner of Public Health may adopt regulations in accordance with the provisions of chapter 54 of the general statutes to carry out the provisions of this section.

Approved July 8, 2019
APPENDIX B: Code D0411

D0411 and D0412 – ADA Quick Guide to In-Office Monitoring and Documenting Patient Blood Glucose and HbA1C Level

Introduction

Diabetes, in its various types, is one of the most common conditions and practicing dentists are likely to encounter it frequently. Diabetes is also a risk factor for periodontal disease.

This ADA guide is published to educate dentists and others in the dental community on coding for two unique in-office monitoring procedures pertinent to this chronic disease. The procedures reported with these codes can help dentists better manage patients with medical comorbidities by assessing their condition chair-side. Findings from these procedures can affect planned oral care treatment, and may also prompt dentists to refer patients who may need to be seen by their physicians for follow-up and management of the chronic condition.

The CDT Code Entries for These Procedures

Code D0411 was added to the CDT Code effective January 1, 2018 and the full published entry is:

D0411 HbA1c in-office point of service testing

Code D0412 was added to the CDT Code effective January 1, 2019 and the full published entry is:

D0412 blood glucose level test – in-office using a glucose meter

This procedure provides an immediate finding of a patient’s blood glucose level at the time of sample collection for the point of service analysis.

Why are these Procedures Needed?

Dentists are not expected to diagnose diabetes but in-office monitoring of patient blood glucose levels on an ongoing basis or immediately prior to treatment are appropriate activities. Findings from monitoring the patient’s glycemic control may prompt a dentist to amend the patient’s oral care treatment planning.

There are several factors associated with increased risk of diabetes, some of which may already be in their dental records, such as:

- Obesity or being overweight
- Ethnic background (diabetes happens more often in Hispanic/Latino Americans, African-Americans, Native Americans, Asian-Americans, Pacific Islanders, and Alaska natives)
- Sedentary lifestyle (exercise less than three times a week)
- Family history (parent or sibling who has diabetes)

A resource that helps identify patients who might be candidates for diabetes screening and steps involved in arriving at the final diagnosis is the Point-of-care prediabetes identification guide (click on hyperlink to open) prepared jointly by the American Diabetes Association, the American Medical Association, and the Centers for Disease Control and Prevention (CDC). For people who have not had a medical diagnosis of diabetes a self-administered risk assessment test can be used to identify high-risk individuals. The CDC’s test form (CDC Prediabetes Screening Test) is paper only that a patient may download and complete. The American Diabetes Association has form that can be completed either online or on paper (Type 2 Diabetes Risk Test).

According to the National Diabetes Statistical Report over 30 million people have diabetes and 84 million people have prediabetes. Further, the U.S. Preventive Services Task Force (USPSTF) recommends that

ADA American Dental Association®

America’s leading advocate for oral health
adults with treated or untreated hypertension (i.e., sustained blood pressure >135/80 mm Hg) should be screened for diabetes. Additional USPSTF information is available online at—

*Diabetes Mellitus (Type 2) in Adults: Screening* - Originally published on: January 13, 2014

If a person with diabetes or at risk for the condition is about to undergo a long complex dental procedure, it is important to know their current blood glucose level — and the D0412 procedure determines the patient’s blood glucose level at the time of sample collection. HbA1c measures the proportion of hemoglobin that is glycosylated (to which glucose is bound) and provides a summary measure of a patient’s average circulating blood glucose level over the previous 2 to 3 month period.

Even though the patient’s HbA1c percentage may indicate good glycemic control, glucose levels vary during the course of a day. Therefore the patient’s actual blood glucose level at the time of procedure delivery could be very low, or very high.

A dentist can determine, using the D0412 procedure, how the patient’s blood glucose level, may affect treatment scheduled for the day’s appointment.

- A glucose level below 70mg/dl is the clinical definition of hypoglycemia alert level, which means the patient is at risk of a hypoglycemic event during the procedure. Therefore the procedure ought not be initiated until the patient’s blood sugar level is in the acceptable range.
- A glucose level over 300 mg/dl could lead to delayed healing of the surgical site and severe infection. This suggests that elective surgical procedures be rescheduled and delivered when the patient’s circulating glucose level is in the acceptable range.

Information on in-office recognition of and action on diabetic emergencies – hypoglycemia or hyperglycemia – is on page 82 of the ADA publication The ADA Practical Guide to Patients with Medical Conditions, 2nd Edition (Copyright © 2016 American Dental Association). This manual may be ordered online [www.adacatalog.org](http://www.adacatalog.org) or by telephone 800-947-4746.

**Questions and Answers**

The following Questions and Answers are intended to provide readers with insight and understanding of both procedures and their reporting, including points to consider before offering either the D0411 or D0412 service to your patients.

1. What type of equipment, is needed for these in-office testing procedures?

   As dentists are not expected to diagnose diabetes, in-office monitoring of patient blood glucose levels on an ongoing basis or immediately prior to treatment may utilize “finger-stick” measurement tools. Neither of the two CDT Code entries specify the measurement tool used for the procedure. Selection of the appropriate tool is determined by the dentist.

   There are federal regulations to consider. Laboratories and providers performing in-office testing are regulated under the Clinical Laboratory Improvement Amendments of 1988 (CLIA). The dental office may require a “CLIA Certificate of Waiver” in order to perform blood glucose testing using CLIA waived test kits. Waived tests typically include systems cleared by the FDA for home use. Providers providing patient testing with a CLIA certificate of waiver must follow manufacturer’s instructions and perform testing only with test kits that have been assigned a “CLIA waived” status by the FDA.

2. How are these “finger-stick” procedures delivered?

   There are established protocols for acquiring and assaying the small sample of blood for a Point of Contact Test (POCT). Protocol steps include: a) finger selection; b) massaging, cleaning and drying the site; c) skin puncture with a lancet; d) wiping away the first blood before collecting the
Within dentistry there is no consensus that blood sugar monitoring is considered a standard of care. In fact the New Jersey State Board of Dentistry has explicitly stated that HbA1c screening is not presumed to be a standard of care. A dentist should provide a patient with sufficient information about the monitoring procedure, including its relevance to both oral and general health, so that she or he can make an informed decision.

7. How do I close the referral loop – informing the patient’s physician – of the finger-stick findings?
   The findings should be conveyed to the patient’s physician or appropriate health care provider. Before doing so be sure to have an information release form signed by the patient on file. These referrals must be tracked and documented. Failure to do so may lead to liability issues.

8. What should I do with the results if the patient does not have a physician or other health care provider who can act on the information?
   The patient should be informed of the screening’s findings, be directed towards resources containing more information, and encouraged to become a physician’s patient of record for their other health needs. These actions must be noted in the patient’s dental records, with appropriate follow-up when possible (e.g., next visit).

9. What components of the D0411 or D0412 procedure may be delegated to staff and which may only be performed by the dentist
   As with any procedure, the practitioner providing the service is determined by state law and licensure. Direct or indirect supervision by a dentist may, or may not, be a requirement.

10. What documentation should I maintain in my patient records, and what will be needed on a claim submission when reporting D0411?
    The patient’s records would include the same information about services provided as is done with other dental procedures – plus notations of the activities described in the answers to questions 7, 8 and 9 above, as applicable.
    A dental claim would be coded and completed in the same manner as other dental procedures (e.g., date of service, CDT code, full fee).

11. What dental benefit plan coverage – commercial or governmental – is anticipated?
    As with any procedure documented with a CDT Code there is no guarantee of coverage by a patient’s dental benefit plan.

12. What factors should I consider when determining my full fee for the D0411 or D0412 service?
    Dentists and other practitioners in the dental community acquire their skills and expertise through training and experience. It is up to each individual to determine the value of their time and the time required to provide the service when determining their full fee. Other unique factors such as the cost of acquiring and maintaining a supply of the finger-stick test materials may also be considered.

Questions or Assistance?

Call 800-621-8099 or send an email to dentalcode@ada.org

Notes:

- This document includes content from the ADA publication – Current Dental Terminology (CDT) ©2018 American Dental Association (ADA). All rights reserved.
- Version History
sample without "milking the finger" site; e) placing the sample into the analyzing device; and f) reading the results.

Every blood donor has experienced skin puncture with a lancet. There can be some variations in steps e) and f), dependent on the test device used.

3. What do the D0411 or D0412 procedure results indicate?

For the D0411 procedure the analyzing device reports the percentage of hemoglobin that is glycosylated. There is a recognized range of percentages that is used to indicate whether the patient’s HbA1c is considered to be in the normal, prediabetes or diabetes range, as illustrated:

![HbA1c Test Results Continuum](image)

For the D0412 procedure the analyzing device reports blood glucose as a milligrams per deciliter (mg/dl) figure. There is a recognized range of hypoglycemic (low) through hyperglycemic (high) blood sugar levels, as seen in this high level illustration:

![Blood Glucose Test Results Continuum](image)

More information about the above results continuums (e.g., different levels of hypoglycemia and interventions) is published by the American Diabetes Association in "Standards of Medical Care in Diabetes—2019 Abridged for Primary Care Providers".

4. Are there rules or regulations regarding in office HbA1c testing documented with CDT code D0411, or in-office blood-glucose level testing documented with CDT code D0412?

Yes, be sure to check your state’s Dental Practice Act to determine if testing is within the scope of your license. There are also federal and state regulations that may affect your business decision to provide this service. Remember the purpose of these tests is to understand the risk of glycemia related complications at the time of the scheduled appointment and not to render a diagnosis of diabetes.

5. What is HbA1c?

Hemoglobin A1c, also known as glycated hemoglobin, is a measure of the amount of glucose attached to the hemoglobin in red blood cells and is directly proportional to the average circulating glucose levels. Patient fasting is not required prior to the HbA1c test.

6. What are a dentist’s ethical obligations to deliver these procedures to patients (e.g., all patients; those presenting with signs or symptoms or medical history)?

**ADA** American Dental Association
* America’s leading advocate for oral health
APPENDIX C: Prediabetes Risk Test

Prediabetes Risk Test

1. How old are you?

- Younger than 40 years (0 points)
- 40–49 years (1 point)
- 50–59 years (2 points)
- 60 years or older (3 points)

2. Are you a man or a woman?

- Man (1 point)
- Woman (0 points)

3. If you are a woman, have you ever been diagnosed with gestational diabetes?

- Yes (1 point)
- No (0 points)

4. Do you have a mother, father, sister, or brother with diabetes?

- Yes (1 point)
- No (0 points)

5. Have you ever been diagnosed with high blood pressure?

- Yes (1 point)
- No (0 points)

6. Are you physically active?

- Yes (0 points)
- No (1 point)

7. What is your weight category?

(See chart at right)

Write your score in the boxes below

<table>
<thead>
<tr>
<th>Height (in)</th>
<th>Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4'10&quot;</td>
<td>119-142</td>
</tr>
<tr>
<td>4'11&quot;</td>
<td>124-147</td>
</tr>
<tr>
<td>5'0&quot;</td>
<td>128-152</td>
</tr>
<tr>
<td>5'1&quot;</td>
<td>132-157</td>
</tr>
<tr>
<td>5'2&quot;</td>
<td>136-163</td>
</tr>
<tr>
<td>5'3&quot;</td>
<td>141-168</td>
</tr>
<tr>
<td>5'4&quot;</td>
<td>145-173</td>
</tr>
<tr>
<td>5'5&quot;</td>
<td>150-179</td>
</tr>
<tr>
<td>5'6&quot;</td>
<td>155-185</td>
</tr>
<tr>
<td>5'7&quot;</td>
<td>159-190</td>
</tr>
<tr>
<td>5'8&quot;</td>
<td>164-196</td>
</tr>
<tr>
<td>5'9&quot;</td>
<td>169-202</td>
</tr>
<tr>
<td>5'10&quot;</td>
<td>174-208</td>
</tr>
<tr>
<td>5'11&quot;</td>
<td>179-214</td>
</tr>
<tr>
<td>6'0&quot;</td>
<td>184-220</td>
</tr>
<tr>
<td>6'1&quot;</td>
<td>189-226</td>
</tr>
<tr>
<td>6'2&quot;</td>
<td>194-232</td>
</tr>
<tr>
<td>6'3&quot;</td>
<td>200-239</td>
</tr>
<tr>
<td>6'4&quot;</td>
<td>205-245</td>
</tr>
</tbody>
</table>

| 1 Point | 2 Points | 3 Points |

You weigh less than the 1 Point column (0 points)

Total score: [ ]

If you scored 5 or higher

You are at increased risk for having prediabetes and are at high risk for type 2 diabetes. However, only your doctor can tell for sure if you have type 2 diabetes or prediabetes, a condition in which blood sugar levels are higher than normal but not high enough yet to be diagnosed as type 2 diabetes. Talk to your doctor to see if additional testing is needed.

If you are African American, Hispanic/Latino American, American Indian/Alaska Native, Asian American, or Pacific Islander, you are at higher risk for prediabetes and type 2 diabetes. Also, if you are Asian American, you are at increased risk for type 2 diabetes at a lower weight (about 15 pounds lower than weights in the 1 Point column). Talk to your doctor to see if you should have your blood sugar tested.

You can reduce your risk for type 2 diabetes

Find out how you can reverse prediabetes and prevent or delay type 2 diabetes through a CDC-recognized lifestyle change program at https://www.cdc.gov/diabetes/prevention/lifestyle-program.

Adapted from Bang et al., Ann Intern Med 151:775-783, 2009. Original algorithm was validated without gestational diabetes as part of the model.
APPENDIX D: Recruitment Flyer

RESEARCH STUDIES SEEKING PARTICIPANTS

Recruiting Licensed Practicing Dental Providers in Connecticut to participate in an anonymous survey

Examining Opportunity in the Dental Community to Identify Prediabetes

We are from UConn Health doing research pertaining to new legislation passed in Connecticut allowing dental providers to administer an in-office point-of-service test to measure a patient's hemoglobin A1c (HbA1c) percentage. This finger stick test measures average blood sugar levels over the past 3 months.

This survey is anonymous, and we will not collect any identifiable information (name, age, practice name, address).

This study will help us learn about:

- Awareness of the new legislation in Connecticut
- Current utilization of the in-office point-of-service HbA1c test
- Perceptions of screening patients for prediabetes in office

This is a brief survey (17 questions) and should take approximately 5-10 minutes to complete. Risks are minimized by anonymized responses and there are no direct benefits associated with this research.

If you would like more information, you can contact Helen Swede at (860) 679-5568 or via email at swede@uchc.edu or Kirsten Carew at (860) 777-5100 or via email at carew@uchc.edu.

QR Code will link to anonymous survey:
APPENDIX E: A1C test kit example

A1CNow+ System (Monitor w/20 Strips) PTS Diagnostics (Diabetes)
by A1CNow+
⭐⭐⭐⭐⭐ 68 ratings | 59 answered questions
Amazon’s Choice for “a1c now”

Price: $182.00 & FREE Shipping

You can get 5% back on all Amazon.com purchases with the Amazon Prime Store Card. No annual fee.

Not eligible for Amazon Prime.

Eligible for return till 2020-05-31 and restocking fee may apply

• Expiration dates vary. Please ask a question about the product for current dates.
• Detects hemoglobin A1C with results in 5 minutes
• No fasting required
• No doctors prescription required
• CLIA waived for home and professional use