CE Course:
Assessing and Treating Patients with Diabetes in Dental Settings

By: Mihaela Popa , RDH, MBA & Tracy Ross, RDH, M.Ed.

Educational Objectives

By the end of this course the learner will be able to:

- Describe diabetes mellitus and its prevalence in the United States.
- Differentiate between the pathophysiology of type 1, 1.5, 2 and gestational diabetes.
- Explain the links between (uncontrolled) diabetes and periodontal diseases.
- Identify the steps for prediabetes and diabetes risk assessment.
- Determine the appropriate protocols to prevent and address a medical emergency during dental treatment for a patient with diabetes mellitus.

INTRODUCTION

For years, assessing the risk for caries, oral pathology and periodontal diseases has been recommended and is viewed by many as the standard of care in dentistry. With the emerging interprofessional relationship between dentistry and medicine, coupled with the strong possibility of a bidirectional relationship between diabetes and periodontal disease[1], it is appropriate for dental professionals to consider performing a simple glucose screening for all new patients and those who are periodontally involved.

Diabetes Mellitus

Diabetes mellitus (DM) is the seventh leading cause of death in the United States. The 2017 National Center for Chronic Disease Prevention and Health Promotion National Diabetes Statistics Report estimated that 30.3 million (9.4%) people have diabetes, 23.1 million have been diagnosed and 7.2 million are undiagnosed in the United States.[2] Diabetes affects some racial/ethnic groups more than others; a high predilection for American Indian/Alaska Native, Black (non-Hispanic), Hispanic and Asian more so than for non-

Hispanic whites. Diabetes incidence among adults in the USA has been decreasing since 2008, however, diabetes prevalence continues to rise. This can be explained by the fact that adults with diabetes live longer due to better disease management practices. More than 4,100 diabetes self-management education and support programs were offered in the United States in 2016.[3] These staggering numbers suggest that every dental office has patients with some form of diabetes either diagnosed or undiagnosed.

Diabetes Pathophysiology and Classification

Diabetes Mellitus, a group of pancreatic metabolic diseases, is defined by hyperglycemia due to a defect in insulin production by the pancreatic β-cells, limitations in the ability for the body to use insulin effectively, or complications that include both processes.[5]

In a healthy individual, ingested carbohydrates are broken down into simple sugars such as glucose. The glucose passes from the digestive system into the bloodstream; when the blood glucose levels increase, the pancreatic β-cells release insulin. Insulin acts as a key, binding to the receptors on the target cells and allowing glucose molecules to enter the target cells providing them with much needed energy.[4]

There are many classifications of diabetes, however the following four are the most prevalent. Type 1 diabetes, formerly known as juvenile diabetes or insulin dependent diabetes, results from damage to the β-cells of the pancreas causing a total lack of insulin production. In addition, there is a presence of autoantibodies detected with a blood test. These antibodies are proteins that cause an autoimmune response against pancreatic β-cells definitively marking type 1 diabetes an autoimmune disorder. Type 1 diabetes is typically diagnosed early in life with symptoms that include excessive thirst (polydipsia), excessive urination (polyuria) and excessive hunger (polyphagia). In addition, the patient

might experience unexplained weight loss, xerostomia, blurred vision and lethargy;[5] about one-third of the cases can present with diabetic ketoacidosis.[6] Diabetes type 1 accounts for approximately 5-10% of those diagnosed with diabetes and it can also present later in adult life, usually without the classical symptoms mentioned above.[6]

Type 2 diabetes, formerly known as non-insulin dependent diabetes, is caused by limitations of the body to effectively utilize insulin. Type 2 diabetes is far more common, accounting for approximately 90-95% of all cases and has an insidious onset. There is an absence of autoanti-bodies with type 2 diabetes. Type 2 diabetes can go undia-gnosed for many years and can affect adults as well as children and adolescents.[6]

Gestational diabetes (GDM) can be discovered around the 24th week of pregnancy. This type of diabetes usually resolves itself once the pregnancy has ended, however, women who experience gestational diabetes are more likely to develop type 2 diabetes later in life.[6]

Another classification that is becoming more understood is type 1.5 or Latent Autoimmune Diabetes in Adults (LADA). This form of diabetes is slow to progress like type 2 diabetes, however, it presents with the autoantibodies like type 1. LADA is being understood to be a slower progressing late onset type 1 diabetes that can be misdiagnosed as type 2. Approximately 10% of patients with diabetes have type 1.5 making it the second most common form of diabetes in America. Because of the slow progression of type 1.5, insulin therapy is not always indicated in the first months or years of diagnosis. [7]

Diabetes Risk Factors

A common risk factor for type 2 diabetes includes a first degree family history. Other risk factors include high-risk race/ethnicity (African American, Hispanic/Latino, Native American, Asian American and Pacific Islander), age (≥ 45 years), history of cardiovascular disease, hypertension or therapy for hypertension, high cholesterol levels, lack of physical activity, poor diet, obesity (≥25kg/m^2 or more than ≥23kg/m^2 in Asian Americans), history of GDM or delivery of a baby weighing > 9 lbs, polycystic ovarian syndrome or acanthosis nigricans.[5,6] The American Association of Clinical Endocrinologists added to these risk factors antipsychotic therapy for schizophrenia and/or severe bipolar disease, chronic glucocorticoid exposure, sleep disorders in the presence of glucose intolerance including obstructive sleep apnea, chronic sleep deprivation and night-shift occupation.[8]

Cardiovascular disease occurs more in diabetic patients than in non-diabetic patients and at a younger age than non-diabetics.[9] Hypertension is an important risk factor that when combined with type 2 diabetes can significantly raise the risk for a myocardial infarction and stroke.[10] Because hypertension is a modifiable risk factor for cardiovascular disease associated with diabetes mellitus it should be monitored at every dental visit. In November 2017, the American College of Cardiology and American Heart Association task force on clinical practice guidelines announced new blood pressure targets and treatment recommendations for hypertension (Table 1). The definition of high blood pressure is now any systolic pressure over 130 mm/Hg and any diastolic pressure over 80 mm/Hg.[11] The new 2017 blood pressure guidelines might open up a new category of patients being at risk for developing diabetes.

Table 1: New Blood Pressure Guidelines[11]

Category	Systolic		Diastolic
Normal	<120 mmHg	and	<80 mmHg
Elevated	120-129 mmHg	and	<80 mmHg
Hypertension Stage I	130-139 mmHg	or	80-89 mmHg
Hypertension Stage II	≥140 mmHg	or	≥90 mmHg

Diagnostic Tests for Diabetes

The Expert Committee on Diagnosis and Classifications of Diabetes Mellitus, through years of analysis and research has set the standards for understanding the results of the different forms of glucose testing and publishes them every year in the month of January. The results were based upon elevated glucose levels and its correlation with advancement of retinopathy. The committee recognized a level of diabetes that showed blood glucose levels higher than normal, but not high enough to diagnose diabetes. This classification is termed "prediabetes."[6]

Because of the lack of insulin, or insulin resistance, the body cannot break down the glucose efficiently. Therefore, glycemic levels must be monitored constantly to ensure the diabetes is managed properly. Fasting plasma glucose (FPG), 2-h plasma glucose (2-h PG) as part of Oral Glucose Tolerance Test (OGTT) and glycated hemoglobin assay (HbA1c or simply A1c) are the main tests used for prediabetes and diabetes diagnosis and for monitoring the disease management (Table 2). FPG is a blood test performed

after 8-h of fasting. OGTT is also completed after 8-h of fasting but followed by 75g of glucose intake. The blood glucose levels are repeated after specific time intervals and can take up to 2 hours to complete. These tests reflect only the blood glucose levels at the time the blood sample was drawn.[6,12]

Table 2: Diabetes Tests Values used for Prediabetes and Diabetes Diagnosis[6]

Blood Glucose Test Type	Healthy/ Normal Values	Prediabetes	Diabetes
Fasting Plasma Glucose (FPG) (8 hours fasting)	< 100 mg/dL	100-125 mg/dL	≥126 mg/dL
Oral Glucose Tolerance Test / 2-Hour Plasma Glucose (2h-PG)	< 140 mg/dL	140-199 mg/dL	≥200 mg/dL
Hemoglobin A1c (HbA1c)	< 5.7%	5.7-6.4%	≥6.5%

Hemoglobin is a protein component of the blood that carries oxygen to all parts of the body. Glucose attaches irreversibly to the hemoglobin and glycates. Because red blood cells survive approximately 120 days, this glycated hemoglobin can be measured in the form of A1c to identify a two to three month average of blood glucose levels. The A1c is calculated into a percentage.[12] Patients with prediabetes and diabetes should be encouraged to have the test repeated every 3-6 months.[6] A1c values between 5.7% and 6.4% indicate prediabetes while values of 6.5% and higher indicate the presence of diabetes. Since A1c values might be challenging for patients to understand, American Diabetes Association recommends converting the A1c into estimated average glucose (eAG) which is expressed in the same unit of measurement, mg/dL, as the glucose test the patients perform at home (Table 3).[12,13]

The diagnosis for prediabetes or diabetes is established by the medical doctors and it is based on repeating several tests. Different tests might be appropriate for different patients.[6] While A1c is the test of choice for most patients, it has some limitations. A1c test is not recommended for patients with high red blood cell turnover such as sickle cell disease, pregnancy (second and third trimester), hemodialysis, recent blood loss, transfusion, or erythropoietin therapy.[6,12]

Bidirectional Relationship

The relationship between periodontal disease and diabetes has been confirmed through research over the last 50 years. Many research reviews and meta-analyses reports confirm that patients with diabetes, especially those with poorly controlled blood glucose levels, are at a higher risk for periodontitis and tooth loss.[14-17] The research does not reveal as clearly the effects periodontal disease may have on diabetes. However, there have been studies on the impact proper periodontal treatment has on A1c levels. For instance, in one study, a small sample group of 36 individuals with type 2 diabetes were treated for periodontal disease during an 18 month period. A control group of 36 people with type 2 diabetes who were matched for parameters received no therapy. Over a nine month observation period there was an increase glycemic index in the control group of 6.7% whereas the treatment group improved

Table 3: The Relationship between Hemoglobin A1c and Estimated Average Glucose (eAG)[13]

A1c (%)	eAG (mg/dL)
5	97
5.5	111
6	125
6.5	140
7	154
7.5	169
8	183
8.5	197
9	212
9.5	226
10	240
10.5	255
11	269
11.5	283
12	298
12.5	312
13	326
13.5	341
14	355
14.5	369
15	384

by 17.1%. Even though this study included a small sample population, it could be concluded that periodontal treatment has a positive impact on glycemic control.[18] Additionally, a meta-analysis of five studies reviewed and analyzed 371 patients with periodontitis and type 2 diabetes and their change in A1c levels after periodontal therapy was performed. All five studies described that A1c did improve after therapy for at least three months.[19]

Although diabetes is not responsible for causing periodontitis, it is known to exacerbate it. When the periodontium is inflamed, the neutrophils release matrix metalloproteinase-8 (MMP-

8), an enzyme responsible for destruction of type I and type III collagen fibers of the periodontium. Research has shown that patients with diabetes have higher levels of MMP-8 than patients without diabetes, and therefore they are at higher risk for developing periodontal disease.[20]

More studies will certainly need to be performed, but this evidence suggests that poorly controlled diabetes, individuals with undiagnosed diabetes and individuals with periodontal disease can be educated and helped significantly with appropriate periodontal therapy treatment, motivational interviewing for a healthier lifestyle, reducing modifiable risk factors, and medical management to improve their physical and dental health.

Dental Team's Role

The dental team's role should include not only caring for patients diagnosed with diabetes, but also identifying the patients who are unaware of their increased blood glucose levels. In 2015, 7.2 million adults over 18 years of age in the United States were undiagnosed with diabetes, while 84.1 million had prediabetes.[1] Numerous studies have indicated that about 30-55% of asymptomatic patients with one or two risk factors for developing type 2 diabetes and who agreed to have their A1c checked in a dental setting had A1c levels consistent with prediabetes and 8% had A1c levels consistent with diabetes.[21-22] As of January 1, 2018, the American Dental Association has introduced CDT code D0411 – HbA1c in-office point of service testing.[23] The A1c test can now be performed in a dental setting utilizing a A1c point-of-care (POC) instrument certified by National Glycohemoglobin Standardization Program (NGSP).[23,24] "Accuracy, precision, ease of use, and price, among other considerations" should be taken into account when selecting an A1c POC instrument for office use.[24]

Asymptomatic Adult Patients

During medical history review, if asymptomatic adult patients present with one or two type 2 diabetes risk factors (overweight, family history of diabetes, etc) a risk assessment screening should be performed.[23] Figure 1 illustrates a proposed protocol for prediabetes and diabetes screening in a dental setting, which could be performed within 10 minutes following the patient's informed consent. On the American Diabetes Association website, a free type 2 diabetes risk assessment test is available in both English (Figure 2) and Spanish.[25] This risk assessment test can be performed to

determine if the patients are low or high risk. For patients whose score indicates high risk, a A1c POC test can be performed chair-side with the result being available within 5 minutes.[26] If the A1c test score is ≥8% the treatment should be postponed and a medical clearance should be requested for that patient. If A1c values are < 8.5 % but >5.7%, a glucose test can be administered to determine the glucose level at that specific moment in time to prevent a possible medical emergency. All patients with A1c values >5.7% should be provided with referrals to their primary care physicians or medical clinics for further investigation. A pilot study of A1c chairside screening protocol indicated that having the patients, the periodontists and the dental hygienists signing the referral resulted in more than half of the patients scheduling a follow-up care within 2 weeks.[26]

Figure 1: Proposed Protocol for Assessing Prediabetes and Diabetes in Dental Setting
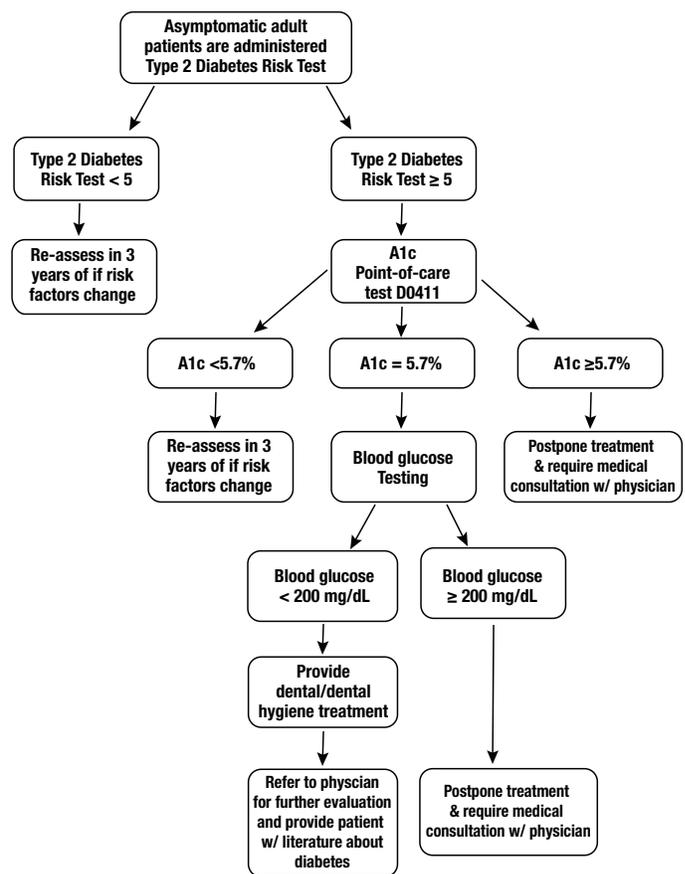
Figure 2: Type 2 diabetes risk assessment test

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Adult Patients with Diabetes

During the medical history review it is prudent to ask the patients with diabetes the results of their most recent A1c. The dental professional should always inquire about their medications including whether there are any changes in dosage, if they are taking the medications regularly, when they last took their medications, last time they ate and what they ate.[27,28] (Table 4) Discovery of this information can help the clinicians decide if patients can safely receive dental hygiene therapy at that moment, or if they need to stabilize their blood glucose levels first.[27]

Patients with diabetes can be on different regimens of medication to help control their condition.[29] As part of the assessment procedure, dental clinicians should also review the side effects of any medications the patients are taking[27] as some (glucocorticosteroids, thiazide diuretics and atypical antipsychotics) could increase the risk for developing diabetes.[29] Sometimes, even though patients are compliant with their medication(s) and lifestyle recommendations (diet, exercise), A1c levels consistent with controlled (A1c <7%) or moderately controlled levels (A1c between 7% and 8%)[30] cannot be

> **"I had a patient I'd seen** in my office every 3-4 months for close to 10 years. His oral hygiene was poor with heavy plaque and bleeding with periodontal pockets consistently ranging from 3-5 mm. He was in his late 30's when I began to treat him, was of low income status, had a slower mentality, and was not interested in changing his oral hygiene habits at home. One day he came in and, when reviewing the health history, he mentioned his medical doctor told him his blood sugar was elevated and recommended a low sugar diet. Once I started scaling, I noticed lower plaque levels and less gingival bleeding. By simply changing his diet he had, to some degree, improved his oral health.
>
> This patient sparked my interest to learn more about how diabetes affects the oral cavity, periodontal status and overall health. My initial research led me to understand how many Americans are walking around with some form of hyperglycemia without even knowing it. With a simple questionnaire and the HbA1c available for chairside assessment, I asked myself, wouldn't it be prudent for dental hygienists to assess glycemic levels for those patients who present at higher risk? Just as taking vital signs for patients has become a routine assessment, so can assessing for this potentially extremely damaging disease."
>
> ~ Tracy Ross, RDH M.Ed

Table 4: Follow-up Questions for Patients with Diabetes[27,28]

✓ When were you diagnosed with diabetes?

✓ What type of diabetes do you have?

✓ Do you have any diabetes-related complications?

✓ Would you say your diabetes is well controlled?

✓ What was your last blood glucose test? What was your last A1c result and when was it last checked?

✓ What medication are you taking to manage your diabetes? Or has your medication or dosage have changed since your previous visit?

✓ Are you taking your medication regularly? Did you take it today?

✓ Did you eat today? What did you eat and when?

achieved.[31] In these cases, the oral care providers should work closely with the patient's medical team to determine what the safest protocols are for those patients.[27]

Medical Emergency Recognition and Management

Medical emergencies that can occur in the dental setting related to diabetes include hyperglycemia, ketoacidosis and hypoglycemia reactions. Hyperglycemia, high blood sugar, is a rare but serious emergency. Hyperglycemia may occur with people who have a higher demand for insulin such as those who lack exercise or have gained weight in short a period of time. It could also develop with those who are undiagnosed for diabetes, or those who are diagnosed but are neglectful with their therapeutic regimens. The development of hyperglycemia is relatively slow so signs and symptoms are not readily noticeable but eventually, if untreated, could lead to unconsciousness. Clinical signs of severe hyperglycemia include hot, dry skin, a bright red color to the face and signs of dehydration.[27]

As the glucose levels increase and insulin is not available to metabolize it, the cells burn fat instead of glucose for energy and ketones are formed in the blood resulting in severe metabolic acidosis and causing Kussmaul's

respirations. These are deep, labored respirations that are often accompanied with fruity or sweet smelling breath indicative of the high levels of circulating blood glucose. Diabetic ketoacidosis is a life threatening emergency that needs medical attention.[27]

Medical treatment for hyperglycemia is the administration of insulin to help stabilize metabolism. The patient should be placed in a supine position with 6 liters of oxygen administered. Emergency rescue teams should be activated, vital signs monitored, and basic life support provided as needed. The patient will be transported to the hospital for definitive diagnosis and treatment.[27]

Hypoglycemia is more likely to occur in the dental office. It can affect both diabetic and non-diabetic individuals. If the blood glucose level falls below 50mg/dL in adults, or 40 mg/dL in children, loss of consciousness can occur fairly rapidly unless proper management is taken. Patients with diabetes may take their medications in the morning and then rush to their dental appointment without eating to avoid being late, increasing their risk of hypoglycemia during the appointment. Signs of hypoglycemia include mental confusion, extreme hunger, slurred speech, skin that is cold, wet and sweating and agitation.[27]

Emergency treatment for hypoglycemia is the administration of 3 grams of glucose. Position the patient in the supine position if the patient has lost consciousness. If the patient is still conscious, position them in any position they find most comfortable. Vital signs should be monitored and 3-4 ounces of oral carbohydrates in the form of glucose tablets, fruit juice, cake icing, soft drinks or candy bars should be administered every 10 minutes until the symptoms subside.[27]

To best prevent a hypoglycemic emergency, scheduling mid-morning appointments for those with diabetes better ensures that their proper medication and meal regimen will be followed. Always ask the patient if they ate and took their medications before the appointment. If they ate, but did not take their medication and this is a normal pattern for them, dental treatment can be performed without concern of a hyperglycemic event. If they took their prescribed medications but did not eat, a simple blood glucose test should be given and a glucose/sugar source should be administered if blood glucose is < 70.[27]

"Last summer, in a casual conversation, my mom shared with me a few things about our family history. Both her parents have passed away from complications of type 2 diabetes; my grandfather was going blind and, following, a tractor accident, refused to get any medical help as he did not want to spend the rest of his life without one of his most precious senses, his sight. My grandmother, on the other hand, lived many years with complications from diabetes (loss of sight, dementia), which required my mom spending 10 years of her life caring for her mother until she passed away. She added that her sister is struggling with diabetes and her average glucose levels were over 200mg/dL, sometimes reaching levels of 300mg/dL. With such a strong family history, I realized my mother was also at high risk for developing diabetes.

I took her to a primary care physician requesting blood tests to determine her risk for diabetes. Unfortunately, the blood tests (A1c levels and fasting plasma glucose test) indicated she was pre-diabetic. We had a serious conversation about the disease and how to stall it as long as possible. She understood, made some life style changes by modifying her diet and walking 30 minutes about three days a week. Three months later her A1c levels dropped from 6.0% to 5.9%, very close to a normal A1c (5.6%). She was so excited she became even more motivated, increasing her activity level walking 30-60 minutes for five days a week, eating smaller portions. When we reevaluated the A1c three months later, to our disappointment, it was the same level, 5.9%.

As a hygienist and educator, I started looking for answers. In my research, I learned the medication she was taking was increasing her blood glucose. Working with the primary care physician to decrease her medication, hopefully my mother's blood glucose will continue to decrease.

Through this journey I discovered many tools that we, as dental professionals, can use to identify patients at risk for diabetes, or even with diabetes, and refer them to medical professionals for further evaluation and hopefully change their lives."

~ Mihaela Popa, RDH, MBA

Conclusion

Dental teams can play an important role in assessing patients for elevates blood glucose levels and making the appropriate referrals. Using the assessment risk test, performing the A1c POC test when appropriate, and raising the patient's awareness about diabetes seems to the next step for dentistry.

Resources/References

About the Authors

Mihaela Popa, RDH, MBA, is an Associate Professor in the dental hygiene program at West Coast University in Anaheim, CA. Mihaela's interests include radiology, CAMBRA and international community outreach. Her outreach interests have taken her to Nepal and the Republic of Moldova and she is looking forward to future opportunities abroad. Mihaela is a member of the dental hygiene honor society, Sigma Phi Alpha, CDHA, ADHA and ADEA.

Tracy Ross, RDH, M.Ed has been in dental hygiene education since 2011. She holds a Master's in Higher Education which has helped her see education through the eyes of the new generation. Currently, at West Coast University, she facilitates blended learning courses in General Pathology, Immun-ology and Medical Terminology, and Medically Compromised Care and Emergencies. She is on the student regional council for California Dental Hygienists' Association and hold a board position as student liaison for Orange County Dental Hygienists' Association.

Home Study Correspondence Course

"Assessing and Treating Patients with Diabetes in Dental Settings"

Circle the correct answer for questions 1-10

1. Which of the following is True about diabetes in the United States?
   a. Diabetes is the second leading cause of death
   b. Diabetes affects some racial/ethnic groups more than others
   c. Diabetes prevalence is decreasing
   d. Adults with diabetes have shorter life expectancies than previously

2. Which form of Diabetes affects over 90% of the population?
   a. Type I
   b. Type I.5
   c. Type 2
   d. Gestational

3. Gestational diabetes is characterized by which of the following?
   a. It appears during the first trimester
   b. It is always insulin dependent
   c. It predisposes for Type 2 diabetes later in life
   d. It is an autoimmune disorder

4. Which of the following are risk factors for Type 2 diabetes?
   a. Family history
   b. Obesity
   c. History of cardiovascular disease
   d. Hypertension
   e. All of the above

5. Which of the following measures a two to three month average for glucose levels?
   a. A1c
   b. FPG
   c. OGTT

6. Multiple research studies confirm that patients with diabetes are at higher risk for periodontitis and tooth loss.
   a. True
   b. False

7. Dental patients who exhibit signs of mental confusion, hunger, agitation, slurred speech and cold wet skin most likely are experiencing:
   a. Hyperglycemia
   b. Hypoglycemia
   c. Cardiovascular event
   d. Heat Stroke

8. Emergency treatment for hypoglycemia should include the monitoring of vital signs and_____.
   a. The administration of insulin
   b. The administration of glucose/sugar
   c. Administering the chairside A1c test
   d. Performing an assessment risk test

9. Besides reviewing current medications, prevention of a hypoglycemic emergency includes which of the following?
   a. Ask the patient when they last ate and what they ate
   b. Ask the patient if they took their medication before they came
   c. Ideally schedule appointments for mid-morning
   d. All of the above

10. If asymptomatic adult dental patients present with one or two risk factors for Type 2 diabetes, what is the recommended course of action?
   a. Refer them to a physician
   b. Perform a risk assessment test
   c. Administer the chairside A1c test
   d. Perform a dietary analysis

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Keep a copy of your test for your records.