

# Continuing Education

## Sweet Skills for Helping Patients with Diabetes

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## EDUCATIONAL OBJECTIVES

1. Discuss the role of diabetes progression in causing further complications
2. Compare the differences between normal hemoglobin A1c and blood glucose goal values with the altered goal values for a patient with diabetes
3. Educate patients on the correct use of glucometers and other testing supplies
4. Compare common anti-hyperglycemic agents that are used in type 2 diabetes
5. Assess and interpret reasons for patient non-adherence
6. Identify common vaccines recommended for patients with diabetes

## INTRODUCTION

Diabetes is a metabolic disorder resulting from the abnormal metabolism of foods that we eat. It is characterized by elevated blood sugar, which is often called hyperglycemia. Too much sugar (also referred to as glucose) in the blood can lead to many disabling complications.

The incidence of diabetes continues to increase each year with numbers having tripled since 1980.<sup>1</sup> According to the Centers for Disease Control and Prevention (CDC) in 2012, 21.3 million Americans have been diagnosed with diabetes.<sup>1</sup> People are now living longer with the disease partly due to improvements in healthcare over the last three decades.<sup>1</sup> Complications, although still high, are trending downward.<sup>1</sup> The CDC estimates that 8.1 million Americans still remain undiagnosed and 86 million Americans have pre-diabetes.<sup>1</sup> Pre-diabetes indicates that blood sugar levels are higher than normal but not high enough to be diagnosed as diabetes. Pre-diabetes increases a person's risk of developing diabetes and having a stroke and heart disease.<sup>2</sup> Medical costs associated with diabetes are nearing 200 billion dollars annually.<sup>3</sup> Not only can this disease lead to debilitating complications, it is also leading to debilitating consequences on our health system.

There are two types of diabetes. Although they have different pathways leading to insulin dysfunction, both types can result in hyperglycemia when uncontrolled. Insulin is a hormone that is made by specialized cells (beta cells) in the pancreas. It helps transport glucose into other cells in the body to be used as energy. Problems result when glucose cannot enter the cell and remains in the blood vessels. In type 1 diabetes, beta cells no longer make insulin. Therefore, there is no insulin to aid in glucose transport into the cell. The onset of type 1 diabetes is rapid and usually occurs during childhood. In type 2 diabetes, insulin is made but the cell is resistant to insulin. Without the cell's response to insulin, glucose will remain in the blood vessels. The body begins to produce more and more insulin as the disease progresses to try and overcome the cell's resistance. The onset of type 2 diabetes is gradual and most commonly occurs in adulthood; however, an increase in the rate of childhood obesity has led to a rise in the number of children

diagnosed with type 2 diabetes mellitus. Type 2 diabetes is most common as it comprises 90-95% of people diagnosed.<sup>2,4</sup>

The progression to type 2 diabetes can be relatively unnoticeable since it occurs over a long period of time. There are several risk factors that increase a person's likelihood of developing diabetes. Obesity or a lack of physical activity can result in an unhealthy amount of extra weight and stress on the body. Also, increasing age and family history of diabetes increases the risk. Disease states that change the integrity of the blood vessels' structure, such as high blood pressure and high cholesterol, can predispose a person to diabetes.<sup>1,2,4</sup>

Complications arise when blood glucose remains elevated and uncontrolled. Examples include heart disease (heart attack and stroke), kidney disease, and gum disease which result from vessel damage caused by elevated glucose. Diabetes can also decrease blood flow to the arms and legs resulting in nerve damage. This can cause numbness leading to injury or infection.<sup>2,4</sup>

## BLOOD GLUCOSE TESTING AND GLYCEMIC ASSESSMENTS

As mentioned previously, diabetes is a metabolic disorder resulting from the abnormal metabolism of foods that we eat. Our body does not properly process the glucose that comes from our diet or the glucose produced in our bodies. Whether a patient has diabetes or not, two values are used to assess a patient's blood glucose control. The first value is blood glucose, which is normally obtained from a blood sample, and the second value to consider is the hemoglobin A1c, or A1c for short. A1c testing is carried out by obtaining a blood sample from the patient and is most often performed by the patient's healthcare provider; however, home A1c tests are available. Here's what each of these values tell the patient:

- **Blood glucose:** Tells the patient what their blood glucose value is at that instant.
- **A1c:** Tells the patient about their glycemic control over the previous 3 months.<sup>5</sup>

## Blood Glucose Testing

Diabetic patients should monitor their blood glucose levels as directed by their healthcare provider. This is done at home by the patient. Glucometers are utilized to analyze the blood for the amount of glucose present at the time of testing. Though there are several glucometers available on the market, they all function similarly. Listed below are examples of common glucometers:

- Accu-Chek Aviva Blood Glucose Meter
- Freestyle Lite Blood Glucose Monitoring System
- Bayer Contour Next Blood Glucose Monitoring System
- Bayer Contour Next Ez Blood Glucose Monitoring System

When comparing glucometers, some differences are the size of the meter and results display (which can either make the results easier or harder to read), time to result, multiple test location options other than fingertips, and amount of memory for storage of test results. The most important detail of choosing a glucometer is determining if the patient's insurance covers the product. For instance, Blue Cross/Blue Shield may cover a different glucometer than Medicaid.

Patients also need lancets, test strips, and either alcohol swabs or soap and water when testing their blood glucose. The process for testing blood glucose is as follows:

1. Sterilize the area that will be tested to obtain the blood sample.
2. Insert the test strip into the glucometer to turn it on.
3. Prick the chosen area (side of fingertip, forearm, thigh, fleshy part of palm) with the lancet.
4. Wipe away the first drop of blood.
5. Allow a new drop of blood to form; patient may have to squeeze finger to help a new drop to form.
6. Place end of exposed test strip to drop of blood and allow capillary motion to take blood up into test strip (Normally, meters will beep when test strip has enough blood).

Other tips for testing blood glucose:

- Not all glucometers are exactly the same, so always read the owner's manual before using.
- Know the skin thickness of the area to be pricked; lancets are available in differing needle lengths so you can correlate the skin thickness to the needle length to maximize comfort<sup>6</sup>.

As mentioned earlier, A1c testing is normally performed by the patient's healthcare professional to allow for assessment and management of the patient's diabetes, but in-home A1c tests are available for patients to purchase at most pharmacies. The testing process is fairly similar to that

of testing for blood glucose. Bayer's A1cNow SELFCHECK® home testing kit comes with a descriptive step-by-step instructional diagram for testing your A1c at home:

1. Obtain blood sample from finger prick in blood collecting device (capillary tube).
2. Insert capillary tube into "shaker" filled with solution.
3. Shake the combined capillary tube and shaker.
4. Sit shaker aside and insert cartridge into the monitor.
5. Watch for "SMPL" (sample) on the monitor display and insert contents of the shaker.
6. Wait five minutes for results<sup>7</sup>.

A study with 110 patients was conducted to determine the accuracy of in-home A1c results when performed by patients.<sup>8</sup> The patients performed two separate A1c tests using the A1cNow SELFCHECK and was followed by a third test by a healthcare professional. A venous blood sample was taken to compare laboratory A1c results to those of the self-administered A1c tests. The results showed that patients were competent and precise at performing the test independently. Results also showed that the A1c results from the self-administered tests were similar to that of A1c results retrieved from the laboratory. With this being said, patients should always relay any results obtained from medical testing to their healthcare provider and should not adjust disease management based off of a self-administered test unless authorized by their healthcare provider.

## Normal and Target Values

Diabetic patients have different blood glucose and A1c goals than patients without diabetes. Also, blood glucose goals differ based on if the patient has eaten or not. Patients normally have their A1c tested every 3 months.<sup>4</sup> Table 1 below shows the differences in the glycemic goals for diabetic patients and normal patients:

Table 1<sup>49</sup>

Comparison of Glycemic Goals		
Value	Normal Patient	Diabetic Patient
A1c*	4.0-5.6%	<7.0%
Fasting/Pre-prandial** Blood Glucose	<100 mg/dL	80-130 mg/dL
Post-prandial*** Blood Glucose	<140 mg/dL	<180 mg/dL

\*Patients can have their A1c tested without regard to meals

\*\*Patients' fasting blood glucose values are determined when they test their blood glucose after not eating or drinking for 8 hours; pre-prandial blood glucose values are obtained right before meals. The glycemic goals for either scenario are the same.

\*\*\* Patients obtain post-prandial blood glucose values when they test their blood sugar within 2-hours after eating a meal.

## Referral Values

When patients without a diabetes diagnosis come into the pharmacy with either self-tested blood glucose values or even self-tested A1c values, a referral to the patient's primary care provider may be needed based on the results. The referral values are listed below:

### Pre-diabetes

- Fasting blood glucose of 100-125 mg/dL
- A1c of 5.7-6.4%

### Diabetes

- Fasting blood glucose  $\geq 126$  mg/dL
- Random blood glucose  $\geq 200$  mg/dL with classic symptoms of high blood glucose (increased urination, increased hunger, increased thirst, etc.)
- A1c of  $\geq 6.5\%$ <sup>4</sup>

*\*\*The above values are ONLY referral values and should be used to recommend that the patient see their primary care provider.*

## Emergency Room Referral

For patients with diabetes, the patient may need a referral if their blood glucose is too high (hyperglycemia) or too low (hypoglycemia). Patients with elevated blood glucose may be at risk for very serious, life-threatening conditions. Diabetic ketoacidosis (DKA) and hyperosmolar hyperglycemic state (HHS) are related to elevated blood glucose.<sup>10,11</sup> DKA occurs due to insulin insufficiency and an imbalance of hormones that are trying to compensate for the lack of insulin. The imbalance of hormones causes an increase in ketone production leading to an increase in the acidity of the body. In HHS, the kidneys are attempting to compensate for the high amounts of glucose in the blood through increased urination. The kidneys can only produce so much urine which allows glucose to buildup in the blood. Both complications are characterized by severe dehydration. Generally, type 1 diabetes mellitus patients are more prone to developing DKA and type 2 diabetes mellitus patients are more prone to developing HHS. The most common factor that leads to these life-threatening conditions is infection. The warning signs for each are similar: increased urination, increased hunger, increased thirst, weight loss, vomiting, and weakness. The key difference is that DKA patients' blood glucose is generally  $>250$  mg/dL and HHS patients' blood glucose is normally  $>600$  mg/dL. These patients should be directed to an emergency room for proper treatment.

Low blood glucose levels in a patient can be very serious and even life-threatening. Patients should know ways to prevent and treat low blood glucose.

## Prevention of low blood glucose

- Proper timing of administration of diabetic medications especially in relation to medications that should be taken with meals (Ex. short acting insulin, glimepiride).
- Meal planning can help prevent skipping meals.
- Planning meals, medication and blood glucose testing in relation to daily activities, such as exercising, that may lower blood glucose.
- Alcohol can actually lower the body's blood glucose so do not drink alcohol on an empty stomach.

## Treating low blood glucose

- When a patient notices symptoms of low blood sugar (shaky, light-headed, etc.), they should check their blood glucose to know what level is their "low." Blood glucose levels of  $<70$  mg/dL are more serious.
- After checking their blood glucose, a "quick-fix" sugar source should be consumed such as a half-cup of juice or non-diet soda, 3-5 pieces of hard candy, or 3-4 glucose tablets. Chocolate is NOT a quick-fix sugar source.
- Patients should recheck blood glucose values after fifteen minutes.
- If values are still low, another quick-fix sugar source should be consumed, and blood glucose should be rechecked in 15 minutes.
- If values are  $<70$  mg/dL after two consecutive blood glucose checks, the patient should seek medical attention<sup>12,13</sup>.

## TREATMENT

Treatment of diabetes should be designed to maintain blood glucose levels to an appropriate goal for the patient. Some patients may need one medication; some may need up to three medications or insulin therapy. Designing a treatment regimen is patient specific. Anti-hyperglycemic medications have different side effects and efficacy profiles that can help guide a clinician in choosing the best medication for the patient. Type 1 diabetes requires the use of insulin since these patients do not make their own insulin. Our focus will be on the agents that are used for type 2 diabetes since this makes up the majority of the patients diagnosed with diabetes.

Patients usually try lifestyle changes first. These include counseling/education, healthy eating ideas and exercise. If a patient is overweight, weight loss improves the body's ability to use insulin. If these methods are tried but blood glucose or A1c measurements remain above goal, then metformin is often the first agent tried. Metformin works to

decrease glucose production in the liver. It can lower A1c about 2% while keeping a low risk of hypoglycemia (low blood sugar). It is also inexpensive and can reduce the incidence of cardiovascular events. Unfortunately, metformin has a high incidence of diarrhea and stomach cramping. These side effects can decrease over time when the medication is taken as prescribed. If metformin does not lower blood glucose to the appropriate goal after 3 months, another agent can be added. Dual therapy can also be considered if a patient's initial A1c is 9% or more. There are several options for 'add-on therapy'; they continue to lower blood glucose another 1% on average. All are equally recommended by the American Diabetes Association guidelines. They are listed below in Table 2 with important points outlined.<sup>4</sup>

**Table 2** <sup>4,14,15</sup>

<b>Class of Anti-Hyperglycemic Agents with Examples</b>	<b>How They Work</b>	<b>How They are Taken</b>	<b>Advantages</b>	<b>Disadvantages</b>
<u>Sulfonylureas</u> <i>Glyburide (Glynase®)</i> <i>Glipizide (Glucotrol®)</i> <i>Glimepiride (Amaryl®)</i>	Increases the amount of insulin in the body	Once or Twice a Day	Inexpensive Very effective Oral	Weight gain Increased risk of hypoglycemia
<u>Thiazolidinediones</u> <i>Pioglitazone (Actos®)</i> <i>Rosiglitazone (Avandia®)</i>	Increases the body's sensitivity to insulin	Once a Day	Inexpensive Very effective Low risk of hypoglycemia Oral	Weight gain Edema/Heart Failure Risk of bone fractures
<u>DPP-4 Inhibitors</u> <i>Sitagliptin (Januvia®)</i> <i>Saxagliptin (Onglyza®)</i> <i>Linagliptin (Tradjenta®)</i> <i>Alogliptin (Nesina®)</i>	Increases the amount of insulin in the body; Decreases the amount of glucose in the body	Once a Day	Low risk of hypoglycemia Few side effects Oral	Expensive
<u>SGLT2 Inhibitors</u> <i>Canagliflozin (Invokana®)</i> <i>Dapagliflozin (Farxiga®)</i> <i>Empagliflozin (Jardiance®)</i>	Increases the amount of glucose in the urine in order to decrease the amount in the blood	Once a Day prior to the first meal	Weight loss Low risk of hypoglycemia Lowers blood pressure Oral	Expensive Increased urination Genital yeast infections
<u>GLP-1 Receptor Agonists</u> <i>Exenatide (Byetta®, Bydureon®)</i> <i>Liraglutide (Victoza®)</i> <i>Dulaglutide (Trulicity®)</i> <i>Albiglutide (Tanzeum®)</i>	Increases the amount of insulin in the body; Decreases the amount of glucose in the body; Helps the patient feel full longer	Inject once or twice a day within an hour of morning or/and evening meals	Weight Loss Low risk of hypoglycemia Decreases blood sugar after eating a meal	Nausea/ Vomiting/ Diarrhea Expensive Increased heart rate Injectable
<u>Long Acting Insulin</u> <i>Glargine (Lantus®)</i> <i>Detemir (Levemir®)</i>	Increases glucose movement into cells; Decreases glucose production	Inject Once a Day	Highly effective for all patients	Risk of hypoglycemia Weight gain Injectable

Choosing an agent depends on the patient's preference and their history with diabetes. The benefits of taking the medication must outweigh the side effects or complications that can progress from uncontrolled diabetes. Remember, in order for the medication to work, the patient must take it.

### **MEDICATION ADHERENCE AND MAJOR COUNSELING POINTS**

Medication adherence is whether or not a patient takes a drug as prescribed and if they choose to continue the therapy. It's estimated that 20 to 50 percent of patients are not adherent to their medications.<sup>16</sup> Medication non-adherence can be detrimental to patients with diabetes. The lack of blood glucose control can cause unwanted symptoms such as frequent urination, and long-term elevated blood glucose can lead to kidney, eye, nerve, and heart conditions. Some of the most common reasons that patients are not adherent with their medications are:

- Lack of patient counseling which can lead to the patient improperly taking the medication
- Lack of understanding of treatment importance
- Lack of knowledge of the effects of the medication
- Forgetfulness
- Financial limitations<sup>17</sup>

A pharmacy technician has the most contact with patients. Upon noticing that a patient is not regularly picking up a prescription or has never picked it up, the patient's non-adherence can be addressed to find the underlying cause of medication adherence.

Other recommendations for medication non-adherence are specific to the situation. If a patient is having trouble taking a medication regularly, a pill box may be the solution. Pill boxes can be useful for sorting medications by day taken and time of day taken. For patients that have smart phones, medication adherence apps (Ex. MyMedSchedule, Medisafe Medication Reminder) are available for free download and will send the patient reminders to take their medications. Some patients are not educated on the proper use of their medications. These patients should be encouraged to ask questions about their current medication regimens to ensure they are being adherent. Pharmacists can play a key role in educating the patient about their medication. If patients are having trouble with medication expenses, several options can be considered. The patient's primary care physician may be consulted to determine if another drug therapy could possibly be cheaper. Some drug manufacturers have financial assistance programs to aid in reducing prescription costs. An Internet search for coupons can be performed to help with the cost of many brand-name medications. The pharmacy team should always assess

patient medication adherence to maximize the patient's quality of life.

### **IMMUNIZATIONS**

High blood glucose causes changes to many of the body's structures. This combined with the complications of diabetes can increase the risk of infection and disease. All children and adults should receive the routine vaccines recommended by the CDC.<sup>18</sup> However, certain vaccines are highly recommended for patients with diabetes in order to give extra protection.

Influenza is a common infectious disease that is associated with increased complications in a patient with diabetes versus a patient that does not have diabetes.<sup>4</sup> The CDC recommends that the influenza vaccine be given annually beginning at 6 months old.<sup>18</sup> There are two types of injectable influenza vaccines: inactivated and live attenuated. Patients with diabetes are encouraged to get the inactivated vaccine. The inactivated vaccine contains parts of the virus that have been killed. Therefore, it is unable to 'cause' the flu. If the patient is diagnosed with influenza after receiving the vaccine, it is likely that the patient had the flu (without symptoms) before getting the vaccine. Following vaccine administration, it takes about two weeks for the patient to have an immune response such that the body can overcome the influenza virus.<sup>19</sup> The inactivated influenza vaccine will contain three (trivalent) or four (quadrivalent) strains of virus. Each year the CDC studies influenza trends in order to best predict the strains that will be most problematic the following year. If a patient is 65 or older, there is a high-dose influenza vaccine that is recommended.<sup>19</sup> It contains a greater amount of the vaccine in hopes to initiate a greater immune response in this population that is at greater risk for complications.

In addition to the influenza vaccine, there are several other vaccines recommended by the CDC for patients with diabetes.<sup>4,18,19</sup> Information about each is listed below.

#### **Tetanus, diphtheria, pertussis (Td and Tdap)**

- The Tdap vaccine should be given as a one-time dose with the Td vaccine given every 10 years after.
- Tetanus is an infection that is associated with major or minor wounds. Although most people think of stepping on something, like a rusty nail, as being the major culprit for infection, half of all tetanus infections occur indoors.
- Diphtheria is a respiratory infection characterized by a bluish white film on the tonsils and throat.
- Pertussis is also referred to as whooping cough and is very contagious especially in children and those with a compromised immune system. Pertussis can progress to pneumonia and lead to additional complications.

### **Pneumococcal Conjugate (PCV13) and Polysaccharide (PPSV23)**

- PCV13 and PPSV23 protect against pneumococcal pneumonia. PPSV23 is administered as a one-time dose if the patient is younger than 65 years. After the age of 65, patients with diabetes are recommended to get the PCV13 followed one year later by PPSV23.

### **Other vaccines to consider recommending**

- Zoster protects against shingles and is usually given once the patient is 60 years old.
- Measles, mumps, rubella (MMR) can be given if the patient has not had or was not exposed to these diseases.

Vaccines are an important component to a patient's health care and should be recommended when possible.

## **CONCLUSION**

Many components make up the intricacies of diabetes management. Understanding the disease state and its prevalence in our society today is crucial in preventing and managing the disease. Trends in our population such as increases in the number of obese patients are contributing to the rise in diabetes diagnoses. With diabetes, patients have impaired blood glucose control due to the decrease in insulin sensitivity. Uncontrolled levels of blood glucose can

precipitate serious complications such as kidney, heart, eye, and nerve dysfunction.<sup>2,4</sup> With the risk of complications that can result from diabetes, diabetes management is of the utmost importance.

Educating patients on lifestyle changes, blood glucose monitoring, and medication adherence give the patients the tools for managing diabetes. Lifestyle changes include healthy eating habits and regular exercise. These changes help promote insulin sensitivity and, in turn, slow the progression of the disease. Blood glucose monitoring is essential for evaluating the patient's disease state management. Also, blood glucose monitoring can help patients assess acute situations in which referral for further medical attention is warranted. Discussions about medication adherence can help the patient get the maximum benefit from their drug therapy.

Medication regimens are patient specific. Some patients have a difficult time controlling their blood glucose so they may need to be on a more rigorous drug therapy. Other patients may experience side effects to certain medications and cannot tolerate that particular therapy. These components of diabetes control can be carried out in the pharmacy. Pharmacy staff play a vital role in educating patients and keeping them safe.

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