Being able to effectively participate in the care of people with diabetes can be a rewarding experience for everyone who works in a healthcare office. Diabetes is a condition that is often best treated through the combined efforts of many people, each with different skills and expertise. It is estimated that approximately 90 to 95% of people with diabetes are cared for by primary care practices. The ultimate degree to which a primary care practice can be successful in providing diabetes care often depends on the training and coordination of the entire office staff. The ability of primary providers, clinical and office support staffs to work as a team will ultimately lead to better health outcomes for those who have diabetes.

**What is diabetes?**

Diabetes mellitus results from a number of potential abnormalities in the ability of the body to handle the metabolism of glucose. Glucose (a sugar) is an important source of energy for the body; it is the fuel that the body runs on. When the body cannot properly metabolize glucose, levels of glucose in the blood rise; this is referred to as hyperglycemia. Hyperglycemia, if occurring rapidly, can lead to what are referred to as acute complications of diabetes. These include conditions called diabetic ketoacidosis or hyperosmolar coma. Hypoglycemia, a decrease in blood glucose level, is also an acute complication.

Long-term elevations of glucose levels can result in the chronic complications of diabetes. These include:

- **Microvascular complications including**
  - Diabetic retinopathy
    (Vision problems due to damage to the blood vessels in the retina, the back of the eye)
  - Kidney disease
- **Diabetic neuropathy**
  (Nerve problems, causing pain, often in the feet and legs, as well as problems with function of other organs)
- **Macrovascular complications**
  - Cardiovascular disease (heart attack)
  - Peripheral vascular disease (Poor circulation)
  - Stroke

The goal of diabetes treatment is to prevent both acute and chronic complications of diabetes. For that reason, treatments are used to try to prevent glucose levels from rising.

Research studies in the last couple of decades have confirmed that hyperglycemia increases the risk of complications. However, particularly with the chronic macrovascular complications of type 2 diabetes, there is evidence that the process involves many more risk factors (elevated lipids, high blood pressure) that increase the likelihood of vascular events.
It is important to meet the treatment challenge for diabetes because of the significant personal and economic costs of suboptimal therapy. People with diabetes are hospitalized one and a half to three times more often than people who do not have it. Their risk of atherosclerotic disease is two to four times greater. The highest incidence of adult blindness, chronic renal failure, and nontraumatic amputations occur among people with diabetes. The goal of diabetes treatment is not measured only in terms of blood glucose levels, it is reflected in a more global effort: to prevent, or at least reduce, the effects of chronic complications.

There is strong evidence that a comprehensive approach to diabetes care can positively impact patients’ long-term health. Key among the treatment goals are:

- Aggressive glucose control targeting normal blood glucose levels as closely as possible
- Management of other metabolic risk factors
- Continual screening for and prevention and treatment of complications

People with diabetes must take an active part in their own care. To do so they must receive education about diabetes and acquire the necessary skills in order to self-manage their disease. This education is not a luxury, but a necessity. It is the process of engaging the patient as an active participant in his or her own treatment program that makes diabetes all the more challenging to the healthcare professional, and often what necessitates the involvement of a care team to help with this process.

While the common thread among all people with diabetes is that their blood glucose level is higher than normal, the causes for this elevation can vary. Therefore, in order to understand the clinical approach to diabetes, it is important to appreciate the multiple factors that can occur within someone with diabetes that can result in the development of this condition.

**Normal Glucose Metabolism**

In a person who does not have diabetes, glucose is normally present in the blood before meals at a level between 60 and 120 milligrams per deciliter (mg/dL). Glucose comes into the body via food that is eaten, primarily carbohydrate foods: starches, such as bread, potato, and pasta; and sugars, such as fruit, juice, sweets and desserts. When glucose is eaten and absorbed through the wall of the gastrointestinal tract, it enters the bloodstream and travels to cells throughout the body. Insulin, a hormone, is needed for glucose to pass through the cell membrane and enter the cell to provide energy. This hormone is produced by the pancreas and attaches to insulin receptors located on the outer surfaces of cells. The interaction between insulin and its receptor triggers the process that allows glucose to enter the cells and be used as a source of energy. However, energy needs extend beyond the immediate period after the meal when the glucose level tends to be highest. Therefore, glucose must be stored for later use, and this occurs in muscle and the liver.

Any interruption at a number of steps in the normal glucose homeostatic mechanism, such as an interruption of the pancreas’ ability to produce insulin or derangement of insulin’s ability to signal the cells to allow the glucose influx, can lead to hyperglycemia.
The Pancreas
The pancreas is an endocrine gland that is located below and behind the stomach. Within the pancreas are the insulin-producing clusters of cells known as the islets of Langerhans. A normal pancreas contains about 100,000 such islets. Of the cell types found in these islets, it is the glucose-sensitive β cells that make the insulin. They are able to measure the blood glucose level accurately and within seconds of changes, and determine the quantity of insulin that is needed to keep the glucose level within a very precise range.

The typical pattern of insulin secretion from the pancreas occurs in the following manner. Right after food is ingested, the incoming glucose (often from starch that is digested in the GI tract into glucose) reaches the pancreas through the bloodstream and stimulates the secretion of insulin. There is an immediate rise in insulin levels shortly after a meal (within an hour or two), which helps the incoming glucose to be distributed either for immediate energy needs or stored for later use. The insulin secretion—and level—then settles down to a basal level: a relatively steady level that maintains a stable glucose level in the blood until the next meal. Insulin also helps regulate glucose levels when more energy is needed for physical activity.

What goes wrong to cause diabetes?
There are two types of diabetes, and each reflects different problems that lead to elevated glucose levels.

Type 1 Diabetes: In type 1 diabetes the pancreas makes no insulin. This is due to a destruction of the β cells that make insulin. People with type 1 diabetes must replace the insulin that their pancreas can no longer make, and doing so requires that they take daily insulin injections. They must also balance their insulin doses with the amount of food they take in (energy in) and the amount of activity they do (energy used). To do so, they are asked to monitor their diabetes by checking blood glucose levels periodically during the day, follow a meal plan that helps them control their carbohydrate intake, and try to exercise regularly for good health; the person with type 1 diabetes must strive to maintain a balance among insulin dose, carbohydrate intake, and level of physical activity. Only about 10% of people with diabetes have type 1.

In the past, type 1 diabetes was called insulin-dependent or juvenile diabetes. These terms are no longer used. Although type 1 is more common in children and young adults, it can actually occur at any age. Type 1 diabetes cannot be treated with antidiabetes oral medications.

Type 2 Diabetes: The hallmark of type 2 diabetes is that the insulin that the body makes does not work properly. The interaction between the insulin and the cells of the body to allow the glucose to enter does not function normally, causing glucose to build up in the bloodstream. This is referred to as insulin resistance—the body is resistant to the effects of insulin. In theory, if enough insulin could be pumped into the body, it would overcome this insulin resistance. Early in the course of type 2 diabetes this is actually what happens. The pancreas tries to make more insulin to overcome the resistance problem. This may work for a period of time. In fact, the person may maintain normal glucose levels and not be aware that there is a problem. With time, however, the pancreas is not able to keep up with the increased demand for insulin and the glucose level rises. This is often referred to as relative insulin insufficiency.
Some people with type 2 diabetes can control their blood glucose levels with a meal plan, weight loss, and increased activity. These work to reduce the insulin resistance, and allow the person's own insulin to work more efficiently. However, if these lifestyle interventions are not able to sufficiently reduce the insulin resistance, medications may be needed. Some medications help the pancreas make more insulin to try to overcome the insulin resistance. Other medications work directly to reduce the insulin resistance. Newer medications, and some under development, work by other mechanisms. Regardless of the mechanism, all medications try to re-establish the balance between the quantity of insulin and its ability to act, and glucose levels and activity. Many people use a combination of medications that work by various mechanisms, and may also use insulin replacement itself to try to bring the glucose levels back to normal. It is estimated that 90% of people with diabetes have type 2.

It is very common for patients with type 2 diabetes to feel that they have failed in their self-care when they need medications or insulin. One of the best ways office staff can help is to be positive and reassure patients that they are not to blame. Office staff can often help patients understand that there is a natural progression of the disease, and that their body will make less insulin over time.

Type 2 patients are usually over 40 years old; they may be overweight and have a strong family history of diabetes. They often have other risk factors for cardiovascular disease such as elevated lipids (cholesterol), high blood pressure, and excess weight in the abdominal area, called abdominal obesity. Type 2 can also occur in overweight children, adolescents and young adults, and although type 2 diabetes in younger people is less common, with the epidemic of obesity that we are currently seeing, it is becoming more prevalent. People with type 2 diabetes should be counseled that it is very common to need medicine or insulin or both to treat their diabetes over time. They also must understand that their most important goal is to maintain their blood glucose levels in target range.

How is diabetes diagnosed?
Diabetes is diagnosed with one of the following blood tests. The test should be performed in a laboratory using a method that is NGSP-certified and standardized to the DCCT.

- A1C ≥ 6.5%
- Fasting plasma glucose: > 126 mg/dL (after 8-hour fast)*
- Casual plasma glucose (test done at no specified time in relation to meals):
  > 200 mg/dL with classic symptoms
- Oral glucose tolerance test: > 200 mg/dL at 2 hours*

Diabetes cannot be diagnosed from a fingerstick using a home or office blood glucose meter, but must be from a blood (venous or capillary) draw that is then sent to a laboratory. This is because the meters are not as accurate as the laboratory testing. However, if diabetes is suspected, it is certainly fine to do a meter reading initially to see where the glucose value may be. If found to be high or even equivocal, testing should be repeated by one of the methods noted above to confirm the diagnosis officially.

*Must be repeated and found to be elevated twice before a diagnosis of diabetes can be made.
Blood Glucose Target Levels:
Target glucose levels for diabetes must be individualized based on treatment, other medical conditions, and a person’s ability for self care. However, in a general sense, ideal targets would be:

- Before meals: 70–130 mg/dL
- 2 hours after meals: Less than 180 mg/dL
- Bedtime: 90–150 mg/dL
- A1C: < 7%

Not all glucose readings will be in these ranges. But the goal is to get patients as close as possible to these targets. There is also some controversy about A1C goals, particularly for people with type 2 diabetes. Some groups have long advocated a target of less than 6.5%, while other look for a target of less than 7%. Recent studies have raised a question about the safety of values approaching the mid 6% range for some people with long-standing type 2 diabetes and the potential for underlying heart disease, but not everyone feels that the concern is warranted, and not necessarily for those with shorter duration diabetes. How aggressive one is with respect to A1C should be individualized. The ongoing discussions about targets should also be monitored by clinicians because there are likely to be further adjustments or commentary about how these goals should be determined in the near future.

Common Terms and Tips
Glucose: A type of sugar that our bodies use for energy. Glucose comes from the food we eat and can also be made in the liver.

**TIP:** Blood sugar is a nonmedical term often used to refer to blood glucose. Patients need to understand that glucose does not just come from eating sugary foods. It is produced when our bodies break down all carbohydrates that a person eats.

Carbohydrate: Carbohydrate affects blood glucose levels more than protein or fat. To regulate blood glucose, it is important for meal plans to include a proper amount of carbohydrate based on a person’s energy needs, physical activity level, and type and amount of diabetes medication. Carbohydrate is found in starches such as bread, rice, cereal, pasta, starchy vegetables, and beans; fruit; milk and yogurt; and sweets such as ice cream, candy, cookies, and cake.

**TIP:** Some people can mistakenly think that if glucose comes from carbohydrate, and one’s blood glucose level is high, then cutting carbohydrate food intake will help. Certainly, consuming excessive carbohydrates is not recommended. However, carbohydrates are best at stimulating the production of insulin. Eating a balanced amount of carbohydrate leads to more effective insulin secretion and is a good thing. Cutting down or cutting out carbohydrate intake does not help and may hamper a person’s blood glucose control.

**TIP:** Carbohydrate counting is a type of meal planning for people with diabetes and an important part of self-care. One type of carbohydrate counting uses the concept of an insulin-to-carbohydrate ratio. Using this system, people estimate the amount of carbohydrate they are going to consume, and base their insulin dose on that amount.
Insulin: A hormone made in the pancreas that enables the movement of glucose from the bloodstream into the cells of our bodies. When insulin replacement is needed, at present it must be given by injection or by insulin pump. The goal of insulin therapy is to provide insulin coverage of two central insulin functions: 1) basal insulin – the insulin that continually diffuses in a fairly even amount throughout the day and night, and 2) mealtime, bolus or prandial insulin, which is a surge in insulin secretion occurring in response to incoming meals. The various insulin products that are available differ most significantly based on their time of action. Each insulin is defined by the time of the onset of its action, the peak or most prominent action, and the duration of its action. Rapid-acting insulins (aspart, glulisine, lispro) replicate the insulin surge from a normal pancreas that occurs after meals. Regular insulin is an older form that was used more commonly before the development of rapid-acting insulin. It has a later peak and longer duration of action. It also mostly, but not exclusively, covers the time period after meals. Intermediate insulin (NPH) peaks between 4 and 12 hours. Multiple injections of intermediate insulin during the day cover basal insulin needs. Newer peakless basal insulins (detemir, glargine) provide a smooth insulin level for about 24 hours, and have become very popular. They can provide for basal insulin needs more reliably and evenly than the older NPH given as multiple injections.

**TIP:** Describing insulin as being similar to a key that opens the door to our bodies’ cells and lets the glucose pass in can help patients understand how insulin works. It is also useful to give patients a sense for the time course of insulin action. Having this insight can help patients be more effective in understanding and self-managing their own insulin treatment programs.

Monitoring: Diabetes control is usually measured in two ways. The A1C reflects the average glucose levels over a 2- to 3-month period. Glucose monitoring—checking glucose levels at specified times during the day and examining the glucose patterns—is another measure used in diabetes control. Correlating these glucose patterns with eating, physical activity, and timing, among other factors influencing glucose levels, is important and allows people with diabetes to more effectively strike a daily balance of all factors influencing blood glucose levels. Keeping records of the monitoring data, whether on paper or electronically, is an important part of this process and allows people to see all of the factors being monitored in one flow sheet. It is recommended that all patients with diabetes learn how to monitor their blood glucose levels. The actual schedules for monitoring will differ based on the diabetes treatment program (particularly with insulin) and individual patient interest and ability. Meters are used to measure the glucose levels. A drop of blood is obtained and put on a strip or drum, which is then read by the meter. (Please see Blood Glucose Monitoring Basics in the Joslin Insulin Therapy CareKit.)

**TIP:** Today’s blood glucose meters make it much easier and faster for patients to check their blood glucose levels. Office staff can be helpful by showing empathy and encouraging the patient to discuss any difficulties they are having with their healthcare provider. Providers and office staff should reinforce the importance of monitoring by reviewing monitoring records at every patient visit.
Insulin Pens: Insulin pens are a simple and convenient way to inject insulin, and their use has become increasingly popular whether the patient is taking insulin once a day or is on multiple daily injections. However, pens can only inject one insulin at a time and do not permit mixing two types of insulin in one pen for one injection. Premixed insulins are available in pens, however, and can be given as one injection. Pens are particularly popular for use in basal bolus treatment programs, particularly for the premeal insulin injections, which are often given on the run during the day, when eating out or traveling.

*Please see Insulin Injection Devices in the Joslin Insulin Therapy CareKit.*

**TIP:** Most insulin pen manufacturers have instructional videos on their websites that can provide more information about pen use.