

Type 2

Stopping



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Exercise and diabetes— small steps to success

Despite being one of the most important cornerstones of diabetes management, physical activity is often underutilized. Exercise, along with healthy eating and medication, if prescribed, is a vital part of managing the disease. The best way to start an exercise pattern is for your patient to choose a convenient activity that he or she enjoys.

By Barbara Ann Gattullo, APRN-BC, CDE
Associate Professor • Department of Nursing • Kingsborough Community College • Brooklyn, N.Y.

Physical activity can help manage weight; lower BP, low-density lipoprotein cholesterol, and triglycerides; increase high-density lipoprotein cholesterol; improve muscle tone and bone strength; decrease anxiety; and improve overall health. Benefits specific to patients with diabetes include improved glycemic control, increased insulin action leading to decreased insulin resistance (particularly

At least 171 million people in the world have diabetes, including 16 million people in the United States alone, and this number will increase to 366 million by the year 2030, according to the World Health Organization. Type 2 diabetes is now appearing in individuals in their 30s, and the incidence of the disease in pediatric patients has increased tenfold over the past 30 years. We give you the tools you need to help your patients fight this growing epidemic.

By Andrew Herman, MS, RN
Staff Nurse • AmLake VA • Tacoma, Wash.

diabetes:

the epidemic

Diabetes occurs when the pancreas can't secrete insulin (type 1) or when the body's cells can't recognize insulin (type 2). Statistical spikes in type 2 diabetes incidence are directly linked to increased levels of obesity associated with unbalanced dietary patterns and decreased levels of physical activity. Inhalation of industrial air pollution and tobacco smoke has also been implicated as a cause of insulin resistance. In this article, I'll review the consequences of untreated and poorly-treated type 2 diabetes, lab values, medications and treatments, and critical patient teaching points.

Typecast

Type 1 diabetes

Type 1 diabetes affects 5% of patients with diabetes. In this type, a genetic defect in the immune system causes the body to produce antibodies against its own insulin-producing pancreatic beta cells. Beta cell mass diminishes to the point where the patient must be supplied with exogenous insulin. The onset of this disease is usually between ages 10 and 12 in girls and between ages 12 and 14 in boys. In one-third of patients, type 1 diabetes appears before age 20, and most cases develop before age 30. There's also a delayed form in which pancreatic antibodies appear in adulthood.

Environmental factors associated with the onset of type 1 diabetes are rubella,



The great carbohydrate debate

When it comes to diabetes, the topic of carbohydrates is one that most are quick to disagree about. Healthcare practitioners and patients with diabetes often have differing opinions about meal planning. Understanding what carbohydrates are and what they do is vital to the successful nutritional management of diabetes.

By Barbara Ann Gattullo, APRN-BC, CDE
Associate Professor • Department of Nursing • Kingsborough Community College • Brooklyn, N.Y.

“Carbs”—short for carbohydrates—are a commonplace part of the diet language, especially for people with diabetes. The first question your patient is likely to ask? What's a carbohydrate?

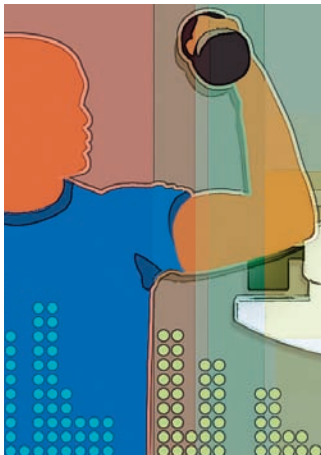
All the food we eat, with the exception of meats and meat substitutes, fats, and oils, contains a mixture of carbohydrate, protein, and fat that the body converts to the energy that's

in patients with type 2 diabetes), decreased HbA1C, increased cardiovascular fitness, and an improved overall mental health outlook. Because of these identified benefits, it seems reasonable to recommend that patients with diabetes follow the physical activity guidelines for the general population if not contraindicated.

Specific recommendations

The U.S. Department of Health and Human Services physical activity guidelines suggest that adults older than age 18 perform 150 minutes/week of moderate exercise or 75 minutes/week of vigorous aerobic activity or an equivalent combination of the two. For those older than age 65 or those with disabilities, either following adult guidelines or remaining as physically active as possible has been suggested. The guidelines recommend muscle strengthening activities that involve all major muscle groups to be carried out 2 or more days each week.

To add to this, the American Diabetes Association (ADA) and



the American College of Sports Medicine formulated a joint statement that emphasizes the positive benefits of exercise for patients with type 2 diabetes.

Choosing an exercise program

Physical activity has long been believed to be an important way to control and manage weight. Weight management is defined as calories eaten from food and drink being equal to calories burned at rest and with physical activity. Whichever method of weight management

your patient chooses, it's important to remember to encourage a patient who loses weight to continue working on ways to keep it off.

When choosing an exercise program that works for your patient, it's essential to discuss types of exercise and which activities fit the individual's lifestyle. Aerobic, anaerobic, and resistance exercises can be recommended when appropriate. Patient age and previous physical activity level should be considered.

Aerobic exercise is steady and increases the heart rate to at least 70% of maximum, while increasing the use of oxygen. Aerobic exercise burns glucose and fat and provides the greatest benefit for blood glucose and weight management. Suggested exercises might include walking, bicycling, and swimming.

Anaerobic exercise doesn't use oxygen to help release energy from the fat cells but is known to build muscle tissue. Anaerobic

coxsackie, and other viral infections.

Type 1 diabetes may be accompanied by another autoimmune disorder, such as hypothyroidism, pernicious anemia, or alopecia. The type 1 patient is subject to rapid increases in blood glucose, with development of ketoacidosis.

Type 2 diabetes

Type 2 diabetes affects 95% of patients with diabetes and exists when insulin resistance causes extracellular glucose levels to rise above 126 mg/dL (after 8 hours of fasting). Patients at particular risk are those who exceed the recommended weight-for-height tables, eat poorly-balanced meals, and lead sedentary lifestyles. Pregnant women may also develop diabetes (see *Warning! Gestational diabetes*). Hypertension, tobacco smoking, and a family history of type 2 diabetes are considered risk factors as well.

Excess glucose in the circulation can cause oxidant damage to cell surfaces and metabolic derangements within the cell itself. This causes destruction of cells and,

Warning! Gestational diabetes

The stress of pregnancy in an otherwise healthy woman can induce insulin resistance known as gestational diabetes. A woman is at higher risk for gestational diabetes if she's older than age 25, has a family history of diabetes, has a history of poor obstetric outcomes, or has delivered a baby weighing more than 9 lb. Treatment with insulin may be required.

Pregnant patients with diabetes need to check their blood glucose levels before meals and 1 hour postmeal. If the result is high, the urine should also be dipstick tested for ketones. However, the first morning urine specimen can yield a false-positive result. Tight blood glucose control reduces the possibility of birth defects.

eventually, tissues. Even a slight upward trend in blood glucose is associated with an increased risk of damage to nerves and blood vessels throughout the body.

Prediabetes

A healthy human body will keep its blood glucose level within a narrow range despite the level of food intake. In prediabetes, various cells within the body, such as in the liver, fat, and muscle, develop a resistance to the action of insulin. Glucose is less able to be metabolized into cells and accumulates in the extracellular circulation. The pancreatic beta cells, in an effort to compensate, secrete increased amounts of insulin, which increases insulin levels in the circulation. Over a period of approximately 7 years, the beta cells gradually burn out and the body's blood glucose levels rise. Development of insulin resistance is associated with obesity, lack of physical activity, and smoking. Forty-one million people in the United States have prediabetes; 25% of these individuals will develop type 2 diabetes within 10 years.

Immediate nursing interventions for the patient with prediabetes are to recommend healthier eating habits, cessation of smoking, and increased physical activity to reduce body weight by 1 to 2 lb/week. Skeletal muscle handles 80% of the body's glucose disposal. Exercise can thus intensify the action of insulin and lower blood glucose. Such lifestyle changes can significantly delay the onset of type 2 diabetes.

The damage done

Osmotic diuresis occurs in response to high blood glucose levels as the kidneys struggle to expel excess glucose. Here we see the classic symptoms of polyuria and polydipsia. If the body can't metabolize glucose into cells by conventional means, it will attempt to convert fat stores into

essential for life. It's important to understand carbohydrates in order to manage diabetes because they're broken down into glucose—the sugar that people with type 2 diabetes have in excess in the bloodstream.

The debate

Everyone agrees that the body uses carbohydrates for energy as glucose, and that they're the main nutrient in foods that affect after-meal blood glucose levels. Knowing how much carbohydrates patients with diabetes should eat is a question that leaves healthcare practitioners and patients with differing points of view. Most healthcare practitioners will agree that blood glucose stays more stable when the intake of carbohydrates is limited, but remain aware that carbohydrate foods also tend to contain vitamins and minerals. Patients with diabetes wonder why they can't eat and enjoy the same foods as others. What we do understand, however, is that everyone involved may, in a sense, be right.

Let's take a closer look.

The breakdown

Sugars, starches, and fibers are identified as carbohydrates, which are labeled as either simple or complex. Simple carbohydrates are sugars; complex carbohydrates are starches and fibers. The three basic sugars identified are glucose (or common table sugar), fructose, and galactose. After these sugars combine in a chain, larger sugars, such as sucrose, maltose, and lactose, are formed.

When sugars are formed together in a chain, they help develop starches and fibers. Starch sources, such as potatoes, bread, pasta, and white rice, are the main sources of dietary carbohydrates. Fiber, a structural component, isn't considered a nutrient. Fibers can be either soluble or insoluble. Soluble fibers, which can dissolve in water, are found in foods such as oat bran, barley, legumes, bananas, blueberries, carrots, and artichokes. These foods cause a slowed digestion, but can help lower a person's cholesterol count. Insoluble fibers are found in wheat, vegetables, and whole grains. Because these foods add bulk to the diet, food passes more quickly through the stomach and intestines. Fiber doesn't directly supply the body with energy, although eating fiber may indirectly affect blood glucose and provide benefits, such as effective waste elimination.

Glycogen, a complex carbohydrate, is the body's own glucose storage chest. Between meals when glucose levels aren't sufficient to



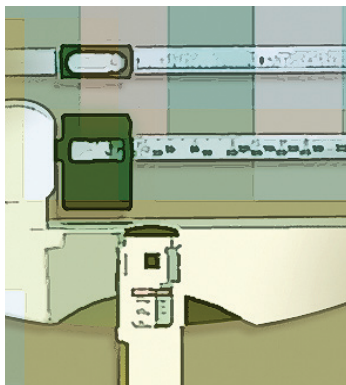
means without air, and refers to the energy exchange in living tissue that's independent of oxygen. Anaerobic exercise is brief, high-intensity activity during which anaerobic metabolism is taking place in muscles. It provides a number of health benefits, such as improving muscle bulk, preventing osteoporosis, and decreasing fat composition in the body. Examples of anaerobic exercise include weight lifting, sprinting, and jumping; any exercise that consists of short exertion, high-intensity movement is an anaerobic exercise. These activities can't last long because oxygen isn't used for energy and a byproduct called lactic acid is produced. Although anaerobic exercise has benefits, it doesn't lower insulin resistance or significantly lower BP or cholesterol. It's important to remember that some anaerobic exercises increase intraocular pressure and should be avoided by patients with preexisting diabetes complications.

Resistance exercise takes place when a muscle contraction is opposed by an outside force to increase strength or endurance. Using weights may carry out a resistance exercise. These exercises are believed to improve the action of insulin and bring about metabolic improvements. Once again, patients need to be cautioned about extensive resistance exercising if they have preexisting complications.

Exercise has been described as light, moderate, or strenuous in nature. Light exercise doesn't make a patient breathe heavier, but the pulse rate may increase slightly. Moderate exercise involves noticeably heavier breathing, with a pulse frequently above 100 beats/minute. Strenuous exercise involves rapid breathing, with a pulse rate above 160 beats/minute.

When considering which level of exercise is correct for your patient, it's prudent to remember that what's considered light exercise for one patient may be different for another, depending on the person's level of fitness. The effect of any exercise on blood glucose depends on the time spent on the activity. It's also important to note if your patient is taking insulin because a change in the management plan may become necessary.

Previous guidelines suggested that before recommending a program of physical activity, patients should be assessed for conditions that might contraindicate certain types of exercise or predispose them to injury. Uncontrolled hypertension, severe autonomic or peripheral neuropathy, a history of foot lesions, and unstable proliferative retinopathy are several complications to be considered. The ADA consensus on evaluation of patients with diabetes before beginning an exercise program has concluded that



glucose. However, this causes a release of fatty acids (ketones) into the bloodstream and the pH of the blood drops.

Acidic blood processing through the brain can put the patient into a coma-like state known as diabetic ketoacidosis (DKA). The symptoms of DKA may be mild early on, but can rapidly worsen. The patient may begin with nausea, vomiting, abdominal pain, and weakness. As dehydration worsens, the pulse rises and the BP drops. The lungs convert the ketones into acetone and exhale the classic fruity-odor breath. Respirations become deeper and labored as the body attempts to raise the pH. Some patients may still have enough insulin in reserve to avoid DKA, but will gradually develop hyperosmolar hyperglycemic nonketotic coma, with severe dehydration.

Sensory nerves are especially sensitive to the effects of surplus extracellular glucose because of their unique morphology. One of the earliest symptoms of diabetes is a subtle numbness and tingling of the distal extremities, which results from depletion of the myelin sheath that regulates sensory nerve conduction. This patient will be at an increased risk for falls and foot ulcers due to decreased reflexes and a decreased sense of pressure, temperature, and vibration. These symptoms are worse when blood glucose is poorly controlled.

An excess amount of insulin in the circulation (hyperinsulinemia) is associated with coronary and carotid artery disease and hypertension. Oxidation of low-density lipoprotein (LDL) cholesterol causes vascular plaque formation. Glucose binds with collagen, causing stiffening of the vascular walls. Cellular oxidation drops production of nitric oxide, a vasodilator, and hypertension results. Chronic hypertension intensifies vascular complications and places the patient at greater risk for renal failure.

Diabetes isn't without its effects on the gastrointestinal (GI) tract. High

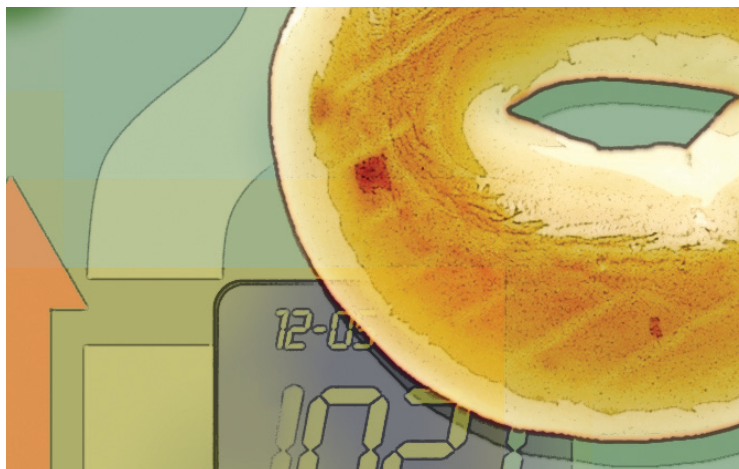
What's HbA1C?

Glucose binds irreversibly to the hemoglobin portion of red blood cells to form glycohemoglobin. HbA1C makes up 80% of this complex. The HbA1C value measures the patient's average postmeal plasma glucose over the previous 2- to 3-month period. Glucose, however, can bind to either the alpha or beta chain of the Hgb molecule, which can cause a measurement artifact depending on the lab method used. Altered protein levels secondary to liver disease can also make the test less accurate. Every percentage point decrease in HbA1C equals a 40% reduced risk of microvascular complications. It's advisable to keep the HbA1C under 6.5%.

blood glucose levels trigger the release of pancreatic amylase, which slows gastric emptying. Neuropathy of the nerves supplying the stomach can also contribute to this process. The patient may experience nausea, vomiting, bloating, or a feeling of early satiety when eating. Neuropathy can affect bladder functioning, with a decreased sensation of bladder filling. And glucose in the urine puts the patient at higher risk for urinary tract infections.

High blood glucose delays the function of white blood cells, making the patient more prone to infection. For example, patients with diabetes are at nearly twice the risk for developing periodontal disease. High glucose levels in saliva combine with plaque to form an acidic environment conducive to dental caries.

Neurovascular disease in the retina can occur as a result of high blood glucose levels. The patient may at first experience blurred vision. In response to chronic vascular damage, the retina produces new vessels. However, the new vessels are fragile and cause bleeding, scarring, and retinal detachment. Diabetes is the most common cause of adult blindness.



satisfy the body's needs, small chunks of glucose are made available from glycogen. The liver addresses glucose levels, which can drop during intense exercise or periods of fasting.

Proteins have long been considered building blocks for the body. Diabetic nephropathy occurs in 20% to 40% of patients with diabetes and is the single leading cause of end-stage renal disease. This warrants early management to decrease risk and slow progression of the disease. A safe consideration for patients with diabetes is that protein should be approximately 20% to 40% of the total dietary intake. Although protein intake should be monitored, leaving out or severely limiting the intake of protein could lead to muscle cell disintegration.

Fats typically provide more than half of the body's energy needs. Fat, which is formed into fatty acids, is stored in fat cells as triglycerides. Fat cells are very accommodating and store unlimited amounts of triglycerides. We do know that fat leaves the stomach more slowly and may delay the rise in blood glucose after a large meal for as long as 10 hours. With this in mind, patients with diabetes need to consider how a high-fat snack at bedtime affects early morning blood glucose readings.

Unsaturated fats are usually found in plant products, such as olive oil and corn oil, and remain liquid at room temperature. Saturated fats are found in animal products, such as butter, and are usually solid at room temperature. Trans fat may contain saturated or unsaturated fatty acids, which can be safely enjoyed when minimally included in the diet. Although fat has less of an effect on blood glucose, it's important to appreciate the negative effect fat intake has on the cholesterol level. Another accepted fact is that when eating low-fat diets, insulin sensitivity is improved, which will help to manage blood glucose.

Low, moderate, or high?

Low-carbohydrate diets call for as little as 20 to 30 g of carbohydrates per day. Saturated fats are permitted, but trans

screening an asymptomatic patient isn't recommended, but clinical judgment should be used, as appropriate. Certainly, high-risk patients should be encouraged to start with short periods of low-intensity exercise and increase the intensity and duration slowly.

For example, if a patient with hypertension were to choose weight lifting instead of an aerobic exercise modality, such as walking, worsening of hypertension could occur. Using the lower extremities causes smaller increases in systolic BP than activities involving the upper extremities.

Help your patient choose the type of exercise that's right for him.

Special considerations

When discussing exercise with your patient, a few concerns should be considered:

- In the presence of proliferative diabetic retinopathy or severe nonproliferative diabetic retinopathy, vigorous aerobic or resistive exercises may be contraindicated because of the risk of triggering a hemorrhage or retinal detachment.
- Decreased pain sensation in the extremities results in an increased risk of skin breakdown, infection onset, and joint deformity and instability caused by Charcot disease. Previously, patients with neuropathy were advised to engage in non-weightbearing activities. However, it's now believed to be more appropriate to consider moderate-intensity walking because it hasn't been proven to cause an increase in foot ulcers.
- Autonomic neuropathy can increase the risk of exercise-induced injury through decreased cardiac responsiveness to exercise, postural hypotension, and gastroparesis (the reduced ability of the stomach to empty its contents), which can predispose a patient to hypoglycemia resulting from the neuropathy.
- Physical activity can increase urine protein excretion. It's believed that restrictions for patients with diabetic kidney disease aren't warranted because vigorous exercise hasn't been proven to be related to its progression. One might also consider the possibility of exercising with diabetes as precipitating or exacerbating cardiovascular disease such as arrhythmias, excessive increase in BP (exercise should be performed at an intensity that avoids a hypertensive response), angina pectoris, and myocardial infarction.

Pregnant patients with diabetes who perform anaerobic exercises have a more rapid diversion to fat metabolism. This results in an

Nephropathy develops insidiously over a period of years. The increased glomerular filtration rate from chronic purging of glucose brings on renal cell hypertrophy and kidney enlargement. Damage to the renal filtration system begins with microalbuminuria, moving to frank proteinuria and then end-stage renal disease.

Diagnostic detective

A randomly drawn plasma glucose level of greater than 200 mg/dL suggests the presence of diabetes. More specifically, diabetes is present if an individual's blood glucose level is greater than 126 mg/dL after 8 hours of fasting. Prediabetes is present if an individual's fasting blood glucose level is between 100 and 125 mg/dL. The American Diabetes Association recommends an HbA1C value of less than 6.5%; a value of greater than 6.5% indicates diabetes (see *What's HbA1C?*).

Diabetes is also associated with high triglyceride levels (greater than 250 mg/dL); triglycerides should be reduced to less than 150 mg/dL. Patients with diabetes often have high-density lipoprotein cholesterol levels below 35 mg/dL; target levels for men should be greater than 45 mg/dL and for women, greater than 55 mg/dL. The target level for LDL cholesterol in patients with diabetes is less than 70 mg/dL. High urine albumin (greater than 20 mcg/minute) can be a marker of early renal disease in patients with diabetes.

The march of the treatments

There are treatments that address all manifestations of diabetes. First and foremost is control of blood glucose levels, which can delay the onset of severe complications. Maintaining good finger-stick and food intake records helps keep glucose levels under control. Balanced nutrition must be practiced to

Do the math

In adult patients with diabetes:
 $1,500 \div \text{total daily insulin dosage} = \text{expected mg/dL blood glucose decrease/unit of insulin}$

lower triglycerides, LDL, HbA1C levels, and body weight. An HbA1C blood draw should be performed at least twice a year. BP must be kept under control, smoking should be discontinued, and exercise should be encouraged (see *“Exercise and diabetes—Small Steps to Success”*). Remember that exercise increases caloric needs and has a 24-hour residual effect on blood glucose levels. Blood glucose must be checked before and after exercise to avoid severe drops in glucose levels. Exercise shouldn't be done if the patient's blood glucose level is less than 80 mg/dL or greater than 240 mg/dL.

Feet should be inspected daily for any break in the skin using a mirror and/or another person's assistance. Shoes and socks should be worn regularly to avoid lacerations. Feet should be washed with mild soap in lukewarm water and dried well, especially between the toes. Toenails should be trimmed straight across. Any foot ulcer should be treated aggressively to avoid infection and the possibility of amputation. Special shoes, casts, splints, and thick dressings have been developed to promote healing and reduce friction on the foot. Antibiotic treatment of infection is done cautiously; topical antibiotics are preferred. Any pain from neuropathy in the distal extremities can be treated with tricyclic antidepressants, antiepileptic drugs, or capsaicin cream.

Regular inspection of the oral cavity for edema, redness, bleeding, loose teeth, and thrush should be done to prevent periodontal infection. An active infection causes the release of cytokines and stress hormones, which can increase insulin resistance. Antimicrobial rinses can be used, as well as nystatin to treat oral thrush.

fat is discouraged. Raw or cooked vegetables, popcorn, and milk could be suggested.

Moderate-carbohydrate diets are estimated at 40 to 50 g per day. Limited saturated fats found in red meats are permitted, but trans fat isn't.

High-carbohydrate diets are estimated to be 75% carbohydrate. No animal products, eggs, or dairy are eaten. Staples such as beans and lentils are permitted. The intake tends to focus on grains, fruits, and vegetables and an increased intake of fiber, white rice, pasta, bagels, and beans.

Knowing how many servings per day a person should consume depends on height, weight, age, sex, and activity level. A dietitian can help your patient construct a meal plan that's the right balance for him or her.

What's the glycemic index?

The glycemic index is a measure of how different foods containing the same amount of carbohydrates affect blood glucose levels. At one time, the glycemic index held promise as a meal-planning method, but responses proved quite variable. When low glycemic index diets have been compared with high glycemic index diets, some short-term studies showed benefits and some didn't. However, two 1-year studies reported that no benefit was seen in HbA1C results, which gives an average of 2- to 3-month blood glucose testing results.

What we do accept as fact is that the best way to determine how certain foods affect the body is to test blood glucose more often.

Estimating portion sizes

How does your patient know how much is enough? Estimating the volume of a serving of food by comparing it with an object such as a fist, which equals about 1 cup; the palm of the hand, which equals about 3 oz; or the thumb tip, which equals about 1 teaspoon helps a person develop a practical approach to portion sizing. A food list may be used to determine the amount of carbohydrates in a particular food. Remind your patient to measure only the portion of the food to be eaten, which will provide more accurate information.

A less practical method of monitoring carbohydrate intake is to weigh foods on a scale. Your patient must identify the amount



increased risk for diabetic ketoacidosis (DKA). Concentrations of free fatty acids and ketones reach higher levels in pregnant women than in nonpregnant women, again increasing the risk of DKA.

Elderly patients with diabetes should plan exercise to accommodate preferences, functional capacity, and coexisting cardiovascular diseases. Physical limitations can be accommodated through such activities as stationary biking, swimming, or water aerobics. The older patient with diabetes should be encouraged to exercise with others, take rest periods, remain safe, and be alert to the possibility of hypoglycemia along with the timing for exercise.

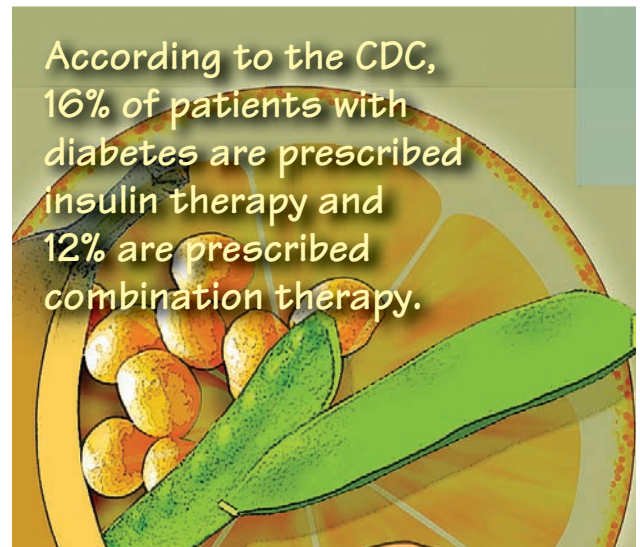
Asthma and diabetes have been linked. The common denominator appears to be inflammation. Asthma is treated with steroids and these steroids may also increase the risk of diabetes complications secondary to hyperglycemia. A person may experience exercise-induced bronchospasm (EIB) during or after exercise. EIB makes it difficult to exercise so many people avoid physical activity and this lack of exercise can lead to other problems, such as diabetes.

Getting your patient started

The best place for your patient to start is to choose an activity that's enjoyed and is convenient. Patients will be more likely to stay with a program that they like and one that isn't too difficult to do. Remember to stop and consider what might be stopping your patient from enjoying exercise.

Share the following tips with your patient:

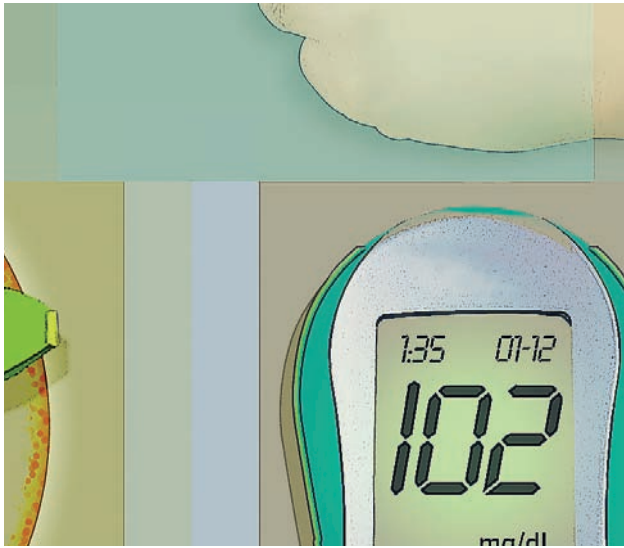
- Consider having a glucose meter available. Test blood glucose before and during exercise, if necessary.
- Go easy on yourself. Start slow, take precautions, set small goals, and measure them so you can be successful. Remember to think long term, but start small.
- Learn how often, how long, and how hard to perform a physical activity.
- Increase physical activity gradually.
- Select appropriate footwear to protect your feet. Examine your feet before and after each exercise session.
- Plan to exercise 1 to 3 hours after eating.
- Wear a medical-alert bracelet that indicates that you have diabetes.
- Have a list of contacts available.
- Dress in layers in case you get too warm.
- Drink water before, during, and after your activity.
- If you feel sick, don't exercise until you're feeling better.
- Monitor for the presence of ketones, a sign of faulty carbohydrate metabolism in uncontrolled diabetes, and don't exercise if present.
- Don't allow yourself to become demotivated.
- Be creative in finding ways and time to exercise. Consider walking the steps instead of taking the elevator, and walking to chores instead of driving a car.



Earlier treatment with insulin has been recommended for tighter blood glucose control to delay the onset of renal failure. Hypertension should also be addressed with angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers. Antihypertensive medications should be tried early in the course of renal failure because these aren't tolerated as well when renal failure is more advanced. The patient will need to restrict protein intake to less than 0.8 g/kg/day at the onset of renal failure and to less than 0.6 g/kg/day if renal failure is advanced.

Medication station

During insulin resistance, a false signal is sent to the liver that the body needs more glucose. The liver then mobilizes its glycogen supply and spills more glucose into a circulation already saturated with extracellular glucose. The **biguanides**, such as metformin, are given to reduce the liver's glucose production. The dosage of metformin is increased cautiously due to GI adverse reactions such as diarrhea. Contraindications include renal dysfunction, congestive heart failure (CHF), DKA, and hypoxemia.



Sulfonylureas, such as glipizide and glyburide, stimulate the pancreatic beta cells to secrete insulin.

Thiazolidinediones, such as rosiglitazone and pioglitazone, represent an attempt to reverse insulin resistance. These drugs mobilize a protein to the surface of muscle and fat cells that allows recognition of insulin and influx of glucose. However, they're idiosyncratically associated with fluid retention and peripheral edema. Thiazolidinediones aren't recommended for CHF patients. This is especially true when they're given in combination. Recent warnings have been issued that link rosiglitazone with an increased risk of myocardial infarction.

According to the CDC, 16% of patients with diabetes are prescribed insulin therapy and 12% are prescribed combination therapy. If the patient's fasting blood glucose level exceeds 350 mg/dL or the HbA1C exceeds 6.5%, exogenous insulin must be initiated. Insulin combined with a sulfonylurea gives the patient a better chance of getting the HbA1C below 6.5%. Most patients with type 2 diabetes will eventually need both basal and bolus insulins.

Bolus insulins are short- and rapid-acting analogs given to control postmeal spikes in blood glucose. Subcutaneous

of carbohydrate in the food to be eaten, estimate the portion size based on one of the common measuring devices, and do the math of the number of grams of carbohydrate multiplied by the portion size. However, the steps may become burdensome to your patient. Knowing which plan works best for your patient depends on caloric needs, blood glucose goals, food preferences, daily schedules, medications, exercise plans, monitoring schedules, and his or her desire for flexibility.

Labels tell all

The U.S. FDA requires that all packaged and processed foods list key nutrient information and ingredients on labels. In the United States, the label must contain the grams of total carbohydrates, as well as the grams of sugar and dietary fiber in a single serving. The carbohydrate listing includes everything in the food that's carbohydrate: starch, fiber, sugar, and sugar alcohols. The percentage listed identifies how much of the daily recommended food intake is in each serving. It's important that your patient pays attention to the portion size listed because it may not be the amount normally eaten and an adjustment may be needed.

Don't be misled by free foods

Free foods are foods that have little or no effect on blood glucose levels. They're defined as having fewer than 20 cal or 5 g of carbohydrates per serving. When eating multiple servings of free foods, calories and carbohydrates can still mount up and must be counted as part of the food plan.

The impact of diabetes self-management

Diabetes self-management education is the cornerstone of care for all patients with diabetes who wish to achieve successful health-related outcomes.

Patients should interact with the multidisciplinary team that includes nurses, physicians, and dietitians who may also be certified diabetes educators.

Medical nutrition therapy (MNT) is an integral component of diabetes prevention and management.

Medical nutrition therapy is an important component of diabetes management.

Suggestions for small steps to success

When educating your patient about the benefits of undertaking an exercise program, consider the following:

- Remember the benefits of a good stretch: push, pull, and lift your way to success.
- Make a strong start by beginning strength-training activities, if permitted. A simple activity such as lifting a soup can while walking around the house could turn out to be a beneficial exercise for the muscles.
- Start off on the right foot and walk your way to a healthier life. Consider purchasing an inexpensive pedometer just to see how many steps you're already walking.
- Substitute activity for inactivity. Consider adding something simple, such as stretching or doing yoga, while watching TV.
- Get in the swim. Water is an equalizer; it supports arms and legs, and provides gentle, natural resistance that can help build muscle strength.
- Find the support you need to remain motivated.

Exercise 911

During exercise, and often for hours afterwards, blood glucose levels go down. Hypoglycemia is one of the most common emergencies in patients with diabetes. With the use of more intense



insulin regimens, improved blood glucose control often comes with the risk of more frequent hypoglycemia.

Hypoglycemia is generally classified as low, moderate, or severe. The designated term is often based on the specific symptoms of low blood glucose that the patient is experiencing. Symptoms that patients experience vary, so relying on blood glucose readings alone isn't entirely significant.

When a patient experiences mild or moderate symptoms of low blood glucose, the symptoms are often manifestations of the sympathetic

nervous system's response to the low blood glucose level. Signs, such as shakiness, sweating, rapid heartbeat, headache, feeling hungry, nervousness, anxiety, and lightheadedness, are often dependent not only on low blood glucose but also on how quickly the patient's blood glucose level is dropping. Signs of severe hypoglycemia can include unconsciousness, seizure activity, confusion, and inappropriate behavior and/or conversation.

Hypoglycemia is rare in patients with diabetes who aren't being treated with insulin or insulin secretagogues, and therefore no

short-acting regular insulin takes effect in 30 minutes and peaks in 2 to 5 hours. The patient's finger stick will read most accurately 4 hours after the dosage. Regular insulin is best suited to treat a more slowly absorbed fat/protein meal. The beta chain of the human insulin molecule has been reengineered to yield the rapid-acting aspart analog, which takes effect in 15 minutes, peaks in 45 minutes, and tapers off after 90 minutes. Subcutaneous insulin aspart provides better control of a quickly absorbed, high-carbohydrate meal. The finger stick will read most accurately 2 hours after the dosage.

Basal insulins are the intermediate- and long-acting analogs that provide 50% of the daily insulin requirement. They're usually administered at bedtime, or twice a day (at breakfast and bedtime). Subcutaneous intermediate-acting insulin peaks in 3 to 6 hours and tapers off in less than 16 hours. The alpha and beta chains of the human insulin molecule have been reengineered to create the less-soluble, long-acting glargine analog, which provides 24-hour coverage. The abdominal route provides the most rapid and consistent dosage. Beta-blocking medications potentiate the action of insulin. Steroids, lithium, nifedipine, and oral contraceptives antagonize insulin.

Covering the bases

Basic diabetes teaching leads to better patient compliance. Because so much of diabetes care is dependent on self-care, assess the patient's ability to access and prepare medications, correctly administer insulin, and correctly respond to episodes of hypo- or hyperglycemia. Give the patient printed material, including a written follow-up plan and available education classes and community services. Tell the patient about the availability of assistive devices such as drug organizers and voice-prompting glucometers. Patients with diabetes

Warning! Older patients and diabetes

Blood glucose control should be less aggressive for the older patient with diabetes. Any drop in blood glucose from overtreatment can bring on catecholamine secretion, which can task a weak cardiovascular system. Glucose levels should be moderately controlled to prevent the development of immediate symptoms (such as blurred vision). Any development of a hyperglycemic, hyperosmolar state in an older patient with diabetes can be serious.

Carbohydrate intake should be consistent to avoid abrupt changes in insulin dosages. However, because of limited resources and reduced mobility, many older patients don't have access to a variety of foods and tend to consume lower levels of calories, iron, calcium, and vitamins A and C. Weight gain, not loss, may be the goal for some.

Physical exercise goals should be more moderate if the patient has active arthritis or a history of cardiovascular disease. Well-fitting shoes are necessary with exercise. Patients must check their feet after exercise for calluses and ulcers and may need help doing so. Despite a blunted sense of thirst, adequate hydration is needed with exercise to prevent episodes of orthostatic hypotension. Distal sensory neuropathy may place older patients with diabetes at higher risk for falls.

should be aware that they're at increased risk for cardiovascular complications and that tight glycemic control lessens the rate of microvascular symptoms and improves LDL and triglyceride levels.

Balanced nutrition and weight control play a major role in diabetes teaching (see *Warning! Older patients and diabetes*). A patient trying to lose weight should reduce caloric intake by 500 to 1,000 kcal/day. Nonpregnant women need at least 1,000 to 1,200 kcals/day; men need 1,200 to 1,600 kcals/day. Help patients fashion a flexible diet based on their lifestyle, motivation level, foods they usually consume, and

The American Diabetes Association recognizes the impact that nutritional management therapy plays in the maintenance of an overall healthy lifestyle. Because nutrition issues must be individualized and can be complex in diabetes management, it's recommended that a registered dietitian who has diabetes management experience be the one who provides MNT.

Carb counting for patients with diabetes takes practice, and it can be discouraging when blood glucose testing doesn't produce a normal result. Eating well with carbohydrates has been addressed over and over again, but the debate still exists as to whether patients with diabetes should focus primarily on carbohydrates or not. Some of the following tips may prove helpful to your patient who's beginning to count carbohydrates:

- Accept that you have diabetes.
- Allow yourself to become smart about diabetes.
- Start your carbohydrate management plan by eating at home.
- Test your blood glucose levels frequently and keep records for review.
- Be a label reader.
- Simple is comfortable.
- Figure out what foods work positively for you. Be consistent, but not boring with food choices.
- Plan ahead and know how foods affect blood glucose readings.
- Know portion size estimates.
- Avoid senseless munching.
- Don't worry about being an expert; welcome support.
- Allow for setbacks to serve as a guide for future successes.

The power of education

Diabetes is common, costly, and complex, and may seem frustrating for your patient at times. Proper patient education can result in less distress, better outcomes, and greater adherence to recommended treatments. Adherence, a voluntary, collaborative involvement of the patient in a mutually designed plan of action, gives your patient a choice and makes him or her an active participant in care. Teaching carb counting takes patience and time



preventive measures for these patients are generally suggested.

For patients taking insulin and/or insulin secretagogues, physical activity can cause hypoglycemia if the medication dosage or carbohydrate consumption isn't altered. For these individuals, it's suggested that added carbohydrates should be ingested if preexercise blood glucose levels are below 100 mg/dL. Typically, patients would be instructed to take 15 g of carbohydrate before exercising. Suggestions could include 4 oz of juice, 3 to 4 glucose tablets, or 4 oz of regular soda. A repeat blood glucose reading is advised after this treatment. If a reaction is severe enough that unconsciousness occurs, an injection of glucagon can be given to change stored glycogen to glucose. It will reverse hypoglycemic reactions and increase the use of fats and amino acids for energy production. Of course, educating a family member or significant other should be a part of this treatment plan.

Patients with type 1 diabetes deprived of insulin for 12 to 48 hours can experience hyperglycemia and should be advised that vigorous exercise should be avoided in the presence of ketones. Although it isn't necessary to cancel exercise in the face of hyperglycemia alone, it's generally advised to forego exercise until the patient feels better and the urine and/or blood is free from ketones.

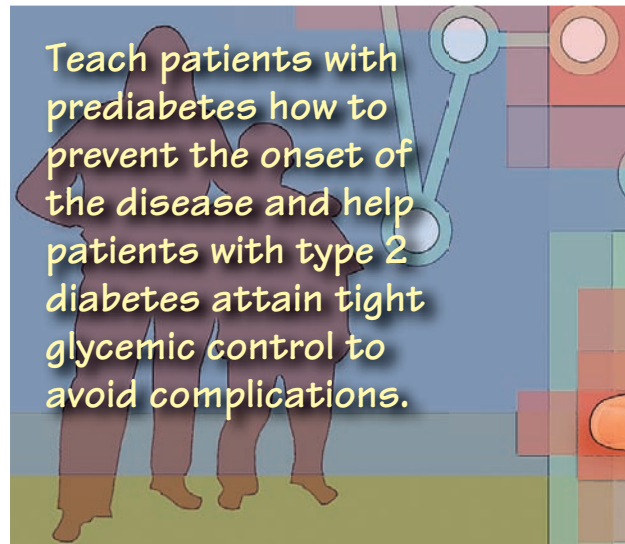
Can patients with diabetes really exercise safely?

Clinical intervention designed to implement exercise patterns suggests that participation is higher when patients are made aware of what constitutes an unhealthy lifestyle and when they perceive themselves as being more susceptible to the complications of diabetes that can result from inactivity. Although physical activity is vitally important for managing diabetes, many of the individuals who begin formal exercise programs don't sustain these behaviors beyond 6 months.

Complications of diabetes are inevitable. Regardless of pharmaceutical interventions, unless lifestyle interventions are negotiated, initiated, and maintained through patient education, training, and empowerment, little success will be achieved. Providing ongoing support is one of the main ingredients in the recipe of helping patients maintain gains achieved through education.

Incorporating physical activity into one's lifestyle has been identified as one of the content areas to be included in a diabetes self-management education (DSME) program. DSME is the ongoing process of facilitating the knowledge, skill, and ability necessary for diabetes self-care. DSME is an essential and effective aspect of diabetes healthcare. All patients with diabetes should be offered individualized DSME on an ongoing basis.

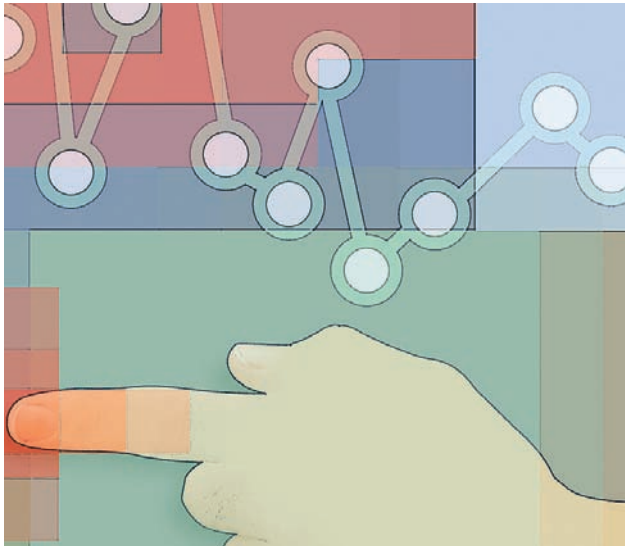
Healthcare professionals need to know their patients. We must stop and ask questions. Give your patient the opportunity to choose



medication schedule. A sensible diet for patients with diabetes is low in fat, low in sugar, sufficient in fiber, and smaller in food portions. Remember that carbohydrates are the primary nutrient that raises blood glucose levels (see *"The Great Carbohydrate Debate"*).

Meals must be timed with subcutaneous insulin doses. Snacks are added to prevent hypoglycemia. The patient should estimate total caloric need and then divide this evenly over the day. Meals should be spaced at least 3 hours apart. Having meals at set times reduces fluctuation in glucose levels.

Finger sticks are a key to diabetes treatment, although capillary blood specimens aren't as accurate as plasma draws. The forearm and thigh are possible alternative sites for testing, but rapid changes in glucose levels are best detected in a fingertip sample. Glucometer user error accounts for most of the variation in readings. Artificially low readings are often caused by an insufficient amount of blood on the test strip or drying out of strips from exposure to air. Patients using insulin should check their blood glucose level at least four times a day (see *Do the math*). Patients using multiple insulins should perform finger sticks before and after meals.



Controlling the future

With type 2 diabetes, an ounce of prevention is worth a pound of cure. Coach patients who are still in the prediabetes phase that exercise and proper diet can prevent or significantly delay the onset of this disease. And help patients with type 2 diabetes envision a future of tight glycemic control to avoid cardiovascular, vision, and neuropathic complications. ■

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for both the patient and the teacher. Start by asking your patients what they feel they need to know.

The following tips may prove helpful as you embark on diabetes education:

- Take the time to get to know your patient. Don't stereotype patients, such as all patients with diabetes are likely to be "cheating on the diet."

- Ask your patient how he or she likes to learn. Uncover hidden information about your patient, such as cooking skills. Striking a familiar note may help with the implementation of the plan.

- Keep it simple. Begin first with what a carbohydrate is and then progress to making food choices and meal plan selections.

- Stop and ask your patient if he or she has any questions.

Remember to be a partner in your patient's care. Ask open-ended questions such as: "What would you do if a certain situation arose?" Build on life experiences.

- Let your patient play. Experience with choosing the right foods to eat and setting up a satisfying meal plan will translate into effective learning.

- Never forget to follow up. Patients should never be expected to have 100% recall. Keep your education patient-focused. Tap into your patient's thoughts and feelings about how the plan is going. Can anything be changed? Give feedback. Thinking in a "one size fits all way" will have your patient coming up short.

- Always reinforce.

To help patients overcome barriers, practitioners must understand that patients adhere to chronic disease recommendations when the treatment regimen makes sense and seems effective and when they think that the benefits exceed costs, believe it's important, have confidence they can succeed in the regimen, and when they have support.

Remember: Be a coach, be a mentor, and reinforce that the best diet is the healthy diet that the patient will follow. ■

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The author has disclosed that she has no financial relationships related to this article.

activities that he or she enjoys. Remember, diabetes isn't a "one size fits all" disease. If we aren't open to our patients' thinking and feelings, they'll continue to come up short. ■

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