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HEART INSTITUTE
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MINTO PREVENTION & REHABILITATION CENTRE
CENTRE DE PREVENTION ET DE READAPTATION MINTO

Understanding Diabetes

About This Kit

Diabetes is one of the most common chronic diseases in Canada. Over 2 million Canadians are estimated to have diabetes. People with diabetes are about three to five times more likely to develop coronary heart disease than people without diabetes. Coronary heart disease is by far the leading cause of death among people with diabetes.

Diabetes cannot be cured, but it can be controlled. If you have diabetes, it is critical that you learn all you can about your diabetes. If you don't have diabetes now, you can benefit from learning about diabetes and practicing the lifestyle skills to help prevent it. In this kit you will:

Step 1.   Learn about diabetes
Step 2.   Understand your blood glucose values

This kit is one of several Heart Institute Prevention and Rehabilitation Centre (HIPRC) educational kits on Preventing and Reversing Coronary Heart Disease. Ask about other kits in this series, including:

- Understanding Coronary Heart Disease
- Understanding Risk Factors for Coronary Heart Disease
- Understanding Cholesterol and Triglycerides
- Preventing and Managing High Cholesterol and Triglycerides
- Understanding Blood Pressure
- Preventing and Managing High Blood Pressure
- Managing Diabetes
- Exercising With Diabetes
- Understanding Stroke
- Understanding Risk Factors for Stroke

Step 1

Learn About Diabetes

People with diabetes have problems regulating the amount of sugar or *glucose* in their blood. When left untreated, they have too much glucose in their blood. Once the amount of glucose in the blood exceeds a certain level, excess glucose spills over into the urine. *Diabetes mellitus* comes from the Greek word *diabetes* (to flow through; urine) and the Latin word *mellitus* (sweetened or honey-like).

When you eat sugars and starches, the body changes them into a form of sugar called glucose. Glucose enters the blood and is carried to all of the cells of the body where it is ready to be used for energy. The hormone *insulin,* which is produced in the pancreas, is responsible for moving the glucose out of the blood and into the cells. Too much glucose in the blood, a condition known as *hyper* (high) *glycemia* (glucose), is dangerous and can cause damage to organs in the body. Too little glucose in the blood (*hypoglycemia*) means the cells can't get the energy they need to function properly.

Types of Diabetes

There are two main types of diabetes:

Type 1 Diabetes – With type 1 diabetes, too much glucose builds up in the blood because the pancreas is either completely unable to produce insulin or is able to produce only a tiny amount. People with type 1 diabetes must have insulin injections for the rest of their lives. This condition was previously referred to as juvenile-onset diabetes because people are generally younger than 30 years of age when they are diagnosed. However, type 1 diabetes can develop at any age.

Type 2 Diabetes – With type 2 diabetes, too much glucose builds up in the blood mainly because the cells become resistant to the insulin the body makes. The pancreas still secretes insulin. Insulin levels in the blood may be normal or even too high, but the body doesn't respond properly to the insulin's action. People with type 2 diabetes don't usually take insulin injections. They are more likely to take oral medications to help keep their blood glucose levels within a normal range. Some of these medications cause the pancreas to produce more insulin. Other medications make the cells use insulin more effectively. Type 2 diabetes was previously referred to as adult-onset diabetes. People who develop it usually, but not always, are older than 30 when they learn they have it. Type 2 diabetes is widespread. Almost 5% of Canadians have it. As many as 50 percent of these people are undiagnosed (don't know they have diabetes). Undiagnosed diabetes is a serious condition that significantly increases a person's risk for coronary heart disease and other complications of diabetes. *Type 2 diabetes is just as serious a medical condition as type 1 diabetes and should never be taken lightly!*

Complications

If you have diabetes, you can be healthy if you take care of yourself and follow the recommendations of your health care provider. But, if you have diabetes and it is not well controlled, you can get into serious trouble. Some complications occur rather abruptly and can cause a coma, which can be fatal. These are referred to as acute complications. Acute complications usually occur when the blood glucose level rises too high or falls too low.

Acute Complications or Blood Glucose Emergencies

There are three kinds of blood glucose emergencies.

Hypoglycemia – Hypo means low and *glycemia* means blood glucose level. A dangerously low blood glucose level is the most common problem for people with type 1 diabetes, and for those with type 2 who are on insulin therapy or take oral hypoglycemic medicines. When your blood glucose is too low you may:
- Feel shaky, tired, or hungry
- Become sweaty
- Become "crabby" or confused
- Have a rapid heart beat
- Faint or feel light headed

Hyperglycemia With Ketoacidosis – Hyper means high. This condition is a dangerously high blood glucose level accompanied by an excessive build up of *ketones* in the bloodstream (which in turn increases blood acidity, triggering *acidosis*). Untreated hyperglycemia with *ketoacidosis* can lead to coma. People with type 1 diabetes are prone to this condition, but generally people with type 2 need to worry about it only during periods of severe physical or emotional stress. Early warning symptoms are:
- Drowsiness
- Frequent urination
- Intense thirst

Hyperglycemia Without Ketoacidosis – People with type 2 diabetes have a tendency toward this type of complication, which is caused by unchecked high blood glucose levels (hyperglycemia) where the blood shows no signs of ketoacidosis. The result is dehydration, triggering more concentrated blood, which can lead to coma. Early warning signs are:
- Drowsiness
- Frequent urination
- Intense thirst

Factors Causing High and Low Blood Glucose

High Blood Glucose (Hyperglycemia)	*Low Blood Glucose (Hypoglycemia)*
• Too much food • Concentrated sweets (pies, candy, etc.) • Too little exercise • Too little diabetes medicines • Stress (physical or emotional) • Certain medicines, such as steroids	• Not enough food • Skipping or delaying meals • Too much exercise • Too much diabetes medicine • Alcohol

Chronic Complications

Chronic complications do not appear suddenly, but develop over the long-term. These can also be fatal. Three major types of chronic problems can arise.

- *Damage to Blood Vessels* – Diabetes works together with other coronary heart disease risk factors to damage blood vessels. These damaged blood vessels can cause heart attacks, strokes, peripheral vascular disease, claudication, nephropathy, kidney failure, poor circulation, retinopathy, and blindness (see glossary below).

- *Damage to Nerves* – Diabetes damages nerves. This damage may cause numbness or pain or it may reduce feeling, especially in the feet and legs. If you are injured and feel no pain because of numbness, the injury may go unnoticed until get considerably worse. Nerve damage, called neuropathy, may also cause circulation and sexual problems.

- *Decreased Ability to Fight Infections* – High blood glucose slows the work of the white blood cells that fight infections in the body. Infections can become serious very quickly when the body is not able to fight them off. Skin, dental, urinary, and vaginal infections occur more frequently in people with diabetes.

Glossary of Diabetes Complications

- *Intermittent claudication* – This complication is caused by the buildup of atherosclerotic plaque in the arteries to the legs, a condition called *peripheral vascular disease.* The symptoms are pain or lameness *(claudication)* in the buttocks or legs, which is only felt during exercise. It is relieved by rest, which is why it's termed *intermittent.*

- *Retinopathy* – This is a progressive disease *(pathy)* that damages the retina *(retino).* The retina is the area inside the eye that acts like a camera and records images of objects. There are usually no symptoms in the early stages of this disease. Left untreated, the retinal blood vessels slowly become nonfunctional. New blood vessels form in an attempt to maintain an adequate blood supply to the retina. Because these new vessels are very fragile, they rupture easily, reducing vision and finally causing blindness.

- *Nephropathy* – This kidney disease *(nephro)* is caused by damage to the kidneys' small blood vessels. The visible signs are excretion of protein in the urine, swelling of the feet and ankles, and high blood pressure. Left untreated, this condition results in kidney failure.

- *Neuropathy* – There are two forms of this disease of the nerves *(neuro). Peripheral* neuropathy causes damage to the nerves that control sensation, and to a lesser degree, the nerves that control muscle function. People with peripheral neuropathy may lose the protective sensation in their feet, which increases the risk for fractures, foot ulcers, and even amputation. *Autonomic* neuropathy affects the autonomic nerves, the nerves that you don't consciously control. The autonomic nerves control key internal organs, such as the heart.

Screening for Diabetes

Doctors don't know precisely what causes type 1 diabetes or why some people develop the disease and others don't. Most cases of type 1 diabetes are believed to occur as a result of the body's immune system destroying the cells in the pancreas that produce insulin. This is thought to result from genetic factors and poorly understood environmental factors. At the present time, no screening tests are recommended for the routine detection of type 1 diabetes in people who do not have the symptoms.

Just as there are risk factors for coronary heart disease, there are conditions or behaviors that either increase a person's risk of developing type 2 diabetes or are more likely to occur in people who have type 2 diabetes. You are at higher risk for type 2 diabetes if you have these risk factors. Check any that apply to you.

_____ *Age 45 Years or Older* – There is a steep rise in the incidence of diabetes after age 45 years.

_____ *Family History of Diabetes* – Diabetes seems to run in families. If you have a first degree relative (mother, father, sister, or brother) with diabetes, be sure to share this information with your HIPRC mentor and your health care provider. If you are at risk because of your family history, you may be able to delay the onset of diabetes or prevent it altogether by exercising regularly and keeping your weight in a healthy range.

_____ *High-risk Ethnic Population* – If you are a member of a high-risk ethnic population (Aboriginal, Asian-Canadian), you should be aware of your increased risk and take action to prevent the onset of diabetes.

____ ***Overweight*** – Excess weight is stored as body fat and fat cells are resistant to insulin. The higher your percentage of body fat, the less effectively the body is likely to respond to insulin and the higher the level of blood glucose. Body Mass Index (BMI) is the measure that evaluates body fatness. BMI is calculated by using a formula that takes into account your height and weight (the formula is: BMI = weight in kilograms divided by height in meters squared). For adults ages 35 and older, a BMI equal to or greater than 27 is a major risk factor for diabetes. The BMI concept was used to calculate your short-term and long-term weight goals. Find your height on the chart below, then look across to the weight nearest to your current weight. See the ranges of BMI and their interpretation. At-risk weights are lower for people under age 35. If you are very muscular, this interpretation may not apply to you.

Body Weight According to Height and Body Mass Index (BMI)

Height			*Body Weight (Pounds)*				*Body Weight (Kilograms)*		
(Inches)	*(cm)*	**BMI**	**25**	**27**	**30**	**BMI**	**25**	**27**	**30**
58	147.3		119	129	143		54.0	58.5	64.9
59	149.9		124	134	149		56.2	60.8	67.6
60	152.4		127	138	153		57.6	62.6	69.4
61	154.9		132	143	159		59.9	64.9	72.1
62	157.5		136	147	163		61.7	66.7	73.9
63	160.0		141	152	169		64.0	68.9	76.7
64	162.6		146	158	176		66.2	71.7	79.8
65	165.1		150	162	180		68.0	73.5	81.6
66	167.6		156	168	187		70.8	76.2	84.8
67	170.2		159	172	191		72.1	78.0	86.6
68	172.7		165	178	198		74.8	80.7	89.8
69	175.3		169	182	203		76.7	82.6	92.1
70	177.8		175	189	210		79.4	85.7	95.3
71	180.3		179	193	214		81.2	87.5	97.1
72	182.9		185	199	221		83.9	90.3	100.2
73	185.4		189	204	226		85.7	92.5	102.5
74	188.0		195	210	234		88.5	95.3	106.1
75	190.5		199	215	239		90.3	97.5	108.4
76	193.0		205	222	246		93.0	100.7	111.6

Interpreting BMI
25 or less   = ideal weight
27 or less   = healthy weight
27 to 30   = overweight
30 or higher = obesity

If you are overweight, losing as little as five to ten percent of your weight could improve how your body uses insulin. For some people, it is all that is needed to bring their blood glucose within normal levels.

If your body shape causes you to store excess fat in your abdomen or waist area, you should be even more careful to keep your weight in a healthy range. Research has shown that people who store excess fat in their abdomen, called central obesity, are at greater risk for diabetes and heart disease than people who deposit excess fat in their hips and thighs, called peripheral obesity. You can determine if you have central obesity by measuring your waist-to-hip ratio. Ask your mentor to measure your waist-to-hip ratio or you can do it yourself.

What is Your Waist-to-Hip Ratio?

1. Use a tape measure to measure your waist (at its smallest) and your hips (at their largest).

Waist = _____inches   Hips = _____ inches

2. Divide your waist measurement by your hips measurement.

_____inches   / _____inches = _____

3. You have "central obesity" if:
- *You are male and your ratio is greater than 1.0*
- *You are female and your ratio is greater than 0.8*

_____ ***Female and Gave Birth to a Baby Weighing More Than Nine Pounds or Developed Diabetes During Pregnancy*** – Although many of these women do not develop diabetes later in life, if you are in this category, you should be aware that you are at higher risk for future diabetes.

_____ ***High Blood Pressure*** – If you are taking medication for high blood pressure or have a systolic blood pressure of 140 mmHg or higher and/or a diastolic blood pressure of 90 mmHg or higher, you are at an increased risk of having diabetes.

_____ ***HDL ("good") Cholesterol of 35 mg/dl or Less and/or Triglyceride Level of 250 mg/dl or Higher***

_____ ***Previous Diagnosis of Impaired Glucose Tolerance*** – People with impaired glucose tolerance have too much glucose in their blood, but not so much to qualify as a diagnosis of diabetes. There are no symptoms of diabetes. If you have impaired glucose tolerance, you are at an increased risk of developing diabetes and coronary heart disease in the future.

The Canadian Diabetes Association recommends a fasting blood glucose test to screen for diabetes in all adults age 40 years and older. If normal, the test should be repeated every three years. Testing should be considered before age 40 or be carried out more frequently in individuals who have any of the other risk factors for diabetes.

Preventing Diabetes

There is no cure for diabetes, but it can be managed and type 2 diabetes can often be prevented. Managing or preventing diabetes is especially important if you have any other risk factors for coronary heart disease, such as high blood pressure, high blood cholesterol, cigarette smoking, physical inactivity, or overweight. *The foundation of diabetes prevention and management is correct nutrition, regular exercise, and if necessary, medication.* Because coronary heart disease is the most important health hazard for people with diabetes, controlling other coronary heart disease risk factors is also of vital importance for all people with diabetes.

Symptoms of Diabetes

Some people with diabetes have very mild symptoms or no symptoms at all. Increased urination and thirst are two of the most common symptoms of diabetes. Other symptoms may include:
- Unexplained weight loss
- Fatigue or weakness
- Hunger
- Infections and cuts that are slow to heal
- Numbness, tingling, burning, or intense sensitivity in certain areas of the skin, especially in the feet and legs
- Dry, itchy skin
- Frequent bladder or vaginal infections
- Blurred vision
- Impotence

If you develop any of these symptoms, be sure to promptly report them to your health care provider. The best way to know if you have diabetes is to have a fasting blood glucose test. Your blood glucose level is evaluated as part of your HIPRC assessments. Often diabetes is discovered during a screening or a routine check-up.

Step 2

Understand Your Blood Glucose Values

_____

Know Your Numbers

The diagnosis of diabetes is made largely on the basis of a blood glucose test. A normal fasting blood glucose level is below 6.1 mg/dl. Fasting means at least eight hours without eating any food or drinking anything other than water. If your fasting blood glucose level is 7.0 mg/dl or higher, you have diabetes. A diagnosis of diabetes must be confirmed on a subsequent day. Fasting blood glucose values of 6.1 to 6.9 are referred to as *impaired fasting glucose* or *impaired glucose tolerance*.

	NORMAL (for people without diabetes)	TARGET GOAL (for diabetics)	ACTION MAY BE NEEDED	ACTION REQUIRED
Fasting Glucose	3.8 - 6.1	4.0 - 7.0	7.1 - 10	>10
Glucose 1-2hr after meal	4.4 - 7	5.0 - 11	11.1 - 14	>14
Glycated Hb* (Hemoglobin A1c)	0.04 - 0.06	< 0.07	0.07 - 0.084	> 0.084

The values in this chart are for non-pregnant adults. "Action May Be Required" depends on individual circumstances. Such actions may include enhanced diabetes self-management, education, and/or consultation with your doctor. *Hemoglobin A1c* is a blood test that provides a good indication of a person's average blood glucose level over the preceding six to 10 weeks. This is why this test is often called "the blood test with a memory." Although this test is currently not recommended to help diagnose diabetes, it is recommended as a test to help people with diabetes manage their condition.

The Goal of Diabetes Management

The goal of diabetes management is to avoid the acute and chronic complications of diabetes. This is best accomplished by keeping blood glucose levels in the recommended ranges shown in the chart above.

Other Important Goals

If you have diabetes, it is critical that you take action to control your other coronary heart disease risk factors. Because you have diabetes, your other risk factor goals are more rigorous than for most people without diabetes. In fact, your goals are similar to those for someone with known coronary heart disease.

Risk Factor Goals for People With Diabetes
- LDL "bad" cholesterol   Less than 2.5 mg/dl
- HDL "good" cholesterol   Greater than 1.0 mg/dl
- Triglycerides   Less than 1.7 mg/dl
- Blood pressure   Less than 130/85 mmHg

If you have diabetes, which of these risk factors do you currently have under good control?

See the HIPRC education kits in the series "Preventing and Reversing Coronary Heart Disease" for more information to help you manage your risk factors and achieve your goals.

Monitoring Your Blood Glucose Level

If you have diabetes, your health care provider will teach you how to use a glucometer to monitor your blood glucose. It is quick, easy, and accurate. Your doctor will tell you the number of times and when you should test each day. Once your blood glucose is under good control, you may only have to test several times a week if you do not take insulin. A family member should also learn how to do the test, so you can get help if you are not feeling well.

Self-Monitoring Tips
- Do the test exactly as instructed.
- Test at the appropriate time.
- Always record the date, time, and results.
- Check your blood glucose more often when you are ill.
- Call your healthcare provider if you have questions or problems.

Urine Testing for Ketones

A urine ketone test is the only practical way you can test for excessive amounts of ketones in your blood. It is done by placing some urine on a chemically treated strip, tape, or tablet and looking for a change in color to indicate if you're in the danger zone. The combination of high concentrations of glucose and ketones in the blood is serious because it indicates a dangerous insulin deficiency.

Whenever your blood glucose level is above 13.2 mmol/L, do a ketone test, especially if you have type 1 diabetes. If moderate or large amounts of ketones are present, call your health care team immediately. If trace or small amounts of ketones are present, you should test your blood glucose and ketones every three or four hours. If your blood glucose and ketone numbers are not going down after two tests, call your doctor.

Understanding Diabetes

Before Your Next Visit

In the time between your visits with your mentor, you should read and complete your educational kits. Use this sheet to record your work. Think of this as "homework." Bring this sheet with you to your next visit.

❑ If you have diabetes, which of these risk factors do you currently have under good control? Check all that apply.
___LDL "bad" cholesterol
___HDL "good" cholesterol
___Triglycerides
___Blood pressure

❑ Complete the statements in "Check Yourself" to be sure you understand the key concepts in this kit.

Check Yourself

1. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ is by far the leading cause of death among people with diabetes.
2. With type 1 diabetes, too much glucose builds up in the blood because the pancreas is either completely unable to produce _ _ _ _ _ _ _ or is able to produce only a tiny amount.
3. With type 2 diabetes, too much glucose builds up in the blood mainly because the cells become _ _ _ _ _ _ _ _ _ to the insulin the body makes.
4. Type 2 diabetes is just as _ _ _ _ _ _ _ a medical condition as type 1 diabetes and should never be taken lightly.
5. Acute _ _ _ _ _ _ _ _ _ _ _ _ _ usually occur when the blood glucose level rises too high or falls too low.
6. Chronic complications develop over the long-term and cause damage to blood vessels and _ _ _ _ _ _, and decrease the body's ability to fight infections.
7. Diabetes seems to run in _ _ _ _ _ _ _ _.
8. _ _ _ cells are resistant to insulin.
9. Increased _ _ _ _ _ _ _ _ _ and thirst are two of the most common symptoms of diabetes.
10. The best way to know if you have diabetes is to have a _ _ _ _ _ _ _ blood glucose test.
11. Diabetes is a major risk factor for coronary heart disease and _ _ _ _ _ _.
12. If you have diabetes, your healthcare provider will teach you how to use a _ _ _ _ _ _ _ _ _ _ to monitor your blood glucose.

Answers: 1) Coronary heart disease; 2) insulin; 3) resistant; 4) serious; 5) complications; 6) nerves; 7) families; 8) Fat; 9) urination; 10) fasting; 11) stroke; 12) glucometer

Write any questions for your mentor here.