

MANAGING CYSTIC FIBROSIS- RELATED DIABETES (CFRD)

An Instruction Guide for Patients and Families | 6th Edition



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This information meets the guidelines and standards of the Cystic Fibrosis Foundation's Education Committee.

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TABLE OF CONTENTS

INTRODUCTION	5
CHAPTER 1: Cystic Fibrosis-Related Diabetes (CFRD)	6
Diabetes	
Non-CF Diabetes	
CFRD Causes	
CFRD-Caused Health Problems	
CFRD Symptoms	
CHAPTER 2: How We Diagnose CFRD	9
Tests Used to Diagnose CFRD	
CHAPTER 3: Treating CFRD	11
Insulin	
Insulin Types	
Insulin Treatment	
Insulin Pens, Syringes and Pumps	
Continuous Glucose Monitors	
Oral Agents (Diabetes Pills)	
CHAPTER 4: Blood Sugar Testing	19
When to Check Blood Sugar	
How to Check Blood Sugar	
Blood Sugar Testing Results	
Summary	
CHAPTER 5: How We Manage CFRD	23
Tests to Help Manage CFRD	
Other Tools to Manage CFRD	
CHAPTER 6: The Diabetes Care Team	25
CHAPTER 7: Low Blood Sugar (Hypoglycemia)	26
What Is Hypoglycemia?	
Low Blood Sugar Symptoms	
Low Blood Sugar Causes	
Low Blood Sugar in CF Without Diabetes	
Low Blood Sugar Treatment	
Driving and Low Blood Sugar	
Sick Days and Low Blood Sugar	
Exercise and Low Blood Sugar	

CHAPTER 8: Abnormal Glucose Tolerance in CF	30
Other Types of Abnormal Glucose Tolerance in CF Treatment	
CHAPTER 9: Nutrition and CFRD	31
A High-Calorie Healthy Diet Carbohydrates Reading Food Labels for Carbohydrates Insulin Correction Doses Eating a Balanced CF Diet Insulin Coverage of High-Calorie Supplements and Tube Feedings Special Cases	
CHAPTER 10: Nutrition and CFRD When Pregnant	39
Planning for Pregnancy Gestational Diabetes Nutrition When Pregnant Special Concerns	
CHAPTER 11: Carbohydrates in Common Food Items	43
Carbohydrate Counting Common Household Measurements Estimating Portion Sizes Food Lists Sample Meal Plan Sample Menu	
GLOSSARY:	53
IMPORTANT RESOURCES:	62
Cystic Fibrosis Foundation (CF Foundation) American Diabetes Association (ADA) American Association of Diabetes Educators (AADE)	

INTRODUCTION

If you are reading this, you or someone you love has likely been told they have cystic fibrosis-related diabetes (CFRD). This guide was written to add to the information given to you by your diabetes and cystic fibrosis (CF) care teams. The chapters cover the topics needed to manage CFRD. To help you focus on the main points, learning goals are listed at the start of each chapter.

If you've been told that you have CF and diabetes, you might feel stressed by the added health care responsibilities. You might feel hopeless when you think you cannot do one more thing. Diabetes is not the "last straw," though. To manage it well, learn as much as you can. You should be able to do all the things you want to do — and continue to eat your usual high-calorie diet for your CF. Learning the skills from this book can help keep you as healthy as possible.

An Important Note for Our Patients and Their Caregivers

The Cystic Fibrosis Foundation is a leader in the efforts to advance and promote specialized care that improves and extends the lives of people with CF. Thanks in large part to the care provided by the Foundation's Care Center Network, the median predicted age of survival for people with CF is about 40 years and is increasing. To ensure this trend continues, the Foundation provides its accredited care centers with up-to-date guidelines based on the latest research.

The Cystic Fibrosis Foundation, together with the American Diabetes Association and the Pediatric Endocrine Society, sponsored a consensus conference on CFRD in 2009. The guidelines and definitions presented here reflect the consensus by experts in CF and diabetes. The authors and the CF Foundation hope this guide will help you and your family understand the unique nature of CFRD, and help you manage it and live well with diabetes.

CHAPTER 1: CYSTIC FIBROSIS-RELATED DIABETES (CFRD)

Learning Goals

At the end of this chapter, you should be able to

- Understand how the body uses *insulin** to turn food into fuel for the body.
- See that CFRD is common among people with CF, especially in adults.
- List the differences between CFRD and Type 1 or Type 2 diabetes.
- State the causes of CFRD.
- Understand the symptoms of CFRD.

Diabetes

When people eat, food breaks down into *sugar*, fat and *protein*. Sugar enters the bloodstream and *blood sugar* (also known as *blood glucose*) levels rise. The increase in blood sugar signals the *pancreas*, an organ in the abdomen, to *secrete* insulin. Insulin works by helping protein, fat and sugar leave the blood and enter the cells where

they are used for fuel. People with *diabetes* either do not make enough insulin or do not respond to insulin the right way, so sugar cannot leave the blood and enter cells. People with diabetes do not convert food into fuel very well. They lose weight, lack energy and can have other problems.

Diabetes is very common in people with *cystic fibrosis (CF)*. It most often occurs as they get older. People with CF and diabetes have a unique type of diabetes called *cystic fibrosis-related diabetes (CFRD)*. Few people with CF have normal *glucose* levels. One study found that up to 75 percent of adults with CF have some form of *glucose intolerance* where their bodies have trouble converting sugar into fuel. CFRD affects about 20 percent of adolescents and 40 to 50 percent of adults with CF. CFRD is not the same as diabetes found in people without CF. There are important differences in the way it is *diagnosed* and treated. You and those who care for you need to know how CFRD is unique.

Non-CF Diabetes

The most common types of diabetes for the general population are Type 1 and Type 2 diabetes. CFRD has some features that are common in both. *Type 1 diabetes* occurs most often in childhood. People with Type 1 diabetes can't make insulin, so they must take insulin to stay alive. This is why Type 1 diabetes is often called *insulin-dependent diabetes*. People with Type 1 diabetes who miss insulin doses get very sick, which can lead to *ketoacidosis* (a life-threatening change in blood acidity).

Type 2 diabetes is sometimes called *non-insulin-dependent diabetes*. It is caused by the lack of a normal response to insulin in addition to the pancreas not making enough insulin. This type of diabetes occurs most often in adults who are overweight. People with Type 2 diabetes don't often get ketoacidosis, but they can get very sick when their blood sugars are too high. Some people with Type 2 diabetes use insulin. Some take pills. Most are asked to lose weight. Some people can manage Type 2 diabetes through diet and exercise alone.

DIABETES

Type 1: The body stops making insulin.

Type 2: The body lacks normal responses to insulin (most important) and doesn't make enough insulin.

CFRD: The body doesn't make enough insulin (most important) and sometimes lacks normal responses to insulin.

*Words that appear italicized and bolded are defined in the glossary starting on page 52.

CFRD Causes

CFRD is unique to people with CF, though it shares features with both Type 1 and Type 2 diabetes in people who do not have CF. As in Type 1 diabetes, the pancreas does not make enough insulin. Thus, people with CFRD have *insulin deficiency* and require insulin replacement. Insulin deficiency is primarily due to scars in the pancreas (fibrosis) caused by thick sticky mucus. Even people with CF who do not have diabetes have partial scarring of the pancreas and make less insulin than normal.

The main cause of Type 2 diabetes is *insulin resistance*. This means the body's cells require more insulin than normal to change food into fuel and keep blood sugar levels under control. When people with CF become insulin resistant, their body's cells do not use insulin the right way, which leads to high blood sugar levels. Thus, insulin resistance in someone with CF who is also insulin deficient can contribute to the development of CFRD.

Insulin resistance in CF can be caused by the following:

- *Underlying infection* in CF can lead to low-grade, *chronic inflammation* and insulin resistance. Insulin resistance becomes significantly worse during an acute exacerbation. This is why diabetes is often first diagnosed during an acute illness — the sudden spike in insulin resistance “unmasks” insulin deficiency in the person who cannot make extra insulin.
- *Steroids* are drugs such as prednisone or methylprednisolone that are sometimes needed to treat lung disease. Insulin resistance is a side effect of steroid medications. Thus, blood sugar levels are often higher during steroid treatment and can reach diabetic levels.
- During pregnancy all women need very high amounts of insulin. Because of their underlying insulin deficiency, women with CF often can't make the extra insulin and develop high blood sugars. If the high blood sugars occur only during the pregnancy (not before or after), it is called “*gestational diabetes*” rather than CFRD.

There are many problems associated with Type 2 diabetes that are not usually part of CFRD including obesity, high *cholesterol*, high blood pressure and heart disease. Also, people with type 2 diabetes can often be treated with pills to make them more sensitive to insulin. This treatment is not appropriate for people with CFRD because the pills do not treat the primary problem of insulin deficiency.

Once you are diagnosed with CFRD, whether while hospitalized or as an outpatient, you will always have CFRD. However, you may not always need to take insulin. If your blood sugars are high only when you are sick or on steroids, you may need insulin only at those times. If your blood sugars are high when you are well, you will need insulin at all times. Even if your blood sugars are normal after an illness, your doctor may recommend you stay on insulin so you don't lose weight.

**DIABETES GOAL:
KEEP BLOOD
SUGARS
AT NORMAL
LEVELS.**

CFRD-Caused Health Problems

Although CFRD is unique, many of the problems caused by diabetes are the same for all types. These include eye, kidney and nerve problems. Other problems are specific to CF: insulin deficiency makes it hard to maintain a healthy weight, especially enough muscle mass, and both insulin deficiency and high blood sugars cause worse lung function. These problems are caused by many years of blood sugar levels that are too high. **Every person's goal for diabetes treatment, no matter what kind the person has, is to keep blood sugar levels as normal as possible.** This helps to prevent diabetes-caused problems.

YEARS OF TOO-HIGH BLOOD SUGARS CAUSE PROBLEMS WITH

- Eyes
- Kidneys
- Nerves
- Maintaining weight and muscle mass (in CFRD)
- Maintaining lung function (in CFRD)

CFRD Symptoms

CFRD often has no symptoms, so you might not know you have it. Other diabetes symptoms are similar to CF symptoms that you may already have.

Having to *urinate* often (*polyuria*) and needing to drink often (*polydipsia*) are classic symptoms of diabetes. These symptoms are caused by high blood sugar levels (*hyperglycemia*). It's easy to overlook these symptoms in CF. People with CF often drink more (and then use the bathroom more) because of dry mouth. Other symptoms of CFRD include feeling very tired, losing weight without trying or having a hard time gaining weight, and a loss of lung function that you can't explain. Infection and lung disease can also cause these symptoms, so diabetes may not be found unless certain blood tests are run to look for it. Unlike people with Type 1 diabetes, it is very rare for people with CFRD to get ketoacidosis.

Any time you have weight loss that you can't explain or have a hard time gaining weight, your CF care team should run diabetes tests. If you know you have diabetes and are having problems keeping your weight up, review how you manage diabetes with your *diabetes care team*. Treatment of your CFRD should be included as part of your overall CF treatment plan. Contact your CF care center to learn more about diabetes. You can find the nearest CF care center by calling **1-800-FIGHT CF (1-800-344-4823)** or by visiting the CF Foundation website at **www.cff.org**.

CFRD SYMPTOMS

- There may be no symptoms
- Polyuria
- Polydipsia
- Being very tired
- Losing weight
- Not able to gain weight
- Loss of lung function

CHAPTER 2: HOW WE DIAGNOSE CFRD

Learning Goals

At the end of this chapter, you should be able to

- List the tests used to *diagnose* CFRD.

Tests Used to Diagnose CFRD

Oral Glucose Tolerance Test (OGTT)

The *oral glucose tolerance test (OGTT)* is recommended annually by age 10, and any other time CFRD is suspected. First, you must *fast* overnight (nothing to eat or drink) for eight hours. Then, your blood is drawn to measure your *baseline* or *fasting blood glucose* level. You will then be asked to drink a glucose drink. Your blood sugar is measured again two hours later, and many centers also test at 30, 60 and 90 minutes. Your blood sugar results after two hours will show if you have diabetes. If your fasting blood sugar is 126 mg/dL or 7.0 mmol/L* or more, and/or if your blood sugar at two hours is 200 mg/dL or 11.1 mmol/L or more, you have CFRD.

Results of your annual OGTT are compared with the baseline glucose to see what's happening with your CFRD over the years. Make sure you get your annual OGTT when you are well and not fighting an infection.

Fasting Blood Glucose

This test measures your blood glucose after you haven't eaten for at least eight hours. You don't need to drink a glucose drink for this test. If your blood glucose level is more than 126 mg/dL or 7.0 mmol/L, you have CFRD.

Casual Blood Glucose Levels

A *casual (random) blood glucose* level is one that is drawn without caring what time of day it is or when a meal was last eaten. If this level is 200 mg/dL or 11.1 mmol/L or more, and you have symptoms of diabetes — having to urinate more often, drinking more liquids than usual, unintentional weight loss, feeling more tired than usual — then diabetes is likely. You will need to follow up with a fasting blood glucose test or an OGTT to confirm the diagnosis of diabetes.

Hemoglobin A1c

Hemoglobin A1c (HbA1c) is a test that is used to diagnose diabetes in people without CF. If it is high (>6.5%), it means you have diabetes. But if it is low, this does not mean you do not have diabetes because the test is often falsely low in people with CF. Further testing using the OGTT is recommended.

TESTS FOR CFRD

- Oral glucose tolerance test
- Fasting blood glucose
- Casual blood glucose
- Hemoglobin A1c

*In the United States, blood sugar levels are reported as milligrams per deciliter (mg/dL). In Canada and Europe, they are reported as millimoles per liter (mmol/L). Both are used in this guide.

Chapter 2: How We Diagnose CFRD

TEST	TIME	BLOOD GLUCOSE LEVEL	DIAGNOSIS	ACTION
OGTT	Done in the morning after an 8-hour fast	2-hour glucose ≥ 200 mg/dL (≥ 11.1 mmol/L)	CFRD	You will be followed by your CF and endocrinology team and treated with insulin.
		2-hour glucose 140-199 mg/dL (7.8-11.0 mmol/L)	<i>Impaired glucose tolerance (IGT)</i>	You are at higher risk for developing diabetes; you will be closely monitored by your CF team. Repeat OGTT annually or earlier if symptoms occur.
		Mid-OGTT glucose ≥ 200 mg/dL (≥ 11.1 mmol/L), OGTT otherwise normal	<i>Indeterminate glycemia (INDET)</i>	You are at higher risk for developing diabetes; you will be closely monitored by your CF team. Repeat OGTT annually or earlier if symptoms occur.
		2-hour glucose < 140 mg/dL (< 7.8 mmol/L)	Normal	Repeat OGTT annually
Fasting blood glucose	Done first thing in the morning after an 8-hour fast	< 100 mg/dL (< 5.6 mmol/L)	Normal	Starting at age 10, or earlier if symptoms occur, do OGTT annually.
		100-125 mg/dL (5.6-6.9 mmol/L)	<i>Impaired fasting glucose (IFG)</i>	You are more likely to develop diabetes; you will be closely monitored by your CF team. Repeat OGTT annually or earlier if symptoms occur.
		≥ 126 mg/dL (≥ 7.0 mmol/L)	CFRD	You will be followed by your CF and endocrinology team and treated with insulin.
Casual (random) blood glucose	Done at any time regardless of time of last meal or snack	< 200 mg/dL (11.2 mmol/L)	<i>Non-diagnostic</i>	Starting at age 10, or earlier if symptoms occur, do OGTT annually.
		≥ 200 mg/dL (≥ 11.1 mmol/L)	High risk of CFRD	If symptoms are present, do a fasting blood glucose test, otherwise OGTT.

CHAPTER 3: TREATING CFRD

Learning Goals

At the end of this chapter, you should be able to

- State how insulin helps lower blood sugars and improve *nutrition*.
- Understand the effect of insulin deficiency in CF.
- List the different types of insulin and explain how they work.
- Explain why diabetes pills are not used to treat CFRD.

Insulin

What Insulin Is

Insulin is a *hormone* that lowers blood sugar levels. It is made in the pancreas by *beta cells* located in a part of the pancreas referred to as the *endocrine pancreas*. A separate part of the pancreas — the *exocrine pancreas* — makes *digestive enzymes* that flow into the *intestine* to help digest food. Most people with CF have damage to the whole pancreas and do not make enough digestive enzymes. They have to take *enzyme supplements*. People with CF who do not need enzyme supplements often do not get CFRD.

What Insulin Does

Insulin helps your body cells use the energy (calories) from the food you eat for fuel and growth. Food contains three kinds of nutrients: *carbohydrates* (sugars and *starches*), protein and fat. Insulin helps the body cells absorb these nutrients.

Carbohydrates are changed to sugar for the body's instant fuel needs. Insulin allows the sugar to move from the blood into the cells where it is burned for fuel. The body cannot turn sugar into fuel without insulin. Without enough insulin, sugar builds up in the blood until it spills into the urine. This loss of sugar through the urine makes people with diabetes need to go to the bathroom a lot and be thirsty.

Muscles are made from protein. Insulin allows the body cells to take up the building blocks of protein (*amino acids*) and build muscle tissue. Without enough insulin, protein breakdown and muscle loss occur. Muscle loss can affect breathing because lung function depends on muscle strength.

Lastly, insulin allows the body to use and store fat in the diet as body fat. Without enough insulin, the body's fat stores are drained and weight loss occurs.

People with CF make less insulin, which can cause CFRD. Right now, insulin is the only treatment proven to work for CFRD. Insulin can be given only by a shot. No one brand of insulin is better than another, but it is important for you to learn about all types of insulin and how they work.

INSULIN HELPS

- Sugar in the blood get into the cells.
- The body turn sugar into fuel.
- The cells use amino acids to build muscle.
- The body use and store fat.

CLASS OF INSULIN	TIME TO START WORKING	PEAK	LASTS	GENERIC NAME (BRAND NAME)	NOTE
Rapid-acting	15 to 25 minutes	30 to 90 minutes	3 to 5 hours	Lispro (<i>Humalog</i> ®) Aspart (<i>NovoLog</i> ®) Glulisine (<i>Apidra</i> ®)	Covers carbohydrates in meals and snacks. May be taken 5-15 minutes before eating. Used in insulin pumps.
Short-acting	30 minutes to 1 hour	2 to 3 hours	6 to 8 hours	Regular	Covers carbohydrates in meals. Take 30 minutes before eating. May also be used for <i>tube feedings</i> .
Intermediate-acting	1 to 1.5 hours	6 to 8 hours	12 to 18 hours	NPH	Covers carbohydrates in meals. May also be used for tube feedings.
Long-acting	Glargine: 2 hours Detemir: 3 to 4 hours	Glargine: no peak Detemir: minimal peak 6 to 8 hours	Glargine: 24 hours Detemir: up to 24 hours	Glargine (<i>Lantus</i> ®) Detemir (<i>Levemir</i> ®)	<i>Basal</i> or <i>background insulin</i> . Necessary for all-day insulin needs, but not strong enough to cover carbohydrates consumed.

Insulin Types

Insulin types are grouped by how fast they work and by how long they last in the body. There are four broad classes of insulin:

- Rapid-acting (*lispro, aspart, glulisine*)
- Short-acting (*regular*)
- *Intermediate-acting (NPH)*
- Long-acting (*glargine* and *detemir*)

Insulin action (when it peaks, or when it is the strongest, and how long it lasts) may vary from person to person.

Rapid-Acting Insulin

Lispro (Humalog®), aspart (NovoLog®) and glulisine (Apidra®) start working 15 to 25 minutes after they're taken. They have their peak effect in 30 to 90 minutes. They can be taken five to 15 minutes before a meal. These insulins are most often used to cover the carbohydrates in meals and snacks and are also used in *insulin pumps*.

Short-Acting Insulin

Short-acting (regular) insulin starts working 30 minutes after it's taken. It has its peak effect in two to three hours and lasts six to eight hours. This varies from person to person. Regular insulin should be given at least 30 minutes before eating so that it is working as food is being digested.

Intermediate-Acting Insulin

The body uses NPH more slowly than short- or rapid-acting insulin. It has its peak effect in six to eight hours and lasts about 13 hours. This varies from person to person. NPH can be used with regular insulin for *nighttime gastrostomy tube feedings*.

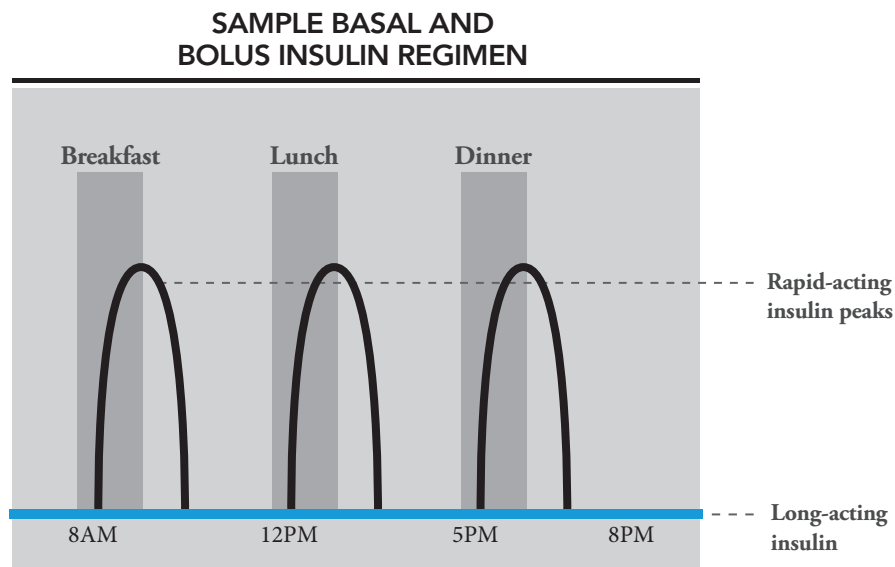
Long-Acting Insulin

Glargine (Lantus®) is called a basal insulin because one dose gives a constant amount of insulin for about 24 hours with no peak. Basal insulin gives your body the insulin it needs when you are not eating. Basal insulin is not strong enough to give the extra insulin needed to cover meals. People who take glargine still need to cover meals and snacks with rapid-acting insulin. Glargine cannot be mixed in the same syringe with other insulins.

Detemir (Levemir®) is another long-acting insulin that can be taken once or twice a day. It also is not strong enough to cover meals and snacks. Detemir should not be mixed in the same syringe with other insulins.

Many people with CF need rapid-acting insulin only before meals and snacks. Long-acting insulin is needed if you have high blood sugar levels before breakfast.

DID YOU KNOW?
Often 1 unit of rapid-acting insulin will lower blood sugar about 50 mg/dL (2.75 mmol/L).



Insulin Treatment

Basal Insulin

Everyone needs a small amount of insulin at all times. This background or basal insulin is made by the pancreas. Most people with CF make less insulin than people without CF who do not have diabetes. People with CFRD may or may not need to take long-acting insulin, depending on whether they make enough of their own basal insulin.

Meal Coverage

Normally, the pancreas secretes insulin as a *bolus* (all at once) to cover the spike in blood sugar that occurs when you eat. People with diabetes take rapid-acting insulin before meals and snacks to provide the insulin bolus. Often, the best way to figure out a pre-meal insulin dose is to count the total number of carbohydrates in the meal. See Chapter 9, “Nutrition and CFRD.”

Correction Insulin

If your blood sugars are too high before a meal, you can add extra rapid-acting insulin to your normal insulin dose to “correct” or lower your blood sugar. Often, one unit of rapid-acting insulin will lower your blood sugar about 50 mg/dL or 2.75 mmol/L. Work with your diabetes care team to find your *correction dose*.

How Often Insulin Is Given

Most people with CFRD need three or more rapid-acting insulin shots per day to control blood sugar levels. The more often people with diabetes take rapid-acting insulin with their food, the better their blood sugar control will be. You can adjust your insulin dose based on what you eat. Taking insulin with meals and snacks allows you to eat when you want and as much as you want, and still keep your blood sugar under control.

Most people with CFRD have high blood sugar levels after meals but their blood sugar returns to normal again four or more hours after eating. They may need to take rapid-acting insulin only before each meal.

Long-acting insulin is added when you have fasting hyperglycemia. It is typically given once or twice per day. Take your rapid-acting insulin 5-15 minutes before you eat. This way it will work better to help your body absorb the carbohydrates in your meal and prevent your blood sugar from going too high. Your insulin type and the time it is given should be matched to your eating, activity and sleeping schedule. You should give your caregiver or diabetes care team as much information as you can about your habits. You can achieve your best blood sugar control if your insulin shots fit your routine.

Some people with CF have high blood sugar levels only during nighttime *nasogastric* or *gastrostomy* drip feeding (also called tube feedings). If this is the only time you have high blood sugar, you may be given one shot of intermediate-acting insulin or a mix of short-acting plus intermediate-acting insulin at the start of the feeding. Tube feedings can also be covered by an insulin pump.

When Do You Need More Insulin?

When people get sick, they need more insulin. Insulin also doesn't work as well when people receive *corticosteroids* like prednisone. People without diabetes can make more insulin in their pancreas when they are sick. People with CFRD can't, so their blood sugars rise. Check your blood sugar often to see if you need more insulin. Sudden high blood sugar levels may mean your body is stressed or you are getting sick. This may be the first sign that a “little cold” is really a bigger illness needing stronger treatment. Always tell your doctor if your blood sugar levels rise without warning.

BLOOD SUGARS RISE WHEN

- You are getting sick and while you are sick.
- You are stressed.
- You don't have enough insulin in your bloodstream.
- You are taking steroids like prednisone.

Chapter 3: Treating CFRD

Getting enough insulin while sick will prevent weight loss and help you heal faster. When you check blood sugar levels often and record the results or download the results on the computer, you can see patterns of low or high blood sugar at certain times of the day (*pattern management*). This information can help you and your doctor adjust your insulin dose between visits.

NAME:									
DIABETES SELF-CARE RECORD									
Time	Insulin		Blood Sugar	Food Intake		Carbohydrate Information	Physical Activity		Other Factors
	Type	Amount		Amount	Type of Food/Drink		Grams	Type	
Breakfast			Before						
			2 hours after						
Snack									
Lunch			Before						
			2 hours after						
Snack									
Dinner			Before						
			2 hours after						
Snack									

Storing and Handling Insulin

Insulin that isn't open should be stored in the refrigerator up to the expiration date. Once opened, insulin is good at room temperature for one month. Many people like to inject room temperature insulin because cold insulin may sting. To warm the insulin, roll the bottle/pen between your hands for one to two minutes. Use alcohol wipes to clean the top of the bottle/pen before taking the insulin out.

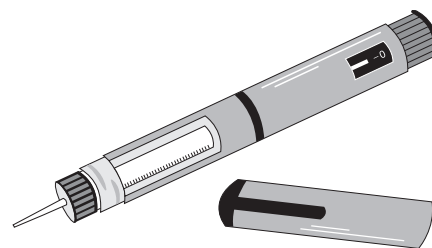
Except for NPH, insulin is clear and should be thrown away if it looks cloudy. Any bottle/pen of insulin that looks "clumpy" should be thrown away. Insulin should be thrown away if it freezes or gets hotter than 86°F. NovoLog® and Apidra® are stable to 98.6°F.

Insulin in a pen, or *cartridge* for use with an *insulin injection pen*, should be stored in the refrigerator until opened. Once in use, pens of Lantus®, Levemir®, Humalog®, and NovoLog®, Apidra®, and regular insulin are good for 28 days, and NPH insulin is good for 14 days. Once insulin pens are in use, they should be stored at room temperature. To avoid damaging your insulin, never leave it in the car or any other place where it may get too hot or too cold.

Insulin Pens, Syringes, and Pumps

Insulin Injection Devices/Pens

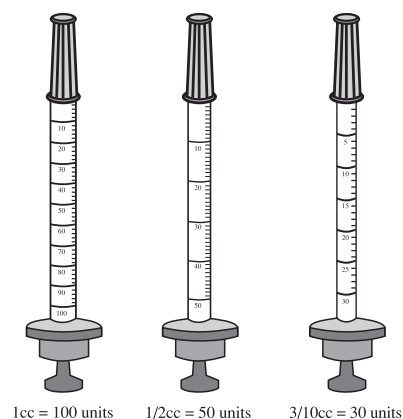
You can choose between many *insulin injection devices*. They are often called “pens” because they are about the size of an ink pen. The pen needle is 29 to 33 gauge, which is about the same size or smaller than an insulin syringe needle. Insulin is stored in a cartridge inside the pen. Some pens can be reused, though their cartridge of insulin is thrown away when empty. Other pens are thrown away when the insulin runs out. Insulin cartridges and disposable pens come with varied types, or mixes, of insulin. Your diabetes doctor can help you choose the best type of insulin for you. An insulin pen can be convenient because you don’t have to draw up the dose of insulin from a multiuse vial; instead you dial the dose you want to deliver. It’s quick, precise, and easy to carry with you. An insulin injection device can be useful if you take only rapid-acting insulin before meals.



Syringes and Needles

Insulin can be given using a specific insulin syringe with a needle. This is different than a traditional medication syringe. Insulin syringes measure insulin as units per cubic centimeter (cc). The most common type of insulin sold in the United States contains 100 units of insulin per cc (U-100 insulin). A standard insulin syringe holds either 3/10 cc (30 units), 1/2 cc (50 units), or 1 cc (100 units). A 3/10 cc syringe is simpler to use with small insulin doses (30 units or less). This is probably the size of insulin syringe you will use.

Needles have varied widths. Smaller widths have larger numbers. A 31-gauge needle is the smallest needle. A 20-gauge needle is very large. Most insulin syringe needles are 29- to 31-gauge. If you prefer short needles, ask your doctor or diabetes educator to prescribe them.



Taking Insulin Shots with a Syringe

Before taking an insulin shot, always check the bottle/pen to be sure you are getting the right type of insulin and that it has not *expired*.

When mixing both intermediate- and short- or rapid-acting insulin in a syringe from a multiuse bottle, always draw the short- or rapid-acting insulin into your syringe before you withdraw the intermediate-acting insulin. Never mix long-acting insulin (Lantus® or Levemir®) in the same syringe with short- or rapid-acting insulin. This will destroy the long-acting insulin.

Some people choose to use pen devices instead of having to mix two different kinds of insulin in a syringe. You have to take two injections with the pens (because you cannot mix pens), but the extra shot may outweigh the burden of mixing from the bottle.

Once you withdraw the right amount of insulin, your skin should be cleaned with soap and water or alcohol. Try not to use alcohol on your skin a lot as it may dry out.

Chapter 3: Treating CFRD

Work with your diabetes educator to find the best plan for you. She or he can teach you the proper technique when drawing up insulin from a vial and/or when giving an injection with a pen device. Both methods have special directions for delivering a dose.

Insulin Injection Sites

Insulin can be given in the thigh, buttocks, upper arm and tummy. The best place for you will likely be where you have the most fat below the skin. The needle should be put just under the skin into fat. It may help to pinch up a fold of skin and fat before putting in the needle. Choose a new place to give the insulin each time (also called rotating the injection site). Be sure to hold the needle under the skin for 10 seconds before you take it out to make sure all the insulin was delivered. The picture on page 18 shows some good places to give insulin.

Insulin Pumps

Instead of taking insulin shots, some people use insulin pumps (also called *continuous subcutaneous insulin infusions or CSII*). Insulin pumps deliver insulin in two ways:

- **Basal rate** is the background/continuous drip of insulin 24 hours a day. It takes the place of the injectable background insulin dose (glargine or detemir).
- **Bolus insulin** is given immediately at the touch of a button to cover carbohydrates consumed or if a correction dose is needed to lower a high blood sugar level. This is called the **bolus dose**.

A pump gives insulin through an *infusion set* (a thin, short plastic tube), which is put into the skin using a tiny needle. Think of the infusion set like an **IV** except it goes in the subcutaneous tissues (fat tissue just under the skin) rather than a vein or artery. The infusion set needle starts at the site but is then removed; the plastic catheter stays behind to deliver the dose. The plastic catheter is short, fine and flexible so you usually can't feel it once it's in place. The infusion set is the size of a quarter and stays on the skin with strong tape for two to three days. The infusion set connects to the pump.

The pump acts as a mini-calculator. It can tell if a correction dose is needed based on your blood sugar value, total carbohydrates consumed and length of time since your last insulin dose. The pump rate can also be slowed down or sped up for a prescribed amount of time. For example, if you are exercising and do not want to get low blood sugar during your workout, you could temporarily stop or decrease the basal rate while you're exercising. If you have an overnight tube feeding, the pump can be set at a higher basal rate for a period of time and cover the carbohydrates being dripped in while sleeping. When on a steroid burst, the pump can be set to temporarily add 10 to 20 percent more basal insulin to help with the high sugar values that occur with using steroids.

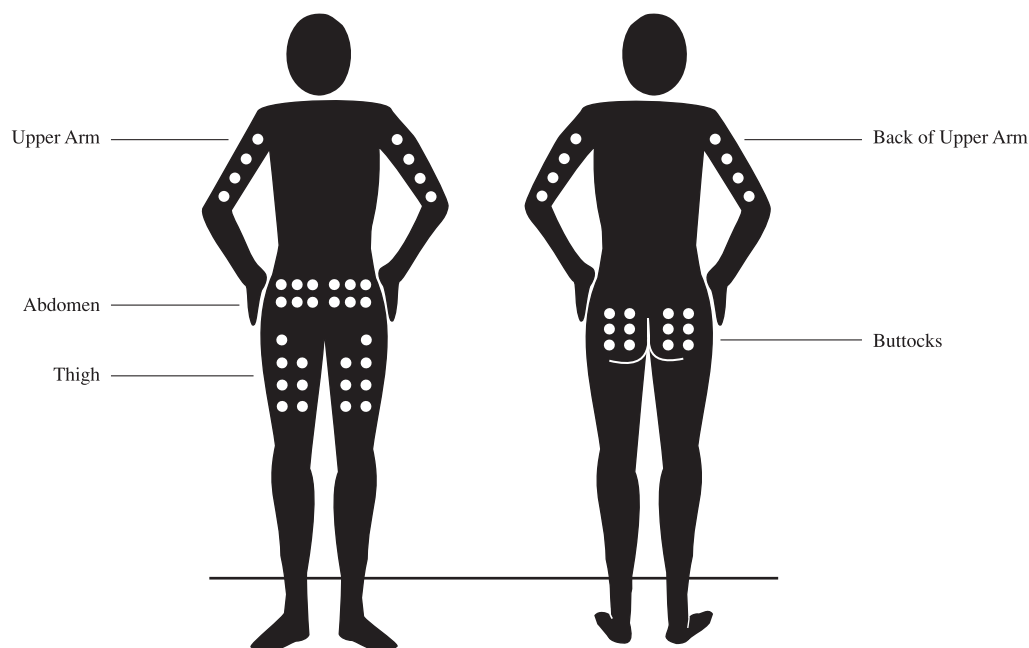
For many people with CFRD, an insulin pump is ideal because the pump settings can be adjusted rapidly and precisely to fit their frequently changing needs. The pump offers great blood sugar control without the need for daily shots. Keep in mind that an insulin pump needs to be worn 24 hours a day. The pump is the size of a pager and you get used to the tubing, but it cannot be taken on/off for more than a couple of hours, since it is the only source of insulin once you start it. You still need to check your blood glucose at least four times a day and count your carbohydrates. To learn more about insulin pumps, meet with your diabetes care team.

Continuous Glucose Monitors

Continuous glucose monitors record your glucose levels around the clock. As with the insulin pump catheter, a sensor is placed in the subcutaneous tissues (fat tissue just under the skin) for up to seven days. During that time, the monitor takes in glucose from the *interstitial fluid* (fluid between the cells of the tissues) and converts it to blood glucose data. Those data then displayed on a receiver for you to interpret. The continuous sensor does not alter the insulin dose, but instead gives you more information about blood sugar patterns. People who have difficulty recognizing low blood glucose are the best candidates for a sensor.

Sugar levels in interstitial fluid lag behind blood sugar levels (that is, sugar shows up in blood more quickly than in the fluid), so the continuous glucose monitor cannot be used to make immediate decisions about managing your blood sugar. Instead, it shows trends in your blood sugar levels and can help you and your care team identify any changes you might need in your diabetes management plan.

The monitor receiver will alarm you if your blood sugar level gets too high or low. This is especially helpful at night when you are sleeping. The monitors need to be “calibrated” with finger-stick blood sugar levels, so you still need to check your blood sugar four times a day. Once calibrated, the monitor will give all the extra data in between.



Oral Agents (Diabetes Pills)

Experts agree that pills are not as effective as insulin in treating CFRD; therefore, insulin is the only medical treatment recommended.

CHAPTER 4: BLOOD SUGAR TESTING

Learning Goals

At the end of this chapter, you should be able to

- Explain what blood sugar levels are okay for certain age groups and times of the day.
- State when blood sugar should be tested.
- List the steps taken to check and record blood sugar levels.
- Understand the reasons for wrong results.

When to Check Blood Sugar

Most doctors advise that you check your blood sugar at least three or four times a day to help decide how much insulin you need. Most people with diabetes check their blood sugar before breakfast, before lunch, before dinner and before their bedtime snack. Blood sugars also rise after you eat; therefore, you may need to check your blood sugar two to three hours after eating a meal to make sure your insulin dose is correct. This is known as your *postprandial glucose level*. Typical glucose goals for adults, adolescents, children and pregnant women are shown in the table on page 20. Check with your diabetes care team to see what your goal should be.

Key times to check your blood sugar levels:

- Two to three hours after your largest meal once in a while. This reading should be less than 180 mg/dL or 10.0 mmol/L.
- If you take intermediate-acting insulin (NPH) in the evening, check your blood sugar in the middle of the night once every two to three weeks to make sure that low blood sugar does not occur during sleep.
- If you get *nighttime tube feedings*, check your blood sugar before the tube feeding starts, three to four hours after the tube feeding has started (once or twice a week) and at the end of the tube feeding. You will likely need more insulin if your blood sugar level is more than 150 mg/dL or 10.0 mmol/L in the middle of the tube feeding.
- If you get feedings all at once, check your blood sugar before the bolus and two to three hours after the bolus.
- You will likely need more insulin if your blood sugar level is more than 150 mg/dL or 10.0 mmol/L two to three hours after a bolus feeding.
- If your blood sugar level is often higher than 200 mg/dL or 11.0 mmol/L, you need more rapid-acting insulin before your meal.

Chapter 4: Blood Sugar Testing

	Fasting and pre-meal mg/dL (mmol/L)	2 to 3 Hours after eating mg/dL (mmol/L)*	Bedtime mg/dL (mmol/L)
Adults	80-130 (4.4-7.2)	<180 (10.0)	90-150 (5.0-8.3)
Adolescents	90-130 (5.0-7.2)	<180 (10.0)	90-150 (5.0-8.3)
School-age children	90-180 (5.0-10.0)	<200 (11.1)	100-1830 (5.6-10.0)
Children <6 yrs	100-180 (5.6-10.0)	<200 (11.1)	110-200 (6.1-11.1)
Pregnant women	≤ 95 (5.3)	≤ 120 (6.7)	60-99 (3.3-5.5)

** If your blood sugar level is less than 100 mg/dL or 5.5 mmol/L, add 15 grams of total carbohydrates to your bedtime snack. See Chapter 9, “Nutrition and CFRD.” If your blood sugar level is less than 70 mg/dL or 3.9 mmol/L, add 15-30 grams. If your blood sugar is less than 100 mg/dL at bedtime, recheck your blood sugar in the middle of the night to make sure you are not too low. If this happens more than once in a week, call your diabetes care team for advice.*

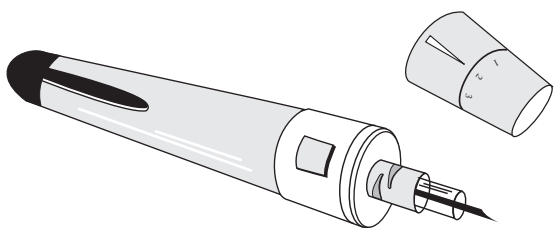
The only sure way to check blood sugar levels at home is with a blood **glucose meter**. Studies show that you cannot guess your blood sugar levels based on how you feel.

How to Check Blood Sugar

Finger “Sticks”

You’ll need a **lancet** to check your blood sugar. A lancet has a tiny spring-loaded needle made for gently getting a drop of blood from the tip of your finger to check your blood sugar. Before using a lancet, wash your hands with warm water to clean them and increase blood flow. Washing your hands also helps remove any sugar on your finger so your reading won’t be falsely high. You may need to use alcohol to clean your finger if you can’t wash your hands. Don’t use alcohol if you can wash your hands, because alcohol dries out the skin.

It can help to put your hand on top of a table. Prick the side of the finger rather than the fleshy pad. That will hurt less. If you don’t get a drop of blood after pricking your finger, hold your hand down at your side to increase blood flow to your finger. Change the finger you use each time so your fingers don’t get sore.



CHECK YOUR BLOOD SUGAR

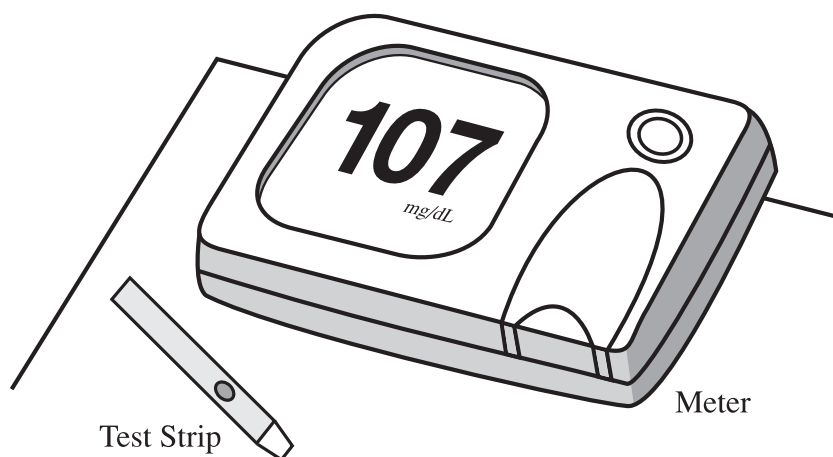
- When you first wake up.
- Before lunch.
- Before dinner.
- Before a bedtime snack.
- Two to three hours after largest meal.
- Any time your activity or eating patterns change.

FINGER STICKS

- Prepare the lancet.
- Wash your hands or clean your finger with an alcohol swab.
- Prick the side of your finger.
- Put a drop of blood on the test strip.

Glucose Meters (Blood Sugar Meters)

There are many brands of meters for sale. Each meter differs in the way it is used. Each brand has test strips that are made to go with the meter. To get correct results, keep the test strips in their bottle until they are ready for use. Do not use *generic* or out-of-date test strips because they may not work properly with your meter and may give you incorrect results. **Use the test strips that are right for the meter! Follow all of the steps for coding, cleaning and checking to see that the meter is working right. If you have problems with your meter, you can call the 1-800 phone number on the back of the meter for help.**



Blood Sugar Testing Results

Recording Results

Record your results after each test and review your blood sugar levels every one to two weeks. That way you know your baseline blood sugar level and can see if it becomes more erratic. Patterns in blood sugar readings at certain times of day may signal a need to change your insulin dose. When you record your results, you can also note any special things going on at the time that might account for those results. For instance, next to a low blood sugar reading you might write, “I did not eat enough” or “I worked out more than normal.”

Downloading software has become a more common way of self-monitoring blood sugar levels. Often blood glucose meters come with downloading cables, or you can purchase them separately. The meter companies have free downloading software that stores the information. You can print it out and bring it to your appointment or send it to your diabetes team for assessment.

Insulin pumps and continuous glucose monitors also have downloading software that allows you and your diabetes team access to complete records and assess blood sugar levels, insulin doses and trends. Smartphone apps also will help you keep detailed logbooks and/or store data for your immediate access.

Whatever program works best for you is the one you should use. New gadgets also give you something to be excited about and help you have better control of your blood sugar levels.

Summary

Good blood sugar control is very important for your health. Record your blood sugars in a diabetes self-care record, which you will get in your diabetes clinic. Write down events that may affect your blood sugar such as exercise, stress, not enough insulin, etc. Bring along these results, and your meter, when you come to the clinic. If the results are often outside of the desired range, your insulin dose should be changed. Between clinic visits, you can call, email, mail or fax the test results to your diabetes care team. Your doctor can make changes in insulin or you can make some changes on your own. The longer you have CFRD, the more comfortable you will feel about changing your insulin dose.

Good diabetes control can only occur with blood sugar testing. The whole family must support this effort. In many states, insurance companies must pay for diabetes supplies by law. The local American Diabetes Association (ADA; www.diabetes.org) can tell you more about the laws in your state. You and your diabetes care team will work together to help you manage your diabetes. The more you check your blood sugar, the better you will be able to manage your diabetes.

WRONG RESULTS:

Your blood sugar reading may be wrong if

- Your finger is not clean and dry.
- You do not follow all of the meter's steps for use and care.
- The meter parts are dirty (such as with dried blood).
- The codes on the strip and the meter don't match.
- The drop of blood is too small.
- The test strips are generic, expired or not properly stored.

CHAPTER 5: HOW WE MANAGE CFRD

Learning Goals

At the end of this chapter, you should be able to

- List the tests used to manage diabetes.
- Explain how the diabetes care team and *ophthalmology* visits help to manage CFRD.

Tests to Help Manage CFRD

Hemoglobin A1c

Normally, red blood cells live about three months. Hemoglobin A1c shows how much sugar is “stuck” to your red blood cells. The test shows how high your blood sugar levels have been for the past three months. It shows long-term blood sugar control. Hemoglobin A1c can be measured at a clinic visit. You do not have to fast. The recommended hemoglobin A1c for adults with diabetes is less than 7 percent. People with CFRD often have an artificially low hemoglobin A1c. This is because their red blood cells live for less than three months. This test can still be used to track your blood sugar over time, but your current blood sugar values are more precise.

Urine Microalbumin

Uncontrolled diabetes can eventually lead to kidney damage. The amount of protein in your urine (*urine microalbumin*) shows the health of your kidneys. After you have had CFRD for five years, your diabetes care team will check the protein level in your urine once a year (a “spot” urine check). To be diagnosed with kidney damage, you must have two out of the three abnormal urine tests over a three-to six-month period. Medications can treat this. Good blood sugar control can help prevent kidney damage.

Blood Pressure

Uncontrolled blood pressure can also lead to kidney damage and other health problems. Your blood pressure should be checked at every routine clinic visit. Blood pressure should be less than 140/90 mmHg. If it is higher, your blood pressure should be checked again on a different day to confirm the diagnosis of high blood pressure. Good blood pressure control can help prevent kidney damage and other health problems. Unlike people without CF, you should not decrease your salt intake to help control your blood pressure. Medications can treat high blood pressure.

Urine Sugar Testing

Urine can be tested for sugar, but **this is not a sure way to diagnose or manage diabetes.**

The blood sugar level that causes sugar to spill into the urine varies from person to person. Often it varies in the same person from time to time. Urine sugar testing should never be done instead of blood sugar testing.

Urine or Blood Ketone Testing

When body cells use fat for fuel instead of sugar, the body makes *ketones*. Ketones are found in the urine and blood. People with CFRD don't often have large ketone levels and don't usually need to test for ketones. Your doctor will tell you if you need to check for ketones.

Lipid Profile

Blood *lipids* (fats) are cholesterol and *triglycerides*. People with type 1 and type 2 diabetes are at risk for heart disease and stroke if their cholesterol and triglyceride levels are high. *Lipid profiles* are checked every year in people with type 1 and type 2 diabetes. People with CFRD who need enzyme supplements to digest food appear to be at a very low risk for heart disease and stroke. They don't often need routine lipid profile checks. People with CFRD who don't need enzyme supplements should have their lipid profiles checked yearly. If you have a strong family history of stroke or heart disease, or if you are taking immunosuppressant medications after a transplant, you will need an annual lipid profile.

Foot Exam

Nerve damage (*neuropathy*) can occur in people with CFRD who have uncontrolled blood sugars over time. After you have had CFRD for five years, you need to be tested each year for nerve damage. To test for nerve damage, your doctor will examine your feet with a tool called a *monofilament* to see if you can feel it.

Other Tools to Manage CFRD

Diabetes Care Team Visits

Besides your routine visits to the CF Foundation-accredited care center, you should also be seen by a diabetes care team every three to four months. These visits are very important to help you manage your CFRD. Your team will examine you and review your diet, your blood sugar control and your insulin doses. Always bring your blood glucose meter to these appointments. Uncontrolled diabetes can cause the body to heal more slowly, so you should show your diabetes care team any new wounds or wounds that haven't healed as they should. During these visits, discuss any questions you have about your diabetes treatment plan to help control your blood sugars and prevent future problems.

Yearly Ophthalmology Visits

In about 10 to 23 percent of people with CFRD, uncontrolled diabetes over time can cause *retinopathy*, or eye disease. This eye disease can cause blurred vision at first and blindness later on if blood sugars are not well controlled. After you have had CFRD for five years, you should schedule an ophthalmology visit to see an *ophthalmologist* (eye doctor) once a year. The doctor will do a complete eye exam to see if you have retinopathy. If you do, the ophthalmologist can treat it. Good blood sugar control can help prevent it.

CHAPTER 6: THE DIABETES CARE TEAM

Learning Goals

At the end of this chapter, you should be able to

- Describe the members of the total care team.

Although you may know your *pulmonologist* (lung doctor) well, you may not know an *endocrinologist* (diabetes doctor). If you have CFRD or abnormal glucose tolerance, you should see a diabetes doctor and a lung doctor. The diabetes doctor will design a treatment plan to meet your diabetes needs and maintain health.

Most diabetes doctors work with *certified diabetes educators (CDEs)*. These are often nurses and dietitians with special training to manage diabetes. Get to know the nurses and dietitians who work with your CF and *endocrine* doctors. Diabetes educators can help you manage your diabetes by teaching you about blood sugar control and insulin dosing. Diabetes educators can teach you how to tell when insulin doses need changing. Other members of the diabetes care team include a social worker or psychologist. You may end up not meeting all of the diabetes care team members if you already work closely with the CF dietitian and social worker.

Your diabetes and CF doctors and you need to work as a team to manage your diabetes. Your total care team includes YOU and your family; your CF doctor, nurse, dietitian and social worker; and your diabetes doctor, nurse, dietitian, diabetes educator and social worker.

You are the most important member of your total care team! Your role on the team is to tell the others what you need and how you feel. **Bring your blood glucose meter to all clinic visits.** Tell them about your medicines (particularly prednisone/steroids) and physical activity. Tell them about your schedule (when you wake up, go to bed, eat meals and eat snacks) so they can help you create a routine that works for school or work days and weekends. This makes it simpler to manage diabetes. Being open with the other team members allows the total care team to match your treatment to your needs as a person with CF and CFRD.

CHAPTER 7: LOW BLOOD SUGAR (HYPOGLYCEMIA)

Learning Goals

At the end of this chapter, you should be able to

- List the common signs of low blood sugar.
- Explain how to treat low blood sugar.
- Describe how to manage diabetes on days when you are too sick to eat your normal diet.
- Explain how to avoid low blood sugar with exercise.

What is Hypoglycemia?

Hypoglycemia is low blood sugar. Levels less than 70 mg/dL or 3.9 mmol/L are too low and can be dangerous. Blood sugar levels this low don't often occur unless a person is taking insulin. People who are taking insulin shots can have very low blood sugar levels. **Blood sugar levels can drop fast and must be treated fast!** When you are newly diagnosed with CFRD, you and the people you live and work around must learn the symptoms of hypoglycemia and how to treat it.

Low Blood Sugar Symptoms

The body gives a warning when blood sugars are getting low. **WARNINGS VARY FROM PERSON TO PERSON.** Others may see these symptoms in you before you do. If your blood sugar is low and you don't treat it, you may pass out, have a *seizure* or have *convulsions*. If you are taking insulin, you must treat your low blood sugar right away so that symptoms don't worsen. Symptoms often occur when blood sugar levels are not yet low enough for you to pass out.

The early signs of low blood sugar are caused by the release of a hormone called *adrenaline*. Adrenaline is also called the "fight or flight" hormone because most people release it when they are excited or scared. Among other things, it dilates the pupils, raises the heart rate and makes people feel shaky and sweaty. If you feel these symptoms, check your blood sugar. If it is less than 70 mg/dL or 3.9 mmol/L, you need to treat it quickly by eating foods or drinking liquids that contain carbohydrates.

COMMON SYMPTOMS OF LOW BLOOD SUGAR

- Sudden hunger
- Upset stomach (nausea)
- Shaky feeling hands or body
- More sweat than normal (often a "cold" sweat)
- A pale face color
- Weakness
- Headache
- Confusion (you may feel or look "spaced out" or "dazed")
- Blurred vision or double vision
- A change in the way you act or feel (crying, feeling nervous, acting "drunk" or angry, etc.)
- Fast heartbeat
- Tingling or numbness in your lips and mouth

Low Blood Sugar Causes

When your body doesn't have enough sugar to burn for fuel, your blood sugar level drops. Low blood sugar tied to insulin use is often called an *insulin reaction* or a *reaction*.

Low Blood Sugar in CF without Diabetes

People with CF who are not taking insulin may have slightly low blood sugar levels and feel the warning symptoms listed above. These symptoms occur because your body's own insulin secretion isn't well timed to when you eat your meals. Although slightly low blood sugar can feel bad, it is not a danger. Your blood sugar should never drop really low unless you are taking insulin.

People not taking insulin who feel low blood sugar symptoms can stop or prevent them by eating small meals every two to three hours. These meals should contain carbohydrates. Ask your dietitian to help you with a meal plan if you have low blood sugars.

Low Blood Sugar Treatment

The best treatment for very low blood sugar is to eat or drink a simple sugar source. If your blood sugar is less than 70 mg/dL or 3.9 mmol/L, you should take 15 grams of carbohydrates (such as in three or four glucose tablets; ½ cup of regular soda, juice or lemonade; 1 tablespoon of sugar or honey; or one piece of medium-sized fruit). If your blood sugar is less than 50 mg/dL or 2.75 mmol/L, you should take 30 grams of carbohydrates (a double serving of the above). If you are taking insulin, you should always carry glucose tablets with you. Use them when you feel "low" but don't have time to test or when you have no other sugar source.

It is not safe to feed a person who has passed out because they will likely choke. If your blood sugar is so low that you pass out or can't drink, someone else needs to give you a *glucagon* shot and call 911. Glucagon is a hormone that "squeezes" extra sugar out of the liver and raises the blood sugar level. You should have glucagon with you at all times. Those who live with you should know how to give it. Glucagon can cause nausea and vomiting for up to six hours.

Even if the package is not opened, glucagon expires after one year. Check your glucagon now and then to see when it expires. Replace it when needed. Always wear an ID bracelet or necklace stating that you have diabetes and CF. This is the first thing that rescue workers look for. It tells them that you might need glucagon or *intravenous (IV)* sugar if your blood sugar is dangerously low.

LOW BLOOD SUGAR WITH INSULIN USE IS OFTEN CAUSED BY

- Late or missed meals and snacks.
- Extra exercise that burns more sugar.
- An insulin dose that is too high.
- Absorbing the insulin too fast, which can happen with exercise or if the shot is given in the muscle instead of just under the skin.
- Lack of low blood sugar warning symptoms (for example, when you are asleep).
- Getting too much insulin or wrongly mixed insulin types.
- Drinking alcohol on an empty stomach when taking insulin.

TO TREAT LOW BLOOD SUGAR, EAT OR DRINK ONE OF THESE:

- Three or four glucose tablets
- ½ cup of regular soda, juice or lemonade
- 1 Tbsp of sugar or honey
- 1 piece of medium-sized fruit

Driving and Low Blood Sugar

You can drive with diabetes, but you must take extra precautions to stay safe. The following are steps you can take to prevent low blood sugar while driving.

IMPORTANT:
ALWAYS HAVE
A QUICK-ACTING
SUGAR WITH YOU,
AND WEAR AN ID
THAT STATES YOU
HAVE DIABETES
AND CF.

- Check your blood sugar before you drive. NEVER drive if your blood sugar is less than 100 mg/dL or 5.5 mmol/L.
- Eat a snack with carbohydrates before you drive.
- Pack plenty of snacks with carbohydrates for long trips.
- Pull over and check your blood sugar if you feel shaky. If it is low, eat a snack.
- Don't take insulin on an empty stomach before driving to a restaurant. Take insulin when you get your food.
- Keep glucose tablets in your car.

Sick Days and Blood Sugar

When you are not able to eat your normal diet, it can be hard to control blood sugar. Your blood sugar often rises when you are sick. You are also more likely to get dehydrated if you have a fever, *diarrhea*, high blood sugar or are throwing up. If you are throwing up or have lost your *appetite*, tell your diabetes care team.

These guidelines will help you manage your blood sugar when you can't eat your normal diet:

- Check your blood sugar every four to six hours.
- Tell your doctor if your blood sugar is higher than normal.
- Use your normal insulin dose, unless your doctor tells you to change.
- If you can't eat solids, drink liquids. Replace 15 grams of carbohydrates from solids with 15 grams of carbohydrates from liquids.
- Sip at least 8 to 12 ounces of *fluids* every hour. Alternate fluids that contain carbohydrates (juice, milk, supplements, soda) with fluids that do not (water, sugar-free drinks).
- Even if your blood sugar is not high, call your doctor if you can't eat your normal diet for more than 24 hours or if you have diarrhea or are throwing up for more than six hours.
- If you are supposed to check your urine for ketones when well, check more often when sick. Call your doctor if your urine ketones are moderate or high.
- Don't miss CF treatments when sick!

Chapter 7: Low Blood Sugar (Hypoglycemia)

- Tell your doctor or CF care team when you have a fever!
- Higher than normal blood sugar levels may mark the start of a more severe illness. Always tell your CF Foundation-accredited care center team and your diabetes care team if your blood sugar is high for more than two days.

Exercise and Low Blood Sugar

Routine exercise is good for many reasons. It can help control your blood sugars by making your body respond better to insulin. Exercise can strengthen your lungs and help you feel better. Exercise can help with depression. All people with CFRD should do some type of moderate aerobic exercise for at least 150 minutes per week.

Exercise may also cause low blood sugar because muscles use sugar for fuel. People with CFRD can work out safely as long as they understand the following:

- You may need to adjust your insulin dose to match your activity level. Even if your blood sugar is more than 100 mg/dL or 5.5 mmol/L, eating an extra carbohydrate snack before starting is wise.
- You may need an extra 15 to 30 grams or more of carbohydrates for each hour of intense or lengthy exercise.
- The blood-sugar-lowering effect of a workout can last as long as 12 to 24 hours, so you may need to eat an extra bedtime snack with carbohydrates on the days you've exercised really hard.

Record your exercise in your diabetes self-care record so that your doctor will know if exercise caused low blood sugar.

TIPS FOR EXERCISING

- Check your blood sugar before, during and after your workout so you can watch your blood sugar patterns.
- Eat a snack with carbohydrates before you begin if your blood sugar is less than 100 mg/dL or 5.5 mmol/L.
- Have a source of carbohydrates with you (such as glucose tablets).
- To prevent low blood sugar, eat 15 to 30 grams of carbohydrates for every 30 minutes to one hour of continuous exercise.

CHAPTER 8: ABNORMAL GLUCOSE TOLERANCE IN CF

Learning Goal

At the end of this chapter, you should be able to

- Describe the other types of abnormal glucose tolerance in CF and know treatment for each.

The oral glucose tolerance test (OGTT) discussed in Chapter 2 is used to diagnose not just CFRD but also the other types of abnormal glucose tolerance that are very common in people with CF. Abnormal glucose tolerance is not the same as diabetes, but people who have abnormal glucose tolerance are at high risk for developing diabetes in the future.

Other Types of Abnormal Glucose Tolerance in CF

Indeterminate Glycemia

If your fasting and two-hour OGTT results are normal, but you have a high blood glucose reading in the middle of the OGTT, this is called indeterminate glycemia (INDET).

Impaired Fasting Glucose

Impaired fasting glucose (IFG) occurs when your fasting blood glucose is 100 mg/dL to 125 mg/dL, or 5.6 mmol/L to 6.9 mmol/L.

Impaired Glucose Tolerance

Impaired glucose tolerance (IGT) occurs when your blood glucose levels are 140 mg/dL to 199 mg/dL or 5.6 mmol/L to 11.0 mmol/L at two hours during the OGTT.

Treatment

IFG and INDET are considered pre-diabetic and they carry a high risk of developing diabetes in the future. In children with CF who have not reached puberty, both IGT and INDET could indicate an early diagnosis of CFRD. The CF Foundation recommends that all people with CF have an annual OGTT starting at the age of 10 to screen for abnormal glucose tolerance or CFRD. You should also be tested if you have diabetes symptoms, when you are sick and/or when you are taking steroids.

Avoid drinking too many sweet drinks, such as soda or large amounts of fruit juice or other sweetened beverages. Eat meals and snacks throughout the day, all with the same amount of carbohydrates. Talk with your dietitian about spreading carbohydrates throughout the day to even out your blood sugars.

CHAPTER 9: NUTRITION AND CFRD

Learning Goals

At the end of this chapter, you should be able to

- Describe a high-calorie healthy diet.
- Figure out carbohydrate content from a standard food label and adjust insulin.
- Manage late meals, alcohol and sugar substitutes.

A High-Calorie Healthy Diet

To ensure good health, it is important to maintain a healthy body weight. With type 1 or type 2 diabetes, people are often advised to eat a low-fat, low-salt, and sometimes low-calorie diet. People with CF have different nutrition needs, though. Even with CFRD, you still need to eat your normal high-calorie, high-protein, high-fat, high-salt diet to help you get and maintain a healthy body weight. Keeping your blood sugar at near-normal levels will help to maintain your weight and ensure good health. You can learn to manage your blood sugar by balancing your food, insulin and physical activity.

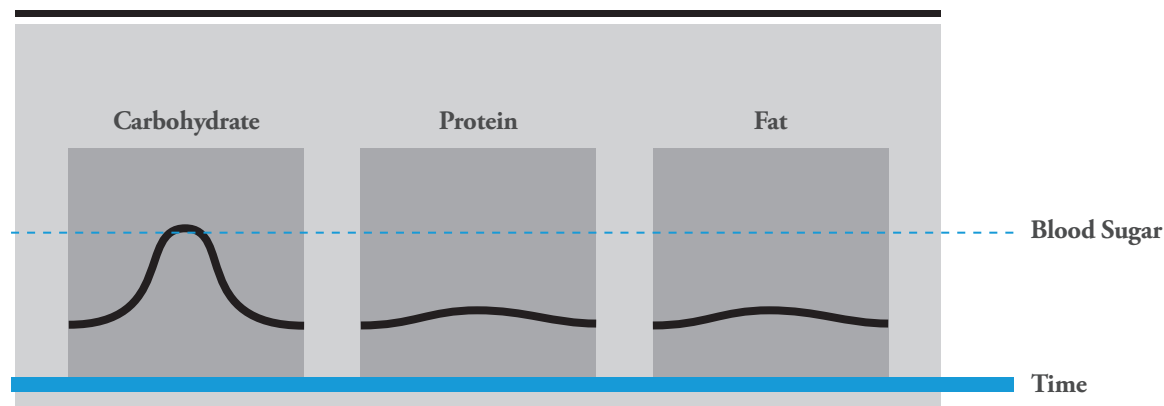
A healthy diet means eating a variety of foods from all food groups. Added fats and sweets provide a good source of extra calories. All foods are healthy and, when eaten in the right amounts, can help you reach and maintain a healthy body weight. The only change is that, now that you have CFRD, you need to learn how to measure or count the foods that affect your blood sugar the most.

The six major food groups contain six different nutrients: carbohydrates, protein, fat, vitamins, minerals and water. Carbohydrates, protein and fat provide fuel (calories) for our bodies. Foods that contain carbohydrates affect blood sugar the most because the body turns them into sugar. Foods that are made up mostly of protein and fat have much less of an effect on blood sugar. The graphs below show how carbohydrates, protein and fat affect blood sugar.

THE SIX MAJOR FOOD GROUPS

1. Grains
2. Fruits
3. Vegetables
4. Meats
5. Dairy
6. Fats

NUTRIENT EFFECTS ON BLOOD SUGAR



Carbohydrates

The main way to control blood sugar with diet is to monitor the carbohydrates in your meals and snacks. This does not mean that you should avoid carbohydrates. They contain important nutrients and are the body's main source of fuel.

Carbohydrates are turned into sugar that is then used as fuel for all body functions. The two main types of carbohydrates in these foods are sugars and starches. When eaten in the same amounts, both types affect blood sugar the same way. Foods that are high in fiber have no special effect on blood sugar.

CARBOHYDRATES ARE FOUND IN

- Grains (bread, rice, pasta and cereal)
- Fruits (fresh, canned and dried fruit)
- Starchy vegetables (potatoes, corn, peas and winter squash)
- Milk and yogurt
- Beans, peas, and lentils
- Desserts
- Sweetened drinks
- Snack foods

By checking your blood sugar and watching the amounts and kinds of carbohydrates you eat, you will learn how varied combinations of foods affect your blood sugar levels. Make sure that you eat carbohydrates at times when there is enough insulin in your body to change them into fuel. If you are on a fixed insulin dose (two or three shots per day with the same dose each time), you will be better able to manage blood sugar by eating the same amount of carbohydrates during each of your daily three meals and three snacks. Eat at about the same times each day, too.

People who are willing to take four or more shots of rapid-acting insulin per day or use an insulin pump have more options when choosing when and how much to eat. If you want more options, your doctor or diabetes educator can teach you how to adjust your rapid-acting insulin, based on how many carbohydrates you plan to eat during meals and snacks. This is called an *insulin-to-carbohydrate ratio*. Your dietitian can help you learn *carbohydrate counting* so you can use this method.

Reading Food Labels for Carbohydrates

Food labels will tell you the carbohydrate content in the foods you eat using “grams of carbohydrate.” On this food label, the serving size is ½ cup. All of the nutrient values listed below the serving size are based on ½ cup of this food. As you can see, the total carbohydrate content in ½ cup of this food is 13 grams.

If you plan to eat more than the listed serving size, multiply the amount shown on the label by how many servings you plan to eat. For example, if you plan to eat 1 cup of this food item, you will be eating two times the serving size on the label, because ½ cup x 2 = 1 cup. To find the total carbohydrate content of your 1 cup of food, multiply 13 grams by 2, which equals 26 grams.

Nutrition Facts	
Serving Size 1/2 cup (90g)	
Servings Per Container 4	
Amount Per Serving	
Calories 100	Calories from Fat 30
Total Fat 3g	5%
Saturated Fat 0g	
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 300mg	13%
Total Carbohydrates 13g	4%
Dietary Fiber 3g	12%
Sugars 3g	
Protein 3g	

Carbohydrate Counting, Breakfast Example

Food Item	Carbohydrate Grams
8 ounces whole milk	11 g
1 cup sweetened dry cereal	28 g
1 large banana	27 g
2 slices of toast	32 g
Margarine or butter	0 g
2 fried eggs	0 g
TOTAL	100 g

Daily Meal Plans

Here is an example of a meal plan using carbohydrate grams for someone needing about 3,000 calories per day. Servings of meat, vegetable and fat (they have no or very little carbohydrates) would be added to foods for a well-balanced diet.

Meal	Carbohydrate Grams
Breakfast	75 to 90 g
AM Snack	30 to 45 g
Lunch	75 to 90 g
PM Snack	30 to 45 g
Dinner	75 to 90 g
Bedtime Snack	30 to 45 g

Basing your diet on carbohydrate grams gives you options and helps you control your blood sugar levels (along with insulin and physical activity). You and your dietitian can base your own meal plan on your normal eating habits. If you want more options in your meal plan, talk to your doctor, dietitian or diabetes educator about insulin changes and using an insulin-to-carbohydrate ratio. See Chapter 11, “Carbohydrates in Common Food Items,” and review your meal plan with your dietitian.

Insulin-to-Carbohydrate Ratios

Using an insulin-to-carbohydrate ratio will give you the most options about when and how much you eat. To use this method, you need to know

- How to count the carbohydrates in the foods you eat (see Chapter 11, “Carbohydrates in Common Food Items”).
- How insulin works (see Chapter 3, “Treating CFRD”).
- How to “match” or adjust your rapid-acting insulin to the carbohydrates you plan to eat.
- How to use a “correction dose” of insulin when your blood sugar is outside your target range.

YOUR RECORD SHOULD CONTAIN

- The time of shot, meal and blood sugar check.
- The type and dose of insulin(s).
- Your blood sugar before the meal or snack and two hours after.
- The amount of food eaten (using cups, teaspoons, etc.).
- The carbohydrate content of the food eaten (in grams).
- Any physical activity (type and how long).
- Any stress, illness or other medicines (such as steroids) you are taking that may affect your blood sugar.

Most people with CFRD need about one unit of rapid-acting insulin (Humalog®, NovoLog® or Apidra®) for every 15 grams of carbohydrates. Some people need more than this (one unit of insulin for every 7 or 8 grams of carbohydrates). Some people need less (one unit of insulin for every 30 grams of carbohydrates). You and your care team can figure the ratio that’s right for you. You’ll need to keep a detailed record for at least three days to figure your ratio. Bring your record to the clinic.

Your ratio may change from time to time because of illness, stress, weight changes, medicines and physical activity. Work with your care team if your ratio ever stops working well. Once you’ve figured your ratio, you can use it to cover meals and snacks. For instance, if you need about one unit of rapid-acting insulin for every 15 grams of carbohydrates and you planned on eating 90 grams of carbohydrates for lunch, then you would take six units of rapid-acting insulin to cover your lunch ($90 \div 15 = 6$).

Lunch Example

RAPID-ACTING
INSULINS
Humalog®
NovoLog®
Apidra®

Food Item	Carbohydrate Grams
1 turkey and cheese sandwich with mayonnaise	30 g
2 ounces of potato chips	30 g
10 ounces whole milk	15 g
1 medium apple	15 g
Total	90 g

For this lunch, you would take six units of rapid-acting insulin to cover 90 grams of carbohydrates.

Insulin Correction Doses

A correction dose is extra insulin given before meals when your pre-meal blood sugar is higher than the range you want. For instance, your pre-meal blood sugar is 170 mg/dL (9.4 mmol/L) and your blood sugar goal is 80 to 120 mg/dL (4.4 to 6.7 mmol/L). You need one unit of rapid-acting insulin to “drop” or “correct” your blood sugar about 50 mg/dL (2.75 mmol/L) to the top of your goal range, so you would add one unit of insulin to your meal dose. The total for the lunch example above would then be seven units of insulin: six units for the meal and one extra unit for correction. Your doctor or diabetes care team will give you a correction scale when needed. Only rapid-acting insulins are used for correction.

Eating a Balanced CF Diet

Fats

A healthy diet includes a variety of foods and beverages. Most people with type 1 and type 2 diabetes (and most Americans as well) are advised to eat a low-fat diet to help prevent obesity, *atherosclerosis* and heart disease. This advice does not apply to you. People with CF need a high-fat high-calorie diet. **Fats are high in calories. Eat lots of them!** Adding fats and carbohydrates will increase your total calories. If you are trying to gain weight, choose high-fat foods.

The *enzymes* you may take when you eat help your body to absorb the nutrients and calories that fats provide. Even with enzymes, you may still end up losing or *malabsorbing* some of the fat you eat. Work with your dietitian to make sure your enzyme doses are correct so you can get the most from the food you eat.

Fat does not have a big effect on blood sugar. It can slow carbohydrates from being released by the stomach when you eat a lot of fat at a meal, though, so it has an indirect effect on blood sugar. The more fat in your food, the later your blood sugar may peak. Eat many types of high-fat foods, as well as foods high in *omega-3 fatty acids*, which have many good health benefits.

Examples of Added Fats

Margarine,¹ butter, cream, cream cheese, sour cream

Oil (olive, peanut, canola,² flaxseed,² soybean,² corn, safflower, coconut, sunflower, palm kernel), lard, shortening, mayonnaise,¹ salad dressing³

Bacon, salt pork, fatback, chitterlings

Avocados, black and green olives

Peanut butter, peanuts, pecans, walnuts,² almonds, cashews

Coconut

Sesame seeds,³ tahini,³ pumpkin seeds, sunflower seeds,³ flaxseed³

¹Different brands of these foods have different amounts of fat. Check the labels!

²These foods are high in omega-3 fatty acids.

³These foods may contain some carbohydrates.

Protein

Protein does not have a big impact on blood sugar levels. Still, you need to eat enough protein for good health. The body uses protein to build, repair and maintain muscles and other body tissues. It helps to regulate the immune system and other body processes.

Meats and meat substitutes have varied amounts of fat. Increase calories by **choosing higher-fat meats and cheeses and using high-fat cooking methods** such as frying and deep-frying.

Milk/Dairy

Milk and other dairy products are important sources of protein, carbohydrates and fat. They also provide calcium and other vitamins and minerals. Eat or drink at least three to four servings per day. A serving size of milk is 8 ounces, or 1 cup. With the exception of cheese, most dairy products contain carbohydrates and need to be counted.

Fruits

Fruits, fruit juices, canned fruit and dried fruit provide carbohydrates, vitamins, minerals and fiber. They are part of a balanced diet. Fruit juice, in particular, contains a concentrated amount of carbohydrates. Fresh fruit contains fiber. See the food lists in Chapter 11, “Carbohydrates in Common Food Items.”

Vegetables

Vegetables are an important part of a balanced diet. Eat at least three servings per day. A serving size is typically ½ cup of cooked vegetables or vegetable juice or 1 cup of raw leafy vegetables. Non-starchy vegetables have about 5 grams of carbohydrates per serving. Because vegetables are low in calories, try stir-frying them with oil or adding cheese sauce, butter, margarine or dips for extra calories. Starchy vegetables, including corn, peas, winter squash and potatoes, have more carbohydrates than non-starchy vegetables. See the food lists in Chapter 11, “Carbohydrates in Common Food Items.”

Grains, Grain Products and Beans

Breads, cereal, rice, pasta and beans provide an important source of fuel in the form of carbohydrates as well as fiber, vitamins and minerals. You should eat at least six servings of grains every day. Try to eat at least three servings of *whole grains* every day.

Salt and Other Vitamins and Minerals

Whether they have CFRD or not, people with CF lose lots of salt each day in their sweat. The lost salt needs to be replaced by using extra table salt and eating salty foods. Salt can be added while cooking or at the table. Convenience foods (snack items, canned and packaged foods, and processed meats and cheeses), condiments (ketchup, mustard, soy sauce, pickles, olives), and restaurant and fast foods are often high in salt, or sodium.

You need at least 4,000 milligrams of sodium daily. One teaspoon of salt contains about 2,300 milligrams of sodium. Check food labels for the sodium content to help you choose high-sodium foods.

Eating many types of foods from all the food groups each day plus taking your multivitamin pills will help you get all the vitamins and minerals you need. Your dietitian can tell you which CF multivitamin is right for you.

Free Foods

“Free foods” are foods that have less than 20 calories or less than 5 grams of carbohydrates per serving. Don’t fill up on them. You need lots of calories each day to maintain a healthy body weight. Be careful to watch the portion size or just count it as a carbohydrate unit if the serving size you plan to eat adds up to a carbohydrate unit (such as three or four servings eaten at once).

Free Food Examples	
Beverages/Liquids	Bouillon, broth, gelatin, coffee, tea, lemon and lime juice, club soda, diet soft drinks, sugar-free tonic, water
Sugar Substitutes	<i>Aspartame, acesulfame-K, saccharin, sucralose, neotame, stevia, monk fruit</i>
Condiments	BBQ sauce (1 tablespoon), ketchup (1 tablespoon), horseradish, mustard, relish, salsa, soy sauce, hot pepper sauce, taco sauce, teriyaki sauce, pickles, vinegar
Herbs and Spices	All

High-Calorie Supplements

At times, you may not feel like eating or may not be hungry. You may struggle to gain or maintain weight. *High-calorie supplements* are a great source of extra calories during these times. They can help you gain and maintain weight and improve nutrition status. You can make them part of your daily meal plan using the chart on the next page. The calories of each supplement will vary. Your doctor or dietitian can help you choose the right one for you.

Supplement	Serving Size	Carbohydrate Grams per Serving
Boost Breeze™	8 ounces	31 g
Boost Plus™	8 ounces (1 can)	45 g
Boost Pudding™	1 serving (5 ounces)	32 g
Boost VHC™	8.45 ounces (1 can)	46 g
Carnation Instant Breakfast™	1 serving (1 packet mixed with 8 ounces whole milk or half-and-half)	39 g
Duocal™	2 tablespoons	12 g
Ensure Clear™	6.8 fluid ounces	43 g
Ensure Plus™	8 ounces (1 can)	50 g
Ensure Pudding™	4 ounces	30 g
Power Milk	1 cup whole milk with 1 tablespoon heavy cream and 1 tablespoon chocolate or strawberry syrup	30 g
Scandishake™	1 package mixed with 8 ounces whole milk	70 g

Insulin Coverage of High-Calorie Supplements and Tube Feedings

People with CFRD need to cover the food they eat and their high-calorie supplements with insulin. Some people get many cans of supplement while sleeping by gastrostomy or nasogastric tube. Often, a single shot of combined regular plus NPH insulin given before the drip starts will cover the whole feeding. Check blood sugars three to four hours after the tube feeding starts and when it ends. This will help to fine-tune the insulin dose. An insulin pump can also be used to cover supplemental feedings with a gastrostomy or nasogastric tube.

Special Cases

Late Meals

The timing of meals and snacks matters when you are taking insulin! Review the time-action of your insulin dose with your diabetes care team so you can plan meals and snacks when the insulin is most effective. This will help you avoid low blood sugar. If your meal is late but you have taken your insulin, eat or drink something with 15 to 30 grams of carbohydrates while you are waiting. Try not to delay meals for more than one hour. If your meal is late, check your blood sugar more often to avoid low blood sugar.

Alcohol

Ask your doctor if it is safe for you to drink alcohol. If you plan to drink alcohol, know the effect it has on blood sugar. Do not drink alcohol on an empty stomach when taking insulin because drinking alcohol without food increases the risk of low blood sugar. If you are not careful, alcohol can cause blood sugar to go either too high (from the sugar in mixed drinks) or very low. Do not count the carbohydrates in alcohol towards your insulin dose. Check your blood sugars more often while you drink alcohol.

IF YOU DRINK ALCOHOL:

- Ask your doctor if any amount of alcohol is safe for you.
- Always wear a diabetes ID bracelet or necklace.
- Only drink alcohol when blood sugars are well-controlled.
- Eat foods that contain carbohydrates when drinking alcohol.
- Never drink alone. Be sure to tell your friends that you have diabetes when you drink alcohol.
- Limit alcohol to one drink for women and two for men. One drink is 12 ounces of beer; 4 to 5 ounces of wine; or 1.5 ounces of distilled spirits, cordials or liqueurs.
- Check your blood sugar after drinking to learn your response to alcohol. You may also need to check your blood sugar during the night, especially if you drank too much or you have been physically active while drinking.
- Ask your doctor how your CF medicines interact with alcohol.

When you are drinking alcohol, your liver is busy breaking down the alcohol so it will release less glucose into the blood. This puts you at risk for low blood sugar. See Chapter 6, “Low Blood Sugar (Hypoglycemia).” Signs of being drunk are a lot like signs of low blood sugar. If alcohol has clouded your thinking, you may not treat your low blood sugar the right way. Those around you may not know that you have low blood sugar. This puts you in grave danger!

Sugar Substitutes

Daily use of sugar substitutes is thought to be safe. There are six approved for use in the United States by the Food and Drug Administration. They are aspartame, acesulfame-K, saccharin, neotame, sucralose and stevia. Sugar alcohols are another type of low-calorie sugar substitute. *Sorbitol*, *mannitol* and *xylitol* are examples of these. Too much can cause diarrhea. Use them with caution.

Some foods that contain sugar substitutes, such as sugar-free yogurts, may contain other sources of carbohydrates, such as milk. It is important to read labels to include all carbohydrates in your total count.

Many food items with sugar substitutes are low in calories. If you have CF, you need extra calories. You are better off eating the regular, rather than low-calorie, version of food, except when it comes to regular soda. Drinking too much of this may cause high blood sugar because of its high carbohydrate content. A 12-ounce can of regular soda has about 40 to 45 grams of total carbohydrates. Plus, regular soda has no vitamins or minerals for good health. Eat a balanced CF diet and use good sense when choosing high-calorie foods.

CHAPTER 10: NUTRITION AND CFRD WHEN PREGNANT

Learning Goals

At the end of this chapter, you should be able to

- Explain how gestational diabetes is treated.
- Describe the nutrition guidelines for CF and pregnancy.
- Know how to manage special diet concerns while pregnant.

For your health and your baby's health, it is important to eat a healthy diet and control your blood sugars before and while you're pregnant. Eat many types of nutritious foods. Because of your CF, you need more calories than what is advised for people without CF. If you have CF and are pregnant, you need even more! You will have to eat three meals and many snacks each day to meet your and your baby's nutritional needs. Because your need for protein, calcium, iron and folic acid are increased, you need to take extra vitamins.

Women with CF and gestational diabetes should eat a high-calorie, healthy CF diet to gain the right amount of weight to have a healthy baby.

Check your blood sugar many times each day. Take the right amount of insulin to cover your carbohydrates. Control your blood sugars (see Chapter 9, "Nutrition and CFRD"). Know what your blood sugar goals are. Continue to work closely with your CF dietitian when you are pregnant, even if you develop diabetes.

Planning for Pregnancy

Women with CF who do not have diabetes and who are planning a pregnancy should be tested for diabetes before getting pregnant.

They also should have an OGTT as soon as they find out they are pregnant. The OGTT should be repeated again at the end of both the first and second trimesters to check for diabetes. Diabetes that is diagnosed during pregnancy is called *gestational diabetes*. Be sure to notify your CF team if you develop gestational diabetes.

Insulin should be started when diabetes is diagnosed, to preserve both the baby's and the mother's health and ensure a healthy pregnancy with adequate weight gain for both the mother and the baby. Women with CF who already have diabetes should consult their doctors before getting pregnant. They should have good blood sugar control before getting pregnant. They need to check their blood sugar more often and take the right amount of insulin. During pregnancy, insulin needs increase, especially during the second and third trimesters.

Any woman with CF who gets pregnant should be treated by a high-risk obstetrician. If she has diabetes before getting pregnant or gets gestational diabetes, she also should see an endocrinologist. An endocrinologist is a doctor with special training in the treatment of diabetes and other diseases of the glands that make hormones. Uncontrolled blood sugars and/or poor nutrition status can hurt both mother and baby, and can lead to poor weight gain and possible problems with the baby.

Gestational Diabetes

Women with CF are at high risk for gestational diabetes. This type of diabetes occurs while you're pregnant and goes away when the baby is born. While pregnant, the body naturally makes more insulin. Gestational diabetes occurs when the pancreas can't keep up with the extra demand for insulin. Sometimes gestational diabetes may become CFRD after the baby is born. You will need to have your blood sugars checked by your doctor six to 12 weeks after you deliver your baby to check for CFRD.

If you have gestational diabetes, learn how to count carbohydrates so you can manage your blood sugars until the baby is born. Eating three meals and at least three or four snacks each day will help. Spreading out foods with carbohydrates throughout the day will help. Avoid drinking too many sweet drinks, including regular soda, juice, punch and lemonade. Your CF dietitian can help create a plan with the same amounts of carbohydrates throughout the day.

Try to gain the weight you have been advised to gain. Don't lose weight by not eating certain foods as a way to control blood sugar. Women who have gestational diabetes but do not have CF can watch what they eat, limit weight gain and control blood sugar. For women with gestational diabetes and CF, this way to control blood sugar is not safe for you or your baby. You will likely need insulin at some point to help you gain weight and control blood sugar.

BLOOD SUGAR GOALS ARE

- Less than 95 mg/dL or 5.3 mmol/L while fasting.
- Less than 140 mg/dL or 7.8 mmol/L one hour after meals.
- Less than 120 mg/dL or 6.7 mmol/L two hours after meals.

Blood Sugar Goals While Pregnant

To have a healthy baby, you must keep your blood sugar levels as close to normal as you can while pregnant.

Weight Gain While Pregnant

The amount of weight you should gain while pregnant depends on your *body mass index (BMI)* before getting pregnant. Ask your doctor about your special needs. Work with your dietitian while pregnant to gain the right amount of weight. This is crucial for your health and your baby's health.

Basic Guidelines for Gaining Weight When Pregnant

Body Mass Index (BMI) Before Getting Pregnant	Advised Weight Gain in Pounds (<i>lbs</i>) or Kilograms (<i>kg</i>)
BMI less than 21.9	28 to 40 lbs or 12.5 to 18.0 kg
BMI 22 to 24.9	25 to 35 lbs or 11.5 to 16.0 kg
BMI 25 to 29.9	15 to 25 lbs or 7.0 to 11.5 kg
Pregnant with twins	35 to 45 lbs or 16.0 to 20.5 kg

Nutrition When Pregnant

Calories and Protein

If your weight was normal before you got pregnant, you need to add at least 300 calories and 2 to 3 ounces of protein each day to your diet to meet your increased calorie and protein needs while pregnant. If you were underweight, you will need to add even more calories. Eating larger portions and adding extra fat will help add extra calories. If you are having a hard time gaining weight, add high-calorie supplements to your diet. Be sure to adjust your digestive enzymes so your body can use the extra calories you are taking in.

Great sources of protein are beef, pork, poultry, fish, seafood, eggs, dairy products, dried peas and beans, tofu, nuts and peanut butter.

Calcium

All pregnant women need at least 1,000 milligrams of calcium daily. They can get this by eating four servings of dairy products per day. Women with CF need more than this because not all of the calcium they eat is absorbed from their intestines. You can get about 300 to 400 milligrams of calcium in 8 ounces of milk or yogurt. You can get about 200 to 300 milligrams in 1½ to 2 ounces of cheese. Other good sources of calcium include calcium-fortified soy milk, rice milk or juice; calcium-fortified grain products; green leafy vegetables; and canned salmon or sardines with bones. You may need a calcium supplement if you can't get enough calcium in food.

Iron

While pregnant, your need for iron increases to 30 milligrams per day. Great sources of iron are red meats, liver, eggs, dried peas and beans, and enriched or whole grain breads and cereals. Eating a food high in vitamin C along with high-iron foods will help you better absorb the iron. Good sources of vitamin C are citrus fruits and juices, strawberries, green peppers, broccoli, green leafy vegetables and tomatoes. You may also need an iron supplement.

Folic Acid

You must get enough folic acid in your diet before you get pregnant and during the first trimester for your baby's proper brain and spine development. You need 400 micrograms (0.4 mg) of folic acid per day. Great sources are folic-acid-fortified cereals, breads and grain products; green leafy vegetables; dried peas and beans; and citrus fruits and juices. Ask your CF dietitian if you need a folic acid supplement.

Vitamins A, D and E

It is very important to get the right amounts of vitamins A, D and E while pregnant. You may need more than normal, but too much can be as harmful as too little. People with CF don't absorb these vitamins well. Your care team will check your blood levels to make sure you are getting the right amount.

EVERY DAY WHILE PREGNANT TAKE IN

- 300 extra calories
- 2 to 3 ounces more protein
- 1,000 mg of calcium
- 30 mg of iron
- 400 micrograms (0.4 mg) of folic acid
- 8 to 12 cups of fluids

Special Concerns

Caffeinated Beverages and Sugar Substitutes

Caffeine and sodas sweetened with aspartame appear to be safe to drink while you are pregnant. Because they don't have nutritional value, use these in moderation. Limit your intake of drinks with caffeine and sugar substitutes to 2 cups per day or less.

Alcohol

If you are planning to get pregnant or are pregnant now, do not drink alcohol. No amount is safe for your baby.

Fluid

Be sure to drink plenty of fluids, such as milk, water and/or supplements while pregnant. Drink at least 8 to 12 cups per day.

Seafood Concerns

Fish is a great source of protein and other nutrients. Some seafood is safer to eat while you are pregnant than others. Some fish from polluted waters may contain harmful bacteria and chemicals. Avoid eating shark, king mackerel, swordfish, tilefish and tuna while pregnant.

Check your local health department or department of fisheries about the safety of fish caught in your local lakes and streams. Buy only very fresh fish, and either use it within 24 hours or freeze it right away. Avoid eating raw fish such as sushi when you are pregnant. A few people have eaten raw fish that contained parasites, and others have gotten hepatitis A from raw fish. You can safely eat 12 ounces of shellfish, canned fish, smaller ocean fish or farm-raised fish per week.

Taste and Smell Changes While Pregnant

Many pregnant women notice changes in the way some foods taste and smell. Some foods may taste worse, and some smells may make you queasy. This is normal and likely related to hormone changes. Avoid foods that bother you. If food odors upset your stomach, see if someone else can cook. If you can't eat enough because of taste and smell changes, see your dietitian.

Food cravings can also occur. Some are good, such as craving milk or fruit. Some are harmful, such as craving dirt, clay or laundry starch. These cravings are known as *pica* and may be a symptom of anemia. If you crave nonfood items like these, tell your doctor right away.

Feeling Sick and Throwing Up While Pregnant

Many women feel sick and throw up while pregnant because of hormone changes. These problems often (but not always) go away after the first 12 weeks. Some women really struggle and need to be watched closely by their health care team. Try to "eat through" feeling sick and throwing up so you don't lose weight. Eat smaller meals and snacks more often. Try eating only dry food such as crackers or toast for a morning snack, avoiding drinking during meals, eating cold foods to avoid food smells and eating ice chips if fluids are hard to keep down. Get help from your dietitian if you can't eat enough because you feel sick and are throwing up.

Constipation

Constipation is common during pregnancy. Take your enzymes regularly with meals and snacks. If you are having problems with your bowel movements, talk with your doctor or dietitian. Eat foods high in fiber and drink lots of fluids. Fiber is found in whole grains, bran cereals, fresh fruits, vegetables, dried peas, beans and nuts. Regular exercise helps, too.

CHAPTER 11: CARBOHYDRATES IN COMMON FOOD ITEMS

Learning Goals

At the end of this chapter, you should be able to

- Quickly find the carbohydrate content of common food items.

Carbohydrate Counting

Carbohydrates are the main food nutrient that affects blood sugar. To control blood sugar, it is important to learn how to measure or count the carbohydrates in the foods you eat. This chapter contains lists of the carbohydrate grams in common foods. It also contains common household measurements and portion sizes. All foods are listed in cooked, ready-to-eat portions.

Review this chapter with your dietitian as you plan your own meals based on your eating habits, and decide how to spread out your day's carbohydrates. At the end of this chapter, there is a sample menu and meal plan that you can use. Work with your dietitian to create your meal plan. If you don't have a dietitian, ask your doctor to refer you to one who understands both diabetes and CF.

Common Household Measurements

3 teaspoons (tsp) = 1 tablespoon (Tbsp)

4 Tbsp = $\frac{1}{4}$ cup = 2 fluid ounces

8 Tbsp = $\frac{1}{2}$ cup = 4 fluid ounces

16 Tbsp = 1 cup = 8 fluid ounces

1 cup = $\frac{1}{2}$ pint

2 cups = 1 pint

1 ounce = 30 grams (dry weight)

Estimating Portion Sizes

These handy tips will help you estimate portion size:

3 ounces cooked meat/protein = a deck of cards, or the size of a woman's palm

1 ounce cheese = four stacked dice

$\frac{1}{2}$ cup casserole, grain or vegetable covers about $\frac{1}{4}$ of a standard size dinner plate

$\frac{1}{2}$ cup fruit = a tennis ball

Food Lists

Breads

Food Item	Serving Size	Carbohydrate Grams per Serving
Bread	1 slice (1 ounce)	15
Breadsticks (soft)	1, 6-inch (1 ounce)	17
Challah	$\frac{3}{4}$ ounce	17
Cornbread*	2 ounces	25
Croutons*	12 large	8
Dinner roll	1 roll (1 ounce)	13
Focaccia bread	1 wedge (2 ounces)	28
French bread	1 slice (1.3 ounce)	22
Hot dog/hamburger bun	1 bun (1.5 to 2 ounces)	22 to 30
Lefse	1 plain (1 ounce)	15
Matzo	1 ounce	24
Pita	1 (2 ounces)	33
Taco shell	2 hard shells	14
Tortilla (corn and flour)	1, 6-inch (1 ounce)	13
Tortilla (flour)	1, 10-inch (2.5 ounce)	34

**To get the extra calories you need, eat more of these higher-fat foods.*

Pasta, Grains and Other Side Dishes

Food Item	Serving Size	Carbohydrate Grams per Serving
Barley	$\frac{1}{2}$ cup	22
Chow mein noodles*	$\frac{1}{2}$ cup	13
Couscous	$\frac{1}{2}$ cup	18
Kasha/buckwheat	$\frac{1}{2}$ cup	17
Pasta	$\frac{1}{2}$ cup	22
Pasta side dish (packaged)	$\frac{1}{2}$ cup	22
Rice (white, brown)	$\frac{1}{2}$ cup	22
Rice (wild)	$\frac{1}{2}$ cup	18
Rice-A-Roni™*	$\frac{1}{2}$ cup	22
Rice pilaf	$\frac{1}{2}$ cup	22
Stuffing*	$\frac{1}{2}$ cup	22

**To get the extra calories you need, eat more of these higher-fat foods.*

Chapter 11: Carbohydrates in Common Food Items

Breakfast Items

Food Item	Serving Size	Carbohydrate Grams per Serving
Bagel (small)	1 (2 ounces)	29
Bagel (medium)	1 (3 ounces)	45
Bagel (large)	1 (4 ounces)	56
Biscuit*	1 cup	14
Cereal, bran flakes	1 cup	32 to 45
Cereal, cooked (oatmeal)	1 cup	27
Cereal, (dry, sweetened)	1 cup	25 to 38
Cereal, (dry, unsweetened)	1 cup	22 to 29
Cinnamon roll*	1 small	23
Croissant*	1 (2 ounce)	26
Danish*	1 small (2 ounces)	29
Doughnut* (cake)	1 medium	25
Doughnut* (frosted or glazed)	1 medium	32
French toast* (no syrup)	1 slice	15
English muffin	1 muffin	26
Grits	1 cup	30
Hash browns*	1 cup	26
Muffin*	1 large (3 ounces)	36
Muffin* (giant)	1 giant (6 ounces)	72
Pancake* (no syrup)	1, 6-inch	22
Scone*	1 large (4 ounces)	60
Waffle* (no syrup)	1 small	15

*To get the extra calories you need, eat more of these higher-fat foods.

Starchy Vegetables and Legumes (Beans)

Food Item	Serving Size	Carbohydrate Grams per Serving
Beans (baked)	½ cup	27
Beans, peas, lentils (cooked)	½ cup	20
Corn	½ cup	15
Corn on the cob	1 large ear	28
French fries	Small order (16 to 25 fries)	30
Peas	½ cup	11
Potato (baked)	1 small (3 ounces)	17
Potato (mashed)	½ cup	18
Potato (sweet)	½ cup	20
Potato pancake*	1 medium	11
Potato salad*	½ cup	14
Potatoes au gratin (packaged*)	½ cup	18
Squash (winter)	½ cup	9
Tater Tots™*	½ cup	15

*To get the extra calories you need, eat more of these higher-fat foods.

Chapter 11: Carbohydrates in Common Food Items

Crackers, Chips, and Popcorn

Food Item	Serving Size	Carbohydrate Grams per Serving
Club™ crackers	7 crackers	15
Graham crackers	2 full crackers	21
Popcorn* (microwave)	1 bag	48
Potato chips*	12 to 18 chips (1 ounce)	15
Pretzel sticks	31 sticks (¾ ounce)	15
Rice cakes	2 large cakes	15
Ritz™ crackers*	8 crackers	16
Saltine crackers	7 crackers	15
Tortilla chips*	1 ounce	17
Triscuit™ crackers	5 crackers	16
Wheat Thins™*	12 crackers	16

**To get the extra calories you need, eat more of these higher-fat foods.*

Condiments and Spreads

Food Item	Serving Size	Carbohydrate Grams per Serving
Honey, sugar, jelly, jam	1 tablespoon	15
Peanut butter*	2 tablespoons	5
Syrup (pancake)	2 tablespoons	26
Syrup (pancake, light)	2 tablespoons	12
Syrup (pancake, sugar-free)	2 tablespoons	4 to 8

**To get the extra calories you need, eat more of these higher-fat foods.*

Drinks

Food Item	Serving Size	Carbohydrate Grams per Serving
Cappuccino (espresso, foamed milk)	16 ounces	12
Cocoa (hot)	1 cup (8 ounces)	27
Iced Tea, sweetened	16 ounces	50
Latte (espresso, steamed milk)	16 ounces	18
Lemonade, punch, Kool-Aid™	1 cup (8 ounces)	26
Mocha (espresso, chocolate, milk)	16 ounces	41
Soda (regular)	1 can (12 ounces)	38 to 46
Sports drink	1 bottle (20 ounces)	32

**To get the extra calories you need, eat more of these higher-fat foods.*

Chapter 11: Carbohydrates in Common Food Items

Milk, Milk Substitutes and Yogurt

Food Item	Serving Size	Carbohydrate Grams per Serving
Chocolate milk	1 cup (8 ounces)	26
Milk (2% or whole)*	1 cup (8 ounces)	11
Rice Dream™, vanilla	1 cup (8 ounces)	27
Soy Milk, Silk™, vanilla	1 cup (8 ounces)	10
Yogurt (fruit)	1 cup (6 to 8 ounces)	27 to 45
Yogurt (light)	1 cup (6 to 8 ounces)	11 to 16
Yogurt (plain)	1 cup (6 to 8 ounces)	16

*To get the extra calories you need, eat more of these higher-fat foods.

Fresh, Frozen and Canned Fruit

Food Item	Serving Size	Carbohydrate Grams per Serving
Banana (large)	1	30
Canned fruits (in natural juice)	½ cup	15
Dried fruit	¼ cup	16 to 23
Fresh berries, melon, papaya	1 cup (pieces)	11 to 21
Fresh fruit (raw)	1 medium piece	11 to 18
Fruit sauces, unsweetened	½ cup	15
Grapefruit	½	13
Grapes	15	17
Other fresh fruit (cup)	½ cup	11 to 18
Raisins	¼ cup	29

*To get the extra calories you need, eat more of these higher-fat foods.

Fruit Juices

Food Item	Serving Size	Carbohydrate Grams per Serving
Apple, grapefruit, orange, pineapple	4 ounces	15
Bottled juice	16 ounces	60
Cranberry, grape, prune	3 ounces	15

*To get the extra calories you need, eat more of these higher-fat foods.

Combination Foods

Food Item	Serving Size	Carbohydrate Grams per Serving
<i>Mexican</i>		
Mexican burrito*	1	39 to 65
Fajita	2	40
Quesadilla*	1 entrée size	32-66
Refried beans*	½ cup	17
Taco,* regular, soft	1 small	12 to 18

*To get the extra calories you need, eat more of these higher-fat foods.

Chapter 11: Carbohydrates in Common Food Items

Combination Foods (Cont.)

Food Item	Serving Size	Carbohydrate Grams per Serving
<i>Italian</i>		
Calzone	1 regular	45-93
Fettuccini alfredo*	1 cup	47
Lasagna*	1 cup	31
Manicotti*	2 pieces	36
Pizza (thick, restaurant)*	1 medium slice	27 to 29
Pizza (thin, restaurant)*	1 medium slice	21 to 23
Ravioli*	1 cup	30
Spaghetti sauce from jar	½ cup	11 to 22
Spaghetti with meat sauce*	1 cup	45
Tortellini*	1 cup	37
<i>Asian/Indian</i>		
Chow mein (no rice)	12 ounces	25
Egg rolls*	1 large	15
Lo mein*	8 ounces	37
Mock duck/wheat gluten	3 ounces	3
Naan	1 ounce	11
Rice, basmati or jasmine	1 cup	44
Rice, fried*	1 cup	42
Stir-fry (meat & vegetable)	8 ounces	9 to 15
Sweet & sour pork* (no rice)	8 ounces	46
Wonton (plain)	4 pieces	16
<i>Middle Eastern</i>		
Falafel sandwich	11.6 ounces	85
Gyro sandwich	12 ounces	55
Hummus*	4 tablespoons	8
Tabbouleh	½ cup	15
<i>American</i>		
Casserole (with meat & noodles)*	1 cup	30
Cold-cut sub sandwich*	6-inch	45
Corn dog*	1 regular	23
Grilled cheese sandwich*	1 sandwich	30
Hamburger or hot dog on bun*	1 sandwich	22 to 30
Macaroni & cheese*	1 cup	45
Pot pie*	1 10-ounce pie	55
SpaghettiOs® with meatballs*	1 cup	32
Veggie burger on bun	1 sandwich	26 to 39

*To get the extra calories you need, eat more of these higher-fat foods.

Chapter 11: Carbohydrates in Common Food Items

Combination Foods (Cont.)

Food Item	Serving Size	Carbohydrate Grams per Serving
<i>Southern/Creole</i>		
Hominy	1 cup	33
Hush puppies*	5 pieces	35
Red beans & rice	1 cup	56
Shrimp gumbo	1 cup	19
Succotash	½ cup	17
<i>Soup</i>		
Bean*	1 cup	34
Chicken noodle	1 cup	12
Chili (with beans)*	1 cup	25
Cream of broccoli*	1 cup	20
Minestrone	1 cup	20
Miso (paste)	3 tablespoons	15
New England clam chowder*	1 cup	17
Tomato with milk	1 cup	22
Vegetable beef	1 cup	10

**To get the extra calories you need, eat more of these higher-fat foods.*

Desserts and Sweets

Food Item	Serving Size	Carbohydrate Grams per Serving
<i>Frozen Treats</i>		
Frozen yogurt	½ cup	22 to 30
Fudge bar	1 bar	17 to 30
Ice cream*	½ cup	15 to 30
Ice cream bar*	1 bar	15 to 30
Popsicle	1 popsicle	15
Sherbet	½ cup	22 to 30
<i>Pudding/Gelatin</i>		
Gelatin	½ cup	19
Instant regular pudding*	½ cup	30

**To get the extra calories you need, eat more of these higher-fat foods.*

Chapter 11: Carbohydrates in Common Food Items

Desserts and Sweets

Food Item	Serving Size	Carbohydrate Grams per Serving
<i>Candy</i>		
Chocolate bar*	1 2-ounce bar	30
Fruit roll-up	1 roll	12
Gummy bears	1 small bag	29
Jelly beans	1 small bag	24
Junior Mints™*	regular box, 16 mints	35
M&Ms™*	regular package	34
Peanut M&Ms™*	regular package	33
Skittles™	small package, 40 pieces	54
Snickers™*	1 regular bar	35
Sucker (lollipop)	2	11
Twix™*	regular package, 2 bars	37
Twizzlers™	3 pieces	30
<i>Baked Goods</i>		
Angel food cake	2 ounces	32
Apple crisp*	4 ounces	43
Banana bread*	2 ounces	33
Brownie*	2 ounces	36
Cake with frosting*	3 ounces	35 to 48
Cheesecake (fruit topping)*	3 ounces	41 to 48
Cheesecake (plain)*	3 ounces	26
Cream pie*	1 slice	30 to 53
Fruit pie*	1 slice	43 to 55
Lemon bar*	1 small bar	24
<i>Cookies</i>		
Animal crackers	13 pieces	30
Chips Ahoy!™*	3 cookies	21
Fig Newtons™	3 cookies	33
Fortune cookie	2 cookies	12
Ginger snaps	4 snaps	12
Granola bar (fruit-filled)	1 bar	22 to 41
Granola bar (plain)	1 bar	15 to 20
Homemade cookie*	1 cookie, 1 ounce	14 to 22
Kellogg's™ Rice Krispie Treats*	1 bar	15
Mrs. Fields® cookie*	1 large	24 to 56
Oreo™ cookies*	3 cookies	24
Pepperidge Farm® cookie*	1 cookie	15 to 22
Shortbread cookies*	3 cookies	14
Vanilla wafers	5 cookies	13

*To get the extra calories you need, eat more of these higher-fat foods.

Sample Meal Plan

TIME	CARBOHYDRATE GRAMS
Breakfast	
AM Snack	
Lunch	
PM Snack	
Dinner	
Evening Snack	

Advised Amount of Added Fat per Day:

Advised Amount of Meat, Poultry, Fish, Cheese or Eggs per Day:

Advised Amount of Vegetables per Day:

Chapter 11: Carbohydrates in Common Food Items

Sample Menu

TIME	FOOD ITEM	SERVING SIZE	CARBOHYDRATE PER SERVING
Breakfast			
AM Snack			
Lunch			
PM Snack			
Dinner			
Evening Snack			

GLOSSARY

Acesulfame-K – A sugar substitute. The generic form of Sunett® or Sweet One®.

Adrenaline – A “fight or flight” hormone. Made by the adrenal gland.

Amino acids – The building blocks of protein. Insulin allows the body to take up amino acids and build muscle tissue.

Apidra® (generic: glulisine) – A rapid-acting insulin.

Appetite – A desire for food or drink.

Aspart – A rapid-acting insulin. The generic name for NovoLog®.

Aspartame – A sugar substitute. The generic form of NutraSweet® and Equal®.

Atherosclerosis – When fats clog the inner lining of the artery walls.

Background insulin – A low level of insulin that is needed at all times (also called basal insulin). Some people with CFRD need to take a background insulin.

Basal insulin – A low level of insulin that is needed at all times. See “Background insulin.”

Basal rate – Basal insulin (or background insulin) that is delivered continuously using an insulin pump. Basal insulin is released slowly over a 24-hour period to help control blood sugars between meals and overnight.

Baseline – In diabetes, the fasting glucose level.

Beta cells – Special cells in the pancreas that make the hormone insulin.

Blood glucose – The main sugar in the bloodstream. Also known as blood sugar. A major source of body cell fuel.

Blood sugar – See “Blood glucose.”

BMI – See “Body mass index.”

Body mass index (BMI) – A measurement of body fat, using weight-to-height ratio.

Bolus – All at once.

Bolus dose – A larger dose of insulin given with meals and snacks.

Bolus insulin – A term used specifically for people who wear an insulin pump. Rapid-acting insulin is typically used and is delivered via the insulin pump in a burst for meals and snacks to help control blood sugar.

Glossary

Carbohydrate counting – Counting how many carbohydrates you plan to eat and adjusting your rapid-acting insulin to cover them.

Carbohydrates – The main nutrients that affect blood sugar. There are two types: simple (sugars) and complex (starches). They are used for the body’s instant fuel needs.

Cartridge – In this case, a container of insulin for use with an insulin injection pen.

Casual blood glucose – A blood glucose level drawn without caring what time of day it is or when a meal was last eaten.

CDE – See “Certified diabetes educator.”

Certified diabetes educator (CDE) – A doctor, nurse or dietitian with special training to manage diabetes.

CF – See “Cystic fibrosis.”

CFRD – See “Cystic fibrosis-related diabetes.”

Cholesterol – A lipid (fat) found in the cell membranes of all tissues and transported in the blood.

Chronic – All of the time, or long lasting.

Constipation – When it is hard to have a bowel movement because the feces are dry and hard.

Continuous glucose monitor – A tiny sensor that tracks blood glucose levels day and night. The sensor collects readings every five minutes from the interstitial fluid in the abdomen.

Continuous subcutaneous insulin infusion (CSII) – A method of giving a constant infusion of insulin through an insulin pump rather than insulin taken through shots.

Convulsions – See “seizure.”

Correction dose – Extra rapid-acting insulin given before meals when the pre-meal blood sugar is higher than the target range.

Corticosteroids – Steroid-containing drugs (e.g., prednisone) used to treat lung disease.

CSII – See “Continuous subcutaneous insulin infusion.”

Cystic fibrosis (CF) – A disease that affects the exocrine (mucus) glands of the lungs, liver, pancreas and intestines, often causing frequent airway infections and poor growth.

Cystic fibrosis-related diabetes (CFRD) – A form of diabetes that occurs in people with CF where the body doesn’t make enough insulin or use insulin properly. Diabetes is a problem in which a person’s blood glucose (a type of sugar) level is too high.

Detemir – A long-acting insulin. The generic name for Levemir®.

Glossary

Diabetes – A state in which the body doesn't make enough insulin and/or doesn't respond to insulin the right way.

Diabetes care team – A team of people with special training to manage diabetes. The team might include a doctor (often an endocrinologist), certified diabetes educator (often a nurse or dietitian), social worker and psychologist.

Diagnosed – To decide what the problem or cause of the problem is.

Diarrhea – Passing large amounts of loose stool often.

Digestive enzyme – A substance made in the pancreas that flows into the intestine or that is taken in a capsule with meals and snacks to help digest food.

Endocrine – The hormone-making function of the pancreas and other glands. Insulin is a hormone.

Endocrine pancreas – The part of the pancreas that makes insulin, which helps your body cells use the energy (calories) from food.

Endocrinologist – A doctor with special training in the treatment of diabetes and other diseases of the glands that make hormones.

Enzyme – A substance made in the exocrine pancreas that flows into the intestine to help digest food.

Enzyme supplements – Enzymes, swallowed in pill form, to help the body digest food when the body doesn't make enough enzymes or the enzymes can't get from the pancreas to the intestine.

Exocrine pancreas – The part of the pancreas that makes digestive enzymes, which flow into the intestine to help digest food.

Expired – Old or out-of-date medicine.

Fast/fasting – Nothing to eat or drink for at least eight hours.

Fasting blood glucose – A blood sugar level measured after not eating any food for at least eight hours. "Normal" is less than 100 mg/dL (5.6 mmol/L).

Fluid – Fluids in the diet are also known as liquids, such as water, milk, tea, etc.

Gastrostomy – An opening made through the abdomen into the stomach for a feeding tube or button.

Generic – Any drug that has the same ingredients as a brand name drug but is sold without a brand.

Gestational diabetes – Diabetes only when pregnant.

Glargine – A long-acting insulin. The generic name for Lantus®.

Glucagon – A hormone that "squeezes" extra sugar out of the liver and raises the blood sugar level. It is given as a shot and can be used to treat low blood sugar in someone not conscious.

Glossary

Glucose – A simple sugar, and the main sugar in the bloodstream. A major source of body cell fuel.

Glucose intolerance – When the body has a hard time turning sugar into fuel for cells.

Glucose meter – A small machine that measures blood sugar level.

Glulisine – A rapid-acting insulin. The generic name for Apidra®.

Hemoglobin A1c – A test that shows how much sugar is “stuck” to your red blood cells. It shows long-term blood sugar control. The hemoglobin A1c goal is less than 7 percent.

High-calorie supplements – A great source of extra calories when you don’t feel like eating or aren’t hungry, or when you struggle to gain or maintain proper weight.

Hormones – Chemicals released by cells that either carry messages to other cells or affect cells in other parts of the body.

Humalog® (generic: lispro) – A rapid-acting insulin.

Hyperglycemia – High blood sugar levels.

Hypoglycemia – Low blood sugar levels.

IGT – See “Impaired glucose tolerance.”

Impaired fasting glucose (IFG) – When the body’s fasting blood glucose is 100 mg/dL to 125 mg/dL, or 5.6 mmol/L to 6.9 mmol/L.

Impaired glucose tolerance (IGT) – A fasting blood sugar of 100 to 125 mg/dL or 5.6 to 6.9 mmol/L, and/or a blood sugar of 140 to 199 mg/dL or 7.8 to 11.0 mmol/L two hours after an oral glucose load during an oral glucose tolerance test (OGTT).

Indeterminate glycemia (INDET) – When your fasting and two-hour OGTT results are normal, but you have a high blood glucose in the middle of the OGTT.

Infection – The invasion and/or increase of disease-causing organisms, such as germs, in the body.

Inflammation – The swelling of the body tissues because of irritation or injury. Inflammation occurs with an infection.

Infusion set – A thin, short plastic tube that carries insulin from an insulin pump into the body for a baseline constant dose of insulin all day.

Insulin – A hormone secreted by the pancreas that helps sugar leave the blood and enter the cells where it is used for fuel.

Insulin deficiency – When the pancreas doesn’t make enough insulin.

Glossary

Insulin-dependent diabetes – Also called type 1 diabetes. It most often occurs in childhood. In insulin-dependent diabetes, the pancreas doesn't make insulin, so insulin must be taken daily for the individual to stay alive.

Insulin injection devices – A device with a very small insulin needle and an insulin cartridge stored inside.

Insulin injection pen – See “Insulin injection devices.”

Insulin pumps – Also called continuous subcutaneous insulin infusion (CSII). Insulin pumps are used to give a constant amount of insulin rather than insulin through shots.

Insulin reaction – Low blood sugar, less than 70 mg/dL or 3.9 mmol/L.

Insulin resistance – When body cells can't use insulin the right way, so more insulin is needed to lower blood sugars.

Insulin-to-carbohydrate ratio – A way to “match” or adjust your rapid-acting insulin to the carbohydrates you plan to eat.

Intermediate-acting insulin (NPH) – Insulin, usually given twice a day, that has its peak effect in six to eight hours and lasts about 13 hours. This can vary from person to person.

Interstitial fluid – The thin layer of fluid that bathes and surrounds the cells of the tissues in the body and delivers nutrients to cells.

Intestine – The part of the body where food is digested and nutrients absorbed.

Intravenous (IV) – In a vein.

IV – See “Intravenous.”

Ketoacidosis – A life-threatening change in blood acidity that can occur in people with type 1 diabetes.

Ketones – A chemical the body makes when there's not enough insulin and fat is used for fuel instead of sugar.

Kg – Kilogram. A measurement of weight. 1 kg = 2.2 pounds.

Lancet – A small device with a tiny spring-loaded needle made for getting a drop of blood from the tip of your finger for blood sugar testing.

Lantus[®] (generic: glargine) – A long-acting insulin.

Lbs. – Pounds.

Levemir[®] (generic: detemir) – A long-acting insulin.

Glossary

Lipid profile – A check of blood lipid (fat) levels, including cholesterol and triglyceride.

Lipids – Fats.

Lispro – A rapid-acting insulin. The generic name for Humalog®.

Malabsorbing – Not absorbing the nutrients from food for use by body cells.

Mannitol – A sugar alcohol, used as a sugar substitute.

Monofilament – An instrument used in the doctor's office on the bottom of your feet to check for nerve damage.

Nasogastric – A tube that runs from the nose to the stomach.

Neotame – A sugar substitute.

Neuropathy – Damage to the nervous system from uncontrolled blood sugar over time.

Nighttime gastrostomy tube feedings – See “Nighttime tube feedings.”

Nighttime tube feedings – Getting high-calorie supplements using a pump through a gastrostomy or nasogastric tube during the night or while asleep. Also known as milk drips.

Non-diagnostic – Does not indicate a disease.

Non-insulin-dependent diabetes (type 2 diabetes) – A type of diabetes caused by the lack of a normal response to insulin and/or not making enough insulin. It most often occurs in overweight people over the age of 40.

NovoLog® (generic: aspart) – A rapid-acting insulin.

NPH – See “Intermediate-acting insulin.”

Nutrition – Having to do with the body's need for and use of nutrients found in food.

OGTT – Oral glucose tolerance test.

Omega-3 fatty acids – A certain type of fat (found in some oils and seafood) with many good health effects.

Ophthalmologist – A doctor with special training in the care of people's eyes.

Ophthalmology – The branch of medicine having to do with the eyes.

Oral glucose tolerance test (OGTT) – A test used to diagnose not just diabetes and CFRD but also the varied types of abnormal glucose tolerance in CF.

Glossary

Pancreas – An organ in the body that secretes digestive enzymes and makes hormones, including insulin.

Pattern management – Deciding how much insulin to take based on low and high blood sugar patterns at certain times of the day.

Pica – Wanting to eat non-food items. May be a symptom of anemia.

Polydipsia – Needing to drink liquids often. A classic diabetes symptom.

Polyuria – Having to urinate (pee) often. A classic diabetes symptom.

Postprandial glucose level – Blood sugar level two hours after the largest meal.

Protein – One of the six nutrients found in the six main food groups. Protein is used by the body to build, repair and maintain muscle and other body tissues. It helps to regulate the immune system and other body processes.

Pulmonologist – A doctor with special training to care for people with lung disease.

Reaction – In diabetes, low blood sugar of 70 mg/dL or 3.9 mmol/L or less.

Regular – In diabetes, a short-acting insulin.

Retinopathy – A type of eye disease caused by high blood sugar levels over a long period of time that can lead to blindness. All adults with diabetes should be screened for this once per year.

Saccharin – A sugar substitute. Also known as of Sweet'n Low.

Secrete – To produce and give off (as the cells of the pancreas secrete insulin).

Seizure – Sudden and sometimes violent uncontrolled muscle movement.

Sorbitol – A sugar alcohol, used as a sugar substitute.

Starches – A type of carbohydrate that is also referred to as a “complex carbohydrate.” Starches are found in common foods such as wheat, rice, other grains, potatoes, corn, peas and winter squash.

Steroids – A compound made in the body that regulates many body functions. (See also “Corticosteroid.”)

Stevia – A sugar substitute.

Sucralose – A sugar substitute. Also known as Splenda®.

Sugar – A type of carbohydrate also referred to as “simple sugar.” Also known as glucose or dextrose, fructose (found in fruit), galactose and lactose (found in milk), maltose (malt sugar) and sucrose (table sugar).

Glossary

Triglyceride – A type of fat in the blood that is usually measured with cholesterol levels.

Tube feedings – Getting nutrition supplements using a pump and a gastrostomy or nasogastric tube.

Type 1 diabetes – See “Insulin-dependent diabetes.”

Type 2 diabetes – See “Non-insulin-dependent” diabetes.

Underlying – Something in the background or at the same time.

Urinate – To pee.

Urine microalbumin – The amount of protein (albumin) in urine, which shows kidney health.

Whole grain – The unprocessed grain containing the bran and germ.

Xylitol – A sugar alcohol, used as a sugar substitute.

IMPORTANT RESOURCES

The following is a brief overview of organizations that can provide additional information about cystic fibrosis (CF) and/or cystic fibrosis-related diabetes (CFRD).

Cystic Fibrosis Foundation

The Cystic Fibrosis Foundation is the world's leader in the search for a cure for cystic fibrosis. The Foundation funds more CF research than any other organization, and nearly every CF drug available today was made possible because of Foundation support. The Foundation also supports and accredits a national care center network that has been recognized by the National Institutes of Health as a model of care for a chronic disease. The Cystic Fibrosis Foundation is a donor-supported nonprofit organization. For more information, visit www.cff.org or call 1-800-FIGHT-CF.



Join the Foundation's Facebook community:
[Facebook.com/CysticFibrosisFoundation](https://www.facebook.com/CysticFibrosisFoundation)



Follow the Foundation on Twitter:
[Twitter.com/CF_Foundation](https://twitter.com/CF_Foundation)



Watch the Foundation on YouTube:
[YouTube.com/CysticFibrosisUSA](https://www.youtube.com/CysticFibrosisUSA)

American Diabetes Association (ADA)

This is a national organization of health team members committed to teaching the public about all forms of diabetes. The ADA is a good resource for health and legal information about diabetes. The ADA can be reached at 1701 North Beauregard Street, Alexandria, VA 22311; phone: 1-800-DIABETES (1-800-342-2383); email: AskADA@diabetes.org; website: www.diabetes.org.

American Association of Diabetes Educators (AADE)

This is a national organization of diabetes educators who focus on helping people with diabetes achieve behavior change goals, which in turn lead to better clinical outcomes and improved health status. It's a multidisciplinary profession whose members are already licensed in a related health care field. Most commonly, you will find that they are also nurses/nurse practitioners, dietitians or pharmacists. For more information, visit www.diabeteseducator.org.

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