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## Carbohydrates

### Carbohydrate Counting

Miami resident Jocelyn Reyes, 16, can look at a plate of food and know in a snap how much insulin she needs to cover it. She simply figures how much carbohydrate (starch and sugar) the meal contains. Reyes has been carbohydrate counting for over 2 years. She loves the flexibility it gives her, and her blood glucose control is better than ever. She used to have low blood glucose reactions at night quite often. She has not had a nighttime reaction in 6 months, and her "highs" are not as high.

Delores Long, 41, of Bloomington, Minn., was diagnosed with diabetes a few months ago. She is determined to take care of herself, because she knows the dangers of uncontrolled diabetes. Her mother, who had type II for 30 years, died recently. "She had all the complications except kidney disease," says Long.

Soon after she was diagnosed, Long learned carbohydrate counting from her dietitian. Now she eats about the same amount of carbohydrate at about the same times throughout the day. That consistency in her diet, plus one diabetic medication taken once a day and regular exercise, are keeping her blood glucose levels in the normal range.

There are a lot of ways for people with diabetes to balance food with medication and exercise. Carbohydrate counting is one way, and it is gaining fans from coast to coast.

### Where Does Blood Glucose Come From?

You eat a meal of steak (protein and fat) and baked potato (carbohydrates) with sour cream (fat). Much of this meal eventually ends up in your blood as glucose. But how much, when, and how fast?

Very little of the fat you eat is converted into glucose. Some of the protein you eat is slowly converted into glucose.

In contrast, within 1 to 1 1/2 hours, over 90 percent of the carbohydrates you eat are converted into glucose. You also eat (or should be eating) more carbohydrates than fat or protein.

This means that when you test your blood 1 to 2 hours after a meal, most of the rise in blood glucose that you see is from the carbohydrate you ate.

What balances that glucose? Insulin. So one way to keep good control of your blood glucose levels is to match insulin to carbohydrates. When you take an active role in doing this, it is called Carbohydrate Counting.

## Beginner's Carbohydrate Counting

You may already be familiar with meal planning by using Exchange Lists. Carbohydrate counting is an extension of that.

In "Exchange Lists For Meal Planning", published by the American Diabetes Association and The American Dietetic Association, foods that have about the same amount of a given nutrient, such as protein, fat, or carbohydrate, are grouped together. There are starch/bread, meat, vegetable, fruit, milk, and fat exchanges.

First you and your dietitian work out a meal plan showing the number of food choices (exchanges) you can eat at each meal and snack. Then you can exchange, or trade, any food for another food from the same exchange list.

Here are a few examples of exchanges from the various lists (each food listed is one exchange):

- Starch/Bread: one-half of a 2-ounce bagel; one 6-inch tortilla; 1/2 cup of cooked pasta
- Low-Fat Meat: 1 ounce of turkey; 1/4 cup cottage cheese
- Vegetable: 1/2 cup cooked vegetables; 1 cup raw vegetables
- Fruit: 1 large kiwi; 2 small tangerines
- Milk: 1 cup of skim milk; 8 ounces plain nonfat yogurt
- Fat: 1 slice bacon, 5 large olives.

The following are the foods you need to "count" when you're counting carbohydrates.

- Starch/bread exchanges and fruit exchanges contain 15 grams of carbohydrate.
  - Milk exchanges contain 12 grams of carbohydrate.
1. Each starch/bread, fruit, and milk exchange counts as one Carbohydrate Counting Equivalent.
  2. We will call this 1 Carb. (Although a milk exchange is 12 grams of carbohydrate, and starch/bread and fruit exchanges are 15, for Beginner's Carb Counting, we're going to round them off to 1 Carb each.)
  3. For the most part, meat and fat exchanges do not "count" because they are not converted to glucose as rapidly or completely as carbohydrates are. Another reason is that in real life you do not eat meals that are pure protein or pure fat. You eat mixed meals: starch (carbohydrate), meat, and fat. Usually, the amount of insulin you use to cover the carbohydrate will also cover the glucose that comes from the protein and fat. (But this changes when you eat a big meal that is nearly all protein. See "Meat-heavy Meals")
  4. Vegetable exchanges contain only 5 grams of carbohydrate. Unless you eat a lot at one sitting, that is, 1 1/2 cups of cooked broccoli, you do not count them as Carbs.

## Counting For Consistency

Let's talk real food now. We will start with the easier scenario: people who simply want to eat the same amount of carbohydrate at given times.

If you already have an Exchange List meal plan, you can easily use Carbohydrate counting with it. Let's say your Exchange List dinner has the following exchanges: 2 Starch/Bread, 1 Milk, 1 Fruit, 3 Meat, and 2 Fat. You have a total of 4 Carbs to use in your meal plan.

### You may select:

- 4 Starch/Bread exchanges, for example, the 2 in the original plan, plus 2 Starch/Bread exchanges in place of the milk and fruit exchanges, or

- 1 Starch/Bread, 2 Fruit, and 1 Milk

The meat and fat exchanges are optional and flexible depending on how hungry you are. Let's say your meal plan calls for 2 Starch/Bread exchanges (2 Carbs) for breakfast. You eat a 2-ounce bagel on Monday morning and an English muffin on Tuesday. That's the same amount of carbohydrate both mornings.

You could add an egg and a slice of Canadian bacon on Tuesday and still come out about the same as far as blood glucose is concerned. Or you could eat a third of a cantaloupe instead of the English muffin.

The appeal of Carbohydrate counting is that it allows you to interchange starch/bread, fruit, and milk exchanges without changing the overall carbohydrate content of your diet. Protein and fat have such small and slow effects on blood glucose that you can eat them in variable amounts.

Note that says "variable" amounts, not "unlimited." The egg-bacon-English muffin breakfast is 130 calories higher in calories than the bagel breakfast. The egg and Canadian bacon also add saturated fat and cholesterol.

This points out a drawback to Carbohydrate counting. It counts only carbohydrates--not calories or nutrition.

If you are trying to lose weight or maintain a weight loss, you will want to limit the total number of calories you consume. You will also want to watch your fat intake.

And it is a good idea for all of us, not just people who are trying to lose weight, to limit saturated fat. Saturated fat is the stuff that clogs your arteries, putting you at higher risk of a heart attack. Less than 10 percent of your total calories should come from saturated fat.

Keep in mind that, while vegetable exchanges do not "count" as Carbs, they count a lot for good nutrition. They contain vitamins, minerals, and fiber. Enjoy a variety of vegetables in your meal plan.

Your good health depends on more than good blood glucose control. A balanced diet is important, too. If you are following an Exchange List meal plan you worked out with a dietitian, you are eating a balanced diet. Do not throw it out in favor of rote Carb counting. And watch the calories! Some people gain weight when they start Carbohydrate counting, because they add fat and protein to their meals.

### **Beyond Exchanges**

You can expand your choice of foods beyond what is listed in the exchange lists by looking at the carbohydrate content on food labels. Since May 1994, as a result of the new Nutritional Labeling and Education Act, most packaged foods have food labels that provide carbohydrate information. So now you can find out how much carbohydrate is in a serving size of any packaged food. Every 15 grams of carbohydrate equals 1 Carb.

Just remember that your personal portion size may not always equal what is called a serving size on the label. Be sure to calculate your carbohydrates according to what you are going to eat.

Even foods that are moderately high in simple sugars (cookies, cake, and frozen desserts) have a place in the meal plan.

### **What Is Advanced Carbohydrate Counting?**

You can take a more aggressive approach to Carbohydrate counting. You can measure exactly how

much carbohydrate you are going to eat and then take the amount of insulin that will cover it. You can do this if you use Regular (short-acting) or Humalog (even shorter acting) insulin before meals.

This works best for children who:

- have Type I diabetes.
- are within a reasonable body weight range.
- already eat a balanced diet.
- like to work with numbers and do math.
- are willing to monitor their blood glucose levels before and after meals and keep records of the results.

### **Step 1: Food**

Learn how many grams of carbohydrate are in the foods you eat. Exchange lists are a good place to start. They list the rough carbohydrate content of specific measurements of foods.

Because you will be adjusting your insulin according to what you eat, you will need to measure carbohydrate precisely. So unlike Beginner's Carb counting, milk, fruit, and starch/bread exchanges are not equal. A milk exchange counts as 12 grams of carbohydrate; starch/bread and fruit exchanges are 15 grams of carbohydrate. A vegetable exchange has 5 grams of carbohydrate.

Once you have lists of the carbohydrate content of various foods and you have practiced eyeballing portion sizes of a wide variety of foods, you are ready to start calculating your own insulin-to-carbohydrate ratio.

### **Step 2: Insulin**

Insulin is responsible for regulating blood glucose levels. Blood glucose is affected in large part by the carbohydrate you eat. Therefore, matching insulin to carbohydrate will help you regulate your blood glucose levels.

To use this Carbohydrate counting method, you identify the number of units of insulin you need to cover a certain amount of carbohydrate. For some people, 1 unit of insulin will cover only 5 grams of carbohydrate. For others, 1 unit of insulin covers 20 grams of carbohydrate.

Why the difference? Because one person may be more or less sensitive to insulin than the next person. The more sensitive your body is to insulin, the less insulin you need.

Most people who have Type II diabetes are insulin-resistant. In general, people who have more body fat and are less active, are less sensitive to insulin, and require more insulin per gram of carbohydrate.

Most people with Type I diabetes require 1 unit of Regular insulin for every 10 to 15 grams of carbohydrate they eat. A 1:15 ratio may work for someone who weighs 100 to 125 pounds, whereas a 1:10 ratio may be necessary for someone who weighs 175 to 200 pounds.

To figure out your individual needs, first tell your health care team that you want to start using Carbohydrate counting. Your doctor or dietitian will help you determine your starting dose.

Monitor your blood glucose levels before and after meals and keep careful records. Time your insulin injection according to your pre-meal blood glucose levels

Fine-tune your insulin-to-carbohydrate ratio according to the results. You have hit on the right ratio when your blood glucose level 2 hours after the meal is not more than 50 mg/dl higher than your pre-meal blood glucose.

### **What Is Meant By Fine-Tuning?**

You plan a meal that contains a total of 60 grams of carbohydrate. You decide to try 1 unit of insulin for every 15 grams of carbohydrate ( $60 / 15 = 4$ ). You take 4 units of pre-meal insulin.

If your pre-meal blood glucose level was 100 mg/dl and your 2-hour post-meal blood glucose is not more than 150 mg/dl, you calculated the ratio correctly.

However, if your blood glucose level is 200 mg/dl 2 hours after the meal, try increasing your insulin next time to a 1:12 ratio (5 units of insulin for 60 grams of carbohydrate) or a 1:10 ratio (6 units for 60 grams) to see what you require.

Your blood glucose level should go up after a meal. If it does not go up, that is, if your post-meal blood glucose is very close to your pre-meal level, you should use less insulin the next time. Otherwise, you risk low blood glucose (hypoglycemia).

You can determine your correct insulin-to-carbohydrate ratio only if your blood glucose levels are well-controlled. If you try to do it when your blood glucose levels are abnormally high, you will reach false conclusions.

It will take time to figure out the ratio that works best for you. You will want to work closely with your health care team during this process. Jocelyn Reyes tried four insulin-to-carbohydrate ratios over the course of 6 months before finding the ratio that worked best for her.

Once you determine your normal insulin-to-carbohydrate ratio, you may still need to adjust the ratio. If your blood glucose level before you eat is low, you will take less insulin than you normally would (probably about 1 or 2 units less). If it is high, you will take a little more--perhaps 1 to 4 units.

### **Does Carbohydrate Counting Get Easier?**

Sound kind of complicated? It is. Get guidance from your doctor and dietitian throughout the learning process. Your meal plan is a major player in your diabetes management program. It deserves thought, planning, and professional guidance. This article cannot teach you everything you need to know, but you can use it as an introduction.

Carbohydrate counting gets easier as you go along. You will not always be measuring, weighing, and scribbling on paper. It will soon become second nature, and you will enjoy the flexibility and the feeling of control it gives you.

### **Do All Carbohydrate Have The Same Effect On The Blood Sugar?**

Eating 50 grams of carbohydrate from potatoes will probably have a different effect on your blood glucose levels than 50 grams of carbohydrate from another source.

This may be due to several factors, which include particle size (cornmeal versus whole kernel corn), cooked versus raw consistency (applesauce versus a raw apple), fiber content, liquid versus solid

meals, and the effect of different food combinations eaten at the same meal.

By keeping food and blood glucose records, you will become an expert at calculating your insulin dose for many different foods and food combinations.

### **How Does Fat Affect The Ratio?**

Very little of the fat you eat is converted into glucose, but fats do affect your blood glucose levels. Fats delay the digestion of food and can slow down the absorption of glucose from other foods.

### **How Does Meat Affect The Ratio?**

A small amount of meat does not have much effect on blood glucose, so it does not "count" in Carbohydrate counting. A 12-ounce sirloin steak is another story--it will affect your blood glucose levels. But the glucose you get from protein does not appear in your bloodstream for about 3 to 4 hours. To cover this glucose at the right time, you may need to adjust your pre-meal insulin dose--either increase it or delay it, or perhaps split it into two separate doses: a pre-meal and post-meal dose.

You will need to work out the particulars for yourself. Many people find they need to take 1 unit of insulin for every 3 ounces of meat they eat, especially red meat. Red meat seems to cause higher blood glucose levels than similar amounts of chicken or fish. To fine tune this dose, test your blood glucose 3 hours after a high-protein meal.

### **Is There A difference Between Morning And Evening Ratios?**

Your body normally releases hormones in the early hours of the morning. These hormones make your body more resistant to insulin.

As a result, you may require more insulin per gram of carbohydrate at breakfast than at lunch or dinner.

For example, if you usually require 1 unit for every 15 grams of carbohydrate (a 1:15 ratio) at lunch and dinner, you may need to use 1 unit for every 10 or 12 grams of carbohydrate (1:10 or 1:12 insulin-to-carbohydrate ratio) in the morning. Experience will help you determine the correct ratio.

### **What Will Effect My Insulin-To-Carbohydrate Ratio?**

Many factors determine your insulin-to-carbohydrate ratio:

- your responses to foods,
- your daily activities,
- your emotions,
- your overall sensitivity to insulin, and
- your state of health on a given day.

Eat all your favorite foods and keep track of your blood glucose responses. You may learn that for most foods, the insulin-to-carbohydrate ratio you have figured out works well. A few foods may give you unexpected results.

### **Does The Insulin-To-Carbohydrate Ratio Ever Change?**

- You will require more insulin for a given amount of carbohydrate if you gain weight, and less insulin if you lose weight.
- Hormonal changes, which occur during pregnancy, menopause, and puberty, will affect insulin-to-carbohydrate ratios.

### Test Yourself By Creating A Dinner

Here is how Carbohydrate counting can work for you. At the beginning of the week, you planned this chicken and rice meal, plus dessert, for your Wednesday dinner.

#### Exchanges Meal

- 3 Starch/Bread 1 cup rice
- 3 Meat 3 oz. skinless chicken
- 1 Vegetable 1/2 cup cooked carrots
- 1 Fat tossed green salad with 1 tablespoon salad dressing (Lettuce is a "free" food: less than 20 calories per serving.)
- 1 Fruit 1 1/4 cup fresh strawberries
- 1/2 Milk 1/2 cup skim milk

But on Wednesday, you decide you want something fast and easy like spaghetti with sauce from a jar. The chicken dinner has 4 1/2 "Carbs " (3 Starch/Bread, 1 Fruit, and 1/2 Milk). Create a dinner with the same number of "Carbs" by filling in the amounts of each food below.

#### Food Carbs

\_\_\_ cups pasta 3  
 \_\_\_ cup Pretty Good Pasta Sauce 1  
 \_\_\_ small tangerine 1/2

**Answer:** 1 1/2 cups pasta, 1/2 cup Pretty-Good Pasta Sauce, 1 small plum or tangerine.

### How Much Insulin Should I Give?

When you are doing advanced Carbohydrate Counting, you adjust your insulin dose according to how much carbohydrate you eat.

#### Planned meal Grams of carbohydrate

Grilled chicken sandwich:

bun (2 oz.) 30  
 chicken breast (3 oz.) 0  
 Baked potato (6 oz.) 30  
 1 tablespoon margarine 0  
 Salad:

1 medium, fresh tomato 5  
 1 tablespoon salad dressing 0  
 1 cup fresh fruit salad 30

1/3 cup frozen yogurt 15

Total 110 grams

**To Calculate Your Pre-Meal Insulin Dose:**

If your insulin-to-carbohydrate ratio is 1 :15,  $110/15 = 7.3$  units of Regular insulin. (Round off to 7.0 unless you use an insulin pump and can measure fractional units.)

If your insulin-to-carbohydrate ratio is 1:10,  $110 / 10 = 11$  units of Regular insulin.

**Test Yourself:**

Meal Grams of carbohydrate

1 1/2 cups pasta 45

1/2 cup Pretty Good Pasta Sauce 15

1 small tangerine 7

Total 67 grams

How much insulin should you take to cover this meal if your insulin-to-carbohydrate ratio is 1:10, 1:12, and 1:15?

Answer:

1:10=6.7 units of Regular insulin. Round up to 7 units if you use a syringe rather than a pump.

1:12=5.6 units of Regular insulin. (Round up to 6 units)

1:15=4.5 units of Regular insulin. (Round up to 5 units)

**Carbohydrate counts of foods can be found in the following books:**

Exchange Lists For Meal Planning, American Diabetes Association, The American Dietetic Association.

Convenience Food Facts, by Arlene Monk, DCI Publishing

Exchanges For All Occasions, by Marion Franz, DCI Publishing

Fast Food Facts, by Marion Franz, DCI Publishing.

Calories and Carbohydrates, by Barbara Kraus, New American Library.

Bowes and Church's Food Values of Portions Commonly Used, by Jean Pennington, J.B. Lippincott.

The Corinne T. Netzer Carbohydrate Gram Counter, by Corinne T. Netzer, Dell.

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