

Carbohydrate Counting: A Practical Meal-Planning Option for People With Diabetes

Karmeen D. Kulkarni, MS, RD, BC-ADM, CDE

Lena has been overweight for a few years. She is 52 years old, and she found out that she has type 2 diabetes 1 year ago. She has been seeing a nurse at her physician's office for nutrition information, and the nurse has referred her to a registered dietitian (RD) in the outpatient clinic at the nearby hospital.

Lena brings her food records to her initial visit with the RD. The RD reviews the records, which consist only of Lena's food choices with no portion sizes or amounts consumed listed. The RD recommends that Lena consider weighing and measuring her portion sizes and writing them down along with her food choices. The RD provides Lena with a copy of the American Diabetes Association (ADA) basic carbohydrate counting pamphlet¹ and uses food models to demonstrate appropriate portions of the foods Lena might select.

During the ensuing 3-month period, Lena works with a carbohydrate budget for each meal, uses the basic carbohydrate counting pamphlet, and pays attention to her portion sizes. She loses some weight, improves her glycemic control, and becomes more motivated to continue.

Gino, age 35 years, has had type 1 diabetes for 3 years and enjoys his ethnic Italian food. He consumes carbohydrate foods at all meals and also at bedtime. He has started using an insulin-to-carbohydrate ratio to match his insulin to the amount of carbohydrate he consumes, and he finds this helpful. But he is concerned because his postprandial glucose (PPG) levels are

not within the target range. He expresses his concern to his doctor and is referred to an RD for a consultation.

A nutrition assessment indicates that Gino has tried to reduce his carbohydrate intake and increase his protein intake in order to get his PPG levels into the target range. The RD revisits the basic carbohydrate counting approach with Gino and asks him to work with a carbohydrate budget at each meal and to keep records.

At his return visit, Gino is pleased with his glycemic control but again concerned that if he eats too much carbohydrate, his glycemic control will suffer. During that discussion, the RD reviews the ADA advanced carbohydrate counting pamphlet² with him and also reviews how to rework the insulin-to-carbohydrate ratio, how to use the basal-bolus insulin therapy concept, and how to use an insulin sensitivity factor to determine correction doses of insulin. All this information empowers Gino, and he is willing to implement these carbohydrate counting techniques, not only to be able to enjoy eating carbohydrate foods, but also to maintain optimal glycemic control.

Carbohydrate counting is a meal-planning approach and not a specific diet. It places emphasis on the total amount of carbohydrate consumed, rather than on the source or type of carbohydrate consumed. It assumes that, for purposes of controlling blood glucose, a carbohydrate is a carbohydrate. This approach promotes consistency of carbohydrate intake at specific times of the day and for specific meals.

All people with diabetes can use carbohydrate counting as a meal-planning option.^{3,4}

In assessing a person who is interested in learning about carbohydrate counting, it is helpful to discuss the person's diabetes treatment goals, readiness and motivation to learn the system, education level, ability to perform basic math, conception of portion control, and willingness to do blood glucose monitoring before and after meals while learning the system.³

Two levels of carbohydrate counting have been defined: basic and advanced.^{1,2}

Basic Carbohydrate Counting

Mastery of the basic understanding of carbohydrate counting includes understanding the relationship among food, physical activity, and blood glucose levels. Advanced carbohydrate counting includes understanding pattern management and how to use insulin-to-carbohydrate ratios.⁵

Basic carbohydrate counting helps patients get started with the carbohydrate counting system. Carbohydrate foods are identified as starches, fruit, milk, and desserts. Emphasis is placed on consistency in the timing, type, and amount of carbohydrate-containing foods consumed. Early on, discussion of portion sizes is also key to understanding the concept of what a serving of carbohydrate is. Carbohydrates are measured in grams and may be referred to in grams or servings. One carbohydrate serving is equal to 15 g of carbohydrate.

So what does a carbohydrate serving look like? Table 1 lists some samples.

Table 1. Sample 15-g Carbohydrate Servings

- Starches: 1 slice of bread, 1/3 cup of cooked pasta, 3/4 cup of dry cereal, or 4–6 crackers
- Fruit: 1 small piece of fruit or 1/2 cup of fruit juice
- Milk : 1 cup of nonfat (skim) milk, or 3/4 cup of yogurt
- Desserts: 2 small cookies or 1/2 cup of ice cream

Tools that can be helpful to patients as they become familiar with carbohydrate counting include measuring cups and spoons, food scales, food package labels, carbohydrate counting books, and the food exchange list books. Table 2 shows a typical carbohydrate counting meal plan for people who are learning the system and trying to establish carbohydrate budgets for meals and snacks.

Using Nutrition Facts panels from packaged food labels can help with carbohydrate counting (Figure 1). Educators can review sample labels with patients to teach the information listed in Table 3.

When people are learning to decipher Nutrition Facts panels, the question always arises about whether sugar alcohols are carbohydrate or not. Sugar alcohols are neither sugar nor alcohol. They provide an average of 2 kcal/g and are used to replace sugars or fat and to create foods lower in calories, sugar, and fat. They tend to have a laxative side effect. People who are counting carbohydrates should count as carbohydrate only

Table 2. A Typical Carbohydrate Counting Meal Plan

- Breakfast: 3 carbohydrate servings (45 g)
- Lunch: 3 carbohydrate servings (45 g)
- Dinner: 4 carbohydrate servings (60 g)
- Snack: 1 carbohydrate serving (15 g)
- Total carbohydrates for the day: 165 g

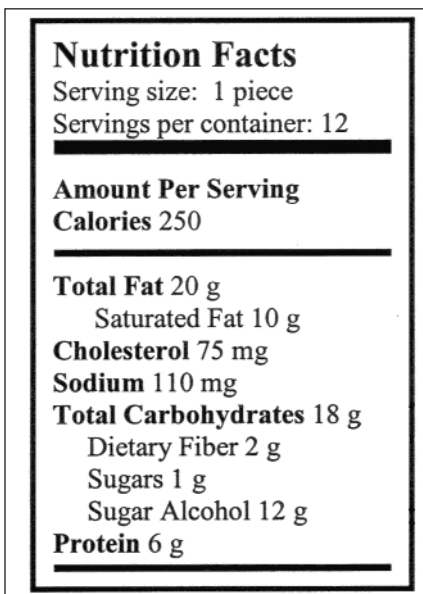


Figure 1. Sample Nutrition Facts panel.

half of the total grams of sugar alcohols listed on the Nutrition Facts panel.

Advanced Carbohydrate Counting

For people who have mastered basic carbohydrate counting and wish to move on to a more advanced carbohydrate counting level (e.g., if they are planning to use an insulin pump or a basal-bolus insulin regimen), the following skills are recommended:

- Understanding of target blood glucose levels
- Ability to apply all aspects of basic carbohydrate counting
- Understanding of the action of insulin and the basal-bolus insulin concept
- Ability to carry out pattern management
- Willingness and ability to keep adequate records.

Additional helpful skills include knowing how to calculate a bolus insulin dose using insulin-to-carbohydrate ratios, how to calculate an insulin sensitivity factor for use in the correction or supplementation of insulin doses when glucose levels are too high or too low before meals, and how to make adjustments for special situations.⁵

Table 3. Carbohydrate Counting Skills That Can Be Taught Using Nutrition Facts Panels of Packaged Foods

- How to locate the serving size of a food product
- How to determine the grams of total carbohydrate per serving
- Understanding that 1 carbohydrate serving equals 15 g of carbohydrate
- Understanding that grams of sugar and fiber are part of the total grams of carbohydrate
- How to count carbohydrate servings:

Grams	Servings
0–5	Do not count
6–10	1/2
11–20	1
21–25	1 1/2
26–35	2

Various approaches and methods exist for determining insulin-to-carbohydrate ratios. A general guideline, at least for patients with type 1 diabetes, is that most people need about half of their total daily dose of insulin for basal (background) insulin and half for bolus doses to cover meals. In type 2 diabetes, the basal and bolus needs can vary substantially from person to person. Bolus insulin doses can be calculated from the insulin-to-carbohydrate ratio based on the total grams of carbohydrate or the total number of 15-g carbohydrate servings to be consumed.⁵ Table 4 explains how to determine an insulin-to-carbohydrate ratio and some considerations to keep in mind regarding this ratio.

Challenges and Advantages

Carbohydrate counting is not an automatic solution to the problem of weight management or to maintaining a balance of healthy food choices.³ It is not a perfect system by any means, and it has its own set of challenges and concerns.

Most people do not enjoy weighing and measuring foods, and the extra work of maintaining food intake records initially and on an ongoing basis can be

Downloaded from http://ada.sagepub.com/journalsPermissions.nav at 17 April 2014

Table 4. Determining an Insulin-to-Carbohydrate Ratio

- Use food records to determine the total amount of carbohydrate eaten at meals and snacks for at least 3 days.
- Determine the average amount of carbohydrate eaten for each meal and snack. (It can be helpful to establish a carbohydrate budget for the person and to ask the person to eat consistent amounts of carbohydrate at specific meals from one day to the next. It is also helpful for the person to practice including a variety of foods and also using a variety of carbohydrate information resources, such as carbohydrate counting books and Nutrition Facts panels on food labels.)
- Study the glucose records with the patient, and use this to estimate an insulin-to-carbohydrate ratio as follows: divide the number of grams of carbohydrate in a meal by the units of mealtime or bolus insulin given. For example, if the person ate 75 g of carbohydrate, took 5 units of rapid-acting insulin, and had appropriate return of glucose to baseline values, the insulin-to-carbohydrate ratio could be estimated to be 1 unit of insulin/15 g (or 1 serving) of carbohydrate. This is often written as a 1:15 insulin-to-carbohydrate ratio.⁵
- There are some considerations to keep in mind regarding insulin-to-carbohydrate ratios:
 - ◆ A person may have more than one insulin-to-carbohydrate ratio (e.g., a ratio of 1:10 for breakfast, 1:12 for lunch, and 1:15 for dinner) based on physical activity, insulin needs, and other variables.
 - ◆ The ratio may change with body weight, variation in physical activity, hormonal changes, and other factors.
 - ◆ A ratio of 1:5 or more would not be unusual in the third trimester of pregnancy in a patient with type 1 diabetes or in a patient with type 2 diabetes.

burdensome. Testing blood glucose levels before and after meals can also be difficult, but it is necessary to precisely identify the appropriate dose of treatment (usually insulin) needed to return glucose to normal levels.

The increased flexibility in terms of types and timing of foods that carbohydrate counting affords can also make weight management a challenge. Patients may be tempted to take more liberties with their eating, given the greater flexibility this management approach provides in controlling blood glucose. This is an issue that should be raised with patients before they begin

using the carbohydrate counting approach.

Patients also need to be counseled that high-fat meals can cause a delay in gastric emptying and therefore in food absorption. Thus, patients eating high-fat foods may require an adjustment in their bolus insulin amount or in the timing of their mealtime insulin to avoid early postprandial hypoglycemia and later hyperglycemia. Similarly, dietary fiber is not usually digested. So patients need to be taught that if a food contains ≥ 5 g of fiber per serving, the total amount of fiber must be subtracted from the total amount of carbohydrate before calculat-

ing an insulin dose. Individual patients may also notice their own unique responses to certain carbohydrate foods and may need to adjust their bolus doses accordingly.⁵

Still, carbohydrate counting offers several strong advantages. It is single-nutrient focused, provides a more precise method of matching food and mealtime insulin, allows flexibility of food choices, creates potential for improved blood glucose control, and is empowering to patients. Understanding the need to adjust insulin for larger or smaller meals, knowing one's own pre- and postmeal blood glucose targets, using pattern management skills, and calculating bolus and basal insulin doses can all help people with diabetes be successful in using this meal planning system.⁵

REFERENCES

¹Daly A, Bolderman K, Franz M, Kulkarni K: *Basic Carbohydrate Counting*. Alexandria, Va., and Chicago, American Diabetes Association and American Dietetic Association, 2003

²Daly A, Bolderman K, Franz M, Kulkarni K: *Advanced Carbohydrate Counting*. Alexandria, Va., and Chicago, American Diabetes Association and American Dietetic Association, 2003

³Gillespie SJ, Kulkarni KD, Daly AE: Using carbohydrate counting in diabetes clinical practice. *J Am Diet Assoc* 98:897–905, 1998

⁴Daly A, Gillespie S, Kulkarni K: Carbohydrate counting: vignettes from the trenches. *Diabetes Spectrum* 9:114–117, 1996

⁵Kulkarni K: Carbohydrate counting for pump therapy: insulin to carbohydrate ratios. In *A Core Curriculum for Diabetes Education. Diabetes Management Therapies*. 5th ed. Chicago, American Association of Diabetes Educators, 2003.

Karmeen D. Kulkarni, MS, RD, BC-ADM, CDE, is coordinator of the Diabetes Center at St. Mark's Hospital in Salt Lake City, Utah.