

Advanced Carbohydrate Counting

Living Well with Your Health Conditions

What is Carbohydrate Counting?

Carbohydrate counting focuses on the amount of carbohydrate (carbs) in your diet. Carbohydrate is the nutrient with the greatest effect on your blood glucose level. Whether you use insulin or not, carbohydrate counting allows you to be more flexible with meal planning and improve blood glucose control. If you are using multiple daily injections of insulin or an insulin pump, carbohydrate counting allows you to match your insulin dose with the amount of carbohydrate in your meals and snacks. By “thinking like a pancreas” you can correct for high and low pre-meal blood glucose by adjusting your insulin dose.

To be successful using carbohydrate counting, you need to:

- be motivated and able to take the time required to improve your diabetes management
- do simple arithmetic (add, subtract, multiply and divide)
- understand insulin action
- read food labels
- count carbohydrates
- understand the relationship between carbohydrate and insulin
- adjust insulin based on your food intake, exercise and blood glucose level

Blood Glucose Targets for Most People with Diabetes

- Pre-meal blood glucose: 4.0 – 7.0 mmol/L.
- 2 hour post-meal blood glucose: 5.0 – 10.0 mmol/L.
- A rise of 2.0 to 3.0 mmol/L is normal after eating.

Carbohydrate Goals for Most People

Each meal:

- 3 – 4 carbohydrate servings or 45 – 60 grams of carbohydrates (active men and women may need more).

Each snack:

- 1 – 2 carbohydrate servings or 15 – 30 grams of carbohydrates. Not everyone needs to snack. If you do snack, you may need to inject extra insulin (talk to your doctor or diabetes educator about this).

Note: One carbohydrate serving equals 15 grams of carbohydrate. See Carbohydrate Basics (in On the Road to Diabetes Health booklet).

Carbohydrate Counting and Insulin Correction

One way to achieve recommended blood glucose targets is by adjusting your insulin to work with the amount of carbohydrate you eat, your activity/exercise and your blood glucose level.

Basal Insulin

Basal insulin is your background insulin supply. You need to have insulin available even when you are not eating. Basal insulins include intermediate and long-acting insulin such as NPH®, Levemir® and Lantus®.

Type	Onset:	Peak	Duration
N / NPH®	1 to 3 hours	5 to 8 hours	up to 18 hours
Levemir®	90 minutes	None	16 - 24 hours
Lantus®	90 minutes	None	24 hours

Bolus Insulin

Bolus insulin can be used when you are eating a meal or snack with carbohydrates (meal bolus) or to correct a high blood glucose (correction bolus). Bolus insulins include rapid acting insulin such as Humalog®, Novorapid® and Apidra®.

Type	Onset	Peak	Duration
Humalog®	10 – 15 minutes	60 – 90 minutes	3.5 – 4.75 hours
Novorapid®	10 – 15 minutes	60 – 90 minutes	3 – 5 hours
Apidra®	10 – 15 minutes	60 – 90 minutes	3 – 5 hours

1. Meal Bolus

Your meal bolus of insulin will depend on the amount of carbohydrate you eat and your insulin to carbohydrate ratio (ICR). Your ICR is the amount of carbohydrate one unit of insulin will cover at a meal/snack.

2. Correction Bolus:

Your correction bolus of insulin will depend on your blood glucose reading and your insulin sensitivity factor (also called correction factor). Your insulin sensitivity factor (ISF) is the amount that one unit of rapid insulin will lower your blood glucose. ISF varies from person to person.

Note: leave at least 4 hours between injections of bolus insulin (meal or correction doses). If you use an insulin pump discuss your needs with your doctor/diabetes educator.

Matching Carbohydrate, Activity Levels and Bolus Insulin Doses

Step			Example									
1	Identify carb containing foods		Grains and starches, fruit, starchy vegetables, milk & alternatives and sweet foods.									
2	Count Carbs	Total the carbs in your meal using carb servings, food package labels (Nutrition Facts table), resource books, restaurant fact sheets, food lists and internet site. Don't forget to subtract the fibre and sugar alcohol!!	Sandwich, glass of milk and apple = 60 grams (g) carb									
3	Calculate Meal Bolus	Determine your bolus or rapid insulin dose: <ul style="list-style-type: none"> Total carbs divided by your "insulin to carb ratio" (ICR). Your ICR is the amount of carb "covered" by <u>1 unit</u> of rapid insulin. Your ratio may be different for each meal and may change with weight gain or loss, changes in fitness level and hormone swings. Be sure to discuss your ratio with your doctor/diabetes educator. My ICR is: _____OR each meal may have a different ICR: <table border="1" data-bbox="456 1188 1156 1299"> <tbody> <tr> <td>Breakfast</td> <td>1 unit</td> <td>_____ gram carbs</td> </tr> <tr> <td>Lunch</td> <td>1 unit</td> <td>_____ gram carbs</td> </tr> <tr> <td>Dinner</td> <td>1 unit</td> <td>_____ gram carbs</td> </tr> </tbody> </table>	Breakfast	1 unit	_____ gram carbs	Lunch	1 unit	_____ gram carbs	Dinner	1 unit	_____ gram carbs	If your ICR is 1:10, divide your meal carbs by 10. For a 60 g carb meal, you will need 6 units of bolus insulin. $60 \text{ g} \div 10 \text{ g} = 6 \text{ units}$
Breakfast	1 unit	_____ gram carbs										
Lunch	1 unit	_____ gram carbs										
Dinner	1 unit	_____ gram carbs										
4	Check Blood Glucose	Check your pre-meal blood glucose level and record on the Carb Counting Daily Worksheet.	Pre-meal blood glucose is 13 mmol/L									
5	Calculate Correction Bolus	When your blood glucose is above your target of _____ mmol/L before meals you need to adjust your insulin using your personal insulin sensitivity factor (ISF; also called <i>correction factor</i>). Your ISF factor tells you how much your blood glucose will drop when you take <u>1 unit</u> of rapid insulin. By using your ISF you can decide how much extra insulin you will need to add to your meal bolus to bring your blood glucose back to your target. Your doctor/diabetes educator will help you determine your ISF.	If your target blood glucose is 7 mmol/L, your pre-meal blood glucose is 13 mmol/L and your ISF is 1:3, the correct dose of bolus insulin can be calculated in one of two ways.									

Step			Example																
		<p>Option 1:</p> <ul style="list-style-type: none"> If your pre-meal target is 7 mmol/L then subtract 7 from your pre-meal blood glucose reading. Divide this number by your ISF. <p>Option 2: Use an ISF scale determined by your doctor/diabetes educator.</p> <p>My target blood glucose is _____ mmol/L.</p> <p>My ISF is _____ OR my correction scale is:</p> <table border="1" data-bbox="479 695 1154 1010"> <thead> <tr> <th><i>Pre-meal blood glucose is:</i></th> <th><i>Adjust insulin by:</i></th> </tr> </thead> <tbody> <tr> <td>_____ - _____ mmol/L</td> <td>-1 unit</td> </tr> <tr> <td></td> <td>0 unit</td> </tr> <tr> <td></td> <td>+1 unit</td> </tr> <tr> <td></td> <td>+2 units</td> </tr> <tr> <td></td> <td>+3 units</td> </tr> <tr> <td></td> <td>+4 units</td> </tr> <tr> <td></td> <td>+5 units</td> </tr> </tbody> </table>	<i>Pre-meal blood glucose is:</i>	<i>Adjust insulin by:</i>	_____ - _____ mmol/L	-1 unit		0 unit		+1 unit		+2 units		+3 units		+4 units		+5 units	<p>Option 1: 13 mmol/L – 7 mmol/L = 6 mmol/L ÷ 3 = 2 units</p> <p>Option 2: Refer to the ISF chart that your doctor/diabetes educator may fill in for you.</p>
<i>Pre-meal blood glucose is:</i>	<i>Adjust insulin by:</i>																		
_____ - _____ mmol/L	-1 unit																		
	0 unit																		
	+1 unit																		
	+2 units																		
	+3 units																		
	+4 units																		
	+5 units																		
6	Total Insulin Dose for the Meal/ Snack	Add your bolus insulin dose and correction dose to get total insulin to inject.	For our example: 6 units + 2 units = 8 units.																
7	Activity Adjustment	If you expect your activity level to be higher than usual within 2 hours of injecting your bolus insulin, reduce the bolus dose by 50%. If you expect your activity level to be higher than usual within 2 to 3 hours after injecting, reduce the bolus dose by 25%.	If you expect to go for a 1 hour walk after breakfast, reduce the bolus insulin dose to 4 units. e.g., 8 units x 50% = 4 units																
8	Inject, Eat & Record	Inject, eat and record on Carb Counting Daily Worksheet.																	
9	Check Blood Glucose	Check blood glucose 2 hours after injecting insulin to confirm that your ICR and ISF are correct. If the blood glucose reading post-meal is not between 5.0 and 10.0 mmol/L, your ICR and ISF may not be correct and you need to ask your doctor/diabetes educator for help. Record on Carb Counting Daily Worksheet.	Your post-meal blood glucose is 8.0 mmol/L so your ICR and ISF are correct for that meal.																

Activity

When you add exercise you will need to increase your carbohydrate intake, reduce your insulin dose or both. For example, if you are not reducing your insulin you may need 15 grams of extra carbohydrate for every 30 to 60 min of extra activity. Blood glucose testing will help you decide what your insulin needs are. For more information, discuss this with your doctor/diabetes educator.

Reading Labels for Fibre and Sugar Alcohols

Nutrition Facts	
Per 2 cookies (50 g)	
Amount Value	% Daily
Calories 120	
Fat 6.0 g	9 %
Saturated 1.5 g +Trans 0g	6 %
Cholesterol 0 mg	0 %
Sodium 80 mg	4%
Carbohydrate 22 g	7%
Fibre 4 g	18%
Sugars 3 g	
Sugar Alcohols 4 g	
Protein 2 g	
Vitamin A 0% Vitamin C 0%	
Calcium 0% Iron 2%	

Look at the serving size (2 cookies or 50 g)

Based on the serving size, figure out the amount of carbohydrate you are eating (22 g carbohydrate if you are eating 2 cookies).

Subtract the fibre from the carbohydrate since fibre does not raise your blood glucose level

- ***22 g carbohydrate - 4 g fibre = 18 g available carbohydrate***

Subtract the sugar alcohols from the available carbohydrate since sugar alcohols have no significant effect on your blood glucose level.

- ***18 g available carbohydrate - 4 g sugar alcohols = 14 g TOTAL available carbohydrate***

Carbohydrate Counting Daily Worksheet

Date: _____ Name: _____ BG: Blood Glucose

Basal insulin:	Morning dose: _____		
	Evening dose: _____		
Bolus insulin:	ICR: 1 u: _____ g carbs	ISF: 1 u: _____ mmol/L	
Meal	Food Eaten (including portions)	Total Carbs (grams)	Bolus Insulin
Breakfast			
Time:			Meal bolus: _____ u
Pre-meal BG:			+ Correction bolus: _____ u
2 hr post-meal BG:			= Total insulin _____ u
AM Snack			Adjust for exercise: <input type="checkbox"/> Y <input type="checkbox"/> No
Lunch			
Time:			Meal bolus: _____ u
Pre-meal BG:			+ Correction bolus: _____ u
2 hr post-meal BG:			= Total insulin _____ u
PM Snack			Adjust for exercise: <input type="checkbox"/> Y <input type="checkbox"/> No
Dinner			
Time:			Meal bolus: _____ u
Pre-meal BG:			+ Correction bolus: _____ u
2 hr post-meal BG:			= Total insulin _____ u
Bedtime Snack			Adjust for exercise: <input type="checkbox"/> Y <input type="checkbox"/> No
Time:			
BG:			

Baking and Counting Carbohydrates: Chocolate Chip Cookie Bars¹

Makes 24 bars.

Ingredients:

	Carbs (grams)	Fibre (grams)
1 cup (250 mL) whole wheat flour	92	16
1 tsp (5 mL) baking soda	-	-
¼ tsp (1 mL) salt	-	-
½ cup (125 mL) non hydrogenated margarine	-	-
¾ cup (175 mL) brown sugar	170	-
1 tsp (5 mL) vanilla	-	-
1 egg	-	-
¾ c (175 mL) chocolate chips	84	3.3
Total	346	19.3

346 g carb – 19.3 g fibre = 326.7 g of available carb. Divide this by 24 servings and you get 13.6 g available carbohydrate per serving!

Be sure that your recipe yield is the same as the recipe or you will have to adjust your calculations.

There are some computer software programs available on the market that can do these calculations for you. Check out EATracker recipe analyzer at www.dietitians.ca. You only need to enter the ingredient names and the amount of each ingredient needed in the recipe along with the number of servings the recipe makes and the program will give you the final amount of carbohydrate per serving.

Method:

1. Preheat oven to 350 F (175 C)
2. Spray an 8x8 inch (20 cm x 20 cm) square pan with non-stick cooking spray.
3. Sift together the flour, baking soda, and salt.
4. Beat together the margarine and brown sugar until light and fluffy.
5. Add the vanilla and the egg. Beat well.
6. Gradually add the flour mixture and incorporate well.
7. Add the chocolate chips, mixing only until they are well distributed.
8. Scrape into prepared pan, smoothing into the corners.
9. Bake at 350 F (175 C) about 12 – 14 minutes, or until baked in the centre.
10. Allow to cool and then cut into 24 equal pieces.

This recipe makes a soft, chocolaty and rich cookie.

¹ Modified from Canadian Diabetes Association Recipe "Chocolate Chip Cookie Bars."

Resources for Carbohydrate Counting

British Columbia Children's Hospital, An Introduction to Basal-Bolus Insulin with Multiple Daily Injections, <http://www.bcchildrens.ca/NR/rdonlyres/5AF5E6DC-6ED6-4650-876F-98F7F0E38921/22679/basalbolus.pdf>

Canadian Diabetes Association (www.diabetes.ca/, order resources from: <https://orders.diabetes.ca/cda/>)

- Basic Carbohydrate Counting for Diabetes Management provides a 2 page summary of the highlights of carbohydrate counting.
- Beyond the Basics: Meal Planning for Healthy Eating, Diabetes Prevention and Management, poster with food groups including carbohydrate servings based on 15 grams of carbohydrate.
- Beyond the Basics: Meal Planning for Healthy Eating, Diabetes Prevention and Management, a manual that contains detailed information on carbohydrate containing foods, healthy lifestyle, managing diabetes care, and eating out, \$29.95 + tax.
- Beyond the Basics: Lifestyle Choices for Diabetes Prevention and Management, Canadian Diabetes Association, \$19.95 + tax.
- Revised Longer Lists of foods to be used with the Beyond the Basics: Meal Planning for Healthy Eating, Diabetes Prevention and Management, December 2005 – version 2.

Health Canada's web page (www.hc-sc.gc.ca/)

- Canadian Nutrient File is a computerized database that reports nutrients in over 5,500 foods. The database allows users to search nutrient values for specific foods.
- Canadian Nutrient File Recipe Proportions is a computerized database that helps quantify the ingredients in Canadian Nutrient File recipes.
- Nutrient Value of Some Common Foods, a booklet that reports nutrients for 1,000 of the most commonly consumed foods in Canada. Booklet is available on the website in PDF (requires Adobe Acrobat to review) and HTML. Booklet can be ordered through:

Publications, Health Canada

Tel.: (613) 954-5995 or 1-866-225-0709; Fax: (613) 941-5366

E-Mail: publications@hc-sc.gc.ca. When ordering, please indicate the Health Canada publication number: HC Pub.: 4771, Cat.: H164-49/2008E, ISBN: 978-0-662-46512-6

US Calorie King for Food Awareness web site (<http://www.calorieking.com/>)

- Calorie King Calorie, Fat & Carbohydrate Counter 2008 Edition (formerly called "The Doctor's Pocket Calorie, Fat & Carbohydrate Counter") is an up to date book of food counts; includes 11,000 food listings. Costs approximately \$8.00 - \$10.00. Can order on-line or at bookstore. ISBN 1-930448-13-9.

US Department of Agriculture (USDA) Agricultural Research Services, Nutrient Data Laboratory Home Page (<http://www.ars.usda.gov/ba/bhnrc/ndl>).

- USDA National Nutrient Database for Standard Reference is a computerized database that reports nutrients in 7,500 foods. Can view on-line or download the data files. An online search is also provided to look up the nutrient content of specific foods.

Books/Booklets

Holzmeister, Lea Ann. The Diabetes Carbohydrate and Fat Gram Guide, American Diabetes Association, 2006.

Reilly-Pardo, Marie. Barbara Kraus' Calories and Carbohydrates, 16th edition. Penguin Group (USA) Inc, 2005.

Netzer, Corrine. 2000, The Complete Book of Food Counts. Dell Publishing. New York.
Natow, Annette and Heslin, Jo-Ann. The Diabetes Carbohydrate and Calorie Counter, 3rd ed., Pocket Books, a division of Simon & Schuster, Inc, New York, NT., 2006

Borushek, Allan, CalorieKing Calorie, Fat & Carbohydrate Counter 2008 Edition (formerly called "The Doctor's Pocket Calorie, Fat & Carbohydrate Counter")

Product information is available at some restaurants. You may need to ask. Some is available on line as well.

Glossary of Terms

Basal – background insulin (long acting or intermediate acting insulin)

Bolus – mealtime or rapid acting insulin

Correction scale – graduated scale telling you how much insulin to take to correct a certain level of blood glucose.

ICR – insulin to carbohydrate ratio. Tells you how much one unit of rapid insulin will cover for the carbohydrates eaten. For example, if you need 1 unit of rapid insulin to cover 15 grams of carbohydrates your ICR is 1:15.

ISF – insulin sensitivity factor (correction factor). Tells you how much one unit of rapid insulin will lower the blood glucose. For example, if you need 1 unit of rapid insulin to drop the blood glucose by 3 mmol/L your ISF is 1:3.

Long acting insulin – insulin that has a long duration often covering ½ to 1 day. Current examples are Levemir® and Lantus®. NPH®, an intermediate acting insulin, may also be used to give you long acting insulin coverage.

Rapid insulin – insulin that usually works 10 – 15 minutes after you inject it. Current examples are Humalog®, Novorapid®, or Apidra®.