Matching Insulin to Carbohydrate

Now that you have learned the basics of carbohydrate counting, you are ready to move on to matching your insulin to the amount of carbohydrate that you eat. If you do not understand carbohydrate counting basics, speak with your healthcare team before learning how to match insulin to carbohydrate. **At the beginning, it is important to have the same carbohydrate intake at breakfast, lunch, and supper from day to day. This will help you decide on the amount of insulin you need to cover the carbohydrate that you eat.** Knowing how to match your insulin doses to what you eat allows you more flexibility in the total amount of carbohydrate that you eat at a meal.

What is an insulin to carbohydrate ratio?

An insulin to carbohydrate ratio, or simply carbohydrate ratio, is the number of grams of carbohydrate that 1 unit of rapid acting insulin will cover. On average, 1 unit of rapid-acting insulin will cover 10–15 grams of carbohydrate. This average number is sometimes used as a starting point. However, since everyone is different, **it is important to decide how much carbohydrate is covered by 1 unit of insulin for you**. Your ratio could vary from meal to meal, with active or less active days, or because of illness or stress.

How do I decide what my insulin to carbohydrate ratio is?

You will need to monitor and keep track of the following:

- Your blood sugar levels before and 2 hours after the first bite of your meal. It is best to work out a ratio for one meal at a time.
- The food that you ate and number of grams of carbohydrate eaten at that meal. (Remember to subtract the fibre).
- The number of units of rapid-acting insulin you took at that meal.
- Any extra activity or exercise. It is best to keep exercise constant during the time that you are trying to decide your insulin to carbohydrate ratio.

It is best to work on this when your blood sugars are fairly stable and in the healthy ranges. Healthy blood sugar targets are 4–7 mmol/L before a meal and 5–10 mmol/L 2 hours after the first bite of a meal. If your pre-meal blood sugar is higher than 4–7 mmol/L, an acceptable rise in blood sugar 2 hours after the meal should be no more than 3 points.

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You will need to increase or decrease the dose of your rapid-acting insulin by 1–2 units every 3 days until your blood sugars are more often in your target ranges. You may also need to adjust the dose of your longer-acting insulin. Speak with your diabetes team about these adjustments.

Once you are getting blood sugar readings in your target ranges most of the time, you can calculate your insulin to carbohydrate ratio. Calculate your carbohydrate ratio once you have target blood sugar readings from 3 or more meals at the same time of day.

Remember the carbohydrate ratio is the number of grams of carbohydrate 1 unit of rapid-acting insulin will cover. Work out the grams of carbohydrate that you ate at that meal and divide by the number of units of rapid-acting insulin that you took.

$$\frac{\text{Grams of Carbohydrate}}{\text{Units of Rapid-Acting Insulin Taken}} = \text{Carbohydrate Ratio}$$

$$\text{Example: } \frac{\text{90 grams of carbohydrate}}{\text{9 units of rapid-acting insulin taken}} = 10$$

In this example, 1 unit of rapid-acting insulin will cover 10 grams of carbohydrate.

Use your information to figure out your carbohydrate ratios:
Your carbohydrate ratio for breakfast is: _____
Your carbohydrate ratio for lunch is: _____
Your carbohydrate ratio for supper is: _____

*If your answer is a decimal, always round **up** to the nearest whole number. For example, 9.3 would be rounded up to 10.

Now you can vary the amount of carbohydrate that you eat at a meal and take the amount of insulin you need to cover the carbohydrate. You will need to re-assess your ratio once in a while.

$$\frac{\text{Grams of Carbohydrate}}{\text{Carbohydrate Ratio}} = \text{Insulin Dose for Carbohydrate}$$

$$\text{Example: } \frac{\text{80 grams of carbohydrate}}{10} = 8 \text{ units of insulin}$$

*If your answer is a decimal, always round **down** to the nearest whole number. For example, 8.7 would be 8.

How do I decide what my correction factor is?

A correction factor is the number of points that your blood sugar is expected to drop with 1 unit of rapid-acting insulin. Your correction factor can also be written as a ratio. For example, a 1:2 ratio means that 1 unit of rapid-acting insulin will drop your blood sugar about 2 points. Knowing your correction factor can help you make insulin adjustments at meals when your blood sugar is higher than your target.

TDD stands for **T**otal **D**aily **D**ose of insulin. This includes both your rapid- and longer-acting insulin. If your total daily dose of insulin is always changing, use an average number.

Use the formula below to see what your correction factor is:

$$\frac{100}{\text{TDD}} = \text{Correction Factor}$$

Example: $\frac{100}{50} = 2$

Calculate your Correction Factor:
Your TDD is _____
100 divided by your TDD is _____

*If your answer is a decimal, always round **up** to the nearest whole number. For example 1.4 would be 2.

Once you know your correction factor, you can calculate how much insulin to take for a correction dose. A correction dose is used to correct for a pre-meal blood sugar that is above your target. The correction dose will help to bring your blood sugar into your target range before your next meal. You should know your insulin to carbohydrate ratio before adding a correction dose of insulin at your meals.

How do I use my correction factor to calculate my correction dose?

The formula below will help you calculate how much insulin you will have to take to correct for a pre-meal blood sugar that is above your target.

$$\frac{\text{Actual blood sugar} - \text{Target blood sugar}}{\text{Correction Factor}} = \text{Correction Dose}$$

For example, if your pre-meal blood sugar is 10 and your target is 6, then your correction dose is:

$$\frac{10 - 6}{4} = \frac{4}{4} = 1 \text{ unit}$$

*If your answer is a decimal, always round **down** to the nearest whole number. For example 1.6 would be 1.

The correction dose of insulin that you would need to take in this example would be 1 unit of rapid-acting insulin.

Putting the Carbohydrate Ratio and Correction Dose Together

Once you have calculated your carbohydrate ratio (the amount of insulin that you need for your meal) and your correction dose (the amount of insulin you will need to correct for a pre-meal blood sugar that is above your target), you add them together to get your dose of insulin for that meal.

Example: Following the examples given above, you need 8 units of insulin to cover your meal plus another 1 unit to correct for a pre-meal blood sugar above your target. Your dose of rapid-acting insulin at that meal will be 9 units.

Adapted from:

1. American Diabetes Association, Advanced Carbohydrate Counting (2003)
2. Walsh, John, Roberts, Ruth : Pumping Insulin (4th edition). Torry Pines Press. San Diego, CA. 2006
3. Pearson, Jan, Bergenstal, Richard: Fine-Tuning Control: Pattern Management Versus Supplementation. Diabetes Spectrum. 14:75-78, 2001
4. Building Competency in Diabetes Education: The Essentials. Diabetes Educator Section of the Canadian Diabetes Association. 2004.
