CHAPTER 8:

FOOD MANAGEMENT AND THE PUMP

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A review of nutrition is found in Chapter 11 of Understanding Diabetes (3) and will not be repeated here. Some type of meal planning program is necessary for all people with diabetes. The Diabetes Control and Complications Trial (DCCT) reported that almost half of the improvement in HbA1c values in the group treated with multiple injections or pump therapy was due to following a nutrition plan. (10) This treatment group had a decrease in the eye, kidney, nerve and cardiovascular complications of diabetes of more than 50%. Carbohydrate (carb) counting was the major food plan used in the DCCT and is required for all people who begin insulin pump therapy at our Center. Carbohydrates are the primary nutrients that affect blood sugar. Thus, knowing how to balance insulin with carbs is essential for optimal blood sugar control. Along with carbohydrates, protein and fat provide fuel for our body. However, protein and fat have a minimal impact on blood sugar. The effect of high fat meals on blood sugars will be discussed later in this chapter.

FOOD RECORDS

Review of a three-day food record by a Registered Dietitian (RD) or your diabetes care provider prior to beginning insulin pump therapy is helpful. Directions and a form that may be copied are given in Table 1. Include both the time insulin is given as well as the time of beginning eating. Through the three-day records it can be determined if the currently used insulin-to-carb (I/C) ratios and/or timing of insulin before meals need to be changed. If an I/C ratio is not currently being used, the RD can recommend ratios to use with pump therapy.

CARB COUNTING AND I/C RATIOS

Carb counting is discussed in Chapter 12 of Understanding Diabetes (3), which includes tables showing the carb content of various foods. Carb counting involves counting the grams of carbs that will be eaten and taking a matching amount of insulin. The grams of carbs covered by one unit of insulin is called the **insulin to carb (or I/C) ratio**. Your RD or diabetes care provider can help you determine an I/C ratio that is best for you. A common I/C ratio is 1/15, meaning that 1 unit of insulin covers 15 grams of carbs. Each person has different insulin needs, so I/C ratios vary from person to person. Sometimes the same person may require different ratios for different times of the day. Most pumps now allow programming of several I/C ratios. An example of how ratios may vary throughout the day (taken from someone's pump) follows:

Time	I/C ratio
6:00 a.m. - 9:30 a.m.	1/10
9:30 a.m. - 11:30 a.m.	1/25
11:30 a.m. - 1:15 p.m.	1/15
1:15 p.m. - 5:00 p.m.	1/25
5:00 p.m. - 7:00 p.m.	1/12
7:00 p.m. - 6:00 a.m.	1/25

This person was still having high blood sugars (>180 mg/dl or >10 mmol/L) after breakfast and dinner. She was able to correct these values by consistently taking her meal boluses 15 to 30 minutes prior to eating (see Timing of Boluses later in this chapter).

TABLE 1:

THREE-DAY FOOD RECORD

Instructions for completing food record:

1. Please write down everything you eat or drink for three days. This includes meals and snacks. Often it's easier to remember what you eat if you record your food intake at the time you eat it.

2. Include the amount of food or beverage eaten. Also include the method of preparation (baked, fried, broiled, etc.), as well as any brand names of products (labels can also be enclosed). Use standard measuring cups or spoons. Record meat portions in ounces after cooking. If you do not have a scale, you can estimate ounces. The size of a deck of cards is about equal to three ounces of meat.

3. Be sure to include items added to your food. For example, include salad dressing on salad, margarine or butter on bread.

4. Include any supplements you take (vitamin, mineral or protein powders). Write down the name of the supplement, what it contains, and the amount taken. Include a copy of the label, if possible.

5. Please include meal and snack times, blood glucose values, amount of insulin, type of food, amount of food, grams of carbohydrate and any activity or exercise. Put a star next to any blood sugar that is two hours after a meal.

The following is an example of how to complete your food record. Please record what you eat on the forms in this chapter. The forms can then be faxed or mailed to your diabetes care provider.

An example for the start of a day follows:

Time	Blood Sugar mg/dl (mmol/L)	Dose: Insulin/Oral Meds	Food (include amounts)	Carbs	Activity/Other (illness, stress, menses, etc.)
8:00	170 (9.4)	4H	Cheerios—1 1/2 cup	34g	
			Fat free milk—1 cup	12g	
			Orange juice—1 cup	30g	
10:00	180 (10.0)				Jog—20 min.

THREE-DAY FOOD RECORD

Name: _____ Home Phone: _____

Date(s): _____ Work Phone: _____

Dietitian: _____ Best time to be reached: _____

Time	Blood Sugar mg/dl (mmol/L)	Dose: Insulin/Oral Meds	Food (include amounts)	Carbs	Activity/Other (illness, stress, menses, etc.)

Please copy as needed.

DETERMINING I/C RATIOS

Many people with diabetes are already using I/C ratios with injections. If that is the case, then those ratios can be used with the start of pump therapy. If I/C ratios have not been previously used, the "rule of 500" will give an approximate ratio to use. The total units of insulin used in a day are divided into 500. For example, if a person receives an average of 50 units of insulin in a day (all types added together), dividing 50 into 500 gives 10. The I/C ratio would then be 1/10. One then gives one unit of insulin for every 10 grams of carbs that are eaten. Thus if 30 grams of carbs are eaten, 3 units of insulin are taken. Fortunately, with smart pumps, all one has to do is enter the grams of carbs in the pump, and the pump does the calculation since the I/C ratios are programmed into the pump at the start of pump therapy. Whether a previously used I/C ratio or a new I/C ratio is used, it is necessary to evaluate the meal bolus doses for each meal of the day in order to determine if they need to be adjusted (see Chapter 6).

MEAL CHECKING

The rapid-acting insulin dosages for meals are best adjusted by measuring blood sugar levels two hours after the meal. When checking/adjusting insulin to determine an I/C ratio, it is helpful to eat a meal with known grams of carbs (e.g., a frozen meal with carbs on the label). The fat content should be less than 20g, as higher fat content delays stomach emptying and keeps blood sugar levels up longer. The "meal check" should be done for each of the three daily meals. It is common for I/C ratios to vary at different times of the day for the same person. Most people aim for a blood sugar below 140 mg/dl (<7.8 mmol/L) two hours after each meal. Others use the ranges suggested by age group in Chapter 7. You may want to discuss this with your doctor.

If the blood sugar value is consistently high, more insulin is needed for the grams of carb in the I/C ratio. An example would be to change from 1/15 (1 unit/15g carb) to 1/12 (1 unit/12g carb).

If the blood sugar level is below the lower limit (often 70 mg/dl [3.9 mmol/L]), a lower amount of insulin is needed. An example would be to change from an I/C ratio of 1/15 (1 unit/15g carb) to an I/C ratio of 1/20 (1 unit/20g carb).

Call your healthcare provider to help you make adjustments.

Careful record keeping for the first one or two weeks of pump therapy is essential. Table 3 in Chapter 7 provides a form for recording the blood sugar, carb amounts and insulin dose. Checking blood sugars two hours after meals allows one to see if the insulin to carb ratio used for a given meal resulted in the correct insulin dose. This is best done when starting with a blood sugar level in the desired range.

It is then important to review the records with the dietitian and physician to decide the best I/C ratios to use at each meal and snack.

CALCULATING CARBS

Accurate carb counting is essential for good blood sugar control with pump therapy. In order to carb count accurately, label reading is a must. Label reading is discussed in Chapter 11 of Understanding Diabetes. (3) All food labels, by law, must list the grams of carbs. Table 2 provides a cheat-sheet for judging carb amounts in foods that do not have a label. Most pumps now provide carb counts for a variety of foods. Unfortunately, when eating out, the carbs may be hard to determine. Most fast food and chain restaurants do have listings of carb contents. There are several books listed at the end of this chapter that provide carb amounts of common foods. We recommend buying one of those books to help with carb counting when a food label is not available. It is also helpful to make a personal cheat-sheet listing the foods that are eaten often along with their carb content.

TABLE 2:

FOODS WITH 15 GRAMS OF CARBS

1 Starch = 1 Fruit = 1 Milk = 15g Carbohydrate*

Food Group	Carbohydrate Content	Portion Sizes
Starch/Grains	**15g**	1 slice bread (1oz) 1 6" tortilla 1/3 -1/2 cup cooked pasta 1/2 small or 1/4 large bagel (1 oz) 1/2 hamburger bun 1/2 cup peas, corn, or mashed potato 1 small potato (3 oz) 1/3 cup rice 1/3 cup pasta 1/3-1/2 cup cooked dried beans
Fruit	**15g**	1 piece fruit (small) 1/2 cup canned fruit 1/2 cup fruit juice 2 Tbsp. raisins 1 1/4 cup strawberries 1 1/4 cup watermelon
Milk	**12g**	1 cup skim, 1%, 2% or whole milk 8 oz plain yogurt

*These amounts are not exact but are close estimates.
NOTE: THIS HALF-PAGE MAY BE COPIED AND CARRIED IN THE WALLET AS NEEDED.

TIMING OF BOLUSES

When we began using continuous glucose monitoring (CGM), we found that most people exceeded the ADA goal of "below 180 mg/dl (< 10 mmol/L) at any time after a meal." As noted elsewhere in this book, eating food results in a blood sugar peak after 60 minutes. Unfortunately, the rapid-acting insulins (Humalog, NovoLog and Apidra) do not peak for 100 minutes. Thus, in order to more closely match the blood sugar peak from food, the insulin bolus must be given 15 to 30 minutes prior to eating. The 30 minutes would be better (assuming the pre-meal blood sugar is not low), but is often not practical. At the minimum, if the blood sugar is not low, the correction bolus plus the food bolus for food that will definitely be eaten should be taken 15 minutes before the meal. Then, if more carbs are eaten, another bolus can be taken later. This is a big advantage for pump users over multiple injections, as most people do not take another shot if they decide to eat more.

BOLUSING FOR HIGH-FAT MEALS

Chapter 6 discussed the Square Wave (or Extended) bolus. This is a portion of the food bolus given over a period of time that the person/family programs into the pump. Most people know their own body best and which foods cause blood sugars to remain high for prolonged periods. High-fat foods delay stomach

emptying and are a common cause of a delayed rise in blood sugar. For some people it is pizza, whereas for others it is Chinese or Italian food. The person/family needs to identify the foods and then balance the immediate vs. the Square Wave (or Extended) bolus to cover that food. Many people begin with half the dose as an immediate bolus and half as a Square Wave (or Extended) bolus. Adjustments may be made the next time the same food is eaten based on how high the blood sugars were after one, two and four hours. If high after one and two hours, more insulin is needed for the immediate bolus (or if low, less as an immediate bolus). If high after four hours, more insulin is needed in the Square Wave (or Extended) portion. Making these alterations is discussed in detail in Chapter 6. The name given to the combination bolus is the Dual Wave (or Combination) bolus. Some pumps even allow naming the meal (e.g., pizza) with a set combination bolus to then be used. In order to take full advantage of pump therapy, we recommend using this feature of the pump. It really can help improve blood sugar levels following meals that cause a delayed rise in blood sugar.

WEIGHT GAIN

A concern often voiced by new pump users relates to weight gain. In our report of 292 youth using insulin pumps for up to eight years, excessive weight gain was not a problem. (5) The reasons some people gain weight when beginning pump therapy include:

1. Better control of blood sugar levels after eating and use of the sugar by the body rather than having the sugar filtered by the kidney and excreted in the urine (not good for the kidneys).

2. People eating more because they can just key extra insulin into the pump (in contrast to having to take another shot).

We explain to all people/families who begin pump therapy that if they eat more, they will gain weight, but they do have the option of eating the same (or less) on pump therapy. Most choose the latter.

CONVENIENCE

It is a great convenience to wear a pump and to be able to enter an insulin dose at any time a person decides to eat food (e.g., at the mall with friends). In the past, a shot of insulin might not have been convenient or available. There is now no reason for not covering food any time carbs are eaten. Food (carbs) is the main cause of blood sugar levels rapidly increasing on a day to day basis, and the means to prevent this is now readily available. Unfortunately, one of the two main difficulties that pump users have (along with insertions coming out) is forgetting to give insulin boluses prior to eating food. This is discussed in Chapter 14, Psychological Aspects of Pump Use. Most people who cannot remember to bolus for food have high HbA1c values and must discontinue use of the pump.

SUMMARY

Insulin pumps have a number of features that provide many advantages in food management. Pump therapy is more convenient than shots. One can easily give insulin any time carbs are eaten. Bolus calculations are done automatically by smart pumps. This improves accuracy in dosing, taking away some of the human error. The extended bolus feature helps to deliver insulin at a rate that more closely matches the delayed rise in blood sugar levels that occur from some high-fat meals. Using all of these features, along with accurate carb counting, can help people achieve optimal blood sugar control and prevent the complications of diabetes.

DEFINITIONS

Carb counting: A food plan in which the grams of carbohydrates (carbs) are estimated and the insulin dose given accordingly.

DCCT: Diabetes Control and Complications Trial. A study that showed that the complications of diabetes were related to higher HbA1c levels (poor glycemic control).

Dual Wave or Combination bolus: A combination of the usual immediate bolus with a square wave or extended bolus. They are explained in the text of Chapter 6 and in this chapter.

Insulin/Carb (I/C) ratio: The grams of carbs (C) covered by one unit of insulin (I). An I/C ratio of 1:15 means that one unit of insulin will metabolize 15 grams of carbohydrate.

RD: Registered dietitian. A person with a college degree in nutrition who has completed an internship and examination.

Rule of 500: A way to roughly calculate the I/C ratio (see text). It is used when the person has not previously used carb counting to determine the insulin dose for food.

Square Wave or Extended bolus: An amount of insulin to be administered by the pump over an extended period of time (entered by the person/family). This is explained in the text of Chapter 6 and in this chapter.

REFERENCES

10. Delahanty, LM, & Halford, BN, Diabetes Care 16; 1453, 1993.

Carbohydrate Counting Resources:

For those wanting more detailed information on carb counting or on carb quantities in foods, there are now entire books written on these subjects.

1. Exchange Lists for Meal Planning, American Diabetes Association and American Dietetic Association, 2003.

2. The Complete Book of Food Counts (7th Edition), by Corinne Netzer, Dell Publishing, 2006.

3. Bowes and Church's Food Values of Portions Commonly Used (17th Edition), by AT Pennington, Lippencott Williams and Wilkins, 2004.

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

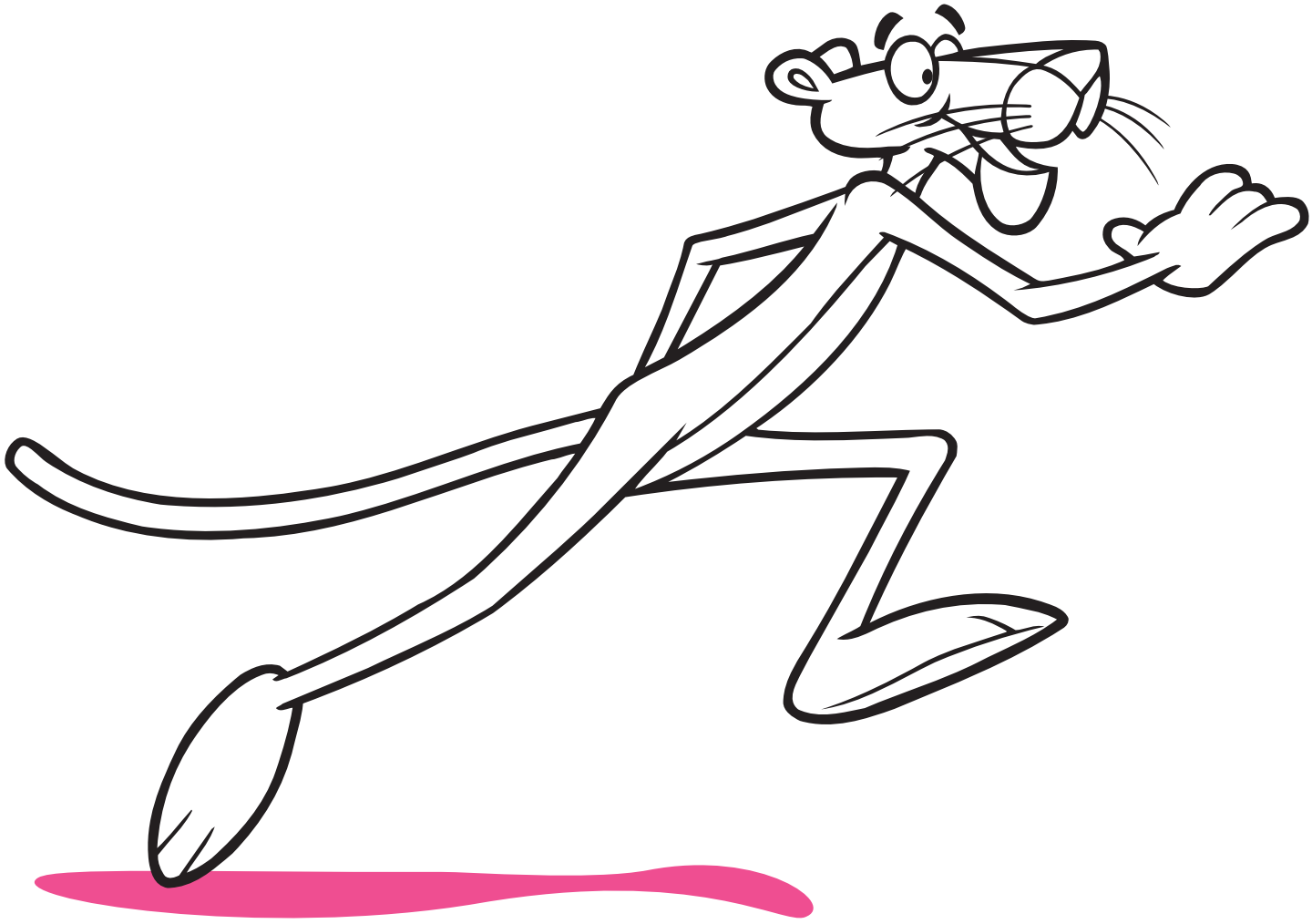
5. Nutrition In the Fast Lane (condensed version), Eli Lilly and Co., 2002.

6. Basic Carbohydrate Counting and Advanced Carbohydrate Counting, The American Diabetes Association and the American Dietetic Association, 2003.
(1-800-232-3472 or 1-800-366-1655).

7. Fast Food Guide, Becton Dickinson Consumer Health Care, Franklin Lakes, NJ, 07417-1883 (www.bd.com/diabetes).

8. Complete Guide to Carb Counting 2nd Edition, H.S. Warshaw and K. Kulkarni, the American Diabetes Association and the American Dietetic Association, 2004.
(1-800-232-3472 or 1-800-366-1655).

9. The Calorie King® Calorie, Fat and Carbohydrate Counter, by Allan Borushek, Family Health Publications, 2007.
Website: www.calorieking.com



THIRTY MINUTES OF EXERCISE FIVE TIMES A WEEK IS IMPORTANT FOR EVERYONE.