

CHAPTER 1:

WHO SHOULD USE A PUMP?

H. Peter Chase, MD

WHAT IS AN INSULIN PUMP?

An insulin pump is a microcomputer designed to provide a constant (24/7) “basal” dose of insulin and to make extra insulin (“boluses”) readily available to manage food or correct high blood sugar levels. For purposes of this book, we will refer to blood glucose meter readings as “blood sugar.” We will refer to continuous glucose monitor (CGM) readings as “glucose levels.” In reality, a blood sugar level is a blood glucose level — they are the same. The insulin is infused under the skin through a cannula (tube) that is connected to an insulin reservoir inside the pump. The infusion cannula is inserted into the skin with a needle, which is then removed, leaving the infusion cannula in place. The infusion cannula should be replaced every two or three days. There have been several research attempts to use implanted insulin pumps. To date, they have been fraught with problems and have not come to fruition. Therefore, this book only discusses pumps that are worn externally.

The insulin pump is designed to deliver rapid-acting insulin in two ways:

1. A programmed **basal rate** (delivered in small amounts every few minutes)
2. A user-initiated **bolus dose** (a quick burst) of insulin given before meals or to correct a high blood sugar level

This book presents the advantages and disadvantages of insulin pump therapy. Families can use this information to decide about using a pump.

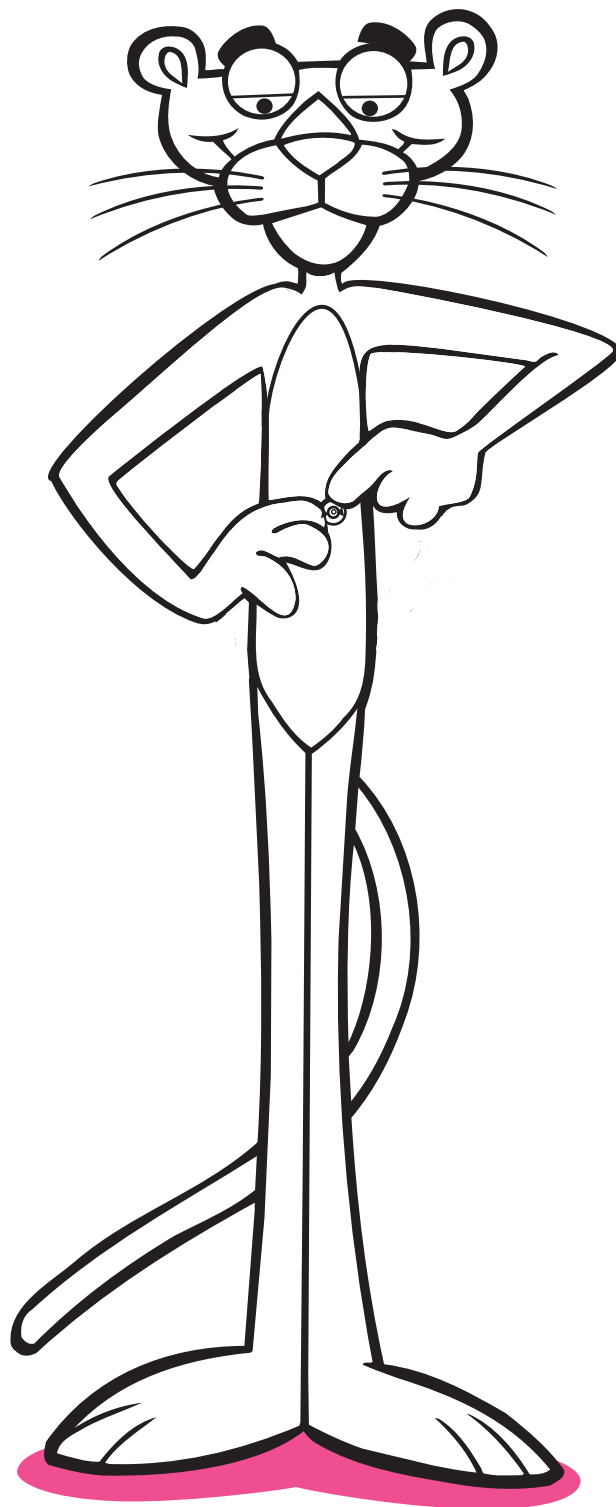


TABLE 1:

IMPORTANT FACTORS WHEN CONSIDERING AN INSULIN PUMP

- | | |
|--|--|
| 1. Self monitoring of blood sugar levels | 7. Adequate communication with the diabetes team |
| 2. Motivation | 8. Realistic expectations |
| 3. Compliance | 9. Problem solving skills |
| 4. Family involvement and support | 10. Manual dexterity |
| 5. Knowledge of carb counting | 11. Health insurance |
| 6. Adequate diabetes knowledge | 12. Literacy |

WHEN SHOULD AN INSULIN PUMP BE CONSIDERED?

Insulin pump therapy requires a high level of diabetes care. The entire family must be committed to help with the daily management, no matter what age a person is when he or she begins pump therapy. The family and health care team need to have a well-established relationship before insulin pump therapy is initiated. Extra visits and training are required to use insulin pumps effectively.

It is important to realize that the current insulin pumps do not vary the insulin dose based on the blood sugar level. The pump is programmed to give a pre-set amount of insulin at regular intervals (called the **basal** rate). The basal rates do not automatically change as blood sugar levels change. In addition, each time food is consumed or when the blood sugar level increases, the pump user (or parent) must use settings in the pump to give a bolus insulin dose. Some “smart” pumps help calculate the amount of insulin to give. **At present, there is not a “closed loop” or “bionic” pump that measures the blood glucose and automatically adjusts insulin administration.** This type of closed-loop pump is still many years away.

There is not a best age to begin using an insulin pump. The time is right when the person with diabetes and the family members are ready and

willing. It must not be solely the parents who want and are pushing for the pump, except in the case of young children. The ability to count carbohydrates and to reliably calculate and give an insulin dose is an obvious requirement for pump use. Younger children who cannot count carbohydrates or reliably give a bolus insulin dose would need an adult’s assistance to use a pump. When this help is readily available, toddlers have had success with pumps. No matter at what age a person begins pump treatment, assistance will be needed when the person is ill, unmotivated, or shows a lack of consistency with daily diabetes management tasks.

WHO IS A GOOD CANDIDATE FOR AN INSULIN PUMP?

A group of diabetes educators was asked this question and suggested the following criteria: (1)

1. Self monitoring of blood sugar levels

The educators all agreed that doing an adequate number of blood sugar checks each day was the top criterion for considering a person for insulin pump therapy. Blood sugar checking is essential to prevent hypoglycemia and diabetic ketoacidosis (DKA). It also is the key to making informed insulin adjustments. Health insurance organizations require evidence of frequent blood sugar checking (usually at least four checks per day for 60 days) to be willing to pay for insulin pump therapy.

When people perform fewer blood sugar checks per day, there is an 18% chance of discontinuing insulin pump therapy. (2) We require prospective pump users to perform at least four blood sugar checks per day, and our rate of discontinuing pump therapy is only 7 percent.

2. Motivation/desire

The second highest criterion for successful pump therapy cited by the diabetes educators was motivation/desire. This obviously includes motivation of the child or adolescent as well as the parents. Other than for younger children, if it is just the parents who want the pump, therapy will likely fail. Parents of young children must both be highly motivated and willing to assume most of the responsibilities. Parents of adolescents often express a desire for their teens to be more involved with the diabetes management. We routinely ask prospective pump families to meet with our social work staff to decide if a teen is ready and willing to take more responsibility for the diabetes.

3. Compliance

Compliance with blood sugar checking, pre-meal insulin bolus administration and infusion site changes is essential. If pre-meal insulin boluses cannot be given consistently, glycemic control (HbA1c levels) can worsen with pump use. Missing meal insulin boluses is the main reason for people to have to stop using a pump at our Center. Similarly, if ketones are not checked with high blood sugar levels (or when infusion cannula problems are suspected), episodes of DKA can increase. Changing infusion sites every two to three days is necessary to avoid infections and/or decreased insulin absorption.

4. Family involvement

Family involvement is very important, especially with young children. This is important in decision-making, set changes and clinic appointments. It also relates to making sure adequate supplies are available. A supportive adult can be of help to any person with diabetes.

5. Knowledge of carb counting

Some form of food management is an important

part of intensive diabetes management. Carbohydrate (carb) counting is ideal for insulin pump therapy because it provides a basis for insulin bolus dosing and flexibility in eating. At the Barbara Davis Center for Childhood Diabetes, we require prospective pump users and their families to be proficient in carbohydrate counting.

6. Adequate diabetes knowledge

Adequate diabetes knowledge is obviously an important criterion for using an insulin pump. All of the basic knowledge in Understanding Diabetes (3) or other educational books cannot be repeated here. It is assumed that basic diabetes education has been completed. A person/family must appreciate what insulin does, what the blood sugar level should be, what hypoglycemia or DKA is and how to prevent these problems. This is one of the major reasons for not initiating pump therapy at the time a person is initially diagnosed. Initiating insulin pump therapy at the onset of diabetes can present knowledge overload.

7. Active communication with the diabetes team

When starting an insulin pump, the types of insulin are completely changed. There are no long-acting (Lantus/Levemir) or intermediate-acting (NPH/Lente) insulins used in a pump. Only the rapid-acting insulins (Humalog, NovoLog or Apidra) are used.

The diabetes team makes an educated guess about the initial insulin pump basal and bolus doses. Daily telephone calls to the diabetes team and faxed blood sugar check results must occur during the first few weeks of pump therapy. There are often mechanical questions or new situations with which to deal. Good communication is essential!

8. Realistic expectations

At least initially, the person/family should not expect diabetes management to be easier using the pump. There is much to learn and it has been described as being "like getting diabetes all over again."

In addition, the person will now be continually connected to a device. For some who are not certain how they will like this, it may help to wear a loaner pump (without insulin) with the infusion cannula taped to the skin. In addition, prior use of the Insuflon™ or a continuous glucose monitor (CGM) may serve as a step in determining a person's ability to tolerate wearing an insulin pump.

9. Problem solving skills

Insulin pump users and their family members must have good problem solving skills. They also must be willing and able to contact the diabetes team members and the telephone help lines offered by all major pump manufacturers.

10, 11 and 12. Manual dexterity, health insurance, and literacy

These three criteria are important, but perhaps less critical to pump success. The cost of a pump (~\$6,000 USD) and of annual supplies (~\$2,000/yr USD) may be difficult for some families. The infusion sets now have automatic inserters and the buttons on the pumps are large enough so that dexterity should not be an issue. As instructive videos and education classes are available, literacy levels are also less critical.

SUMMARY

There are many factors to consider before proceeding with insulin pump therapy. An honest appraisal of these factors is important in leading to safe and successful insulin pump use.

DEFINITIONS

Basal rate: The programmed delivery of insulin every few minutes throughout the day by an insulin pump.

Bolus dose: The giving of immediate bursts of insulin by the person/family to cover food to be eaten or high blood sugar levels.

Insulin pump: A microcomputer worn externally which is able to perform many insulin delivery actions, as directed by the person, family, or diabetes team.

REFERENCES

1. Lenhard, J., *Infusystems USA* 3(1): 1, 2006.
2. Wood, JR, et al, *Diabetes Care* 29:2355, 2006.
3. *Understanding Diabetes* (alias "The Pink Panther Book") 11th edition, 2006. Available by calling: 800-695-2873. Full text available free online at www.BarbaraDavisCenter.org.

