

Chapter 6

Low Blood Sugar (Hypoglycemia or Insulin Reaction)

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There are two emergency problems in blood sugar control for people with diabetes. The first, discussed in this chapter, is low blood sugar or hypoglycemia. (The second, discussed in Chapter 15, is high blood sugar or ketoacidosis.) Low blood sugar comes on quickly and must be treated by the person, family or friends. Early treatment helps prevent a more severe reaction and possible hospitalization.

Any time a person has received a shot of insulin, or an oral diabetes medicine, there is a chance of a low blood sugar reaction. The family of a person with newly diagnosed diabetes must know the signs and symptoms of hypoglycemia before going home the first night.

A normal random (non-diabetic) blood sugar is usually between 70-140 mg/dl (3.9-7.8 mmol/L). Normal fasting values are usually between 70 and 100 mg/dl (3.9-5.5 mmol/L). For purposes of this book, **we define a true low blood sugar as < 60 mg/dl (< 3.2 mmol/L)**. The American Diabetes Association (ADA) defines a low blood sugar level as **any level < 70 mg/dl (< 3.9 mmol/L)**.

TOPIC:

Prevention, Detection, and Treatment of Acute Complications (hypoglycemia – low blood sugar)

TEACHING OBJECTIVES:

1. Present the symptoms, causes, and treatment of mild, moderate and severe hypoglycemia.
2. Identify the appropriate time to contact the healthcare provider.

LEARNING OBJECTIVES:

1. Define mild, moderate and severe low sugar symptoms, causes and treatment.
2. State the appropriate time to contact a healthcare provider.

CAUSES OF LOW BLOOD SUGAR

Hypoglycemia (low blood sugar) occurs because the body doesn't have enough sugar to burn for energy. The level of sugar in the blood falls too low. Sometimes it is called an **insulin reaction**, a **reaction** or a **low**.

Frequent causes are listed below:

- 🐾 Meals and snacks that are late or missed
- 🐾 Extra exercise that burns more sugar than usual
- 🐾 An insulin or oral medicine dose that is too high
- 🐾 An insulin dose peaking at a different time than usual
- 🐾 Giving a shot into muscle which results in rapid absorption of insulin
- 🐾 Making a mistake in the drawing up and giving of an insulin dose
- 🐾 Taking a bath or shower (or hot tub) soon after taking a shot of insulin. (The blood vessels in the skin dilate from the hot water and cause insulin to be rapidly absorbed.) It is always wise to wait at least 90 minutes to take a shower, bath or hot tub after an insulin shot. It is only necessary to wait a short time (10-15 minutes) after being in hot water to then do the shot.

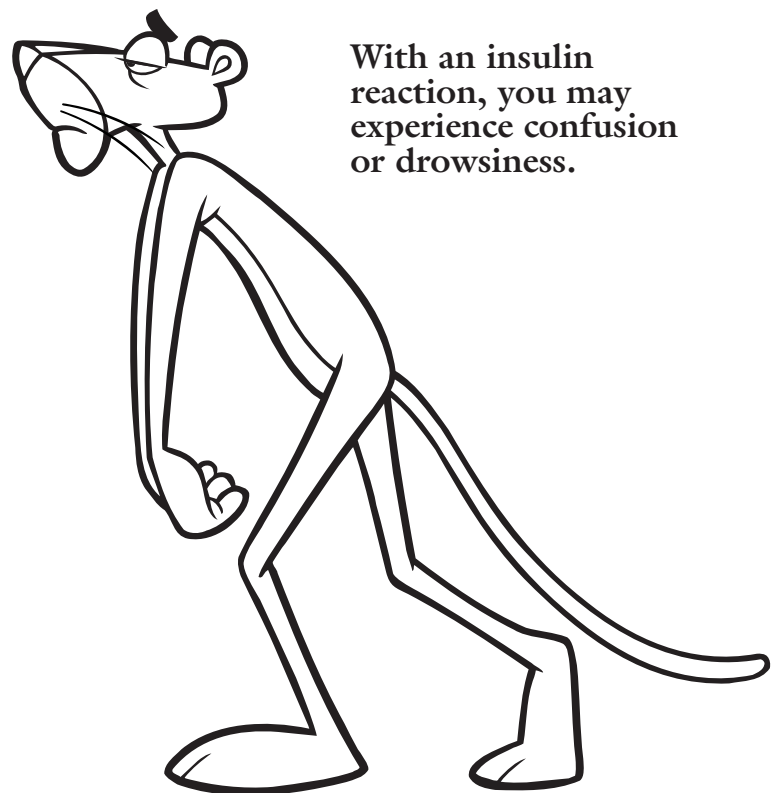
Prevention of low blood sugars (lows) is much wiser than having to treat the lows. When too many lows occur, the stored sugar and adrenaline (epinephrine) are drained. When this occurs, the usual symptoms of a low may not occur. In addition, over treatment (eating too much) after a low can cause a high blood sugar and can increase the HbA_{1c} value (Chapter 14). Paying attention to the seven causes of lows listed above will help to decrease the number of low blood sugars.

SYMPTOMS OF LOW BLOOD SUGAR


Usually the body gives a warning when low blood sugar or an insulin reaction is developing. **DIFFERENT PEOPLE GET DIFFERENT WARNINGS.**


These signs are the most common warnings of an insulin reaction:


- 🐾 **Hunger:** the person may either feel hungry or have an upset stomach (nausea)
- 🐾 **Shakiness:** the person's hands or body may feel shaky
- 🐾 **Sweatiness:** the person may sweat more than usual (often a cold sweat)
- 🐾 **Color:** the face may become pale, gray or red
- 🐾 **Headache**
- 🐾 **Confusion:** the person may feel or look spacey or may appear dazed




With an insulin reaction, you may experience confusion or drowsiness.

 **Drowsiness:** the person may yawn, feel sleepy or may have trouble thinking clearly; preschoolers frequently get sleepy

 **Behavioral changes:** changes in behavior are quite common; often the person may cry, act intoxicated, or they act angry, or they may feel weak or anxious

 **Double vision:** the person may see double or the pupils of the eyes may get bigger; the eyes may appear glassy; the whites of the eyes may look blood shot


 **Loss of consciousness**

 **Seizure or convulsion:** both loss of consciousness and convulsion occur late in the reaction. They are usually the result of not treating a reaction quickly enough.

The first four initial symptoms (hunger, shakiness, sweatiness and color) are due to the output of the “fight or flight” hormone, adrenaline (epinephrine is another name). Later symptoms are more related to the lack of sugar to the brain. Sugar is the main source of fuel for the brain. If the low sugar continues too long, the brain can be harmed. **It is particularly important to prevent severe low blood sugar in young children.** The brain grows very rapidly in the first four years of life.

NIGHTTIME LOWS

People may wake up with symptoms (infants may just cry) when lows occur during the night. *The symptoms may be the same as during the daytime although there are sometimes special clues:*

 **Inability to sleep or waking up alert, hungry, restless, moaning, etc.**


 **Waking up sweating**

 **Waking up with a fast heart rate**

 **Waking up with a headache**

 **Sleep walking**

 **Waking up feeling foggy-headed or with memory loss**

 **Low blood sugar, then an unusually high blood sugar or positive urine ketones (possible rebounding)**

IF ANY OF THESE DO OCCUR, TEST YOUR BLOOD SUGAR

IMMEDIATELY. If low, treat appropriately and call the doctor or nurse the next day. Also think about what was different the previous day (extra exercise, extra insulin, less food, etc.). This will allow planning ahead to prevent a low with a similar cause in the future. Preventing minor lows during the night is very important. **More than half of severe lows occur during the night.** One study in children found that 75 percent of severe lows occur during the night. The use of Lantus insulin (Chapter 8) and insulin pumps rather than insulins that peak during the night (e.g., NPH at dinner or bedtime), is now helping to reduce the nighttime lows.

RECOGNIZING A LOW BLOOD SUGAR

It is important to recognize a low blood sugar at the earliest possible time. By doing this, the reaction will not progress to a severe reaction. The common symptoms are listed above, but they can vary from person to person. The early warning signs of a reaction are due to the release of a hormone called adrenaline. Most people make it when they are excited or scared. Another name for this “fight or flight” hormone is epinephrine. It causes shakiness, sweating, dilated pupils, a rapid heart rate and other symptoms. During the day, it is released when the blood sugar falls below 70 mg/dl (3.9 mmol/L). People who have had diabetes for a longer period of time often make less of the protective hormones with low blood sugar, particularly at night. Some people tend to have only mild reactions and can easily detect symptoms. This seems to be more common in the first few years after diagnosis. Others may have more difficulty detecting symptoms. This seems to happen to people who have had diabetes longer or whose blood sugars run at more normal levels. A term, “**hypoglycemic**

unawareness” is sometimes applied to this condition, and it is discussed later in this chapter. Sometimes this is due to less adrenaline being available. In other cases, the lack of symptoms may be due to a slow or less dramatic fall in blood sugar levels, such as from 70 to 50 mg/dl (3.9 to 2.7 mmol/L) rather than from 170 to 50 mg/dl (9.5 to 2.7 mmol/L). Some people are less likely to detect low blood sugar in the morning because the sugar has fallen gradually during the night. Thus, adrenaline release and its symptoms did not occur. Symptoms are more likely to occur with a greater and faster fall of a blood sugar level.

Different children learn to tell if they have low blood sugar at different ages (see Chapter 18). It may be possible to train young children (or older people who have difficulty detecting low blood sugars) to recognize certain signs.

Parents may frequently need to remind a young child ...

“Remember how you felt shaky (or whatever the feeling was [one toddler would say, “There’s a tiger in my tummy.”]) and you came and told me? You did a good job! Remember to tell a grown up if you feel that way again.”

Ask the child how they feel when a low is found. This will reinforce their awareness of the symptoms. For very young children, the parent can often tell when the child has low blood sugar by the type of cry or fussiness he/she presents. Young children may be unaware of lows because they are busy playing. It is critical for adults to be aware of the need for snacks. A snack is especially important when a child discontinues naps during the day. It can be compared with an adult adding a new exercise program.

PREVENTING INSULIN REACTIONS (THINKING AHEAD)

It is important to prevent lows. This may allow the stores of epinephrine and glucagon

(and other “protective” hormones) to build up so they are available when needed.

Considerations in preventing insulin reactions:

Snacks can be important when:

- ✓ heavy physical exercise or all day exercise is planned: hiking, skiing, etc.
- ✓ the bedtime blood sugar is below 130 mg/dl (7.3 mmol/L).
- ✓ a person has a low (but be careful not to eat in excess).

Insulin:

- ✓ Reduce the dose of insulin which will be acting during the exercise period.
- ✓ Take the insulin injection AFTER a hot shower, bath or hot tub.
- ✓ For some people, with careful insulin dose adjustments, or using Lantus insulin or an insulin pump, extra snacks may not be needed (unless < 130 mg/dl [< 7.3 mmol/L] at bedtime).
- ✓ If doing corrections for high blood sugars at bedtime or during the night, use half the usual dose.

Blood sugar:

- ✓ Doing extra blood tests before, during and after periods of exercise will help to prevent lows and plan for future activity.
- ✓ Knowing a blood sugar level can help decide the amount of treatment needed.
- ✓ Do a blood sugar test during the night if it was a heavy exercise day.
- ✓ Always do a recheck if the value was low prior to the bedtime snack (to be certain it came back up).

False Reaction (False-Low)

A rapid fall in blood sugar can also cause an adrenaline release and symptoms even if a low blood sugar does NOT occur. We call this a false reaction. The symptoms of low blood

sugar occur, but the blood sugar is not low. A common example is when children eat lunch at school. Their blood sugar rises to a value of perhaps 250 mg/dl (13.9 mmol/L) after eating. They then go outside to play and the sugar might fall to 150 mg/dl (8.3 mmol/L) fairly rapidly. Adrenaline is released and the symptoms of having a reaction occur. Yet their blood sugar is 150 mg/dl (8.3 mmol/L) and they **DO NOT HAVE LOW BLOOD SUGAR**. It was just the rapid fall in blood sugar that caused an adrenaline release and made them feel like they were having a reaction. Since the sugar is not truly low, they do **NOT** need to drink sugar pop (soda) or juice, which will only raise their blood sugar. They might feel better if they ate some solid food, such as crackers or fresh fruit. It is important to remember that **THE ONLY WAY TO TELL IF SOMEONE HAD A RAPID FALL IN BLOOD SUGAR OR A TRULY LOW BLOOD SUGAR IS BY DOING A BLOOD SUGAR TEST**. Whenever possible, a blood sugar test should be done when the symptoms of low blood sugar occur.

TREATMENT FOR A LOW BLOOD SUGAR (INSULIN REACTION – see Tables 1 and 2)

The general rule is to **GIVE SUGAR IN SOME FORM AS FAST AS POSSIBLE**. If the reaction is not severe, do a blood sugar test first. If you are not able to do a blood sugar, then just give milk, juice or sugar pop. A person with diabetes won't get sick from excess sugar. It will just cause high blood sugar and then be passed in the urine. Insulin reactions come quickly and should be treated at once by the person, parent, friend or teacher.

Different forms of sugar can be carried with them to treat low blood sugar. **PEOPLE WITH DIABETES SHOULD CARRY SUGAR PACKETS OR GLUCOSE TABLETS IN THEIR POCKETS AT ALL TIMES FOR**

EMERGENCIES. Candy is too tempting. It also may be taken by other children. A special pocket for sugar packets can be sewn inside of gym shorts. Some people carry them in a jogger wallet attached to a shoe. Others slip packets in high stockings. It is often best to wrap the packet in foil or a plastic bag in case of leaks. Insta-Glucose™ comes in a tube and looks like toothpaste. It is available in most pharmacies. A tube of clear cake gel or honey tube from the grocery store will also work. After the blood sugar is back up, the person may want to eat some other longer-lasting solid food, like crackers or 1/2 a sandwich. The liquid sugar will be absorbed more quickly if the person waits before eating the solid food. Gradually, each person will become familiar with the type of reactions that occur. The person will learn how severe the reactions tend to be, when they are most likely to occur and how best to treat them.

Eventually, as a person becomes more familiar with diabetes, it may be possible to treat the various reactions differently. Remember, when possible, it is always wise to do a blood sugar if the reaction is not severe. If the level is above 60 mg/dl (3.3 mmol/L), it may be possible to treat the reaction with fresh fruit and solid food rather than milk, juice or sugar pop. **ALSO, REMEMBER THAT IT TAKES 10 TO 20 MINUTES FOR THE BLOOD SUGAR LEVEL TO RISE, AND IT IS WISE TO WAIT UNTIL THE VALUE IS BACK UP TO RETURN TO NORMAL ACTIVITY. IT IS IMPORTANT TO TEST THE BLOOD SUGAR AFTER THE LOW BLOOD SUGAR TO MAKE SURE IT HAS RETURNED TO NORMAL. SOME PEOPLE USE THE “RULE OF 15,” TAKE 15g OF CARBOHYDRATE AND TEST AGAIN IN 15 MINUTES. (THEN IF THE BLOOD SUGAR IS STILL BELOW 70 mg/dl [3.9 mmol/L], HAVE ANOTHER 15g OF CARBOHYDRATE.)** Some sources of quick-acting sugar with appropriate amounts for people of different ages are given in Table 1.

Table 1

Sources of Quick-Acting Sugar (Glucose) for Hypoglycemia

FOOD (Measured in grams of carbohydrate)	AGE		
	5 years or less (10g)	6-10 years (10-15g)	over 10 years (15-20g)
Glucose Tabs (4g each - check label; some = 5g)	2	3-4	4-5
Instant Glucose (1 tube = 31g)	1/3 tube	1/3-1/2 tube	1/2-2/3 tube
Cake gel (1 small tube = 12g)	1 tube	1 tube	1-2 tubes
Apple juice (1/2 cup = 15g)	1/3 cup	1/3-1/2 cup	1/2-2/3 cup
Orange juice (1/2 cup = 15g)	1/4-1/2 cup	1/2-3/4 cup	3/4-1 cup
Sugar (1 tsp = 4g)	2 tsp	3-4 tsp	4-5 tsp
Honey (1 tsp = 5g; do not use if child is less than two years old)	2 tsp	2-3 tsp	3-4 tsp
Regular pop (soda) (1 oz = 3g)	3 oz	4-5 oz	5-6 oz
Milk (12g/cup)	3/4 cup	1 cup	1 1/2 cup
LIFE-SAVERS® (2.5g each)	4	4-6	6-8
Skittles® (1g each)	10 pieces	10-15 pieces	15-20 pieces
Sweet Tarts® (1.7g each)	6 pieces	6-8 pieces	8-12 pieces
Raisins (1 Tbsp = 7 1/2g)	1-2 Tbsp	2 Tbsp	2 1/2 Tbsp

g = gram; tsp = teaspoon; Tbsp = Tablespoon

TREATMENT BY SEVERITY OF REACTION (see summary, Table 2):

- **Mild Reaction** (such as hunger at an unusual time, pale face, shakiness or irritability): If possible, do a blood sugar test. If below 60 mg/dl (3.3 mmol/L), give a glass of milk, a small glass (4 oz) of juice or sugar pop (soda). Wait 10-15 minutes for absorption of the liquid sugar and then give solid food (crackers, sandwich, fresh fruit, etc.). If the blood sugar is above 60 mg/dl (3.3 mmol/L), give just solid food.
- **Moderate Reaction** (very confused or spacey, very pale or very shaky): Give Insta-Glucose, Reactose™, Monojel™ or any source of simple sugar, such as sugar pop or juice. One-half tube of the Insta-Glucose can be placed between the cheeks and gums, and the person should be told to swallow. Do a blood sugar test as soon as it is possible. Always check for the risk of choking. Repeat the blood test after 10-15 minutes to make sure it is above 60 mg/dl (3.3 mmol/L). If not, repeat the initial treatment and wait another 10-15 minutes. Once the blood sugar has risen above 60 mg/dl (3.3 mmol/L) give solid food.
- **Severe Reaction:** If the person is completely unconscious, it is risky to put the concentrated sugar around the gums. It could get into the airway. It is better to just give glucagon as instructed in Table 3 in this chapter. Remember to do the blood sugar level as soon as possible. If the person does not improve after 10-20 minutes, it may be necessary to call 911 to get extra help. A second dose (same amount) of glucagon (from the same vial) can also be given. In the preliminary part of the Diabetes Control and Complications Trial (DCCT; Chapter 14), one of every 10 people (10 percent) receiving standard treatment had a severe reaction each year. One of four people (25 percent) on intensive treatment (including

insulin pumps) had a severe insulin reaction each year. Every family must have glucagon available and know how to use it (see Table 3). Our current hypoglycemia video may be helpful in understanding how to use glucagon. Adjustments in the next insulin dose may be necessary. Call your diabetes care provider if you need help making this adjustment.

We are concerned about any blood sugar below 60 mg/dl (3.3 mmol/L). When these are obtained frequently in routine testing, the insulin dose or snacks should be changed so that further low values do not occur. In a child under five years old, we are concerned about values below 70 mg/dl (3.9 mmol/L). When values are below these levels at the time of an insulin injection, we usually recommend not giving the usual amount of Humalog or NovoLog insulin (at least until after eating). If two or three values below 60 mg/dl (3.3 mmol/L) are present at the same time of day in the same week, a decrease in insulin dose is probably needed. **CALL THE DIABETES CARE PROVIDER IF HELP IS NEEDED.**

- **Hypoglycemic Unawareness:** Sometimes low blood sugars will be found during routine testing, and the person will not have had symptoms. This may be due to a very gradual fall in the blood sugar, or in young children, because they have not learned to recognize the symptoms. Some adults with very strict sugar control do not release adrenaline and may have the problem medically referred to as **“HYPOGLYCEMIC UNAWARENESS.”** In this case, they must not aim for such strict blood sugar control. Sometimes the insulin dose can be lowered. After blood sugars have been higher for two or three weeks, it may be possible to again recognize low blood sugars.
- **One-sided Weakness (paralysis):** It is not known why, but on rare occasions some people experience weakness (or paralysis) on one side of the body with a severe insulin


Table 2

Hypoglycemia: Treatment of Low Blood Sugar (B.S.)

Always check blood sugar level!

Low Blood Sugar Category	MILD	MODERATE	SEVERE
Alertness	<u>ALERT</u>	<u>NOT ALERT</u> Unable to drink safely (choking risk) Needs help from another person	<u>UNRESPONSIVE</u> Loss of consciousness Seizure Needs constant adult help (position of safety) <i>Give nothing by mouth (extreme choking risk)</i>
Symptoms	Mood Changes Shaky, Sweaty Hungry Fatigue, Weak Pale	Lack of Focus Headache Confused Disoriented 'Out of Control' (bite, kick) <i>Can't</i> Self-treat	Loss of Consciousness Seizure
Actions to take	<ul style="list-style-type: none"> ✓ Check B.S. ✓ Give 2-8 oz sugary fluid (amount age dependent) ✓ Recheck B.S. in 10-15 min. ✓ B.S. < 70, repeat sugary fluid and recheck in 10-20 min. ✓ B.S. > 70, (give a solid snack) 	<ul style="list-style-type: none"> ✓ <i>Place in position of safety</i> ✓ Check B.S. ✓ If on insulin pump, may disconnect or suspend until fully recovered from low blood sugar (awake and alert) ✓ Give Insta-Glucose or cake decorating gel - put between gums and cheek and rub in. ✓ Look for person to 'wake up' ✓ Recheck B.S. in 10-20 min. ✓ <i>Once alert</i> – follow "actions" under 'Mild' column <p>(Can use low dose glucagon: [1 unit per year of age], if very disoriented or out of control)</p>	<ul style="list-style-type: none"> ✓ <i>Place in position of safety</i> ✓ Check B.S. ✓ If on insulin pump, disconnect or suspend until fully recovered from low blood sugar (awake and alert) ✓ Glucagon: <i>can be given with an insulin syringe</i> like insulin Below 5 years : 30 units 5-16 years: 50 units Over 16 years: 100 units (all of dose) ✓ If giving 50 or 100 unit doses, may use syringe in box & inject through clothing. ✓ Check B.S. every 10-15 min. until > 80 ✓ <u>If no response, may need to call 911</u> ✓ Check B.S. every hour x 4-5 hours ✓ High risk for more lows x 24 hours <i>(need to ↑ food intake and ↓ insulin doses)</i>
Recovery time	10-20 minutes	20-45 minutes	<p>→ Call RN / MD ← and report the episode Effects can last 2-12 hours</p>

reaction. This can last for one to 12 hours, but eventually clears. It is particularly worrisome to doctors in emergency rooms. They often insist on a very expensive evaluation to prove that a stroke has not occurred.

 **Preventing Severe Lows:** A parent's greatest fear is a severe hypoglycemic reaction. This is often the biggest factor in not achieving good sugar control (a low HbA_{1c} level, Chapter 14). Unfortunately, the most common time for severe lows to occur is during the sleeping hours. This is because the adrenaline response to hypoglycemia is lower when sleeping and the person is not awakened when the blood sugar falls. The good news is that the incidence of nighttime severe lows is now decreasing. This is due to:

1. Probably the main reason for the decrease is the recent use of basal/bolus insulin therapy using insulin analogs. Most important is the flat Lantus basal insulin, contrasting with the large peaks of NPH or Lente insulins working during the night in past years. The rapid-acting analogs (H, NL, AP) also act during the post meal-time rises in blood sugar, rather than after the rise in blood sugar has already occurred (as occurs with human Regular insulin). This has decreased late-evening lows. The basal insulin from insulin-pump therapy also avoids the peaks during the night and helps to prevent lows.
2. The widespread use of home glucose monitoring has helped to reduce the severe nighttime lows. It has been shown that the risk is greater when the pre-bedtime glucose level is below 130 mg/dl (7.3 mmol/L). Extra snacks when the level is low obviously help if the value is really low at bedtime. It is important to do a repeat check later to make sure the blood sugar level has come back up (\approx 10 percent of blood sugars don't come back up).

3. Education is also a big factor. Families can "think-ahead" and reduce the insulin acting during the night if there has been unusual exercise that day. Parents will often get up at night and do a blood sugar on those nights.
4. Eventually there will be continuous glucose monitors that read accurately at low glucose levels and give alarms to alert families. The current monitors (see Chapter 7) give approximately one false alarm for every true low. This will improve and will someday allow us to prevent most severe lows. In the meantime, we have to do the best we can with the measures outlined above.

GLUCAGON

Glucagon is a hormone made in the pancreas, like insulin. However, it has the opposite effect of insulin and raises the blood sugar level. It is rarely needed, but we ask families to keep it on hand. The expiration date on the box should be checked regularly and, if outdated, a new bottle should be obtained. If a very severe reaction occurs and the person loses consciousness, glucagon should be given promptly. It can be stored at room temperature. It should not reach a temperature above 90° or below freezing. It can be taken in a cooler with the insulin and blood sugar strips for trips away from home.

Use of Glucagon

1. Severe Low Blood Sugar

Glucagon comes in a bottle containing 1 mg as a tablet or powder. There is a syringe containing diluting solution in the emergency kit. The method for giving glucagon is shown in Table 3. **This table may be copied and attached to the glucagon kit.**

Sometimes vomiting will occur after a severe reaction. This may be from the person's own glucagon output or from the glucagon that was injected. It usually does not last very long, and if the blood sugar is above 150 mg/dl (8.3

Table 3

Glucagon Injections – When To and How To

- Use when a person is unconscious or having a seizure.
- Keep in a convenient and known place. Store in a refrigerator during hot weather. Protect from freezing.
- Keep a 3cc syringe available or use the fluid-filled syringe in the emergency kit. An insulin syringe and needle can also be used (preferably a 1.0cc syringe). Some people tape the syringe to the kit so they have this readily available (see video on hypoglycemia).
- If you have the emergency kit, the fluid does not need to be withdrawn from bottle 1 (diagram at right) as it is already in the syringe. Put the liquid into the glucagon vial and swirl gently to mix. The large syringe that the liquid was in can also be used to give the glucagon injection. Draw up the dose indicated below. Clear the air pointing the needle upward.
- Withdraw from the mixed glucagon bottle:
If using an insulin syringe, put needle into center of stopper.
(Estimate dose if using the emergency kit syringe.)
0.3cc (30 units) for a child less than six years old
0.5cc (50 units) for a child 6-18 years of age
1.0cc (100 units) for an adult over 18 years of age
- If using the syringe that comes in the emergency kit, inject into deep muscle (in front of leg or upper, outer arm) though it is OK to inject into the subcutaneous fat. Inject through clothing if needed. If the glucagon is drawn into an insulin syringe then give it just as you would an insulin shot. If a blood sugar has not yet been done, it can be done now.
- Wait 10 minutes. Check blood sugar. If still unconscious and blood sugar is still below 60 mg/dl (3.3 mmol/L), inject second dose of glucagon (same amount as first dose).
- If there is no response to the glucagon, or if there is any difficulty breathing, call paramedics (or 911).
- As soon as he/she awakens, give sips of juice, sugar pop or sugar in water initially. Honey may help to raise the blood sugar for children over the age of 1 year. After 10 minutes, encourage solid food (crackers and peanut butter or cheese, sandwich, etc.).
- Notify diabetes care team of severe reaction prior to next insulin injection (so dose can be changed if needed). Complete recovery may take 1-6 hours.

Please copy this page as often as you wish. Tape a copy to the box of glucagon.



1.
Insert
1/2cc of
air into
fluid
bottle
(1cc
won't fit).
Rotate to
mix.



2.
Draw out
1cc of
fluid from
bottle.



3.
Inject the
1cc of
fluid into
bottle
with
tablet.
Mix.

mmol/L), it is not a big problem. If the person is lying down, the head should be turned to the side to avoid choking. Urine or blood ketones should be checked (see Chapter 5) as they can sometimes also form. If the family is concerned about the ketones, if the blood sugar did not rise, or if the vomiting continues, the diabetes care provider should be called.

2. Low Blood Sugar and Vomiting

Sometimes the blood sugar can be low (< 60 mg/dl [< 3.3 mmol/L]) and the person cannot keep any food down. Glucagon can be mixed (Table 3) and given just like insulin – using an insulin syringe. The dose is one unit per year of age up to age 15 years. Older people can just use the 15 units.

For example: a five-year-old would get five units or a 10-year-old would get 10 units.

If the blood sugar is not higher in 20-30 minutes, the same dose can be repeated. This treatment has saved many ER visits.

DELAYED HYPOGLYCEMIA

Delayed hypoglycemia is also discussed in Chapter 13 on exercise. It usually occurs from 4-12 hours after exercise, however it can occur up to 24 hours after the exercise. For some people, blood sugars can be high after exercise. This is due to the normal response of releasing adrenaline during exercise (or from the extra snacks). Adrenaline causes sugar to come out of the liver and raise the blood sugar. At some point after the exercise, the adrenaline levels go back down (sometimes not until the time of sleep), and the sugar moves back into the muscle and liver. The result can be a low blood sugar or “**delayed hypoglycemia.**”

Prevention involves lowering the insulin dose. This must be done after heavy exercise even though the blood sugar may be high. Taking extra carbohydrate at bedtime (even with high blood sugar) may also be helpful. Exercise is essential for the heart and cardiovascular system. Therefore, it is important to always be thinking about how to best prevent post-exercise lows.

RECORD ALL INSULIN REACTIONS

Record insulin reactions in your record book. Many families circle all values < 60 mg/dl (< 3.3 mmol/L). Try to identify and record the cause of any low or high blood sugars (Table 4). If more than two mild insulin reactions occur in a short time period, call the diabetes care provider to adjust the amount of insulin. It is usually possible to call during office hours, but if a severe reaction occurs, call the care provider prior to giving the next regularly scheduled insulin shot.

MEDICAL IDENTIFICATION

In case of a severe insulin reaction, EVERYONE needs to know about the diabetes. This includes teachers, strangers, police, co-workers, friends and medical personnel. The person with diabetes should wear a bracelet or necklace with this information. A card in the wallet is not good enough; this may not be found by paramedics. A diabetes ID card can also be stapled to the registration of the car in the glove compartment. Bracelets or necklaces can be found at most pharmacies or medical supply houses.

The MedicAlert Foundation
(provides MedicAlert tags)
2323 Colorado Avenue
Turlock, California 95382
888-633-4298
www.medicalert.org

The MedicAlert tag includes a number that can be called 24 hours a day for information concerning both the person and the doctor. The minimum charge for the bracelet or necklace and keeping the information readily available 24 hours per day is \$35. Then the annual membership renewal after the first year is \$20.

A bracelet, necklace or medallion with your personal medical information (name, condition and medications) can be engraved and ordered through American Medical Identifications, Inc.

The prices for an identification tag start at \$21.95.

American Medical Identifications, Inc.
P.O. Box 925617
Houston, Texas 77292
800-363-5985
www.americanmedical-id.com

Colorful sports bracelets are sometimes preferred and can be ordered from FIFTY 50 PHARMACY. The cost per bracelet ranges from \$9.95 to \$14.95 plus \$4.50 for shipping. Mail your order with payment to:

FIFTY 50
1420 Valwood Parkway, Suite 120
Carrollton, Texas 75006
Phone: 800-746-7505
www.fifty50.com

Medical charms are also popular. These work well for attaching to the toddler shoe laces. The addresses are:

Miss Brooke's Company
P.O. Box 558
Bryant, Arkansas 72089
Phone: 888-417-7591
www.missbrooke.com

For those who desire additional choices, see www.tah-handcrafted-jewelry.com.

For people who will not wear a necklace or bracelet, a watch or shoe tag may be the next best choice. There are medallions that stick to the front of a wallet, cell phone, insulin pump, etc. These can be purchased from LIFETAG, Inc., 888-LIFETAG or www.lifetag.com or lifetag2@att.net.

Toddlers should not wear a neck chain (too risky), but they often do well with ankle bracelets, charms or a medallion laced in the shoe. The sports bracelet described above works quite well around the ankle.

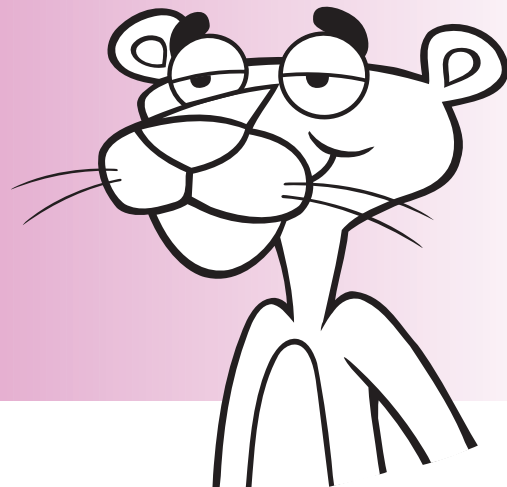
Table 4 Some Factors That Change the Blood Sugar

Lowers:

- ❧ Insulin
- ❧ Hot bath, showers or hot tubs may increase insulin absorption and cause a low blood sugar
- ❧ Exercise, although for some people, the values may be higher immediately following exercise
- ❧ Less food or eating late

Raises:

- ❧ Sugar intake
- ❧ Glucagon
- ❧ Hormones such as glucagon, adrenaline, growth hormone and cortisol (prednisone); their action is opposite to that of insulin
- ❧ Illness (which may cause ketones)
- ❧ Rapid growth; teenagers usually require more insulin with increased growth
- ❧ Menstrual periods (may cause ketones)
- ❧ Emotions such as anger and excitement; some younger children can have lower blood sugars with extra excitement
- ❧ Inhalers given for asthma which have epinephrine derivatives in them



DEFINITIONS

Adrenaline (used collectively to include epinephrine and non-epinephrine): The excitatory hormone. This is released with a low blood sugar or a rapid fall in blood sugar, which then causes the symptoms of low blood sugar (shaking, sweating and pounding heart).

Glucagon: A hormone also made in the pancreas (like insulin) that causes the blood sugar to rise. It is available to inject into people when they have severe (unconscious) insulin reactions.

Hypoglycemia: The term used for a low blood sugar (insulin reaction).

Hypoglycemic unawareness: The term used to describe low blood sugars without the person having any warning signs or symptoms.

Insta-Glucose, Monojel, or Reactose: Source of concentrated sugar that can be purchased. It can be given to a person in case of low blood sugar.

Ketoacidosis (Acidosis): What happens in the body when not enough insulin is available. Blood sugar is usually high at this time. Moderate or large ketones (acetone) are present in the urine. See Chapter 15.

Rebounding (Somogyi reaction or bouncing): The process of blood sugars falling to low levels and then rebounding to high levels. Ketones may sometimes be present when this occurs.

Seizure (convulsion): Loss of consciousness with jerking of muscles. This can occur with a very severe low blood sugar (insulin reaction).

QUESTIONS AND ANSWERS FROM NEWSNOTES

Q Do we still need to keep glucagon?

A YES.

The current statistic (from three studies) is that four percent to 13 percent of standard insulin-treated patients have one or more severe episodes of hypoglycemia each year. With intensive insulin therapy in the DCCT, 25 percent (one in four) of subjects had a severe reaction each year. Glucagon should be given anytime there is loss of consciousness without being able to arouse the person. If paramedics are to be called, it is still wise to give the glucagon before they arrive.

The biggest change in giving glucagon is that two studies have shown it will work just as fast when given subcutaneously (the same place as insulin) as when given into muscle. People used to think it always had to be given into muscle.

The Eli Lilly Company Glucagon Emergency Kit comes with the diluting solution already in the syringe ready to be injected into the bottle with the powdered glucagon for mixing. The syringe and needle they provide can then also be used for the subcutaneous or intra-muscular injection (either is fine).

Some people have rebounding, a high blood sugar and even ketones after glucagon. Vomiting can also occur, but these side effects can be handled.

Q Since I have changed to three injections of insulin per day, and my Hemoglobin A_{1c} has come down, I don't seem to feel low blood sugar reactions. Is this common?

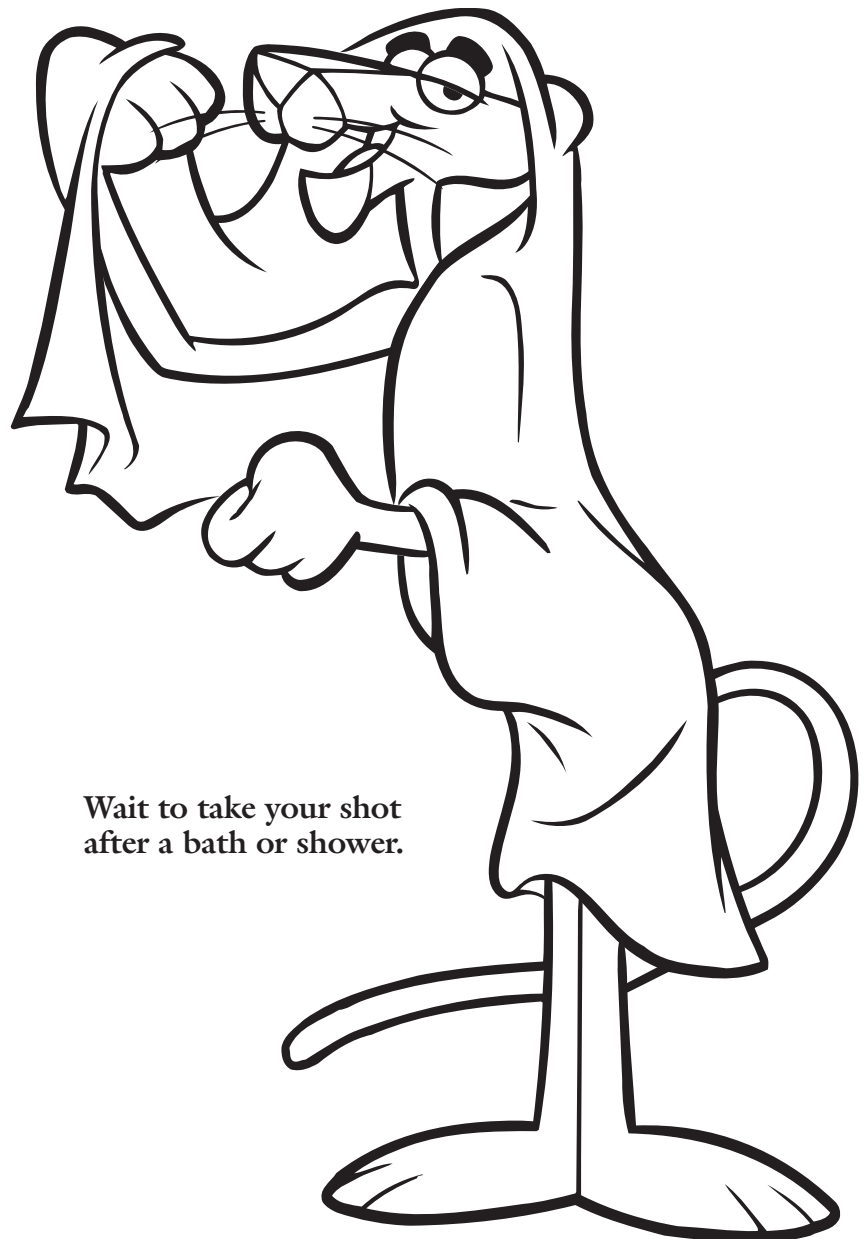
A Unfortunately, this is not unusual. It is called hypoglycemic unawareness. People on intensive insulin therapy often do not make the counter-regulatory

hormones as effectively as they did previously. Adrenaline (epinephrine) output is sometimes reduced in people with very tight sugar control. This is probably the most important hormone, which normally increases with low blood sugar and then causes the symptoms (shakiness, sweatiness, rapid heart beat, etc.). Sometimes it is possible to reduce the insulin dose to let the blood sugars run a bit higher for two or three weeks in order to regain the ability to feel low blood sugars.

Other hormones which normally help to raise the blood sugar may also have reduced output following intensive insulin therapy. Production of the hormone glucagon, made in the pancreas like insulin (normally), is reduced in most people who have had diabetes for longer than one year. Therefore, it also may not be available to help raise the blood sugar. It is important to let your diabetes care provider know if you are having low blood sugars without symptoms.

Q We were recently told at a clinic visit that our child should not be given insulin just prior to a hot bath, shower or hot tub. Would you please explain the reason for this?

A The hot bath or shower (or hot tub) increases the blood flow to the skin. As more blood flows to this area, more insulin is rapidly taken up by the blood (probably primarily Humalog, NovoLog, Apidra or Regular insulins). This can then result in a severe low blood sugar. The answer is to **always take the insulin after the hot shower or bath.** The shower or bath should not be taken in the 30-90 minutes after Humalog/NovoLog/Apidra or in the four hours after taking Regular insulin. This may help to prevent a severe low blood sugar.



Wait to take your shot after a bath or shower.