

Take A BITE Out of Hypoglycemia

10 Proven Strategies for Cutting Down on Low Blood Sugars

By Gary Scheiner MS, CDE

Is it really possible to have too much of a good thing? Take my own “good things” list as an example. I really enjoy popcorn at the movies, lying on the beach, taking my kids to ballgames, and being intimate with my wife. Good things, yes, but only in moderation. If left unchecked, I might become a broke, obese, sunburned sex maniac.

For millions of people with diabetes, insulin and pancreas-stimulating medications (sulfonylureas and meglitinides) are very good things. Without them, blood sugar levels would become wildly out of control. But when taken in too great a quantity, they can produce the opposite extreme: low blood sugar, or hypoglycemia.

Technically, hypoglycemia is defined as a blood glucose level below 60 or 70 mg/dl (it varies depending on which book you read and where your doctor studied). At this low level, many of the body’s key organs, especially the brain and nervous system, become deprived of the fuel they need to function properly.

The Great Limiting Factor

Hypoglycemia presents a serious threat to a person’s physical, intellectual and emotional well-being. It has been called “The Greatest Limiting Factor in Diabetes Management”. Were it not for the risk of hypoglycemia, we could simply load up on insulin or pancreas-stimulating medications and keep the blood sugars from ever rising too high. Unfortunately, hypoglycemia does exist, and it creates a number of problems.

First and foremost is the risk to one’s personal safety. The brain is one of the first organs to be affected by low blood sugar. When the brain receives inadequate fuel, confusion and poor decision-making often result. This can easily lead to life-threatening accidents, loss of consciousness, coma and possibly even death if left untreated for too long.

Personal performance is another area affected by hypoglycemia. The ability to perform in sports, school, work and social situations is affected negatively by low blood sugar. In many ways, having a low blood sugar is like being drunk – it affects our movements, our thoughts, and virtually everything we say and do.

The brain’s ability to detect low blood sugar is an important protective mechanism. However, this mechanism is blunted by repeated bouts of hypoglycemia. With each low, the brain becomes less and less sensitive to the lows – perhaps not recognizing them at all. Without the brain’s reaction to the low, a person with diabetes may remain completely oblivious to the problem. This condition, known as *hypoglycemia unawareness*, puts a person at risk for a severe low (loss of consciousness, etc.) due to the lack of an “early warning” system.

In extreme cases, hypoglycemia can even cause permanent brain damage. With every episode of hypoglycemia, some brain cells die. Considering that we’re starting with *billions* of brain cells, a few here and there is not likely to make any significant difference. However, repeated bouts of severe/prolonged

hypoglycemia have the potential to create noticeable cognitive deficits.

In many instances, low blood sugar also causes anxiety or embarrassment. Some people with diabetes worry about the impression left on others by a hypoglycemic episode. Does it make me look sick? Different? Like I'm not "in control"? The fear of being low in a social situation leads many people toward the opposite extreme: severely high blood sugars around-the-clock.

Because of the need to eat extra food to treat low blood sugar, weight gain can also become an issue. Hypoglycemia can produce a werewolf-sized appetite, resulting in the consumption of excessive calories for several hours. If low blood sugars occur frequently or are consistently over-treated, weight gain will likely result.

Additionally, did you know that low blood sugars can produce significant highs? A "rebound," as this is called, is the body's natural hormonal response to the low. Once hypoglycemia is detected by the brain, adrenaline starts to flow into the bloodstream along with other blood-sugar-raising "counterregulatory" hormones such as cortisol and glucagon. Collectively, these hormones can cause the blood sugar to rise and stay high for many hours following a bout of hypoglycemia.

What Should I Aim For?

I think we're all in agreement that hypoglycemia something to avoid. Unfortunately, with our current state of medical technology, it is usually not realistic to achieve tight blood glucose control without *any* episodes of hypoglycemia. This holds true for everyone with Type-1 diabetes, and many people with Type-2 diabetes who use insulin, sulfonylureas or meglitinides.

Diabetes Medications That Can Cause Hypoglycemia	
Insulins	Oral Medications
Humalog	Amaryl +
Novolog	Glucotrol +
Apidra	Diabeta +
Regular	Glynase +
NPH	Micronase +
Lente	Prandin *
Ultralente	Starlix *
Lantus	Glucovance +
Levemir	Diabinese +
70/30 mix	Tolinase +
75/25 mix	Orinase +

* indicates meglitinide + indicates sulfonylurea

So what is realistic? For starters, accept that an occasional low can occur. It is reasonable to experience a couple of mild low blood sugars each week – lows that you can detect and treat without the need for any outside assistance. It is never acceptable to experience a severe episode of hypoglycemia (a low that causes a loss of consciousness, seizure or unresponsiveness). Following any low that requires emergency medical assistance, additional self-management education and greater attention to control is always in order. A change in therapy may also be necessary.

If you are checking your blood sugars at each mealtime and bedtime, try to have no more than 10% of your readings below 70 mg/dl (or 80 for very young children) at each test time. For example, if you collect your readings for an entire month (31 days) and find the following:

- Pre-Breakfast: 3 lows (10%)
- Pre-Lunch: 2 lows (6%)
- Pre-Dinner: 0 lows (0%)
- Bedtime: 5 lows (16%)

The conclusion would be that there are too many lows at bedtime. A reduction in the

dinnertime insulin (or medication) may be in order. The number of lows at breakfast, lunch and dinner appears to be acceptable.

Top-10 Hypo Prevention Strategies

Part of avoiding low blood sugar involves, how shall I put this, just dumb luck. That's why we usually consider it acceptable to have lows up to 10% of the time. But the majority of hypoglycemia avoidance is well within your control. A number of strategies for preventing lows are listed below:

1. Match your insulin/medication program to your needs. The “peaks and valleys” in your insulin should coincide with the peaks and valleys in your blood sugar levels. This usually means utilizing a “basal/bolus” insulin approach – a long-acting insulin (Lantus or Levemir) working at a low level throughout the day and night, and rapid-acting insulin at each meal/snack. Most adults experience a “dawn phenomenon” in which more basal insulin is needed during the early morning hours, and less in the middle of the day. Daytime doses of intermediate insulin peak in the middle of the day or too early at night and increase the risk for hypoglycemia at these times.

Likewise, mealtime insulin should match the typical glycemic rise induced by dietary carbohydrates. Most starchy and sugary foods cause a rapid blood sugar rise, with a peak occurring about an hour after eating. Rapid-acting insulin analogs (Humalog, Novolog, Apidra) do a nice job of covering the rapid blood sugar rise and then getting out of the way so as not to cause hypoglycemia later on. Regular insulin tends to peak too late and last too long, increasing the risk of hypoglycemia several hours after eating.

For those taking pancreas-stimulating medications, be aware that some – the sulfonylureas -- work constantly (whether you are eating or not), while others, the meglitinides (Prandin, Starlix), work for a short period of

time (just after eating). Obviously, the meglitinides are less likely to cause between-meal lows.

2. Set an appropriate target. Work with your doctor to determine an ideal pre-meal blood sugar level. This is the level that you “aim for” when making your mealtime dosing decisions. For most people with diabetes who take insulin, this is usually 100, 120 or 140 mg/dl. A target below 100 does not leave much margin for error, and may result in a greater frequency of low blood sugars. For those with Type-2 diabetes who use oral medications, targets of 80, 100 or 120 are common.

3. Take a look at your schedule. Are you eating at the times your insulin or medication is working its hardest? For those using insulin pumps, this is not generally an issue as long as the basal rates are set properly. For those using a long-acting basal insulin (Lantus, Levemir), there may be a tendency for the blood sugars to drop gradually during the daytime, so it will be necessary to eat at regular intervals. For those using daytime NPH or Lente, meal timing is a major issue: These insulins begin to work hard approximately four hours after injection, so carbohydrates must be consumed in specific amounts at specific times. For those taking sulfonylureas, it is not a good idea to skip or delay meals since the medication is stimulating extra insulin production throughout the day and night.

4. Use caution when “covering” high blood sugars. Each unit of insulin will cause the blood sugar to drop by a certain amount, but the amount may vary by time of day. For many people, each unit lowers the blood sugar more at nighttime than during the day. Make sure your “correction” doses take this into account. Also, be certain to account for “unused” insulin – the amount that is still active from the previous dose. With rapid-acting insulin analogs, it usually takes about 4 hours for the insulin's activity to fade completely. Regular

insulin takes about 5-6 hours. A blood sugar reading taken 2 hours after a meal can be misleading since the insulin still packs a good deal of punch and the blood sugar should

continue to drop. In *most* cases, rapid-acting insulin analogs work as follows:

Time since insulin was given:	½ hour	1 hour	1 ½ hrs	2 hrs	2 ½ hrs	3 hrs	3 ½ hrs	4 hrs
Insulin “used up”:	10%	30%	50%	70%	80%	90%	95%	100%
Insulin Remaining:	90%	70%	50%	30%	20%	10%	5%	0%

For example, if you gave yourself 5 units for a 4pm snack, then check your blood sugar at 6pm, you still have 30% of your insulin remaining. 5 units X 30% = 1.5 units. This amount should be deducted from any dose that you are about to give yourself.

For the sake of simplicity, some people choose to assume that one-fourth of their insulin is “used up” each hour:

Time Since Insulin was Given:	1 hour	2 hours	3 hours	4 hours
Insulin used up:	25%	50%	75%	100%
Insulin Remaining:	75%	50%	25%	0%

For those who take daytime intermediate-acting insulin, it can be difficult and dangerous to correct for high blood sugars until the intermediate-acting insulin has worn off. NPH and Lente insulins do not always absorb or act in a predictable manner. If they happen to be peaking late one day, you may accidentally give too much insulin to cover a high reading at lunchtime or mid-afternoon. In general, in order to avoid hypoglycemia, it is best to wait at least 10 hours after taking NPH or Lente before correcting for high readings.

5. Adjust doses based on carb intake. Of everything you eat, carbohydrates have the most profound influence on blood sugar levels. Virtually all the carbs in our diet convert into blood glucose fairly rapidly. If your carbs vary,

your insulin and medication doses should vary as well.

Don’t fall into the habit of thinking that carbs act the same way throughout the day. Most people need different doses of insulin or oral medication to cover their carbs at different meals. This is caused by varying levels of stress, insulin sensitivity and physical activity throughout the day.

And if you’re going to go to the trouble of matching your doses to your carb intake, be sure that your carb counts are reasonably accurate. Look up the exact carb count for the foods you are unfamiliar with. (an excellent resource for looking up carb counts is “The Doctor’s Calorie, Fat and Carbohydrate Gram Counter, available in book or CD-Rom versions at my web site, www.integrateddiabetes.com, or by calling 877-SELF-MGT). Measure your portions. And don’t forget to deduct all of the fiber grams and half of the sugar alcohols from the total carb count; fiber is a carbohydrate that does not digest, and sugar alcohols only raise the blood sugar half as much as ordinary sugars.

6. Extend/delay your mealtime insulin when necessary. Not all foods digest at the same rate, so in some instances you will need to prolong your insulin’s action in order to prevent hypoglycemia after eating. For example, foods with a low glycemic index value (such as pasta, beans and dairy products) usually take several

hours to digest. With these kinds of foods, it might take 2-4 hours to see a significant blood sugar rise. If you were to take your full dose of rapid-acting insulin with your meal, the insulin would peak long before the blood sugar rises, resulting in hypoglycemia. To add insult to injury, the blood sugar may rise significantly several hours later once the mealtime insulin stops working and the food finally kicks in.

It is advisable to extend or delay the insulin when consuming food over a prolonged period of time – such as a holiday meal or a bucket of popcorn at the movies. Very large food portions, also take a long time to digest. Think of your stomach as an hourglass and the food as sand trickling through. A very large portion of food, especially with a high fat content, might take several hours to pour through the stomach and into the intestines where it can be absorbed into the bloodstream, whereas a small portion will pour through relatively quickly.

In addition, anyone who suffers from gastroparesis – a nerve condition that causes the stomach to empty more slowly than usual – would benefit from extending/delaying their mealtime insulin.

The extend/delay can be accomplished in a number of ways. For those who take injections, the mealtime rapid-acting insulin can be taken 15-30 minutes *after* eating instead of before or during the meal. The injection could also be broken into a few parts – 50% taken with the meal, and 50% taken an hour or two later. Alternatively, Regular (R) insulin can be used instead of Humalog, Novolog or Apidra when a slow-digesting meal is consumed.

For those who use an insulin pump, there are many options for prolonging/delaying the action of the mealtime bolus. Almost all pumps allow the bolus to be delivered over an hour or two (using the Square Wave or Extended boluses feature). Some allow a portion of the bolus, such as 33%, to be delivered immediately while

delivering the remainder over the next couple of hours (Dual Wave or Combination boluses).

7. Adjust for physical activity. Or, as my wife like to remind me, “Think before you stink”. With the exception of short bursts of high-intensity exercise, physical activity of almost any kind will lower blood sugar levels by accelerating the uptake of glucose by muscle cells. Note the phrase *physical activity* and not *exercise*. Physical activity includes exercises such as jogging, sports participation and almost any form of physical conditioning. It also includes occupational activities and chores such as heavy filing, carpentry, cleaning, shopping, yardwork and home/auto repair. Recreational activities such as golf, gardening, leisurely walking or cycling, and yes – even sex – fall under the heading of physical activity.

It is reasonable to reduce your insulin or oral medication when physical activity is anticipated. There is no way to tell exactly how much the activity will lower your blood sugar, so start out by reducing your dose by 33% when activity is planned within 90 minutes of the meal. For more intense activity, a 50% (or greater) reduction can be made; for less intense activity, a 20 or 25% reduction may be sufficient.

For activity that will take place before or between meals, it makes more sense to check your blood sugar and take a snack beforehand. Again, the amount of the snack depends on many variables, including your body size, the nature of the activity, and the timing/amount of your last dose of insulin or oral medication. As a general rule, those who weigh 100 lbs will need approximately 15-25g carb per hour of activity to keep the blood sugar steady. Those who weigh 150 lbs will need 20-30g; 200 lbs: 25-35g; 250 lbs: 30-40g, and so on.

Don't forget that physical activity that is very intense and prolonged can produce a blood sugar drop several hours later. This is called

“Delayed Onset Hypoglycemia”. For example, many people find that their blood sugar drops during the night following heavy daytime exercise.

I find that my blood sugar drops before lunch whenever I played full-court basketball the night before.

It is important to check your blood sugar more often than usual for up to 24 hours following very heavy exercise. If you detect a pattern of delayed onset hypoglycemia, you can prevent it by consuming extra carbohydrates or lowering your insulin or oral medication at the appropriate time. To prevent the late-morning drops following nighttime exercise, I simply lower my insulin dose at breakfast by 33%.

8. Beware of alcohol’s effects. While many alcoholic drinks contain carbohydrates that raise blood sugar levels fairly quickly, the alcohol itself has a tendency to make blood sugars drop several hours later. This is because alcohol inhibits the liver’s secretion of glucose into the bloodstream. When the liver is releasing less sugar than usual, the blood sugar level may drop.

It is recommended that insulin/medication be reduced, or extra carbohydrates be consumed, after drinking. Those who use insulin pumps can easily lower their basal insulin by 40-50% for approximately 2 hours for every drink consumed. Those who take NPH or Lente at night can lower their dose by a similar percentage after drinking. If you choose to eat to offset alcohol’s blood sugar lowering effects, choose a food that has a lasting effect such as ice cream, peanut butter or yogurt. Fifteen to thirty grams of carb at bedtime should serve as a good starting point.

9. Check often. Managing blood sugars is a lot like driving a car. If you pay attention and keep your hands on the wheel, you’re not likely to

veer off the road. Close your eyes or let go of the wheel for too long and you’ll probably wind up in a ditch. Likewise, the more often you check your blood sugar, the less likely you are to suffer from extreme highs and lows. Checking before breakfast, lunch, dinner and bedtime on a consistent basis, *whether or not you take insulin or medication at those times*, will allow you to catch potential problems before they become too serious. A blood sugar of 75 at lunchtime should alert you of the need to either reduce your insulin/medication or have some extra carbs. Without knowing so, you could easily wind up hypoglycemic in the afternoon.

10. If it’s broke, fix it. Take a look at your blood sugar values every couple of weeks. If you see too many lows at a particular time of day, do something about it! Don’t keep doing the same things over and over, expecting different results. Perhaps you need to reduce, change or eliminate your medication. Maybe your insulin-to-carb ratio at the previous meal needs to be adjusted. Or is it possible that you just need to eat more carbs when you are more active?

As the saying goes, the one constant in life is change. The same goes for your diabetes self-care. What worked yesterday may not work today, so don’t hesitate to make changes if you see a pattern of low readings. A single low could be caused by just about anything, but a pattern of lows indicates a problem with your current program.

Strategize to Minimize

Living with diabetes can be a real pain in the rear sometimes (no pun intended). And nothing makes diabetes more annoying and disruptive in our daily lives than low blood sugar. Take the lows seriously. They present a greater threat to your well being than any single high reading.

While it may not be possible to eliminate the lows entirely, the 10 strategies listed above should allow you to keep their frequency and severity in check.

It may not be possible or practical to implement all 10 strategies at once, so take them one at a time. Try focusing on one each week, and then add another the next week. If in 10 weeks you're not completely satisfied, simply return this issue along with a completed blood glucose logbook for a full refund. Or better yet, give me a call or send an e-mail. Maybe we can figure it out together.

Editor's note: Gary Scheiner is a Certified Diabetes Educator with a private practice near Philadelphia. He provides diabetes self-management education and blood glucose control consulting for individuals throughout the U.S. and abroad through his web site (www.integrateddiabetes.com) and toll-free hotline (877-SELF-MGT). Feel free to contact him with questions or for more information at garyscheiner@prodigy.net.