**Blood Sugar Testing**

When you have diabetes, it’s important to know how much sugar is in your blood. Knowing your blood sugar level will:

- Help you understand the balance of food (carbohydrates), insulin and exercise.
- Help you and your diabetes team to make changes to your diabetes plan.
- Help you identify low blood sugar.

You should check your blood sugar **before each meal and before going to bed** (a minimum of four times per day).

It is important to record your blood sugars, most commonly in your log book. This will help everyone (you, your family, the educators and doctors) recognize patterns in blood sugars and help decide how much insulin you need. In time, families are encouraged to make insulin dose changes on their own, based on the blood sugar patterns they are seeing. **Bring your blood sugar records to each clinic visit.**

**Target Blood Sugar Ranges:**

Examples of target ranges (before meals) are listed below. Your range may be individualized by your diabetes team. Remember that it’s impossible to be in target all the time. Your blood sugar should be in the target range about 50% of the time.

<table>
<thead>
<tr>
<th></th>
<th>Daytime Targets:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>&lt;18 years of age:</strong></td>
<td>4-8 mmol/L</td>
</tr>
<tr>
<td>Consider 6-10mmol/L in younger</td>
<td></td>
</tr>
<tr>
<td>children or in children who</td>
<td></td>
</tr>
<tr>
<td>have had severe or excessive</td>
<td></td>
</tr>
<tr>
<td>hypoglycemia or hypoglycemia</td>
<td></td>
</tr>
<tr>
<td>unawareness.</td>
<td></td>
</tr>
</tbody>
</table>

*Diabetes Canada 2018 Clinical Practice Guidelines*

Your target blood sugar range **before going to bed** may be set slightly higher than your daytime targets to help maintain adequate blood sugar levels while sleeping. Targets at bedtime depend on the type of insulin being used and reflect the action of that insulin.

|                               | Bedtime Targets: |
|                               |                  |
| NPH/N                          | 6-10 mmol/L      |
| Glargine:                      | 6- 8 mmol/L      |
| Insulin Pump:                  | 6- 8 mmol/L      |
Making Sense of Hemoglobin A1c

- Hemoglobin A1C is a simple blood test that is an indirect measure of your average blood sugar (glucose) level for the past 3 months.

- Hemoglobin is a protein inside red blood cells that carries oxygen from the lungs to all parts of the body. Hemoglobin joins with sugar in the blood making glycosylated hemoglobin. The more sugar there is in the blood, the more hemoglobin will join with it. Once joined, hemoglobin and sugar stay that way for the life of the red blood cell-about 3 months. One special type of hemoglobin, A1C, has the most sugar attached to it and that is why it is measured.

- Hemoglobin A1C should be measured at the diabetes clinic every 3-4 months. It is not meant to replace daily blood sugar testing. Blood sugar testing helps you decide how to treat diabetes at that moment. The more often you achieve target blood sugar levels, the lower the A1C will be.

- Keeping A1C in target range can decrease your risk of diabetic ketoacidosis (DKA) and long term complications such as damage to small blood vessels in your eyes, kidneys, heart and feet. If your A1C is higher than target it means that you have a higher average blood sugar level and something in your diabetes plan needs to be changed. Work with your diabetes team to find a plan that best suits your needs.


<table>
<thead>
<tr>
<th>HbA1C Level (%)</th>
<th>Average blood sugar Level (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased risk for Acute and Long-term Complications. 12%</td>
<td>19.5</td>
</tr>
<tr>
<td>11%</td>
<td>17.5</td>
</tr>
<tr>
<td>10%</td>
<td>15.5</td>
</tr>
<tr>
<td>9%</td>
<td>13.5</td>
</tr>
<tr>
<td>8%</td>
<td>11.5</td>
</tr>
<tr>
<td>Decreased risk for long-term complications 7%</td>
<td>9.5</td>
</tr>
<tr>
<td>6%</td>
<td>7.5</td>
</tr>
</tbody>
</table>
Insulin Schedules and Dosing

Insulin is always given under the skin (subcutaneously) with a needle. There are a number of different types and brands of insulin, and different dosing schedules that can be used to keep your blood sugar in the target range.

Your diabetes team will help you decide which form of insulin and schedule may work best for you. Your insulin type and schedule may change over time to meet your changing needs.

Insulin must be given as an injection for it to work. An insulin pill does not exist.

When youth are newly diagnosed with type 1 diabetes, they are often started on three or four injections of insulin per day, using a combination of intermediate or long-acting insulin, plus rapid-acting insulin.
<table>
<thead>
<tr>
<th>Insulin</th>
<th>Types Available</th>
<th>Uses</th>
<th>Starts Working</th>
<th>Works Hardest</th>
<th>Lasts in the Bloodstream</th>
</tr>
</thead>
</table>
| Intermediate-acting     | NPH             | • Provides background or “basal” insulin to keep blood sugar steady between meals and during the night  
                      | N               | • Given at breakfast and bedtime  
                      |                |               | 1 – 3 hours              |
|                         |                 | • Morning dose will cover carbohydrates eaten at lunch time  
                      |                 |               | 4 – 12 hours            |
|                         |                 | • It is **important** to eat the same amount of carbohydrate at lunch and established snacks |                |               | 18 – 24 hours            |
| Rapid-acting insulin    | Lispro (Lp)     | • Provides dose or “bolus” insulin to cover the carbohydrates given at breakfast and supper  
                      | Aspart (Asp)    | • Also used as a correction dose to lower a high blood sugar  | 5 – 15 minutes | 45 minutes to 2 ½ hours | 3 ½ - 4 ½ hours |
|                         |                 |                                                                      |                |               |                          |

DER-CA 2013
### BASAL – BOLUS (Multiple Daily Injections)

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Types Available</th>
<th>Uses</th>
<th>Starts Working</th>
<th>Works Hardest</th>
<th>Lasts in the Bloodstream</th>
</tr>
</thead>
</table>
| Long-acting insulin     | Glargine (G)        | • Provides background or “basal” insulin to keep blood sugar steady during the night and between meals  
                           | Detemir (D)         | • It has no pronounced peak  
                           |               | • Usually given once a day                       | N/A            | N/A            | Up to 24 hours           |
| Intermediate-acting      | NPH                 | • Provides background or “basal” insulin to keep blood sugar steady during the night  
                           | acting insulin     | • Given at bedtime once a day                                                                                                                  | 1 – 3 hours    | 4 – 12 hours   | 18 – 24 hours            |
| Rapid-acting insulin     | Lispro (Lp)         | • Provides dose or “bolus” insulin to cover the carbohydrates given at breakfast, lunch, supper and snacks  
                           | Aspart(Asp)         | • Also used as a correction dose to bring down a high blood sugar                                                                           | 5 – 15 minutes | 45 minutes to 2 ½ hours | 3 ½ - 4 ½ hours           |
Inject into a clean injection site using clean hands. (alcohol is not required)

Gather your supplies, including your pen, insulin and pen needles. If your pen is not pre-loaded, load your insulin cartridge into your pen.

If you are using cloudy insulin, mix by rolling it 10 times and tipping it 10 times to ensure that it is a milky white consistency. (clear insulin does not need to be mixed)

Choose your injection site. (Injection into the back of your own arm is not recommended)

Attach your pen needle and remove both the outer and inner caps.

Prime your pen. Dial up 2 units and depress the plunger while holding the pen needle pointing up. If drops come out, your pen needle is primed, if not, repeat the steps until drops come out of the top of the pen. (GLP-1 pens only need to be primed the 1st time you use them)

Dial your dose and insert pen needle into skin at a 90 degree angle. (refer to chart on page 2 on whether or not you should perform a skin lift and/or inject at an angle)

Remove pen needle and dispose of it in an approved sharps container. Replace pen cap.

Use pen needles and syringes only once.

Store insulin in use at room temperature. (Once in use insulin should not be used for longer than 28 days, or as per manufacturer's instructions. Store extra insulin supply in the refrigerator. Check the expiry date before using.)

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To ensure you are getting your insulin where it needs to go, to be properly absorbed, ask a health care professional to help determine the injection sites and technique that would be best for you.

### Injection Technique. The choices.

<table>
<thead>
<tr>
<th>Injection Depth (mm)</th>
<th>Children (2-6 years)</th>
<th>Children (6 years) &amp; Teens (slim)</th>
<th>Children (6 years) &amp; Teens</th>
<th>Adults (slim)</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>4mm</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>5mm</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>6mm (pen or syringe)</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>8mm</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>Preferable to use shorter pen needles and syringes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8mm (pen or syringe)</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>12.7mm</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
<tr>
<td>Not Recommended</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
</tbody>
</table>

### Did you know?

There is a correct, and incorrect way to perform a skin lift. Delicately lift the skin and subcutaneous tissue, or fatty layer, between your thumb and index finger, leaving the muscle behind.

### References

Did you know?

Insulin is best absorbed in the subcutaneous layer

Insulin injected into the muscle will not be absorbed properly. It may be painful and could be the cause of low or high blood sugars.

Did you know?

Needles come in many lengths from 4mm to 12.7mm long.

New research of the skin shows that on average the skin is only 1.6-2.4mm thick in all people living with diabetes.¹ ²

This means that 4, 5, and 6mm needles are suitable for all people living with diabetes who inject.³ ⁴

Did you know?

How you inject your insulin matters

If you choose to use longer pen needles or syringes, or if you are extremely lean, you may need to perform a skin lift in order to avoid injecting into the muscle.

Review your injection technique with your doctor or diabetes educator today.

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* The needles sizes are for illustrative purposes only and do not reflect the actual size.

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Did you know?

The preferred areas to inject are:
- abdomen
- thighs
- buttocks

abdomen  |  thigh  |  buttocks  |  back of arms

The back of the arm may also be used but you may need help in order to reach the correct area.

Did you know?

A structured rotation pattern includes rotation between injection sites and within an injection site.

For example,
1. Divide your abdomen injection area into 4 areas.
2. Divide each area into smaller sections. Use only one section each week.
3. Rotate within that section, in a circular pattern, with the next injection being 2-3cm from your last.
4. Rotate to the next section the following week, etc.

My Site Rotation Plan

Risk of lipohypertrophy, at your injection sites is higher when you don’t change injection sites often. Injecting into an area of lipohypertrophy may keep your insulin from working the way it should. That’s why it’s important to rotate properly and check your site before you inject.

Steps for site inspection:
1. Stand up and feel the area where you normally inject.
2. Look for puffiness, raised areas, redness, hardness or lumpiness.
3. Discuss any concerns with your doctor or diabetes educator.

It’s all about keeping your injection sites healthy. Establish a routine and keep track!

There are many examples of how to rotate your injection sites. Your diabetes educator can assess your sites, or “real estate” to help you design a site rotation plan that will work best for you.

See next page for an example of an injection site rotation plan.

My Site Rotation Plan

*Educational tools based on FIT Canada Recommendations for Best Practice in Injection Technique.

www.fit4diabetes.com

Notes...
Storing Insulin

Insulin is sensitive to light and temperature. Protect it from direct sunlight, extreme heat, and freezing cold. These extremes will make the insulin less effective.

- Store unopened cartridges of insulin in the fridge.
- Once you start using a cartridge, you can keep it at room temperature or refrigerate it. Either way, once it is opened, **throw it away after four weeks**. Always write the date on the cartridges when you open them.
- Check the expiration date. Do not use insulin that is outdated.
- Always keep extra cartridges/vials of each kind of insulin in your home.

Sharps Safety

“Sharps” refer to needle tips on syringes, pen needles and lancets used for insulin injections and blood sugar tests in the daily care of diabetes.

It's important to be safe – for you and your family, other people and the environment. Someone could get stuck by your needle or lancet if you aren’t careful, which can pass germs.

Discard sharps right after using them:

- Put them in an empty, puncture-proof plastic jug such as a laundry detergent or bleach bottle. When full, tape the lid closed. The bottle can then be disposed of in your regular garbage.
- Sharps containers can often be accessed or purchased at pharmacies. Ask your pharmacy if they have a sharps drop-off program.
Insulin Adjustment

Regardless of the type of insulin regimen that you use, it is important to have a plan to adjust your doses to help reach your blood sugar targets.

Factors That Raise Blood Sugar

- Too little insulin
- Less activity than usual
- More carbohydrate than usual
- Illness or stress

Factors That Lower Blood Sugar

- Too much insulin
- More activity than usual
- Less carbohydrate than usual

Before you make adjustments to your insulin dose, make sure you have considered whether activity or carbohydrates are the cause of the problem.

While a one-time blood sugar out of target does not require an adjustment to your usual insulin dose, a pattern of 3 blood sugars out of target at the same time of day over a week probably means that an adjustment (or dose change) is required. Correction doses of insulin can be used for high blood sugars while you are establishing a pattern. It is important to understand which dose of insulin should be adjusted for a particular pattern or time of day.
Insulin Adjustments for Patterns of High or Low Blood Sugar

Taking the time to look at blood sugar patterns over the course of several days will help you to identify any patterns in your blood sugars. You may find that you are consistently high in the morning, but low by suppertime. While a one-time blood sugar out of target does not require a change to your usual insulin dose, a pattern of 3 blood sugars out of target at the same time of day over a week probably means that a change is required.

Writing down your blood sugar in a logbook after you test is a good way of keeping records for trending patterns, however with meter memory and computerized records, there are now a variety of ways to trend. You may choose to download your meter readings to your computer. Most meters have a customer service phone number on the back. Call them to order a cable or the software required. You may also purchase a blood glucose meter that has computer software internally that will trend on the machine. Choose a method that works best for you.

Experts recommend analyzing the records every 3-7 days to look for a pattern. Break the readings down to times of day as follows:

**Before Breakfast Blood Sugar Value**  
This reading is a result of the overnight long-acting insulin (called basal insulin) usually NPH or glargine.

- If the reading is below target, reduce the evening insulin dose 1-2 units every 3 days until target blood sugar is achieved.

- If the reading is higher than target, increase the evening insulin dose 1-2 units every 3 days until the morning reading is in target.

You need to be careful to prevent lows during the night, so a 3:00 a.m. blood sugar test may be wise at times. Consider if the bedtime snack is affecting the morning blood sugar. Reducing the bedtime snack may help to achieve a morning blood sugar in target.

**Before Lunch Blood Sugar Value**  
This reading is a result of the breakfast rapid-acting insulin.

- If the reading is below target, there was too much rapid-acting insulin taken for the amount of food or activity that morning. Reduce the morning rapid-acting insulin by 1-2 units, or increase your insulin-to-carbohydrate ratio.
• If the before lunch reading is above target, there was not enough rapid-acting insulin taken for carbohydrate that morning. Increase the morning rapid-acting insulin by 1-2 units, or decrease your insulin-to-carbohydrate ratio.

Before Supper Blood Sugar Value
If you are taking insulin 2 or 3 times per day, this reading depends on the long-acting insulin taken in the morning. A higher dose of long-acting insulin is given in the morning to cover lunchtime carbohydrate as well as act as basal insulin. Try to be consistent with the amount of carbohydrate you eat at lunch. More or less carbohydrate at lunch will affect the supper blood sugar.

• A low blood sugar reading before supper means that there was too much long-acting insulin given in the morning. Reduce the morning long-acting insulin by 1-2 units.

• A high blood sugar reading before supper means that there was not enough long-acting insulin given in the morning. Increase this dose by 1-2 units every 3 days until the target blood sugar is achieved.

If You Are Taking Insulin 4 or More Times Per Day
• A low reading before supper means that there was too much rapid-acting insulin taken for the amount of carbohydrate at lunch and the activity in the afternoon. Reduce the lunchtime rapid-acting insulin by 1-2 units, or increase your insulin-to-carbohydrate ratio.

• A high reading at supper means that there was not enough fast-acting insulin taken at lunch. Increase your dose by 1-2 units every 3 days until the supper reading is in target or decrease your insulin-to-carbohydrate ratio.

Before Bedtime Blood Sugar Value
This reading is a result of the amount of rapid-acting insulin taken at supper.

• If the value is low, there was too much rapid-acting insulin taken at supper for the carbohydrate and activity that evening. Decrease the suppertime rapid-acting insulin by 1-2 units every 3 days, or increase your insulin-to-carbohydrate ratio until the target blood sugar is achieved.

• If the value is high, there was not enough rapid-acting insulin given at supper for the amount of carbohydrate eaten. Increase the rapid-acting insulin by 1-2 units every 3 days, or decrease your insulin-to-carbohydrate ratio until the target blood sugar is achieved.

It’s important that the blood sugar tested before bedtime is not too low in order to prevent nighttime low blood sugars. If you have been active during the evening or if your blood sugars have been low and you are adjusting your insulin, check a reading during the night to be sure that you are in a safe range. Experts recommend taking an extra 15
grams of carbohydrate before going to bed if your blood sugar is less than 6 mmol/L. If your blood sugar is less than 4 mmol/L, you should take an extra 30 grams of carbohydrate before bed.

Although adjusting insulin can be quite complicated to begin with, the more you test and think about the blood sugars over time, the easier it becomes. The rewards of insulin adjustment are many. Better blood sugar control means fewer problems with unexpected highs or lows, more freedom to participate in sports and other activities, and a healthier life. Take the time to adjust your insulin and make sure to ask for help when you need it.

References: