Type 2 Diabetes and Insulin

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When most people find out they have Type 2 diabetes[1], they are first instructed to make changes in their diet and lifestyle. These changes, which are likely to include routine exercise, more nutritious food choices, and often a lower calorie intake, are crucial to managing diabetes and may successfully lower blood glucose levels to an acceptable level. If they do not, a drug such as glyburide, glipizide[2], or metformin[3] is often prescribed. But lifestyle changes and oral drugs for Type 2 diabetes are unlikely to be permanent solutions. This is because over time, the pancreas tends to produce less and less insulin[4] until eventually it cannot meet the body’s needs. Ultimately, insulin (injected or infused) is the most effective treatment for Type 2 diabetes.

There are many barriers to starting insulin therapy: Often they are psychological; sometimes they are physical or financial. But if insulin is begun early enough and is used appropriately, people who use it have a marked decrease in complications related to diabetes such as retinopathy[5] (a diabetic eye disease), nephropathy[6] (diabetic kidney disease), and neuropathy[7] (nerve damage). The need for insulin should not be viewed as a personal failure, but rather as a largely inevitable part of the treatment of Type 2 diabetes. This article offers some practical guidance on starting insulin for people with Type 2 diabetes.

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When to start insulin

Insulin is usually started when oral medicines (usually no more than two) and lifestyle changes (which should be maintained for life even if oral pills or insulin are later prescribed) have failed to lower a person’s HbA1c[8] level to less than 7%. (HbA1c stands for glycosylated hemoglobin and is a measure of blood glucose control.) However, a recent consensus statement from the American Diabetes Association and the European Association for the Study of Diabetes suggested that insulin is a reasonable choice if a person’s HbA1c level remains above 7% while he is taking metformin alone. (The effects of metformin should be seen within three to four months of starting it.)

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Large studies of people with Type 2 diabetes have shown that only about 30% of people taking two oral medicines have an HbA1c level of less than 7% after three years. Insulin is usually recommended as the initial therapy for diabetes if a person’s HbA1c level at diagnosis is greater than 10% or if someone’s fasting blood glucose level is consistently above 250 mg/dl.

Studies have shown that many doctors wait until someone’s HbA1c level is higher than 9% to start insulin therapy, which often results in months or years of high blood glucose and an increased risk of developing complications later on. One unfortunate reality is that many busy medical practices are not set up to address the needs of people who take insulin. Starting insulin requires education and easy access to health-care providers who are knowledgeable about insulin therapy, including diabetes nurse educators, pharmacists, and doctors.

Types of insulin

There have been significant innovations in insulin products over the last several years that have made insulin therapy more effective, more accessible, and safer. Before starting insulin, it is helpful to understand its function in the body. Insulin is needed for most cells throughout the body to take in glucose from the blood, which the cells use as fuel. In people without diabetes, the pancreas continuously secretes insulin at a background, or basal, level to provide a stable supply of glucose to the body’s cells and prevent a buildup of glucose in the blood as glucose is steadily released from the liver. In response to eating, the pancreas secretes
a larger pulse, or bolus, of insulin. This bolus of insulin allows the liver to store energy from the food for later use instead of releasing it as glucose all at once, stabilizing the blood glucose level.

Injected insulin that functions as basal insulin is called “long-acting” and provides a relatively low level of insulin for a long period. Insulin that functions as bolus insulin is called “short-acting” or “rapid-acting” and provides a higher level of insulin that is used quickly.

Three types of long-acting insulin are commonly used: NPH (brand name Humulin N), insulin glargine (Lantus), and insulin detemir (Levemir). NPH insulin lasts 10–16 hours in the body. It may initially be taken as a single daily injection, but eventually it usually needs to be taken twice a day. The main advantage of NPH insulin is that it is inexpensive. Its main drawback is that the timing of its peak of action is unpredictable, which can lead to hypoglycemia (low blood glucose) if meals are not timed with injections properly. (An insulin’s “peak” is when it is most active in the body. It varies by type of insulin, and ideally injections are timed so that the insulin’s peak coincides with the rise in blood glucose that follows a meal.)

Insulin glargine is a long-acting insulin that can last up to 24 hours and has little peak in its action, which reduces the risk of hypoglycemia. Another advantage of insulin glargine is that it only requires one injection each day for the vast majority of people with Type 2 diabetes.

The newest long-acting insulin, insulin detemir, usually lasts 16–20 hours. In general, it has less of a peak than NPH but is not as “flat” as glargine. Insulin detemir tends to be the most predictable of the long-acting insulins. It has also consistently been shown to cause less weight gain than the other insulins (or even mild weight loss). Detemir and glargine cost about the same, but both are more expensive than NPH. They cannot be mixed with other insulins in the same syringe, while NPH can. All three basal insulins are available in prefilled pens that do not require syringes or vials. Doses of insulin can be dialed into the pen, and the pens can be carried conveniently in a coat pocket, purse, or knapsack.

The oldest type of short-acting insulin is Regular insulin (brand names Humulin R and Novolin R). It lasts about 6–8 hours and has its peak about 2 hours after injection. It does not start working (lowering blood glucose) until about 30–60 minutes after injection, so it can be difficult to coordinate the timing of injections with meals. For example, if you take an injection of Regular insulin right before you eat lunch, your lunch will likely raise your blood glucose level before your insulin starts working to lower it. You would need to inject the insulin 30–60 minutes before eating lunch to match the rise in blood glucose with the action of the insulin. In spite of this inconvenience, Regular insulin is still widely used because it is very inexpensive, and because many physicians have years of experience prescribing it.

Three other forms of short-acting insulin (considered “rapid-acting”) are insulin aspart (NovoLog), insulin lispro (Humalog), and insulin glulisine (Apidra). These insulins each have a slightly different chemical structure, but all last less than 5 hours and start to work within 15 minutes. They are all relatively expensive but are easier to coordinate with meals than Regular insulin. In general, these three rapid-acting insulins match up better with the body’s release of glucose into the blood after eating, resulting in a lower risk of hypoglycemia, but are no better than Regular insulin at lowering the HbA1c level. All short-acting insulins are available in easy-to-use insulin pens.

Long- and short-acting insulins are also available in premixed combinations such as 70% NPH and 30% Regular, also known as “70/30.” Although premixes may initially appear to be more convenient, they are difficult to tailor to individual needs due to the fixed proportions of the combinations. A person who needs, for example, more short-acting insulin but not more long-acting insulin is out of luck when using a premix. For more information on the different types of insulin, see “Insulin Action times[9].”

How to start insulin

When first prescribing insulin for a person with Type 2 diabetes, doctors generally start with a single daily injection of long-acting insulin. Determining what dose of insulin to begin with can be done in different ways. One option is to choose a starting dose based on a person’s weight. Eventually, many people with Type 2 diabetes will require 1–2 units of insulin for every kilogram of body weight; that is, an 80-kilogram (175-pound) person will require at least 80 units of insulin each day. To start, however, your doctor may begin by prescribing 0.15 units of insulin per kilogram. For an 80-kilogram person, this would be 12 units.
Another option is simply to start with 10 units of insulin, a large enough dose to decrease blood glucose levels for most people but not so large that it is likely to cause hypoglycemia. The dose can then be increased every 3–7 days based on fasting blood glucose values. A morning blood glucose reading of 80–100 mg/dl is ideal, so with numbers that fall in this range, you would not make any changes. If your morning blood glucose readings were under 80 mg/dl, you would decrease your insulin dose by 2 units. Most people, however, will need to increase their dose of insulin above the initial level. It is generally safe to adjust one’s basal insulin according to this scale[10].

Most doctors initially recommend taking insulin in the evening, since this helps reduce a person’s fasting blood glucose level the next morning. However, one problem with taking NPH insulin at bedtime is that it often peaks in the middle of the night, increasing the possibility of hypoglycemia during sleep. Since insulin glargine and insulin detemir do not have a significant peak of action, it is safer to take one of these at bedtime. Depending on a person’s blood glucose trends or personal preferences, basal insulin can also be taken in the morning instead of at bedtime.

One common error made by doctors is to focus too much on normalizing the fasting morning blood glucose level without considering the importance of the bedtime blood glucose level. For example, a person might take 40 units of insulin glargine at bedtime and have an optimal fasting blood glucose level of 110 mg/dl in the morning. However, this person could have a bedtime blood glucose level in the 300’s, which indicates the need to take insulin at dinner (often called “covering” the meal). So although his fasting blood glucose level is fine, this person will still have an HbA1c level greater than 9%. This is why it is important not to rely only on fasting blood glucose levels, but to also use the HbA1c level and, if necessary, blood glucose readings throughout the day to guide treatment.

If after three months of using long-acting insulin alone the HbA1c level is still above 7%, then using Regular or rapid-acting insulin to cover meals will be necessary. Mealtime insulin can initially be given at the largest meal of the day, which is dinner for most Americans. A simple approach for starting mealtime insulin is to decrease the long-acting insulin dose by 10% and take the difference as rapid-acting insulin at dinnertime. For example, if you previously took 20 units of glargine at bedtime, you would take 2 units of aspart, lispro, or glulisine at dinner and 18 units of glargine before bed.

An important concept in insulin therapy is taking “correction doses” of insulin. This means taking extra rapid-acting insulin before a meal to correct for high blood glucose. A common correction dose is 2 extra units of insulin for a premeal blood glucose level above 150 mg/dl; even more will be needed if the level is above 200. Although there is a large range of appropriate correction doses, here is an example of a typical scale[11]. Correction doses can significantly impact blood glucose levels. For example, if you generally take 6 units of aspart with lunch but your blood glucose level before lunch is 250 mg/dl, your usual 6 units will not adequately lower both the current high blood glucose and the anticipated rise from lunch. If you take 4 additional units of insulin, the correction dose will cover your premeal high glucose and the 6 units will cover your meal. Although this system can take a few weeks to adjust to, most people find it rewarding because they can take action to lower their high blood glucose as soon as they know about it, rather than letting it remain high throughout the day.

**Insulin and weight gain**

When first starting insulin therapy, many people complain that they are eating and exercising the same amount as before but gaining weight. This occurs because with insulin, the body is able to use glucose that was previously wasted in the urine. Glucose that is not needed right away for energy is stored as fat. Studies have shown that weight gain may lead people, particularly women, to not follow their prescribed insulin regimen. This is a dangerous practice that can lead to sustained high blood glucose and a higher risk of long-term complications. Weight gain with insulin therapy is not inevitable, but avoiding it or reversing it generally requires eating fewer calories and/or exercising more.

**Continuing oral medicines**

Many people ask whether it is worthwhile to continue their oral medicines once they have started insulin. Many studies have shown that people who use both an oral drug and insulin have better blood glucose
control than those taking long-acting insulin alone. Continuing metformin when beginning insulin, for example, can reduce the weight gain that often occurs in the first year of insulin therapy. Sulfonylurea drugs such as glyburide and glipizide can help reduce high blood glucose after meals and are effective when combined with a single injection of long-acting insulin.

Metformin can be continued even when short-acting insulin with meals is introduced. Glyburide and glipizide are generally discontinued when short-acting insulin is begun.

Thiazolidinedione drugs such as pioglitazone (Actos) are associated with weight gain and fluid retention when combined with insulin, so they are usually discontinued when insulin therapy is initiated.

Another medicine that is commonly used prior to starting insulin is exenatide (Byetta). This injectable drug is associated with significant weight loss, and many doctors opt to continue exenatide when starting basal insulin. However, it must be emphasized that at this time, exenatide is only approved by the US Food and Drug Administration for use along with insulin glargine.

**Back to basics**

The overall goal in treating diabetes is to maintain optimal blood glucose levels to reduce the risk of diabetic complications. For many people, insulin is the best way to achieve this goal. There is no single right way to begin insulin; a regimen should take individual needs and circumstances into account. Insulin doses and regimens are also likely to change over time as people’s lives – and bodies – change. With just a little bit of knowledge, however, you can begin insulin therapy undaunted and ready to take the next step in controlling your diabetes.

**Endnotes:**

5. retinopathy: http://www.diabetesselfmanagement.com/Apices/Diabetes-Definitions/retinopathy/1/
10. to this scale: http://static.diabetesselfmanagement.com/pdfs/DSM0708_035.pdf
11. here is an example of a typical scale: http://static.diabetesselfmanagement.com/pdfs/DSM0708_036.pdf%20

**Source URL:** http://www.diabetesselfmanagement.com/managing-diabetes/treatment-approaches/type-2-diabetes-and-insulin/

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