ABCS OF INSULIN

WHAT IS IT? HOW IS IT USED?

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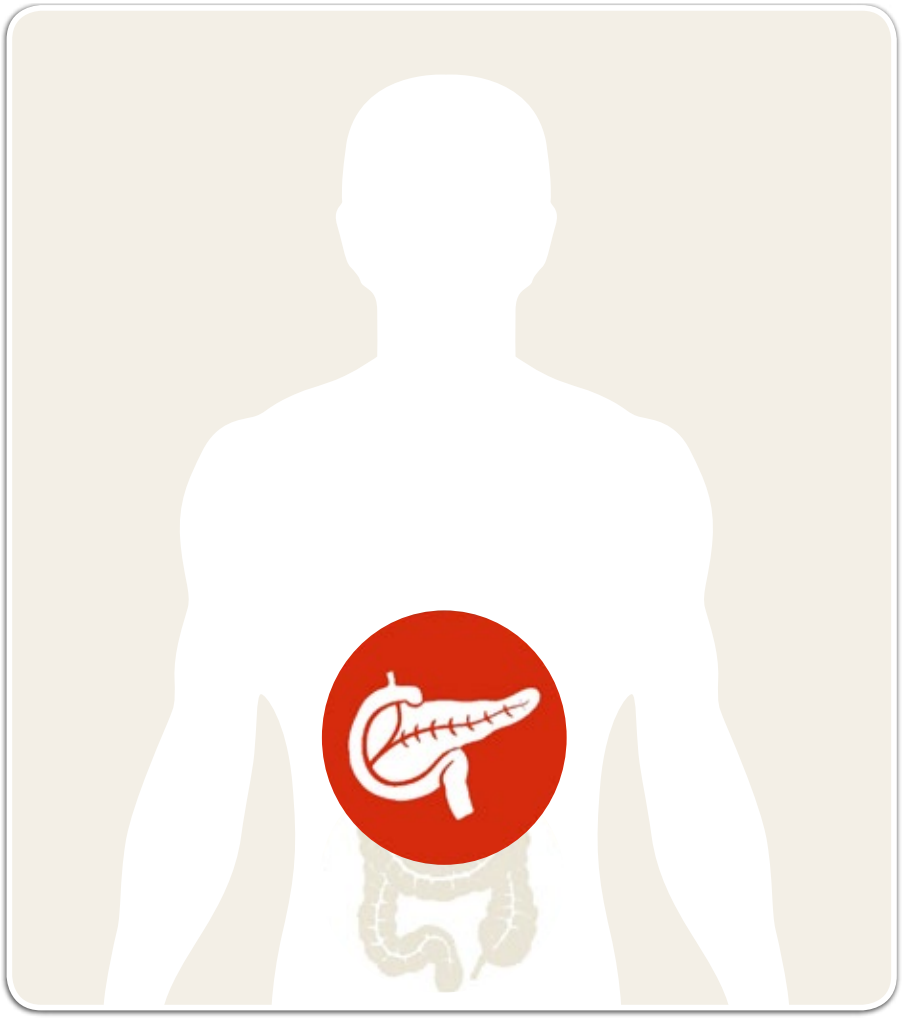
WHAT IS INSULIN AND HOW DOES IT WORK?

Insulin is a substance produced by the beta cells in the pancreas whose function is to transport glucose from the blood into the cells.
In this process, insulin acts like a key that opens a locked door and allows glucose to enter the cells. This allows insulin to help lower the blood glucose level and supply the cells with energy.

__Glucose__ is the chemical name for dextrose. It is an important source of energy from food and is absorbed into the blood via the intestines.



WHAT HAPPENS IN THE PANCREAS?

The pancreas supplies insulin to the blood in two ways:

1. **When the body is supplied with glucose or carbohydrates through meals,** the pancreas produces a corresponding amount of insulin. The greater the uptake of glucose, the more insulin is released.

2. **The pancreas even produces insulin between meals and at night** to ensure a continuous supply of glucose to the organs. If the blood glucose concentration drops too much as a result, the liver releases glucose reserves (glycogen) or provides the body with newly produced glucose (gluconeogenesis). This ensures that there is always a basic supply of glucose.

In Germany, around 1.8 million* people with diabetes are treated with insulin. For them, injecting insulin is part of everyday life. For most affected persons, the injections initially require some getting used to, but with a little practice the injection of insulin is virtually painless.

The following tips will make handling insulin easier for you. These instructions can of course not replace training by your doctor or diabetes counsellor, but are rather intended to supplement or support training.

DIFFERENT TYPES OF INSULIN

Insulins are differentiated according to their origin and the course of their effect over time:

1. Short-acting insulins

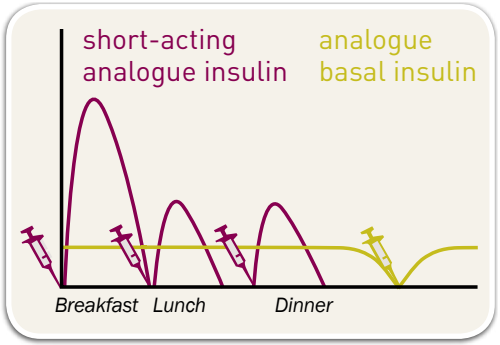
They cover the insulin requirements at mealtimes, so some of them have to be injected a certain amount of time before a meal.

- ✓ **Human insulins (normal insulin or regular insulin):** they are identical to insulin produced in the pancreas and are produced by genetic engineering using bacteria or yeasts. It is often advisable to maintain an interval between the injection and eating, as the effect does not begin until after 15–30 minutes. The effect then lasts for up to 6 hours. Between-meal snacks may be needed to avoid hypoglycaemia.
- ✓ **Analogue insulins (insulin analogues):** they are slightly genetically modified compared to human insulin. Their onset of action follows after only 10–15 minutes and their duration of action is much shorter – a maximum of 4 hours. As a rule, one can dispense with the interval between injection and eating, snacks between meals are usually not necessary and blood glucose is easier to control.

2. Long-acting insulins

These are also referred to as basal insulins or intermediary insulins. They cover the basic needs of the body independent of meals.

- ✓ **Delayed action insulins:** these are human insulins to which a delaying substance has been added. With the common NPH (Neutral Protamine Hagedorn) insulins, the delaying substance is normally the protein protamine, which gives the solution a cloudy appearance. The duration of action is dose-dependent and lasts up to 12 hours. Delayed action insulins with added protamine must be thoroughly mixed before injecting. These insulins normally have to be injected once or twice a day.



- ✓ **Analogue insulins:** these forms of insulin are genetically modified to act for up to 24 hours and therefore need only be injected once or twice a day.

3. Pre-mixed insulins

These contain a short-acting and a long-acting insulin. They are available ready-to-use in different mixing ratios, e. g. 30% short-acting and 70% long-acting insulin. The amount of effective insulin is expressed in units (U).

In Germany, insulin solutions with different concentrations are available. A U100 insulin contains 100 U of insulin in one millilitre of solution. Correspondingly, a U200 insulin contains 200 U of insulin in one millilitre of solution.

* Deutscher Gesundheitsbericht Diabetes 2017 - Die Bestandsaufnahme, Herausgeber Deutsche Diabetes Gesellschaft (DDG) und diabetesDE - Deutsche Diabetes Hilfe, Prof. Dr. Baptist Gallwitz, Verlag Kirchheim Mainz, 258 pages, ISSN: 1614–824X.

CORRECT DOSAGE

The insulin requirement varies from person to person and can also vary in the same person depending on the overall situation. When getting started with insulin therapy, some adjustments may be needed in cooperation with your practice team until the correct dose is found.

The required amount of insulin depends on:

- ✓ **body weight**
- ✓ **physical exercise and sports activities**
- ✓ **physical constitution (how much muscle and fat your body contains)**
- ✓ **nutritional habits**
- ✓ **mental condition (e. g. stress)**
- ✓ **other medications**
- ✓ **Infections may necessitate considerable dose adjustment**

Make sure to note down the insulin therapy guidelines your practice team has discussed with you in your diabetes diary and keep a continuous record of actual insulin units injected and blood glucose levels.

> **!** You can find suitable diaries, e. g. for ordering or downloading, at **www.lilly-diabetes.de**

It is normal for your insulin requirements to change depending on your circumstances, e. g. illness, increased physical activity or a change of job. If you notice that your blood glucose levels are fluctuating widely, do not change your insulin dose until you have consulted your practice team and received appropriate instructions. They will explain to you how to keep your blood glucose level within the normal range by changing your meals or adjusting the insulin dose. Your practice team will also make a plan for you in case you forget to inject your insulin.

CHOOSING THE CORRECT INJECTION SITE

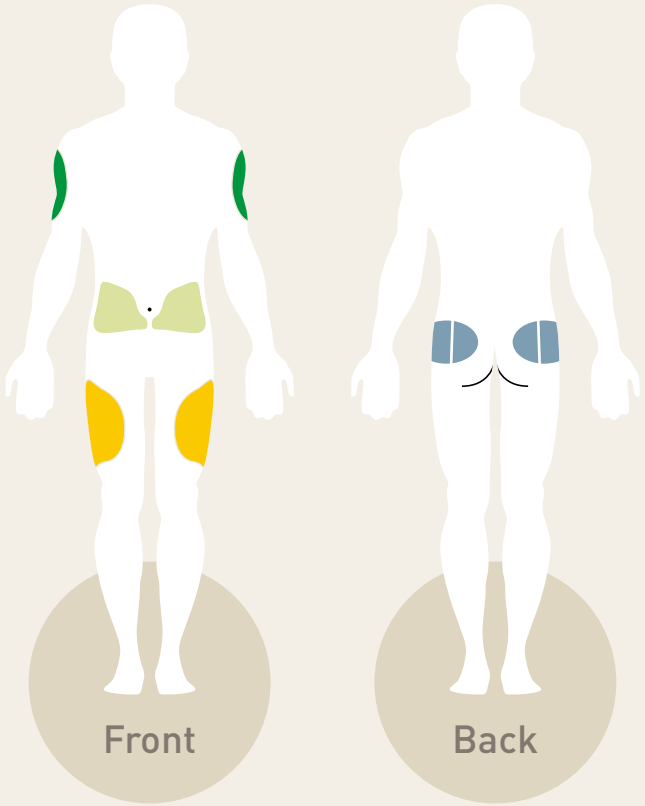
Insulin is injected into the subcutaneous fat tissue, from which it is gradually absorbed into the body. Fat tissue has less blood circulation than muscle tissue. The injection here is less painful and insulin is absorbed more slowly into the blood than after injections into muscle tissue.

The following table provides an overview of suitable injection sites for different insulins:

Where to inject?

- Around the navel
- Front of the thigh
- From the side into the upper arm
- From the side into the gluteus muscle

! Varying the injection site is recommended to avoid swelling and bruising. Also keep a distance of at least 1 cm from the previous injection site.



VARYING THE INJECTION SITE

You should always vary the injection site within the body area you prefer for injections, e. g. the abdomen. Frequent injections in the same place cause fat tissue to accumulate and scleroses, making the area less sensitive to pain. Such sites are called lipohypertrophies. Although injection at these sites is often perceived as more pleasant, the tissue changes often hinder rapid and uniform insulin effect. This may result in severe fluctuations in blood glucose levels and irregular, often increasing, insulin requirements.

- ✓ **If you notice localised fat deposits or dimples, avoid these injection sites for a few months until the skin looks normal again.**
- ✓ **Vary the injection sites on the abdomen or thighs by shifting 2–3 cm horizontally and vertically. For abdominal injections, use the flanks as well.**
- ✓ **Do not inject into scarred areas, since absorption of insulin may also be altered there.**

DIFFERENCES IN INSULIN ABSORPTION

The different insulin types are absorbed by the body at different rates and thus act at different speeds. You can additionally influence this by your choice of injection site, since insulin reaches the circulation at different rates from the different parts of the body:

- ✓ **Abdomen:** **fastest onset of action**
- ✓ **Thighs:** **slower onset of action**
- ✓ **Buttocks/hips:** **slowest onset of action**

You can consciously use this fact if, for example, you want your insulin to act particularly quickly or slowly: If you want to eat something immediately after the injection, you can choose the abdomen as the injection site.

The following table provides an overview of suitable injection sites for different insulins:

Type of insulin	Type of injection	Effect
Long-acting insulins	Thighs / buttocks	Slow insulin uptake, extends duration of effect
Short-acting insulins/ analogues/mealtimes/ corrective insulin	Abdominal wall	Rapid insulin absorption
Pre-mixed insulins	**In the morning:** Abdominal wall	Rapid effect of the short-acting portion at breakfast
	In the evening: Thighs	Slower absorption for sufficient effect overnight

Other options that allow a faster onset of action of insulin:

- ✓ **If you do a lot of exercise after the injection, e. g. sports, the insulin reaches the blood faster.**
- ✓ **High temperatures enhance the effect of insulin, for instance sauna, sunbathing, a hot bath or shower.**
- ✓ **A hot-water bottle can help increase the rate at which insulin is absorbed.**
- ✓ **Massaging the injection site leads to a faster absorption of insulin into the blood.**

THE CORRECT TECHNIQUE

- ✓ **Cloudy insulins** must be mixed before injection, otherwise more solvents than insulin will be injected. For this purpose, the pen is slowly swirled 10–20 times or rolled between the hands before each injection.
- ✓ **Before the injection, check the function of the pen** by holding it vertically with the needle facing upwards and dispensing 1–2 U of insulin until a droplet of insulin appears at the tip of the cannula.
- ✓ Use your thumb, index finger and middle finger to form a **skin fold** such that you only lift fat tissue and not muscle.
- ✓ Hold the **needle vertically or at a 45 ° angle**, depending on the length of the needle and the thickness of the skin fold.
- ✓ Be careful not to penetrate **too deeply** into the tissue.
- ✓ Inject the insulin **slowly**. Hold the skin fold firmly during the injection.
- ✓ **Then leave the needle in the skin for about 10 seconds** so that no insulin escapes from the injection site.
- ✓ **Pen needles should be changed after each injection.**
  Even after a single use, the needle tip becomes duller and can lead to painful skin injuries.

Your practice team will show you how to perform the insulin injection correctly.

WHAT ELSE NEEDS TO BE OBSERVED?

Your body needs insulin to function. We cannot live without insulin. The main task of insulin is to lower blood glucose.
If the blood glucose is lowered too much, this leads to hypoglycaemia. Weight gain can also occur as part of insulin therapy. In some cases, skin changes (lipodystrophy) may occur at the injection sites.

Hypoglycaemia

If too much insulin is injected, blood glucose may be lowered too far, resulting in hypoglycaemia. Hypoglycaemia can also occur if too little is eaten, if insulin intake and meals are not sufficiently coordinated or if too much glucose is consumed through physical activity.

Weight gain

Some patients may gain weight on insulin therapy. To prevent weight gain, a lifestyle with a healthy diet and physical exercise is important.

Lipodystrophy

If insulin is always injected at the same site, this may lead to a change in the subcutaneous fat tissue in some cases. This can either lead to a dimple in the skin (lipohypotrophy) or to small bulges (lipohypertrophy). This is not serious, but should be avoided by varying the injection site, since the insulin absorption rate is sometimes faster and sometimes slower in these areas.

STORING INSULIN

Insulin must be stored properly to remain effective.

Keep the insulin supply and unused pens in the refrigerator. Do not freeze.

After first use, store at room temperature instead of in the refrigerator.

Do not use after the expiry date on the label and packaging.

Protect against excessive heat, moisture and light.

Remove the needle after each use, do not store the pen with the needle attached.

Dispose of a ready-to-use pen 28 days after first use, even if it still contains insulin.

Dispose of the pen and needles according to regulations.

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References

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