



BLOOD GLUCOSE LEVELS AND MEASUREMENT

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BLOOD GLUCOSE LEVELS AND MEASUREMENT

In diabetes mellitus, the blood glucose level is higher than normal. The goal of all diabetes therapies is to bring the blood glucose level into the range of metabolically healthy persons as far as possible and keep it there. This is necessary because untreated excessively high blood glucose levels can damage vessels, nerves and vital organs over time. Regular self-checks – blood glucose measurements – will help you monitor your blood glucose and thus prevent such secondary complications.

What is the healthy range for blood glucose levels?

The blood glucose level shows little variation in healthy persons. The normal level before a meal is between 70 and 110 mg/dl (3.9 and 6.1 mmol/l). Following a meal, the level can increase to 140 mg/dl (7.8 mmol/l). For a patient with diabetes it is important to manage blood

glucose levels so as to approximate this natural curve, thus avoiding both hypoglycaemias and excessively high levels (hyperglycaemias) after meals. High blood glucose levels contribute to development of vascular damage.

RECOMMENDED BLOOD GLUCOSE LEVELS

The German Diabetes Association recommends the following blood glucose level ranges for diabetics (whereby individual target values may vary depending on factors such as age and duration of diabetes):

Type 2 diabetes:

- ✓ Fasting:
100–125 mg/dl (5.6–6.9 mmol/l)
- ✓ 1–2 hours after a meal:
140–199 mg/dl (7.8–11.0 mmol/l)

Type 1 diabetes:

- ✓ Individual therapeutic goals



Blood glucose content is described using different units of measure. Whereas in western Germany measurement is normally in milligrams per decilitre (mg/dl), the international unit of measure millimol per litre (mmol/l) is commonly used in eastern Germany as well as in many clinics throughout the country. The units can be converted as follows:

- $\text{mg/dl} \times 0.0555 = \text{mmol/l}$
- $\text{mmol/l} \times 18.02 = \text{mg/dl}$





HbA_{1c} - THE LONG-TERM BLOOD GLUCOSE VALUE

The blood glucose level is only a momentary picture of the situation. Therefore, a long-term blood glucose value, the so-called HbA_{1c} value, is measured by your doctor at regular intervals. The HbA_{1c} value is a measure of blood glucose concentration over the past two to three months. Glucose molecules in the blood attach to haemoglobin in the red blood cells. The more glucose the blood contains, the higher the proportion of glucose-bound haemoglobin, which is expressed as the HbA_{1c} value.

Type 2 diabetes:

T2

According to the German National Healthcare Guideline, the therapeutic goal for patients with type 2 diabetes is an HbA_{1c} level of 6.5–7.5% (48–49 mmol/l).

Type 1 diabetes:

T1

The goal of treatment for patients with type 1 diabetes is an HbA_{1c} level of <7.5% (58 mmol/l) as long as no problematical hypoglycaemias occur.

INDIVIDUAL TARGET VALUES

The target levels for blood glucose stabilization are only guideline values. The goal is not to achieve strict HbA_{1c} values whatever the cost.

Not every patient is able to maintain a stringent blood glucose reduction therapy competently, and such an approach usually also involves a risk of hypoglycaemias. More lenient metabolic management is therefore tolerated, e.g. in multimorbid or fragile patients or in cases of long-term diabetes with secondary diseases. The target levels should thus always be individualized in cooperation with the patient to accommodate his or her personal situation, accompanying illnesses and age.



Your practice team will work with you to define your individual target levels. Make a note of your personal target levels in your diabetes journal.

BLOOD GLUCOSE CHECK AT HOME

Therefore, good blood glucose management means avoiding extremely high or low levels so as to remain within your personal target range. Blood glucose levels may vary in the course of a day. The reason for this is that the level is influenced, negatively or positively, by your eating habits, especially foods that are high in sugar, movement and sports, stress or illness. These factors sometimes result in excessively high or low blood glucose levels.

Self-measurement of blood glucose can contribute to stabilizing your blood glucose curve by helping you learn how to best react to high or low levels. Training and experience can help you recognize early on, and often prevent, upwards or downwards decompensations. With some diabetes treatment methods, constant self-checking makes sense; with others self-measurement is only necessary at the start of a new therapy for a while until your blood glucose metabolism has stabilized.

The decisive thing is to carefully document the results of self-measurement, e.g. in a blood glucose journal, and to discuss them regularly with your doctor or diabetes advisor. Your measured levels are used to assess the success of a given diabetes therapy and adjust it as needed. You will learn behaviours that positively impact your blood glucose level.



HOW OFTEN IS MEASUREMENT REQUIRED?

How often blood glucose needs to be checked depends on the form of therapy being used to treat your diabetes. Discuss how often to measure blood glucose with your doctor or advisor.

The Association of Diabetes Advisor and Training Professions in Germany (VDBD) recommends measuring several times a day at meals and as needed before retiring during the stabilization and adjustment phase. Measurement frequency can then be reduced when the blood glucose levels are stabilized.

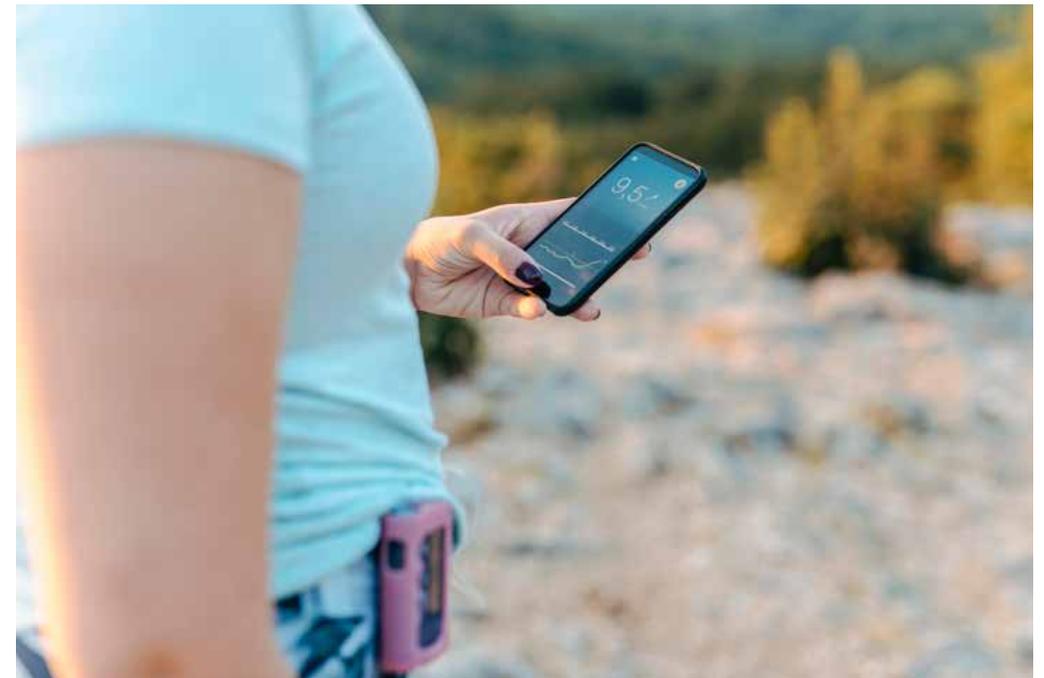
In addition, measurement of blood glucose is appropriate in the following special situations:

- ✓ Before, and perhaps after, significant physical exertion
- ✓ Before driving and when driving for longer periods
- ✓ Before retiring for the night if nocturnal hypoglycaemias are a problem
- ✓ If you feel uncertain, e. g. feelings suggesting hypoglycaemia, or if you feel unwell during sporting activity
- ✓ In case of febrile infection, diarrhoea, vomiting
- ✓ Check the level while on holiday more frequently than at home
- ✓ Intercontinental travel

CONTINUOUS BLOOD GLUCOSE MEASUREMENT

In addition to individually scheduled classic blood glucose measurement up to several times a day, there are also systems for continuous monitoring of the blood glucose curve (continuous glucose measurement [CGM]). This involves long-term attachment of a sensor to the body that continuously measures blood glucose levels. The data are then electronically transmitted and evaluated.

Discuss whether such a device makes sense for you with your diabetes team and whether statutory health insurance will cover the cost in your case.





HOW TO MEASURE CORRECTLY

Modern measuring devices for blood glucose control are available with which measurement can be done simply and with low pain levels. Your doctor, diabetes advisor or pharmacist will explain to you how to measure correctly. Also read the instructions for your measuring device carefully. Here are some tips that may make correct measuring of your blood glucose easier:

- ✓ Always test with washed hands if possible. Cream or traces of sugar, e.g. from fruit, on your hands can falsify the result.
- ✓ The blood drop must not be diluted (e.g. by wet fingers or sweat). It is not necessary to use disinfectants.
- ✓ If your hands are clean, the first drop of blood will be clean and sufficiently measurable. Use the second drop of blood for measurement only if prior handwashing was impracticable.
- ✓ If your device requires encoding, make sure the test strip code matches the code on the device display. **Also note the unit setting, whether mg/dl or mmol/l.**
- ✓ **Before taking the blood sample, shake arm and hand briefly or lightly massage the finger.** This increases circulation and makes it easier to obtain a sufficiently large drop of blood. This means the lancet does not have to penetrate too deeply. Do not squeeze the finger, since otherwise the drop of blood will be diluted with tissue fluid, falsifying the result.
- ✓ **Stick the lancet tip into the side of the fingertip to obtain blood.** This area has fewer nerve endings so penetration of the lancet will not be felt as much. Use the ring, middle or little finger, which are not used as frequently on an everyday basis.
- ✓ Since the lancet is dulled by each use, use a fresh lancet for each blood sampling procedure. A dull lancet that has been used repeatedly causes greater injury to the skin and may cause infections.

- ✓ **Store the test strips in a dry place** (not in the bathroom) within the proper temperature range. They must not become too hot (e.g. in summer in the glove compartment) or too cold.
- ✓ **Test strips and lancet boxes can be discarded with household waste.** Please always dispose of single lancets in the disposal container due to the risk of prick injury.



Document your measuring results e.g. in a blood glucose journal. You can find suitable diaries, e.g. in free downloads at www.lilly-diabetes.de. Some measuring device manufacturers also offer electronic documentation with their devices.

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