

## Self-Monitoring of Blood Glucose (SMBG) and Ketone in Diabetes Guideline

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## Who should be offered self-monitoring of blood glucose?

For patients who are diagnosed with type 1 diabetes (T1DM) and do not want or cannot use a continuous glucose monitoring system, they are required to monitor their blood glucose levels more than four times a day as per NICE Guidance [NG17](#).

Patients who are diagnosed with type 2 diabetes (T2DM) would need to meet certain criteria to monitor blood glucose levels, as shown below:

- Is prescribed insulin.
- Has episodes of hypoglycaemia
- Is taking an oral medication that increases risk of hypoglycaemia.
  - Sulphonylurea (SU) – Gliclazide, Glimepiride
  - Meglitinide – Nateglinide, Repaglinide
- Is pregnant or planning a pregnancy.

## Frequency of monitoring in T2DM

The number of times a patient needs to monitor their blood glucose levels will vary depending on what type of treatment they are using. Below are the various forms of treatment options and recommendations on how many times a patient with Type 2 diabetes should monitor their glucose levels.

- Dietary and lifestyle measure and/or metformin – **do not** offer testing strips.
  - *If a patient wishes to monitor their blood glucose levels a meter and test strips can be purchased from a Community Pharmacy.*
- Dipeptidyl peptidase 4 inhibitor (DPP4i), Glucagon-Like 1 Peptide-1 (GLP1) Agonist, Sodium Glucose Co-Transport 2 inhibitor (SGLT2i), Pioglitazone – do not offer self-monitoring of blood glucose levels as these medications do not carry a hypoglycaemia risk.
- Sulphonylurea (SUs)
  - Maintenance – Two to three times per week (different time during the day).
  - Initiation and titration – Two to three times per week.
    - Drivers – within two hours before driving and every two hours whilst driving.
- Repaglinide
  - Maintenance – Two to three times per week (different time).
  - Initiation and titration – Two to three times per week.
  - Drivers – within two hours before driving and every 2 hours whilst driving.
- Insulin
  - Eligible criteria for Continuous glucose monitoring (CGMs) are available at [NetFormulary](#).

Insulin type and treatment	Testing frequency
Basal insulin	Twice daily
Basal insulin with hypoglycaemia medication	Twice or three times daily
Mixed insulin	Three times a day
Basal Bolus	Minimum four times a day

- Sick day rules
  - During times of illness, it is recommended to observe the sick rule days to make sure the patient's glucose levels are in control. Below are links to managing patients' glucose levels when they are unwell.
    - [Sick Day Guidance for Type 1 Diabetes](#)
    - [Sick Day Guidance for Type 2 Diabetes](#)

### Quantity of glucose testing strips

The quantity of test strips on prescription should reflect the frequency of testing required by the individual patient. Where testing is only required intermittently, prescriptions should be generated only when needed, as an acute prescription and test strips **not** added as a repeat prescription item.

The following recommendations should be used as a guide:

- Two to three times a week - 50 strips every 4-6 month
- Twice a day - 50 strips a month
- Three time a day - 100 strips a month
- Four time a day - 150 strips a month
- Ten times a day - 300 strips a month
- Using Continuous Glucose Monitoring (CGM) - 50 strips every 3 months as per [PrescQIPP Bulletin](#).

### Special circumstances that may require more frequent blood glucose testing

The following circumstances may require that patients monitor their blood glucose levels more often:

- At diagnosis for five to seven- days to understand lifestyle interventions.
- Pre-prandial/postprandial level to assist in drug choice at treatment intensification.
- Co-prescribed glucocorticosteroids.
- Intercurrent illness (sick day rules) (as described above).
- Frequent hypoglycaemia.
- Impaired hypoglycaemia awareness.
- During exercise.

### Initiating self-monitoring of blood glucose - Provide Appropriate Information to Support Person with Diabetes to self-manage their blood glucose levels

1. Agree individualized targets for blood glucose levels - consider age, co-morbidities, and clinical factors.
2. Agree purpose of testing, interpretation, and action to be taken in response to self-monitoring
3. Provide patient information leaflets on SMBG, hypos, driving:
  - [Diabetes why do I sometimes feel shaky dizzy and sweaty](#)
  - [Driving Trend](#)
4. Advise that a diabetes review should be carried out annually.

### In Pregnancy (preconception to the postnatal period) (T1DM, T2DM) and Gestational DM

- Pregnant women with T1DM, or those on insulin with T2DM or gestational diabetes, are eligible for CGM (for example Freestyle Libre 2+) issued on FP10.
- All other patients with diabetes in pregnancy should be advised to self-monitoring their blood glucose levels.
- Offer blood glucose meters for self-monitoring to women with diabetes who are planning a pregnancy.
- Blood glucose target for those who are planning a pregnancy
  - Fasting - between 5 mmol/l to 7 mmol/l
  - between 4 mmol/l to 7 mmol/l before meals at other times of the day.
- Blood glucose targets for pregnant women with diabetes ([NICE, 2015](#)) as follow:
  - Fasting – below 5.3 mmol/l,
  - 1 hour after meals – below 7.8 mmol/l, or 2 hours after meals: below 6.4 mmol/l.
- Cambridgeshire and Peterborough meter for new to SMBG patients in pregnancy (GDM, T2DM) is Roche Instant Accu-Chek meter – more information on which glucose meter are available in [C&P ICB Formulary](#).

### Diabetes and Driving

DVLA precautions – if treated with insulin

#### [A guide to insulin treated diabetes and driving](#)

- Drivers must always carry their glucose meter and blood glucose strips with them even if the driver uses continuous glucose monitoring (CGM).
- They must check their blood glucose before driving and every 2 hours while driving.
- A maximum of 2 hours should pass between the pre-driving glucose check and the first glucose check after driving has started.
- **If blood glucose is ≤5.0 mmol/L, the driver must take a snack; if it is <4mmol/l or feel hypoglycaemic the driver should not drive.**
- **Symptoms of hypoglycaemia can present as the following:**
  - Hunger, anxiety or irritability, sweating, tingling lips, irritability, palpitations, tremor, weakness, lethargy, impaired vision, incoordination, reduced orientation, confusion, irrational behaviour, emotional lability and / or deterioration of cognitive function (when blood glucose levels fall lower than 3.0 mmol/L).
- If hypoglycaemia develops while driving, the driver should stop the vehicle as soon as possible.
- The driver must then switch off the engine. Remove the keys from the ignition and move from the driver's seat.
- The driver must not resume driving until 45 mins after blood glucose has returned to normal; it takes up to 45 minutes for the brain to recover fully.
- If the driver uses CGM to check their blood glucose level and the reading is 4.0mmol/L or below, the driver must stop driving and confirm the glucose level with their finger prick test.
- The finger prick glucose level must be at least 5.0mmol/L before returning to driving.
- The driver should always keep an emergency supply of fast-acting carbohydrate such as glucose tablets or sweets within easy reach in the vehicle.
- Alarms on CGMs must not be used as a substitute for symptomatic awareness of hypoglycaemia.

**DVLA Guidance**

<b>Medication</b>	<b>Group 1 (Car and Motorcycle)</b>	<b>Group 2 (lorries and buses)</b>
<b>Insulin</b>	At times relevant to driving (not more than 2 hours before the start of the first journey and every 2 hours while driving) More frequent monitoring may be required with any greater risk of hypoglycaemia	At least twice daily including on days when not driving (and no more than 2 hours before the start of the first journey and every 2 hours while driving) (memory function required to ensure 3 months of readings are available for assessment) More frequent monitoring may be required with any greater risk of hypoglycaemia
<b>SU and meglitinides</b>	Regularly at times relevant to driving and clinical factors	At least twice per day and at times relevant to driving
<b>GLP1, DPP4i, SGLT2</b>	No requirement	No requirement
<b>Diet alone</b>	No requirement	No requirement

**Ketones: Self-monitoring Guidance and Prescribing Blood Ketone Test Strips**

People with type 1 diabetes are at risk of diabetic ketoacidosis (DKA) and are therefore advised to test their ketone levels when unwell. It's a part of the 'sick day rules' for patients to self-monitor their ketone levels. Advise patients with type 1 diabetes to check their ketone levels if they are feeling unwell or present with symptoms of hyperglycaemia as per [NG17](#), [NG3](#) and [NG18](#).

The following symptoms of hyperglycaemia are:

- Polydipsia and polyuria.
- Weight loss.
- Abdominal pain, nausea and/or vomiting.
- Shortness of breath.
- Lethargy, drowsiness, and/or confusion.
- A possible history of [precipitating factor\(s\)](#).

The best practice to measure ketone levels is via blood capillary. Children, young people, and pregnant people or those with Type 1 diabetes who are planning on becoming pregnant should measure blood ketones.

People that take a SGLT2i for type 2 diabetes may develop DKA with normal blood glucose levels. When patients require a ketone meter, and are started on/switched to a meter which tests ketone levels from the [formulary](#), patient education and training should be provided on initiating/supplying the meter and ketone test strips by competent clinical staff which should include:

- When and how to use the ketone meter and ketone test strips
- How to interpret the results and knowing action to take should they have high ketone levels
- How to store ketone strips and being aware of expiry dates
- Reiterating the sick day rules.

The Trench UK [Type 1 Diabetes: What to do when you are ill](#) and [Type 2 diabetes: What to do when you are ill](#) are useful resources to give to/discuss with patients.

There are educational programmes available for patients to learn more about diabetes and how to monitor their glucose and ketone levels when they are feeling unwell, and how to reduce the risk of developing hypo or hyperglycaemia. Please consider referral if appropriate to a local type 1 diabetes education programme if the patient has not attended a course previously.

Below is the table highlighting appropriate ketone levels and what to do when the levels are out of range.

<b>Category</b>	<b>Ketone Level</b>	<b>Action</b>
Green	<0.6mmol/L	Normal reading: no action required.
Amber	0.6-1.5mmol/L	Risk of developing DKA: Re-test in 2 hours.
Red	1.6-2.9mmol/L	High risk of developing DKA: increase insulin requirement
Warning	>3mmol/L (Or urine ketone of 2+ or greater)	Very high risk of DKA: Seek medical help immediately as this is a medical emergency. If the patient is vomiting, unable to keep fluids down, or is unable to control their blood glucose or ketone levels they must seek urgent medical advice.

How often should a patient test their ketone levels

#### *Type 1 diabetes*

- Treatment group – all patients who have type 1 diabetes.
- Testing frequency - During periods of illness or hyperglycaemia.
- Rationale - Ketone testing is required to facilitate self-management. Adults can monitor blood or urine ketones. Children/young people and pregnant women should only measure blood ketones, using the appropriate meter see [Blood Glucose Monitoring and Associated Test Strip](#) for more information.
- Prescription requirement - Minimum of 1 box of 10 strips, as needed. For children & young people, more ketone test strips may be required - consider 2 boxes of 10 strips when required (please note reduced shelf-life once box opened).

#### *Type 2*

- Treatment group - People at high risk of recurrent diabetic ketoacidosis (DKA) as identified by the diabetes specialist service.
- Testing frequency - During periods of illness or hyperglycaemia following specialist recommendation only.
- Rationale - Recurrent DKA may warrant home ketone monitoring. Do not issue ketone strips solely for use by patients prescribed an SGLT2i but if a patient on one of these agents presents unwell, their blood ketone levels should be checked by a healthcare professional even if blood glucose levels are in the normal range.
- Prescription requirement - Not required routinely unless identified by specialist diabetes service.

## References

- Bath and North East Somerset, Swindon and Wiltshire ICB: [Self-monitoring blood glucose monitoring](#)
- TREND diabetes: [Safe Driving and The DVLA](#)
- TREND diabetes: [Type 1 Diabetes: What to do when you are ill](#)
- TREND diabetes: [Type 2 diabetes: What to do when you are ill](#)
- Gov.uk: [Diabetes and driving - GOV.UK \(www.gov.uk\)](#)
- DVLA: [A guide to insulin treated diabetes and driving](#)
- [Diabetes in pregnancy: management from preconception to the postnatal period, NICE guidance NG3.](#)
- [Type 1 diabetes in adults: diagnosis and management, NICE guideline NG17, published: 26 August 2015.](#)
- [Type 2 diabetes in adults: management, NICE guideline NG28, Published: 2 December 2015.](#)
- East Lancashire Health Economy Medicine Management Board. Guidance for the prescribing of Ketone test strips. Sussex community NHS foundation trust: [Ketone testing and sick day guidance MMB Oct22 v1.pdf \(elmmgb.nhs.uk\)](#)
- [Kent and Medway guidelines for self-monitoring of blood glucose \(SMBG\) and ketones, and preferred formulary choices of blood glucose and ketone meters.](#)
- [Prescqipp Bulletin 333. CGM and insulin pump formulary and commissioning guidance](#)

## Document ratification details

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