

# Blood glucose self-monitoring in type 1 and type 2 diabetes: reaching a multidisciplinary consensus

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## ARTICLE POINTS

**1** The provision of home blood glucose monitoring materials is key to empowerment and the delivery of good glycaemic control safely.

**2** The NSF for Diabetes outlined the importance of regular monitoring of HbA<sub>1c</sub> levels.

**3** General recommendations and specific considerations are given for blood glucose monitoring in type 1 diabetes and type 2 diabetes.

**4** The article concludes with advice on home blood glucose monitoring for different diabetes regimens, and these are outlined in a table.

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## Introduction

**In the light of evidence that emerged from the UKPDS (1998) and the DCCT (1993), individual patients must be made aware of the importance of blood glucose monitoring. A multidisciplinary group of healthcare professionals met to discuss blood glucose self-monitoring in type 1 and type 2 diabetes. This article outlines the consensus that they reached and provides a general basis upon which individual patient care plans may be formulated. Advice is given on home blood glucose monitoring systems for people with different regimens for type 1 and type 2 diabetes.**

**I**n the UK in 2001, approximately £90 million was spent on blood glucose testing strips for people with diabetes (National Prescribing Centre, 2002). This amount is estimated to be 40% more than the amount spent on oral agents to lower blood glucose levels (Tiley, 2002). Therefore the cost of home blood glucose monitoring is of legitimate concern to healthcare providers (Burrill, 2002).

Several primary care trusts (PCTs) in England have recently instructed general practitioners (GPs) to reduce the provision of blood glucose monitoring strips, in some cases suggesting no more than one test per day for all people with diabetes irrespective of the type of diabetes or clinical need. The National Diabetes Support Team (NDST) has responded by making reference to the National Institute for Clinical Excellence (NICE) guidelines published in September 2002, reaffirming that self-monitoring should be used as part of integrated self-care (NDST, 2003).

However, the NICE guidance makes no recommendations for frequency of testing according to treatment regimen (NICE, 2002). In addition, the NDST statement also highlighted the benefits that self-monitoring of blood glucose offers people with diabetes when used appropriately

with suitable training (National Diabetes Support Team, 2003).

The recently published NSF for Diabetes (England and Wales) recommends that diabetes services should be:

*'...person-centred, developed in partnership, equitable, integrated and outcome-orientated.'*

Important elements of the document include Standard 3, which specifies that:

*'...all children, young people and adults with diabetes will receive a service that encourages partnership in decision-making, supports them in managing their diabetes and helps them adopt and maintain a healthy lifestyle.'*

This recommendation relates to both outpatient and inpatient care. Standards 4 and 5 clearly state that all people with diabetes will receive support to optimise their blood glucose control (DoH, 2001).

It is well accepted that in people with type 1 or type 2 diabetes good glycaemic control is essential to minimise the risk of long-term vascular complications (DCCT Group, 1993; UKPDS, 1998). Management of diabetes according to the standards established by the NSF for Diabetes is dependent upon the control

**Table 1: Recommendations regarding blood glucose monitoring in type 1 diabetes**

General recommendations	Specific considerations
<ul style="list-style-type: none"> <li>● Blood glucose monitoring should be regarded as an integral part of treating all people with type 1 diabetes.</li> <li>● People with type 1 diabetes should be educated to monitor blood glucose and adjust treatment appropriately.</li> <li>● As the majority of people with type 1 diabetes are liable to instability of glycaemic control, during such times or periods of instability, monitoring should ideally take place 4 or more times per day to prevent hypoglycaemia and control hyperglycaemia.</li> </ul>	<p>Factors which indicate a need for more frequent testing:</p> <ul style="list-style-type: none"> <li>● Hypoglycaemia unawareness</li> <li>● Frequent hypoglycaemia</li> <li>● Exercise</li> <li>● Certain employments</li> <li>● Intercurrent illness</li> <li>● Driving</li> <li>● Children</li> <li>● Pregnancy</li> <li>● Breastfeeding</li> <li>● Outpatient procedures</li> <li>● Drug/alcohol abuse</li> <li>● Change of insulin regimen</li> <li>● Advanced complications (autonomic neuropathy, nephropathy).</li> </ul>

of blood glucose. The utilisation of home blood glucose monitoring, in addition to regular HbA<sub>1c</sub> measurement, is not however, clearly defined.

Similarly, Diabetes UK have re-emphasised in a position statement that people with diabetes should have access to home blood glucose monitoring which is based on individual clinical need and not on an ability to pay (Diabetes UK, Accessed March, 2004). However, no detailed recommendations on monitoring have been produced. Therefore, guidance is needed.

There is a lack of randomised controlled clinical trials in support of the role of blood glucose monitoring in the treatment of type 1 and type 2 diabetes, and results from meta-analyses are inconclusive (Coster et al, 2000). This deficiency is an important contributor to the variation in practice both in primary and secondary care. Some clinical studies have suggested that home blood glucose monitoring in type 2 diabetes confers no significant benefit in improving glycaemic control (Patrick et al, 1994; Gallichan, 1997). However, there is an increasing body of evidence indicating the benefits of home blood glucose monitoring (Nyomba et al, 2003; Muhrata et al, 2003).

It is the collective view of this

multidisciplinary group that home blood glucose monitoring has an important and essential role to play in ensuring the safety and efficacy of glucose lowering therapies in order to prevent the onset and limit the progression of complications related to hyperglycaemia. In the quest for normoglycaemia, the evidence suggests an increasing risk of hypoglycaemia. From the patients' perspective, this most feared complication of diabetes is a major limiting factor in the achievement of good glycaemic control, especially for people on insulin therapy.

The measurement of HbA<sub>1c</sub> has an integral part to play in the management of diabetes, providing an overall indication of ambient blood glucose levels over time, whereas home blood glucose monitoring provides people with diabetes the opportunity to manage their requirements on a day-to-day basis.

### The need for home blood glucose monitoring

Home blood glucose monitoring empowers people with diabetes to understand and thereby better manage their own glycaemic control. It also forms the basis upon which the clinician can interpret the individual patient's

### PAGE POINTS

**1** Diabetes UK have re-emphasised in a position statement that people with diabetes should have access to home blood glucose monitoring which is based on individual clinical need and not on an ability to pay.

**2** There is a lack of randomised controlled clinical trials in support of the role of blood glucose monitoring in the treatment of type 1 and type 2 diabetes, and results from meta-analyses are inconclusive.

**3** Home blood glucose monitoring has an important and essential role to play in ensuring the safety and efficacy of glucose lowering therapies in order to prevent the onset and limit the progression of complications related to hyperglycaemia.

**4** Home blood glucose monitoring empowers people with diabetes to understand and thereby better manage their own glycaemic control.

**PAGE POINTS**

**1** Individual patients should be made aware of the importance of blood glucose monitoring in recognition of the evidence emanating from the DCCT and UKPDS.

**2** HbA<sub>1c</sub> represents a historical integrated measure of blood glucose and does not reflect the variability in blood glucose concentrations.

**3** Depending on the treatment regimen, knowledge of actual preprandial and/or postprandial blood glucose levels is needed to avoid hyperglycaemia and hypoglycaemia.

**4** Any change in blood glucose lowering therapies requires detailed monitoring of blood glucose to improve safety whilst optimising effectiveness.

**5** People who adopt intensive insulin therapies such as multiple daily injections or insulin pumps require regular feedback regarding blood glucose levels.

glycaemic profile, including both preprandial and postprandial blood glucose levels reflecting lifestyle and different treatment modalities (Blonde et al, 2002).

It is known that people with poor glycaemic control are more likely to suffer from the long-term vascular complications of diabetes and have an increased risk of death from a diabetes-related cause (DCCT Group, 1993; UKPDS, 1998). This group believe that the individual patient should be made aware of the importance of blood glucose monitoring in recognition of the evidence emanating from the DCCT and UKPDS.

This article is intended to provide a general basis upon which individual patient care plans may be formulated. Key factors supporting the need for home blood glucose monitoring in people with type 1 diabetes or with type 2 diabetes can be divided into those that are:

- (1) Absolute requirements for blood glucose monitoring.
- (2) Situations that demand additional information than can be derived from HbA<sub>1c</sub> measurement alone.

**(1) Absolute requirements for home blood glucose monitoring:**

- There is more to diabetes control than by HbA<sub>1c</sub> alone. The gold standard is represented by 3–6 months regular HbA<sub>1c</sub> testing (DoH, 2001). This standard may be only be possible for those people attending a review at 6-monthly intervals. As HbA<sub>1c</sub> reflects glucose exposure over the lifespan of red blood cells (120 days) it is a weighted measure of average blood glucose control, with 50% of the final value reflecting the final 30 days (Pickup, 2003). As such, it represents a historical integrated measure of blood glucose and does not reflect the variability in blood glucose concentrations. Therefore, its interpretation requires additional information derived from blood glucose profiles.
- Hypoglycaemia/hyperglycaemia. Depending on the treatment regimen, knowledge of actual preprandial and/or postprandial blood glucose levels is needed to avoid

either state. Reliance on subjective signs/symptoms (without testing) has been shown on occasions to be disturbingly unreliable (Pramong et al, 1990).

- Alterations in treatment. Any change in blood glucose lowering therapies requires detailed monitoring of blood glucose to improve safety whilst optimising effectiveness.

**(2) Circumstances that require additional blood glucose information:**

- Patients with impaired awareness of hypoglycaemia. Home blood glucose monitoring is mandatory in people who are suspected or confirmed to have unawareness of hypoglycaemia.
- Meeting targets. The national targets defined by NICE, the General Medical Services contract (GMS2) and the NSF for Diabetes require regular HbA<sub>1c</sub> monitoring. In order to achieve these targets, appropriate blood glucose measurements are necessary (NICE, 2002; DoH, 2001; BMA, 2003).
- Everyday circumstances. The following circumstances normally require frequent monitoring of blood glucose in order to avoid hypoglycaemia:
  - Exercise
  - Certain employment (such as shift work)
  - Intercurrent illness
  - Driving of vehicles (drivers must be able to evidence test data)
  - Children
  - Pregnancy
  - Breastfeeding
  - Outpatient procedures
  - Drug/alcohol abuse (monitoring is desirable although it is realised that adherence may be variable and unreliable).
- Intensive treatment programmes. People with diabetes who adopt intensive insulin therapies such as multiple daily injections or insulin pumps require regular feedback regarding blood glucose levels. This is particularly relevant for self-adjustment of insulin dose according to circumstances (content of foods, exercise, etc).

- Patient empowerment. Blood glucose monitoring is an objective basis for people with diabetes to self-regulate their diabetes both safely and effectively. Patient empowerment is a prerequisite for effective diabetes care (DoH, 2001; Diabetes UK website, accessed 2004).
- Pre-pregnancy counselling. Monitoring of blood glucose is desirable to achieve appropriate glycaemic control prior to conception.
- Special clinical situations:
  - Dialysis
  - Acute coronary syndromes
  - Terminal care
  - Perioperative management

The most important principles for regular blood glucose monitoring in patients with type 1 or type 2 diabetes must be quality and stability of control and avoidance of hypoglycaemia (DCCT, 1993).

### Monitoring in type 1 diabetes

In general, glycaemic control is less stable in people with type 1 diabetes than in those with type 2 diabetes and people with type 1 diabetes are at greater risk of hypoglycaemia and hyperglycaemia. More frequent blood glucose testing may therefore be needed. For most people with type 1 diabetes this may require an average of 4 tests per day to include preprandial and bedtime values, on initiation of insulin. More frequent testing is indicated in certain circumstances as can be seen in *Table 1*.

Patient empowerment is an important element in defining the necessary frequency of blood glucose testing (DoH, 2001). Appropriate training and education is therefore required so that people with diabetes can safely adjust their insulin doses according to their blood glucose results. This approach results in a more flexible lifestyle for the patient.

For people who have highly variable blood glucose control, more frequent tests per day may be required for a period of time, according to need.

There could also be benefits from more frequent testing during the 2 weeks preceding a clinic visit. This will provide

both the patient and clinician with detailed data from which to better assess current glycaemic control and form the basis for improving and/or adjusting the treatment (such as insulin dosage). For those patients who are less able to interpret their own blood glucose data, this approach may be particularly useful.

It is well accepted that patients with type 1 diabetes should monitor their blood glucose levels as part of their self-management programmes. The European Diabetes Policy Group states that all patients with type 1 diabetes should test their blood glucose on a regular basis and appropriate training and frequent review of technique should be undertaken (European Diabetes Policy Group 1998, 1999).

### IDF desktop guide recommendations

Recommendations from the International Diabetes Federation desktop guide regarding frequency of home blood glucose monitoring for patients with type 1 diabetes are as follows (European Diabetes Policy Group 1998, 1999):

- Results are recorded (with date and time, insulin dose, hypoglycaemia) to provide a cumulative record as a basis for day-to-day changes in therapy.
- Different patterns of testing according to need:
  - Four or more times a day during illness, lifestyle changes, pre-conception, in pregnancy and impaired awareness of hypoglycaemia.
  - At night (0200–0400 h) if unrecognised night-time hypoglycaemia is suspected.
  - One or two multipoint profiles a week (on different types of day).
  - Once daily testing is the minimum acceptable frequency (at different times of day).
  - Daytime tests preprandially and 1–2 h after meals.
  - Regular bedtime tests in people prone to nocturnal hypoglycaemia.

### Monitoring in gestational diabetes

Because of the risks posed to the foetus

### PAGE POINTS

**1** The most important principles for regular blood glucose monitoring in patients with type 1 or type 2 diabetes must be quality and stability of control and avoidance of hypoglycaemia.

**2** Glycaemic control is generally less stable in people with type 1 diabetes than those with type 2 diabetes and those with type 2 diabetes are at greater risk of hypoglycaemia and hyperglycaemia.

**3** Appropriate training and education is required so that people with diabetes can safely adjust their insulin doses according to their blood glucose results.

**4** Frequent testing during the 2 weeks preceding a clinic visit will provide both the patient and the clinician with detailed data from which to better assess current glycaemic control.



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**1** Pregnant women who can achieve glycaemic control through diet alone should monitor their blood glucose at least once every 2 days including fasting and 1 h postprandial.

**2** People with type 2 diabetes who use insulin or oral hypoglycaemic agents should monitor their blood glucose at least once daily, varying the time of testing between fasting, preprandial and postprandial glucose levels during the day.

**3** People with type 2 diabetes who use a multiple daily insulin regimen should monitor their blood glucose in the same way as those with type 1 diabetes.

**4** Fasting blood glucose should be tested at least once per day during basal insulin dose titration.

**5** Glycaemic control managed by diet and exercise in people with type 2 diabetes is generally best monitored through HbA<sub>1c</sub> testing.

by both hyperglycaemia and its potential teratogenic effects and hypoglycaemia, regular monitoring of blood glucose is important in gestational diabetes especially when using insulin (Homko et al, 1998). Women with gestational diabetes who are on insulin should monitor their blood glucose at least four times per day, ensuring that they include both fasting blood glucose and 1 h postprandial blood glucose measurements.

Pregnant women who can achieve glycaemic control through diet alone should monitor their blood glucose at least once every 2 days including fasting and 1 h postprandial. According to clinical practice, a full profile may be necessary on alternate days.

### Monitoring in type 2 diabetes

People with type 2 diabetes are more stable and do not require monitoring as frequently as those with type 1 diabetes. People with type 2 diabetes who use insulin or oral hypoglycaemic agents should monitor their blood glucose at least once daily, varying the time of testing between fasting, preprandial and postprandial glucose levels during the day. At treatment initiation, the frequency of monitoring may need to be increased. The European Diabetes Policy Group states that all people should have access to effective self-monitoring of blood glucose (European Diabetes Policy Group, 1999, 1999). In practice, the level of monitoring will vary according to the treatment regimen in use and the target level of glycaemic control set for the patient. A minority of people with unstable glycaemic control may require more frequent testing during such periods.

### Multiple daily insulin injection regimens

People with type 2 diabetes who use a multiple daily insulin regimen should monitor their blood glucose in the same way as those with type 1 diabetes as can be seen in *Table 1*.

### Conventional insulin therapy

Fasting blood glucose should be tested

at least once per day during basal insulin dose titration. It is recommended that testing be conducted at different times of the day to avoid hypoglycaemia.

People who are maintained on once daily basal insulin, who have stable glycaemic control and do not experience hypoglycaemia should test their blood glucose twice or three times a week. However, people with type 2 diabetes who require twice-daily insulins should monitor twice a day at various times to include preprandial, postprandial and pre-bedtime blood glucose measurements.

### Combined insulin and oral antidiabetic therapy

People with diabetes who use insulin and an oral antidiabetic agent should monitor their blood glucose at least once per day. During insulin dose titration, fasting blood glucose should be measured once per day. Once the insulin dose is established it is recommended that testing be conducted at different times of the day to identify hypoglycaemia as required, especially nocturnal hypoglycaemia. A minority of people with less stable glycaemic control may require more frequent testing. The risk of hypoglycaemia is relatively low in these people compared with those with type 1 diabetes (Allen et al, in press).

### Diet and exercise

Glycaemic control managed by diet and exercise in people with type 2 diabetes is generally best monitored through HbA<sub>1c</sub> testing (Franciosi et al, 2001). Blood glucose monitoring should not be required routinely when control is stable, however, certain circumstances will require more frequent testing. Therefore, education should be provided regarding blood glucose monitoring technique, interpretation of the results, etc (European Diabetes Policy Group 1999, 1999).

People who self-monitor will be aware of the effect that eating and exercise have on their blood glucose levels. This information can help to motivate people to alter their diet and increase physical

activity in order to improve their glycaemic status where necessary.

Situations that may require blood glucose monitoring, include the following:

- Periods of illness.
- Change in therapy.
- Prescribing of steroids. People with type 2 diabetes who take concomitant steroids should monitor at least once per day, to include midday, before the evening meal and 2 hours after the evening meal.
- Patients with postprandial hyperglycaemia (due to the potential link with macrovascular disease).
- Where regular HbA<sub>1c</sub> testing is not available.

### **Metformin monotherapy (or in combination with glitazones)**

As for diet and exercise. These people are seldom prone to hypoglycaemic episodes.

### **Glitazone monotherapy (or in combination with metformin)**

As for diet and exercise. These people are not prone to hypoglycaemic episodes.

### **Sulphonylurea or non-sulphonylurea insulin secretagogues**

Hypoglycaemia is a common occurrence in people treated with sulphonylureas and less so in those treated with the insulin secretagogues. If severe, hypoglycaemia may be associated with significant morbidity and mortality (Asplund et al, 1983; Holstein and Egberts, 2003; Jennings et al, 1989; Shorr et al, 1997; Miller et al, 2001). Blood glucose should therefore be tested to ensure that asymptomatic hypoglycaemia is identified.

Testing of blood glucose is recommended at least 3 times per week. Testing should be undertaken at different times of the day to ensure that hypoglycaemia is identified. Hypoglycaemia is more common than assumed in people with type 2 diabetes on sulphonylureas (Jennings et al, 1989) and less common on meglitinide

derivatives and may be misinterpreted as an expression of concomitant disease such as macrovascular disease.

### **Special circumstances**

Special circumstances comprise acute coronary syndromes, dialysis, pregnancy, terminal care, driving and metabolic emergencies.

#### **Acute coronary syndromes**

People with diabetes who are in coronary care units should be monitored using hospital laboratory facilities. The patient's coronary care team will determine the frequency of blood glucose monitoring. People who are newly diagnosed with hypoglycaemia need to be educated about blood glucose monitoring as it relates to their treatment (Malmberg et al, 1996).

#### **Dialysis**

Patients undergoing dialysis will be under the care of their renal unit. The patient's renal team will therefore determine the blood glucose monitoring frequency according to the dialysis programme and dialysis perfusate (peritoneal dialysis).

#### **Pregnancy**

Women with type 1 diabetes should monitor their blood glucose at least four times per day to include both fasting and 1h postprandial blood glucose measurements. On occasions a full day profile may be required comprising of 6 or more blood glucose measurements.

Women with type 2 diabetes should be treated as above if they are on insulin treatment.

Women who can achieve optimal glycaemic control through diet alone should monitor their blood glucose once every 2 days and fasting and 1h postprandial blood glucose on alternate days.

#### **Terminal care**

Patients receiving terminal care will require monitoring to ensure that they avoid hypoglycaemia and periods of excessive hyperglycaemia. Monitoring more than once per day may be necessary in people whose diabetes is

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**1** Hypoglycaemia is more common than assumed in people with type 2 diabetes on sulphonylureas, and less common on meglitinide derivatives.

**2** People with diabetes who are in coronary care units should be monitored using hospital laboratory facilities.

**3** Pregnant women with type 1 diabetes should monitor their blood glucose at least four times per day to include both fasting and 1h postprandial blood glucose measurements.

**4** Pregnant women who can achieve optimal glycaemic control through diet alone should monitor their blood glucose once every 2 days and fasting and 1h postprandial blood glucose on alternate days.

**5** Patients receiving terminal care will require monitoring to ensure that they avoid hypoglycaemia and periods of excessive hyperglycaemia.

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- 1 The emergence of metabolic emergencies such as diabetic ketoacidosis require frequent blood glucose monitoring.
- 2 All people with type 1 diabetes should have access to home blood glucose monitoring four or more times per day as required.
- 3 People with type 2 diabetes who use multiple daily insulin injections should have access to home blood glucose monitoring in the same way as people with type 1 diabetes.
- 4 People with type 2 diabetes who are using a conventional insulin regimen and who have stable control should monitor their blood glucose two or three times a week.
- 5 People with type 2 diabetes who have good control on diet and exercise, metformin or glitazone treatment do not need daily home blood glucose monitoring, unless they are destabilised by other factors.

stable, and adjusted as the need arises.

**Driving**

Hypoglycaemia is a very important and potentially dangerous problem for drivers especially in people who are treated with insulin. Blood glucose testing is therefore recommended before any journey, and should be repeated at regular intervals on long journeys (every 2h). However, it is reported that few drivers heed this advice (Graveling et al, in press). Legal precedent in a recent fatal accident case has indicated that it is the responsibility of the driver to ensure personal safety to drive by testing blood glucose. Blood glucose monitoring equipment should be carried in the vehicle. It is recommended that testing is especially important in people who have impaired awareness of hypoglycaemia. It is also recommended that a prophylactic snack should be taken if the blood glucose is less than 5.0 mmol/l (Cox et al, 2002). Blood glucose monitoring is a prerequisite for vocational licences (CI) in insulin-treated drivers (Frier, 1999).

**Metabolic emergencies**

The emergence of metabolic emergencies such as diabetic ketoacidosis (DKA) and hyperosmolar non ketotic hyperglycaemia/coma (HONK) and hypoglycaemia requires more frequent blood glucose monitoring to assist in the assessment of these life threatening situations, to determine response, or lack of, to treatment and the need for hospital admissions. Home blood glucose testing equipment is not designed for use in hospital during the acute stabilisation/treatment period of such metabolic emergencies.

**Conclusions**

Regular monitoring of HbA<sub>1c</sub> is important for all people with diabetes as described in the NSF for Diabetes (DoH, 2001). Provision of appropriate home blood glucose monitoring materials is key to successful patient empowerment to deliver good glycaemic control safely.

All people with type 1 diabetes should have access to home blood glucose

monitoring four or more times per day as required during insulin initiation and adjustment in dosage and/or insulin regimen.

People with type 2 diabetes who use multiple daily insulin injections should have access to home blood glucose monitoring in the same way as people with type 1 diabetes. For people with type 2 diabetes who are using a conventional insulin regimen and who have stable control, blood glucose monitoring two or three times a week should be adequate.

Due to the risk of hypoglycaemia associated with sulphonylureas, based on at least three tests per week, blood glucose should be tested at different times of the day to ensure that asymptomatic biochemical hypoglycaemia is identified.

Well-controlled people with type 2 diabetes on diet and exercise, with or without metformin or thiozolidinedione (glitazone) treatment do not need daily home blood glucose monitoring, unless they are de-stabilised by other factors such as intercurrent illness, etc.

Frequency of testing should be adjusted where control is regarded as unstable due to certain circumstances, in an attempt to improve control whilst at the same time avoiding hypoglycaemia. Recommendations regarding blood glucose monitoring are outlined in Table 2.

***'If you cannot measure it, you cannot improve it'. Lord Kelvin 1824-1907***

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**‘Frequency of testing should be adjusted where control is unstable by exceptional circumstances, to ensure better glycaemic control and avoidance of hypoglycaemia.’**

**‘Provision of appropriate home blood glucose monitoring materials is key to successful patient empowerment to deliver good glycaemic control safely.’**



**Table 2. Recommendations regarding blood glucose monitoring**

Diabetes type	Treatment group	Monitoring regimen
Type 1 diabetes	All people with type 1 diabetes	<ul style="list-style-type: none"> <li>• Blood glucose monitoring should be seen as an integral part of treating type 1 diabetes.</li> <li>• People with type 1 diabetes should be trained to monitor blood glucose and alter treatment appropriately.</li> <li>• The majority of people with type 1 diabetes are liable to instability of glycaemic control and should therefore monitor blood glucose 4 or more times per day to prevent hypoglycaemia and treat hyperglycaemia.</li> <li>• The following situations indicate the need for even more frequent testing: myocardial infarction, dialysis, pregnancy, terminal care, impaired awareness of hypoglycaemia.</li> </ul>
Gestational diabetes	All people with gestational diabetes	<ul style="list-style-type: none"> <li>• For women treated with diet, testing once every 2 days is recommended, including fasting and 1 h postprandial blood glucose.</li> <li>• For women treated with insulin or other pharmacotherapy, it is recommended that blood glucose should be monitored at least four times per day, to include the fasting state and 1 h postprandially.</li> </ul>
Type 2 diabetes	Intensive insulin therapy	As with type 1 diabetes, monitoring should generally take place according to need to prevent hypoglycaemia or hyperglycaemia.
Type 2 diabetes	Conventional insulin therapy	<ul style="list-style-type: none"> <li>• Fasting glucose should be tested at least once per day during titration. It is recommended that testing be conducted at different times of the day to identify hypoglycaemia.</li> <li>• People with type 2 diabetes maintained on daily insulin who are stable and not experiencing hypoglycaemia should test their blood glucose once per day.</li> <li>• Those people with type 2 diabetes requiring twice-daily insulins should monitor twice a day at various times to include pre and postprandial and pre-bedtime blood glucose measurements.</li> </ul>
Type 2 diabetes	Combined insulin and oral antidiabetic therapy	<ul style="list-style-type: none"> <li>• Fasting glucose should be tested at least once per day during titration. In addition, it is recommended that testing be conducted at different times of the day to identify hypoglycaemia.</li> <li>• People with type 2 diabetes who are maintained on daily insulin plus oral antidiabetic therapy should test their blood glucose once per day.</li> <li>• People with type 2 diabetes who have unstable glycaemic control may require more frequent testing.</li> </ul>
Type 2 diabetes	Diet and exercise	<ul style="list-style-type: none"> <li>• HbA<sub>1c</sub> is the real outcome measure in these people. Blood glucose monitoring should not be required routinely. However, people should be trained in blood glucose monitoring, interpretation of the results and appropriate amendments to treatment, as monitoring is required in special circumstances.</li> <li>• Blood glucose may require monitoring, for example, once per day at varying times in the following circumstances: <ul style="list-style-type: none"> <li>• During a period of illness.</li> <li>• When therapy is changed.</li> <li>• If steroids are co-prescribed (to cover midday, before evening meal and 2 h after evening meal).</li> <li>• When regular HbA<sub>1c</sub> testing is not available.</li> <li>• Patients with postprandial hyperglycaemia (due to the potential link with macrovascular disease).</li> </ul> </li> </ul>
Type 2 diabetes	Metformin (+/- glitazone)	As for diet and exercise
Type 2 diabetes	Glitazone (+/- metformin)	As for diet and exercise
Type 2 diabetes	Sulphonylurea alone (or in combination with other oral antidiabetic agents)	<ul style="list-style-type: none"> <li>• Hypoglycaemia is a common occurrence in these people. Blood glucose should therefore be tested to ensure that, if present, hypoglycaemia is identified.</li> <li>• Testing of blood glucose is recommended at least 3 times per week.</li> <li>• Testing should be undertaken at different times of the day to ensure that hypoglycaemia is identified.</li> </ul>