



# Monitoring and Controlling Diabetes



Professor Rachel North PhD MSc FCOptom

Diabetes mellitus (DM) is defined as a group of metabolic diseases characterised by hyperglycaemia resulting in defects in insulin secretion, insulin action, or both secretion and action. It is essential to control plasma glucose levels in order to reduce the risk of diabetic complications. Other complications, such as hypertension, also need to be considered.

## Diagnosis of diabetes mellitus

The aetiological classification of DM is divided into four groups<sup>1</sup> (Table 1).

Classifying diabetes is not always straightforward, as patients may not obviously fit into a single group. Regardless of type, there are questions that need to be answered, such as how is diabetes diagnosed? What level of glycaemia is considered to be abnormal and likely to cause damage? The criteria for diagnosing glycaemia have become stricter and the current criteria for the diagnosis of diabetes are shown below.

There are three ways of diagnosing diabetes<sup>1</sup>:

**1. Fasting plasma glucose  $\geq 7.0$  mmol/l (126 mg/dl)**

*Fasting is defined as no calorific intake for at least eight hours*

OR

**2. Symptoms of hyperglycemia and a casual plasma glucose  $\geq 11.1$  mmol/l (200 mg/dl)**

*The classic symptoms of hyperglycemia include polyuria, polydipsia, and unexplained weight loss. Casual is defined as any time of day without*

Type	Aetiology
I	$\beta$ cell destruction, usually leading to absolute insulin deficiency
II	May range from predominantly insulin resistance with relative insulin deficiency, to a predominantly secretory defect with insulin resistance
III	Other specific types eg endocrinopathies, infections, genetic defects of $\beta$ cell function
IV	Gestational DM

➔ Table 1

Aetiological classification of DM

*regard to time since last meal.*

OR

**3. Two hour (2-h) plasma glucose  $\geq 11.1$  mmol/l (200 mg/dl) during an Oral Glucose Tolerance Test**

*The test should be performed as described by the World Health Organisation, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water. In the absence of unequivocal hyperglycemia, these criteria should be confirmed by repeating the test on a different day.*

The use of HbA1c (glycosylated

haemoglobin) as a diagnostic test for diabetes is not recommended, mainly due to the non-standardised methodology of laboratories resulting in varying reference ranges.

There are people whose glucose levels do not meet the criteria for diabetes, but are regarded as being higher than normal. These patients are considered to have impaired fasting glucose (IFG) if the fasting plasma glucose level is between 5.6 – 6.9 mmol/l (100-125 mg/dl) and impaired glucose tolerance (IGT) if the 2-h plasma glucose is between 7.8-11.1

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mmol/l (140-199 mg/dl). It is believed that people with IGT or IFG are at risk of developing diabetes.

## Monitoring of glycaemic control

Patients are encouraged to regularly monitor their own glycaemic control. This is generally carried out by taking plasma glucose readings, or alternatively, a urine sample can be tested for its glucose content.

There is a range of glucose meters available which give a digital read out of plasma glucose levels. A drop of blood is placed on a strip, which is inserted into the meter. The blood sample is usually acquired from the side of a finger (avoid the forefinger or thumb) using a finger pricking device. The digital display is a great advantage to patients with tritan colour vision defects, as they can obtain an accurate measure of their plasma glucose level.



➔ **Figure 1**

Finger prick device – Soft-Clix pro (by kind permission of Medipost (UK) Ltd - [www.medipost.co.uk](http://www.medipost.co.uk))



➔ **Figure 2**

Clever Chek Codeless Talking Blood Glucose Meter (by kind permission of BBI Healthcare - [www.talkingmeter.co.uk](http://www.talkingmeter.co.uk))

	Hypoglycaemia	Ketoacidosis
Signs and symptoms	<ul style="list-style-type: none"> <li>• Sweating</li> <li>• Pallor</li> <li>• Palpitations</li> <li>• Tingling of lips</li> <li>• Hunger</li> <li>• Trembling</li> </ul>	<ul style="list-style-type: none"> <li>• 'Sweet' smelling breath</li> <li>• Tachycardia</li> <li>• Hypotension</li> <li>• Dehydration</li> <li>• Warm/dry skin</li> <li>• Hyperventilation</li> <li>• Hypothermia</li> <li>• Impaired consciousness</li> <li>• Vomiting</li> <li>• Thirst</li> <li>• Increased urination</li> <li>• Weight loss</li> <li>• Tiredness</li> </ul>
Cause	<ul style="list-style-type: none"> <li>• Delayed food</li> <li>• Too much insulin</li> <li>• Increased activity</li> <li>• Alcohol on an empty stomach</li> </ul> <p>N.B. More common in Type 1 DM</p>	<ul style="list-style-type: none"> <li>• High plasma glucose and too little insulin</li> </ul>
Treatment	<ul style="list-style-type: none"> <li>• Glucose sweets</li> <li>• Fruit juice followed by long acting carbohydrate eg bread.</li> </ul> <p>N.B. If the patient is unconscious intravenous glucose or intramuscular glucagon is required</p>	<ul style="list-style-type: none"> <li>• Insulin and fluids</li> </ul>

➔ **Table 2**

A summary of the effects of hypoglycaemia and ketoacidosis

Previously, when the “BM (Boehringer Mannheim) - test” sticks were commonly used, inaccurate readings could occur, because the patient had to colour match shades of blue to indicate the range of plasma glucose.

New, less painful techniques to acquire the drop of blood are now available including automatic spring loaded finger pricking devices and laser devices. The lancets inserted into automatic devices are available in different gauges; the higher the gauge, the narrower the needle width, which tends to be less painful (Figure 1).

Some of the meters have software packages that allow trends in plasma glucose control to be evaluated and the results can be downloaded onto a computer. For patients with visual impairment, meters have been manufactured with large displays and bold numbers. For those with severe visual impairment, a “talking” blood glucose meter is available (Figure 2).

Urine monitoring, as mentioned above, is less commonly used to assess

glucose levels, despite having the advantage of being somewhat cheaper and less invasive. The drawback is that it fails to provide an accurate measure of the level of plasma glucose at the time taken (due to the time delay between raised plasma glucose levels and urine levels) and hypoglycaemia may thus go undetected.

Also available are meters that indicate plasma ketone levels. This is important for patients with elevated plasma glucose levels that lead to ketoacidosis. Ketoacidosis is an extreme and uncontrolled form of ketosis, which is a normal response to prolonged fasting. In ketoacidosis, the body fails to adequately regulate ketone production causing such a severe accumulation of keto acids that the pH of the blood is substantially decreased. Patients with ketoacidosis have sweet smelling breath (due to acetone). It is a serious condition that can result in death due to complications such as myocardial infarction, infection (frequently pneumonia), acute



Timing	Type 1 DM <sup>3</sup>		Type 2 DM <sup>4</sup>
	Children	Adults	
Before meals	4-8 mmol/l	4-7 mmol/l	4-7 mmol/l
Two hrs after meals	<10 mmol/l	<9 mmol/l	<8.5 mmol/l

⇒ **Table 3**

Target range of plasma glucose levels for diabetic patients

pancreatitis, cerebrovascular accident, adult respiratory distress syndrome or cerebral oedema. Table 2 shows a summary of the causes and effects of hypoglycaemia and ketoacidosis.

### Plasma glucose targets

Self monitoring of plasma glucose is an important part of diabetes management. It can assist in lifestyle and treatment choices, and help to monitor for symptoms of hypo or hyperglycaemia. It is very important that patients are informed as to the aims of self monitoring, what the measurements mean and how they should respond to the results.

Ideally, the plasma glucose levels should be kept as near as possible to normal levels - 3.5 to 5.5 mmol/l before meals and <8.0 mmol/l two hours after meals<sup>2</sup>.

There are various opinions regarding the target range for diabetic patients. Table 3 provides a guide according to the National Institute for Health and Clinical Excellence (NICE)<sup>3,4,5</sup>. The target levels should always be discussed by each patient with their doctor.

### Glycated haemoglobin (HbA1c)

The standardised measurement of HbA1c is used as an indicator of long term control of plasma glucose. These measurements are normally carried out at two to six month intervals, depending upon factors such as the type of DM, plasma glucose control and changes in medication. Guidelines suggest that HbA1c measures should be less than 6.5% and ≤ 7.5% for those at risk of severe hypoglycaemia<sup>2</sup>.

### Glycaemic control in diabetes mellitus

#### Insulin

Insulin is essential to control plasma glucose levels in patients with Type 1 DM and for some patients with Type 2 DM. There are three groups of insulin – animal (bovine, porcine), human (synthetically produced) and analogues. Today, most patients use human insulin and insulin analogues.

There are six main types of insulin that are described according to their speed and/or duration of action (see Table 4) for more information see British National Formulary (BNF) or MIMS). Novo Nordisk, Lilly, Sanofi-Aventis and Wockhardt UK are well known manufacturers of insulin.



⇒ **Figure 3**

Cartridge insulin pens for adults and children (by kind permission of Novo Nordisk - [www.novonordisk.co.uk](http://www.novonordisk.co.uk))



⇒ **Figure 4**

Prefilled insulin pens - Innolet and Flex Pen (by kind permission of Novo Nordisk)

### Insulin administration

The majority of patients inject insulin daily, however, some may use insulin pumps providing continuous subcutaneous insulin infusion. As these are invasive techniques, there is a considerable amount of research investigating non-invasive methods of administering insulin, such as nasal and oral sprays, patches, tablets and inhalers.

Insulin can be injected using syringes, pen devices (which require cartridges of insulin) (Figure 3) and preloaded pens (Figure 4). The pen devices are commonly used and the preloaded pens are particularly useful for patients who have difficulty loading new cartridges. The pen devices give accurate doses of insulin as they have a dial so that the amount of insulin to be injected can be adjusted as required (increments can vary between 0.5, 1 or 2 units depending upon the pen).

Commonly used injection sites are the abdomen and the upper and outer thigh. The site should be rotated as repeated injections at one site can cause lipohypertrophy which reduces the rate of absorption. Other factors that affect the rate of insulin absorption include:

- Speed of absorption – quickest from the abdominal wall, slowest from the thigh
- Exercise – increases when injected limb is exercised
- Subcutaneous blood flow – increases with increasing blood flow eg after hot bath
- Dose – faster with a smaller volume

### Pumps

The use of an insulin pump (continuous subcutaneous insulin infusion) provides an alternative to multiple injections. The pump delivers a continuous flow of short acting insulin 24 hours a day.

A cannula is usually inserted under the skin of the abdomen via a needle, and the pump can be set to deliver the required dose of insulin throughout the day. The amount will vary between people. Extra insulin will be required at meal times and this is easily provided by a push of a button on the pump (Figure 5).



Type of insulin	Injection-time	Peak action	Duration	Comment
Rapid acting analogue	Just before, with or after food	0-3 hours	2-5 hours	-
Long acting analogue	Once a day	-	24 hours	Provides background insulin
Short acting insulin	15-30 mins before a meal	2-6 hours	Up to 8 hours	-
Medium and long acting insulin	Once/twice per day	4-12 hours	Up to 30 hours	Provides background insulin or can be combined with short acting insulins/rapid acting analogues
Mixed insulin	Combination of medium and short acting insulin			
Mixed analogue	Combination of medium acting insulin and rapid acting insulin			

⇒ **Table 4**

Types of insulin categorised according to speed and/or duration of action



⇒ **Figure 5**

Insulin pump (by kind permission Of Smiths Medical international, Watford, UK - [www.smiths-medical.com](http://www.smiths-medical.com))

An insulin pump is usually recommended for patients with Type 1 DM where multiple injections have failed to control the glycaemic levels adequately. It has several advantages including a reduction in the number of injections required (but the cannula does need replacing two-three times per week), a reduction in the total dose of insulin required as the glycaemic control improves and a reduction in the risk of hypoglycaemia. The disadvantages include an increase in daily plasma glucose monitoring (four-six times daily), and infection or

scarring can occur at the insertion site. It is important that patients receive initial training about the use of a pump and also have ongoing support.

### Oral hypoglycaemic agents

Patients with Type 2 DM typically control their plasma glucose levels by diet and oral hypoglycaemic agents. There are a number of different types of tablet available, which are summarised in Table 5 (for full details please refer to BNF or MIMS). These agents are usually categorised as:

- Sulphonylureas - stimulate the production of insulin and increase the number of insulin receptors. These are usually avoided in elderly patients due to the increased risk of hypoglycaemia due to their prolonged duration of action
- Biguanides - increase sensitivity of peripheral tissues to insulin and inhibit liver production of glucose
- DPP-4 inhibitors (gliptins) - block action of enzyme, DPP-4, which destroys the hormone incretin
- Alpha glucosidase inhibitor - attenuates absorption of carbohydrate from gut
- Thiazolidinediones (glitazones) - reduce insulin resistance and improve insulin sensitivity
- Prandial glucose regulator - stimulates insulin release and has a rapid onset and short duration.

### Incretin mimetics

Exenatide is the first of a new class of medications known as incretin mimetics. It mimics the incretin hormone GLP-1 (glucagon-like peptide 1), which stimulates insulin secretion. Exenatide increases insulin secretion and suppresses pancreatic release of glucagon and glucose release from the liver. Most other medications, except Metformin and Acarbose, have been associated with weight gain. By contrast, Exenatide improves weight



Drug	Mode of action	Generic name and frequency of dosing	Side effects *
Sulphonylureas	Stimulate production of insulin and increase number of insulin receptors	Gliclazide - once or twice daily Glipizide - once a day Glimepiride - once a day Tolbutamide - up to three times a day	Hypoglycaemia, nausea, vomiting, diarrhoea, abdominal pain, bloating, indigestion, weight gain, liver function problems, headache, photophobia, visual disturbances, dizziness, drowsiness
Biguanides	Increase sensitivity of peripheral tissues to insulin and inhibit liver production of glucose	Metformin - up to three times daily	Nausea, vomiting, diarrhoea, abdominal pain, liver function problems
DPP-4 inhibitors (gliptins)	Block action of enzyme, DPP-4, which destroys the hormone incretin	Sitagliptin - once daily  Vildagliptin - twice daily  N.B. These tablets are always prescribed with other hypoglycaemic agents	Hypoglycaemia, drowsiness, diarrhoea, nausea, flatulence, constipation, headache, dizziness, allergic skin reactions, sore throat, tremor, weight gain, symptoms of liver problems
Alpha glucosidase inhibitor	Attenuates absorption of carbohydrate from gut	Acarbose - three times daily	Flatulence, diarrhoea, abdominal pain, nausea, vomiting, indigestion, liver function problems, allergic skin reaction
Thiazolidinediones (glitazones)	Reduce insulin resistance and improve insulin sensitivity	Rosiglitazone - once or twice daily  Pioglitazone - once or twice daily	Oedema, blood disorders, increase in blood fats, weight gain, heart problems, constipation  Visual disturbance, oedema, weight gain, sinusitis, numbness, insomnia, liver function problems
Prandial glucose regulator	Stimulates insulin release - rapid onset and short duration	Repaglinide - up to three times daily  Nateglinide - up to three times daily	Hypoglycaemia, allergic skin reactions, liver function problems, abdominal pain, diarrhoea, nausea, vomiting, constipation, visual disturbance

⇒ **Table 5**

Oral hypoglycaemic agents (\*for a complete list of side effects please refer to BNF or MIMS)

control by reducing appetite and liver fat content. The indications for use are improvement of glycaemic control in patients who are taking Metformin, Sulphonylurea or a combination of both. However, like many other drugs it is associated with gastrointestinal side effects and there have been reports that patients may be at risk of acute pancreatitis. This medication has to be injected twice daily using a pre-filled

pen device.

**Insulin**

Occasionally, insulin injections are needed by Type 2 DM patients in order to control their plasma glucose levels. The clinical indications for introducing insulin injections include:

- persistent hyperglycaemia with maximum oral hypoglycaemic agents
- acute symptoms
- continual weight loss

- presence of complications
  - poor healing or recurrent infections
- Alternative methods to injecting insulin are currently undergoing trials. It would be of great benefit if insulin could be administered in tablet form. However, this is problematic due to lability of the macromolecule in stomach acid (insulin is broken down by stomach acid before it can reach the intestines and be absorbed). Studies are underway to investigate methods to



overcome this problem. The use of inhalers that allow insulin to be absorbed via the lungs is being evaluated and with the plasma glucose control apparently being similar to that acquired using insulin injections. Other techniques involve insulin absorption from the mouth via the cheeks, where it is rapidly absorbed into the blood stream. The use of patches is also being investigated but the difficulty of this mode of administration is the passage of insulin molecules across the skin barrier. Trials are evaluating the use of patches that may be used by patients with either Type 1 or Type 2 DM. One company is using a plaster which incorporates a miniature pump that delivers a supply of insulin for several days.

Non invasive methods of administering insulin would be extremely beneficial for patients. Diabetes UK ([www.diabetes.org.uk](http://www.diabetes.org.uk)) states that whilst these new techniques are very exciting, there are several factors that need to be considered including:

- the accuracy of dosage received (to prevent hypo or hyperglycaemia)
- suitability for all ages
- suitability for patients with lung dysfunction
- what are the potential side effects of large doses of insulin sometimes used in inhalers to ensure absorption.

## Other medications

### Statins

It has been reported that cholesterol lowering statins would cut heart attacks and strokes in people with diabetes by a third. Therefore, it is suggested that doctors should consider prescribing statins to diabetic patients who have a substantial risk of having a heart attack or stroke. Statins include Atorvastatin, Fluvastatin, Simvastatin. They also have side effects including constipation, diarrhoea, flatulence, nausea, vomiting, headache and muscle inflammation. Other medications to lower cholesterol include Fibrates, Resins and Ezetimibe.

### Antihypertensive medications

Many patients with diabetes are also

hypertensive, and as a result, life-style changes may be recommended. Blood pressure can be lowered by smoking cessation, a healthy diet, achieving the correct body mass index (BMI), regular exercise, reducing alcohol consumption and salt intake to recommended levels and by reducing stress levels. If this approach does not lower the blood pressure sufficiently, then antihypertensive medications should be prescribed. Angiotensin converting enzyme (ACE) inhibitors are usually the first line approach and calcium channel blockers or diuretics tend to be a second line treatment.

From the above, it can be seen that patients with Type 2 DM may be taking a number of medications including hypoglycaemic agents, antihypertensive tablets, statins and aspirin.

## The effect of glycaemic and blood pressure control upon diabetic complications

There have been two major studies investigating the effect of management upon diabetic complications - UK Prospective Diabetes Study (UKPDS) for patients with Type 2 DM<sup>6, 7, 8, 9</sup> and the Diabetes Control and Complications Trial (DCCT)<sup>10</sup> for Type 1 patients. The long term diabetic complications reported by these studies included retinopathy, nephropathy, neuropathy and cardiovascular disease.

The DCCT trial in the USA investigated whether strict glycaemic control could decrease the frequency and severity of these diabetic complications. A total of 1441 patients with Type 1 DM from 29 centres were monitored for an average of 6.5 years (range 3-9 years). Approximately half of the patients had no retinopathy and the other patients had mild non-proliferative (background) diabetic retinopathy at the start of the study. These patients were randomly assigned to intensive therapy or conventional therapy and the onset and progression of retinopathy and other complications were assessed.

Intensive therapy included (i) insulin injections three or more times daily, (ii) the use of an insulin pump, (iii) plasma glucose monitoring at least four times daily and (iv) monthly examinations at the research centre. In this group, the insulin dosage was adjusted according to the plasma glucose results. Conventional therapy included (i) one or two injections per day, (ii) daily monitoring of urine or plasma glucose levels and (iii) three monthly visits to the centre. This group did not normally make daily adjustments to their insulin dose.

The results of the DCCT study in Type 1 DM patients clearly showed that intensive therapy does reduce the risk of complications:

- In patients with no diabetic retinopathy, intensive therapy reduced the risk of developing retinopathy by 76%
- In patients with mild retinopathy, intensive therapy slowed the progression by 54%, and reduced the development of proliferative or severe non-proliferative retinopathy by 47%
- Intensive therapy also reduced the occurrence of :

- microalbuminuria by 39%
- albuminuria by 54%
- clinical neuropathy by 60%

This study showed that intensive therapy does delay the onset and slow the progression of diabetic retinopathy, nephropathy and neuropathy in Type 1 DM patients. However, strict control runs the risk of severe hypoglycaemia - it was reported that hypoglycaemia increased by two-three fold.

The UKPDS investigated whether improved glucose and blood pressure control might reduce macrovascular and microvascular complications of Type 2 DM. The study resulted in numerous publications that have had a significant impact on both national and international guidelines for patients with Type 2 DM. The study showed that many patients had macrovascular, microvascular and neuropathic complications at the time of diagnosis. The most common were:

- Hypertension 35% (27% men and 45% women)
- Retinopathy 21% (> one microaneurysm)



Reductions in risk for clinical complications	Each 1% reduction in mean HbA1c	Each 10 mmHg reduction in mean systolic blood pressure
Any complication related to diabetes	21	12
Deaths related to diabetes	21	15
Myocardial infarction	14	11
Microvascular complications (retinopathy requiring photocoagulation and renal failure)	37	13

➔ **Table 6**

Reductions in risk associated with decreased HbA1c and systolic blood pressure

- Impotence 20%
- Abnormal ECG 18%

The risk of diabetic complications was found to be strongly associated with previous hyperglycaemia and that any reduction in HbA1c was likely to reduce the risk of complications. The lowest risk was in patients with HbA1c levels in the normal range (<6%). It was also found that the risk of diabetic complications was strongly associated with raised systolic blood pressure<sup>8</sup>. It was concluded that any reduction in blood pressure is likely to reduce the risk of complications with the lowest risk being for patients with systolic pressure less than 120 mmHg. Table 6 shows the reductions in risk associated with decreased HbA1c and systolic blood pressure.

Tight control of blood pressure (<150/85mmHg) was found to provide a significant reduction in the risk of microvascular disease<sup>9</sup>. There was a 34% reduction in the rate of progression of retinopathy by two or more steps using the modified Early Treatment Diabetic Retinopathy Study (ETDRS) scale and a 47% reduction in the deterioration of visual acuity by three lines (using the ETDRS chart). This seems to suggest that tight control of blood pressure prevented the development of diabetic maculopathy which is the main cause of vision loss in Type 2 DM patients.

It should be noted that the introduction of strict control initially caused a progression of retinopathy, but in the longer term it is beneficial in reducing the risk of vision loss.

To summarise, the main UKPDS<sup>11</sup> findings are that improved control of

plasma glucose and blood pressure reduce the risk of:

- Major diabetic eye disease by 25%
- Serious deterioration of vision by nearly 50%
- Early kidney damage by 33%
- Strokes by 33%
- Death from diabetes related causes by 33%

The above studies show the importance of good management not only of plasma glucose but also blood pressure to reduce the risk of complications. So how well are patients doing in achieving good control? The latest National Diabetes Audit, 2006-2007, reviewed the quality of care for people with diabetes in England and Wales<sup>12</sup>. A total of 1.22 million patient records were submitted and some of the key finds included:

- 63% achieved the recommended HbA1c measurements  $\leq 7.5\%$  (NICE guidelines)
- 8% had HbA1c readings  $> 10\%$
- 77% achieved the recommended cholesterol level of  $< 5\text{mmol/l}$  (NICE guidelines)

Of the 12,727<sup>13</sup> records of children and young people (\*under the age of 16 years) reviewed, the following key findings were reported:

- 8% had at least one episode of ketoacidosis\*
- 18% achieved the recommended HbA1c measurements  $\leq 7.5\%$  \*
- 30% had HbA1c readings  $> 9.5\%$
- 79% achieved the cholesterol level of  $< 5\text{mmol/l}$

From the above, it can be seen that improved metabolic control is still required for both adults and children

as 37% and 82% respectively did not meet the HbA1c NICE guidelines. The audit shows that it was more common for girls to have elevated HbA1c levels than boys and hence they were more likely to have episodes of ketoacidosis. For adults, poor control was more frequent amongst the younger age group.

Whilst the proportion of patients receiving all the recommended annual care processes had increased, the audit recommends that Primary Care Trusts should review diabetes care in the community and make improvements, particularly for eye, foot and kidney screening. The key care processes include assessment of HbA1c, BMI, blood pressure, albumin, creatinine, cholesterol, smoking and eye and foot examination. Blood pressure was still found to be the most frequently recorded measurement, with tests for microalbuminuria being the least frequent.

## Conclusion

The risk of developing diabetic complications increases with increasing hyperglycaemia and systolic blood pressure. Therefore, lowering glycaemia and systolic blood pressure reduces the risk of complications. It is important for patients with diabetes to have regular diabetic assessments, control their weight, self monitor and control their plasma glucose levels. If present, hypertension should be strictly controlled.

## About the author

Professor Rachel North is Deputy Head of the School of Optometry and Vision Sciences, Cardiff University. Her research interests include diabetes and its complications. She lectures on the monitoring and treatment of diabetes as part of the MSc in Clinical Optometry module entitled - Optometric Management of Diabetic Eye Disease.

## References

See [www.optometry.co.uk/references](http://www.optometry.co.uk/references)



## Module questions

Course code: c-10560/0

Please note, there is only one correct answer. Enter online or by the form provided

**An answer return form is included in this issue. It should be completed and returned to CET initiatives (C-10560/o) OT, Ten Alps plc, 9 Savoy Street, London WC2E 7HR by April 20 2009**

- 1) Which one of the following is not a sign of hypoglycaemia?
  - a. sweating
  - b. hyperventilation
  - c. pallor
  - d. palpitations
- 2) Which one of the following is not a cause of death due to ketoacidosis?
  - a. hypertension
  - b. pneumonia
  - c. myocardial infarction
  - d. cerebral oedema
- 3) Which one of the following is not used in the management of hyperglycaemia?
  - a. Sitagliptin
  - b. Tolbutamide
  - c. Metformin
  - d. Atenolol
- 4) Which one of the following is not a clinical indication for using insulin in Type 2 diabetes mellitus patients?
  - a. acute symptoms
  - b. persistent hypertension
  - c. continued weight loss
  - d. recurrent infections
- 5) Which one of the following is the most common microvascular condition found in patients newly diagnosed with Type 2 diabetes mellitus?
  - a. retinopathy
  - b. angina
  - c. myocardial infarct
  - d. hypertension
- 6) For the diagnosis of diabetes, the fasting plasma glucose level should be:
  - a.  $\geq 4$ mmol/l
  - b.  $\geq 6$  mmol/l
  - c.  $\geq 7$  mmol/l
  - d.  $\geq 10$  mmol/l
- 7) Which one of the following is the most frequently recorded measurement in a diabetic patient?
  - a. body mass index
  - b. microalbuminuria
  - c. blood pressure
  - d. cholesterol
- 8) Which class of drugs does Repaglinide belong to?
  - a. Sulphonylureas
  - b. Alpha glucosidase inhibitor
  - c. Prandial glucose regulator
  - d. Biguanides
- 9) The Diabetes Control and Complications Trial (DCCT) study found that strict glycaemic control reduced the risk of developing retinopathy in Type 1 DM patients by:
  - a. 47%
  - b. 54%
  - c. 60%
  - d. 76%
- 10) A 1% reduction of mean HbA1c reduces the risk of microvascular complications by:
  - a. 12%
  - b. 21%
  - c. 37%
  - d. 47%
- 11) How many patients did not achieve the recommended cholesterol level in the latest National Diabetes Audit (2006-2007)?
  - a. 23 %
  - b. 63 %
  - c. 77%
  - d. 82%
- 12) According to the UK Prospective Diabetes Study (UKPDS), the systolic blood pressure associated with the lowest risk of complications was:
  - a. 150 mmHg
  - b. 85 mmHg
  - c. 120 mmHg
  - d. 90 mmHg

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