

SECTION 2

Understanding diabetes

What is diabetes?

Diabetes mellitus is a condition where high blood glucose levels (hyperglycaemia) occur. The normal range for blood glucose in a person who does not have diabetes is between 3 and 8mmol/L. This range is maintained during the individual's day to day activities.

Glucose is needed by the body for energy and is obtained from carbohydrate foods such as starches and sugars. The glucose is transported from the gut through the portal system to the body. Glucose that is not immediately used is transformed and stored in the liver. The regulation and storage of glucose is controlled by the hormone insulin.

Insulin is produced by the beta cells of the pancreas in response to a rise in blood glucose concentration. The hormone insulin is responsible for the uptake, storage and use of glucose by the body cells, thus supplying available energy for use in the body. Without sufficient insulin there will be impaired metabolism, not only of carbohydrates, but of protein and fats as well.

Classification of diabetes

The different types of diabetes have different causes and clinical presentation. The common feature for all types of diabetes is **hyperglycaemia**.

Primary diabetes

Type 1: An absolute deficiency of insulin. The exact trigger is unknown but is an autoimmune response. Intensive insulin therapy is required for survival.

Type 2: A combination of insulin resistance (a resistance by the cells of the body to the action of insulin, thereby reducing the effectiveness of insulin) and insulin deficiency. Type 2 diabetes is a progressive disease that requires ongoing monitoring. Most people will need to take oral anti-diabetic medication and eventually many will require insulin.¹

Gestational diabetes

Diabetes occurring for the first time during pregnancy and often lasting only for the duration of the pregnancy. Progression of type 2 diabetes later in life will occur in 5–50% of women with gestational diabetes mellitus (GDM). Around 17% of Australian women with GDM develop type 2 diabetes within 10 years, and up to 50% within 30 years.²

Secondary diabetes

Diabetes as a result of another disorder, for example: pancreatic disease, endocrine disorder, drugs, chemicals or other stresses.

Features of type 1 and type 2 diabetes

Type 1	Type 2
Characteristics	
10 – 15% of all people with diabetes	85-90% of all people with diabetes
no insulin produced	insulin resistance and insulin deficiency
some family history	usually family history
due to damage to beta cells because of auto immune response	age, overweight / overwaist, lifestyle factors
generally occurs in younger people under 40 years but may occur at any age	usually occurs in older people over 40 years, may occur at any age
Onset	
rapid onset (weeks / months)	gradual onset, often no symptoms (months or years)
ketonuria often present (due to lack of insulin)	ketonuria not present as some insulin still being produced
	may present with existing chronic complications
Treatment	
requires intensive insulin therapy either by multiple injections or insulin pump	initially life style education, and will require oral medication and/or insulin therapy after a few years

NB Type 2 diabetes in children

Type 2 diabetes is rapidly increasing in children and adolescents, accounting for approximately 5 percent of diabetes in this age group in Australia.³

Type 2 diabetes in children presents in a similar way as in adults eg there is insulin deficiency and resistance. Often children have a strong family history (present in over 80% of cases) and predominately they are obese. Indigenous and some ethnic groups are at high risk such as Aboriginal and Torres Strait Islanders. Whilst type 2 diabetes is often asymptomatic it may present with ketosis and even mild to moderate ketoacidosis in this group. Type 2 diabetes may have a prolonged asymptomatic phase and so screening for complications should start at diagnosis. Children are at risk for macrovascular complications due to the underlying metabolic syndrome associated with type 2 diabetes.³

The treatment is similar to the approach with adults eg lifestyle and medication.

Prevalence of diabetes

Results of the AusDiab Study released in April 2001, showed that 1 in 4 Australians have a problem with glucose metabolism. The study identified that 3.8% of adults (25 years plus) had diagnosed diabetes, 3.8% had undiagnosed diabetes and 16.3% had either impaired glucose tolerance or impaired fasting glucose.⁴

Diagnosed	3.8%
Undiagnosed	3.8%
IGT of IFG	16.3%
Total	23.9%

The prevalence of type 2 diabetes rises steeply with age and is estimated at:

25 – 34 years	0.3%
35 – 34 years	2.5%
45 – 54 years	6.2%
55 – 64 years	13.1%
65 – 74 years	18.6%
75 years plus	23.6%

The prevalence of childhood diabetes (type 1) is estimated at:

0-14 years old	22 per 100,000 people
15-24 yrs old	15 per 100,000 people
Over 40 years	5 per 100,000

The latest report published by the Australian Institute of Health and Welfare shows that the rate of type 1 diabetes is increasing by 3% per year.⁵

Clinical presentation

The classic symptoms of diabetes mellitus include:

- polyuria
- polydipsia
- tiredness / lethargy.

The symptoms of diabetes vary from individual to individual and in relation to the level of hyperglycaemia. Some people with type 2 diabetes may also be asymptomatic. Symptoms are similar in each type of diabetes, however, intensity and onset varies.

The following terms describe associated symptoms of **hyperglycaemia**.

Glycosuria – the presence of glucose in the urine. When blood glucose concentration exceeds the renal threshold of approximately 10mmol/L in a young person (in older people it can be higher) glucose is excreted in the urine and is detected with a reagent testing strip.

Polyuria – excessive urination. Glucose is osmotically active and requires water for excretion. In uncontrolled diabetes, the filtered glucose ‘pulls’ large quantities of water with it which leads to increased urine production.

Polydipsia – excessive drinking. Polyuria causes loss of water, resulting in dehydration. Dehydration triggers thirst in the person in an effort to replace lost water.

Polyphagia – excessive eating of food. Without insulin, glucose is unavailable to the cells for energy. The body perceives a state of ‘starvation’ and the appetite is increased in an effort to gain enough food for energy. The body also loses nutrients through the urine (glycosuria, ketonuria).

Weight Loss – in type 1 diabetes, protein and fat stores are broken down to be used for energy. Ketones are produced and excreted in the urine.

Ketonuria – in type 1 diabetes there may be the presence of ketones in the urine or blood. When there is not enough insulin to utilise the glucose, fat stores are broken down for energy, ketones are produced. Moderate to large ketones found in urine or blood may indicate ketoacidosis, a life-threatening emergency situation.

Tiredness – caused by the inability to utilise glucose, resulting in insufficient energy supply.

Skin and genital infections – hyperglycaemia results in a lowered resistance to infection, glycosuria results in thrush (monilia / candida infection), pruritus vulvae or balanitis.

Blurred vision – due to change in the shape of the lens of the eye because of hyperglycaemia. Occasionally this is the main symptom and may last several weeks while blood glucose is being stabilised.

Diagnosis and management

Type 2 diabetes

Risk factors and screening

Testing for undiagnosed type 2 diabetes is recommended for the following high risk Individuals:⁶

- people with impaired glucose tolerance or impaired fasting glucose
- Aboriginal and Torres Strait Islanders aged 35 and over
- certain high risk non-English speaking background groups aged 35 and over (specifically Pacific Islander people, people from the Indian subcontinent or of Chinese origin)
- people aged 45 and over who have either or both of the following risk factors
 - obesity (BMI ≥ 30)
 - hypertension
- all people with clinical cardiovascular disease (myocardial infarction, angina or stroke)
- women with polycystic ovary syndrome who are obese.

Individuals presenting the following risk factors are also considered to be at high risk of having undiagnosed type 2 diabetes:

- women with previous gestational diabetes
- people aged 55 and over
- people aged 45 and over who have a first degree relative with type 2 diabetes.

Diagnosis

Diagnosis is based on plasma glucose measurements in conjunction with clinical assessment.^{6,7}

Diagnosis is made in one of the following ways but each must be confirmed on a subsequent day unless unequivocal hyperglycaemia with obvious symptoms are present.

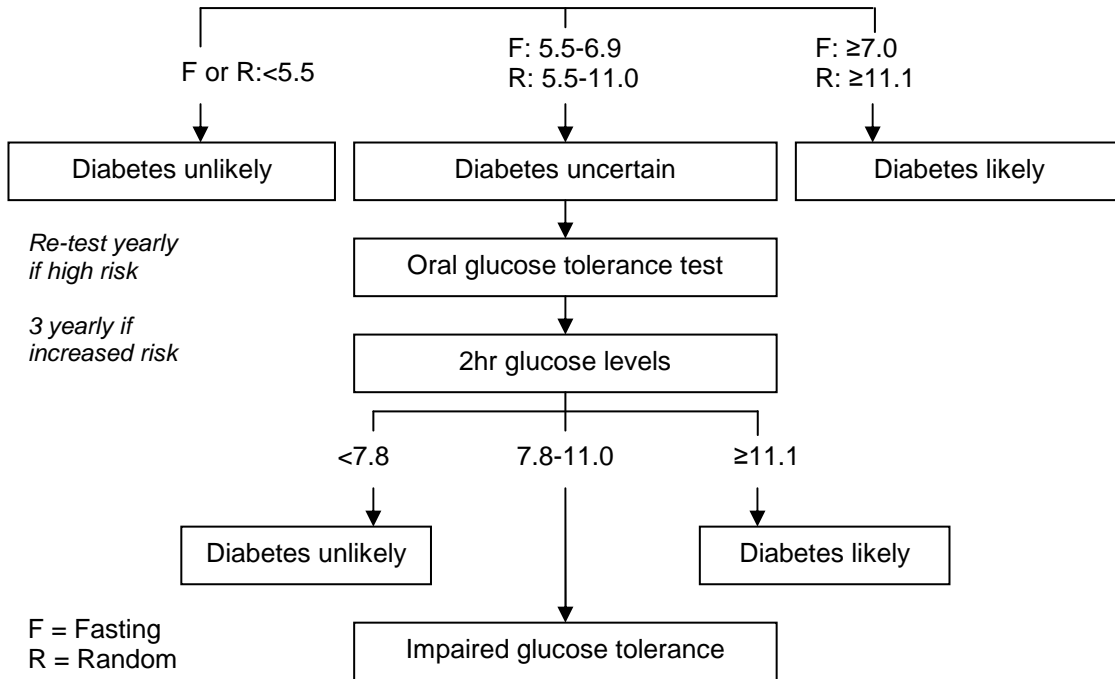
1. Symptoms of diabetes and a random (non-fasting) plasma glucose >11 mmol/L (random means any time of day regardless of last meal).
2. Fasting plasma glucose ≥ 7.0 mmol/L.
3. 2-hour plasma glucose >11 mmol/L during an oral glucose tolerance test (OGTT).

The OGTT (Appendix 1) is unnecessary to diagnose diabetes in people with an unequivocally elevated fasting or random plasma glucose. An OGTT should be performed in a person with an equivocal result. (See Figure 1).

The test is carried out after an overnight fast, following three days of adequate carbohydrate intake (greater than 150g per day). A 75g load of oral glucose is given and the diagnosis of diabetes can be made if venous plasma glucose level fasting is ≥ 7.0 mmol/L or 2 hour post glucose load is ≥ 11 mmol/L.

Figure 1

Glucose levels – venous plasma: mmol/L



A person with type 2 diabetes may first present with long term complications - eg diabetic retinopathy, neuropathy, coronary artery disease, peripheral vascular disease and / or cataracts (refer *Long term complications* – Section 12).

Routine examination may incidentally detect glycosuria and / or hyperglycaemia – eg during pregnancy or as a result of community screening programs.

Ongoing management principles for people with type 2 diabetes

A team approach is essential for the successful management of diabetes, with the active participation of the person with diabetes and if appropriate including family members.

Ideal management involves:

- active involvement of the person with diabetes and their family members
- appropriate treatment plan
- appropriate nutrition and weight control
- appropriate exercise / activity program
- advice for maintaining a healthy lifestyle eg stress management, avoiding smoking
- appropriate safe use of pharmaceuticals as required (oral agents and / or insulin).

The aims of management are to:

- restore the altered metabolism of the person with diabetes and maintain blood glucose levels within the normal range
- identify and reduce risk factors of diabetes related complications
- prevent or delay progression of the short and long term complications
- empower the person to self manage their own diabetes and restore the individual with diabetes to as independent a lifestyle as possible
- provide ongoing management, support and resources.

Principles of medical management:

- people with type 2 diabetes usually progress from lifestyle alone, tablets and then onto insulin⁸
- type 2 diabetes is a progressive disease which needs progressive increases in treatment to maintain appropriate HbA1c levels
- oral medications can be combined with insulin.

See *Medication* - Section 10 for medication pathway in type 2 diabetes.

Type 1 diabetes

Diagnosis

Type 1 diabetes can be diagnosed if the characteristic symptoms and signs are present and the fasting venous plasma glucose concentration is greater than or equal to 7.0mmol/L, and / or the random venous plasma glucose concentration taken at least 2 hours after eating is greater than or equal to 11.1mmol/L. An oral glucose tolerance test (OGTT) is rarely indicated in diagnosis of type 1 diabetes in childhood and adolescence.³ A child or adolescent may present with diabetic ketoacidosis (refer *Unstable diabetes* – Section 7).

The 'honeymoon period' in type 1 diabetes.

The honeymoon period is the time between diagnosis and complete damage to the beta cells of the pancreas. Initially the person's pancreas is still producing some insulin but in decreasing amounts. The person may go from not needing much insulin to needing some insulin, to being totally dependent on insulin within a year.

How long the 'honeymoon period' lasts varies from person to person but people with type 1 diabetes will usually be totally dependent on insulin within one year.

Ongoing management principles (refer *Children and adolescents* – Section 14)

- Children and adolescents with type 1 diabetes should have access to care by a multidisciplinary team trained in childhood diabetes.
- The older child and the family should be recognised as being part of the management team.
- Education from a credentialled diabetes educator (where possible) should be part of the management of type 1 diabetes.
- Education should be adapted to each individual's age, maturity, stage of diabetes, lifestyle and culture.
- After the initial period of diagnosis and education (when frequent contact may be required), the child should be regularly reviewed throughout the year. This should be no less than 3-4 times per year, including one major annual review (paying particular attention to growth, blood pressure, puberty, associated conditions, nutrition and complications) with the multidisciplinary team.
- In rural and remote areas children with diabetes may be successfully cared for by a local paediatrician / physician with training and experience in paediatric diabetes, access to resources, support and advice from a tertiary centre diabetes team.
- The transition from a paediatric to an adult service for the adolescent with diabetes is often difficult. Transfer to an adult service should be comprehensive and include a preparation phase and evaluation phase.³

Principles of medical management

- people with type 1 diabetes are dependent on insulin for survival
- insulin **must not** be stopped under any circumstances
- insulin is not normally used in combination with any other hypoglycaemic agents
- metformin is sometimes used for people with type 1 diabetes who have insulin resistance but the evidence for its effectiveness is limited.³

Gestational diabetes

Risk factors and screening

The Australasian Diabetes in Pregnancy Society (ADIPS) recommends that screening for gestational diabetes (GDM) should be considered in all pregnant women. Risk factors for GDM include.⁹

- glycosuria;
- age over 30 years;
- obesity;
- family history of diabetes;
- past history of GDM or glucose intolerance;
- previous adverse pregnancy outcome; and
- belonging to an ethnic group with a high risk for GDM (Australian Indigenous, Polynesian and South Asian [Indian] groups; Middle Eastern and other Asian groups).

Diagnosis

GDM is diagnosed by OGTT (refer *Pregnancy* – Section 13)

Ongoing management principles (refer *Pregnancy* – Section 13)

- A team approach is recommended for managing women with GDM and, if necessary a virtual team could be used.
- The large health services teams would usually comprise an obstetrician, diabetes physician, a diabetes educator (diabetes midwifery educator), dietitian, midwife and paediatrician. In country areas management by an obstetrician or obstetric general practitioner knowledgeable in GDM management in collaboration with a dietitian, diabetes educator or midwife, is acceptable.⁹
- Insulin therapy is commenced if fasting blood glucose levels exceed 5.5mmol/L or 2 hour post-prandial levels exceed 7mmol/L on two or more occasions in one week.
- Women need to receive appropriate education and support throughout their pregnancy as well as follow up screening and pre-conception counselling.

Follow up annual screening and pre-conception screening

- Women should be screened for diabetes at 6 weeks post-delivery and 12 monthly thereafter.
- Women need to be informed about the risks for type 2 diabetes in the future and the need for preconception screening (refer *Pregnancy* – Section 13).

The oral glucose tolerance test

Indications

1. To confirm diabetes when fasting blood tests are inconclusive.
2. Screening for gestational diabetes (refer *Pregnancy* – Section 13).

Considerations

- Recent illness may give false glucose tolerance test results, therefore it is preferable to perform the test after at least 2 weeks of good health.
- Adequate dietary carbohydrate for the 3 days prior to the test (\approx 150g/day). In most cases this means that the person should have their usual diet.
- Certain drugs, eg hormones, diuretics or steroids, may influence the results, therefore it is important to record any such drugs on the request form.
- This test is ordered by a doctor.

Preparation

- The test is performed in the morning, after a fast of at least 8 hours (but not more than 16 hours).
- Water is permitted throughout this period and during the test.
- The person is advised to rest for 30 minutes before and for the duration of the test. (Sitting in a chair is sufficient).
- No smoking for at least one hour before the test or during the test.

Glucose (75g) in solution is used eg Glucoscan solution.

The dose for children is 7ml of solution (1.84g of glucose) per kg body weight, up to a maximum of 285ml (75g).

The dose for adults is 75g of glucose in solution.

Procedure

Ensure appropriate pathology request form is completed by a medical officer.
Collect venous blood sample immediately before glucose drink then at 2 hours after glucose drink.

Note times for fasting and 2 hr bloods, and label bottles correctly.

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