Diabetes Nurse Practitioner Clinical Guidelines
Role and Scope Of Practice

These NP Clinical Guidelines have been developed for use in the South Metropolitan Health Service for the Nurse Practitioner Diabetes. They therefore reflect the specific Scope Of Practice of the position and the operation of the Rockingham Endocrinology and Diabetes Service at Rockingham General Hospital.
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DISCLAIMER
This document reflects what is currently regarded as safe practice. However, as in any clinical situation there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgment to each individual presentation.
1. Synopsis

The South Metro Health Service (SMHS) Diabetes Nurse Practitioner Clinical Practice Guidelines have been developed in consultation with various stakeholders to provide a framework to assist the Nurse Practitioner with the clinical management of patients with diabetes. This document is supported by two major sets of documents:

(i) The National Health and Medical Research Council of Australia (NH&MRC) draft Clinical Practice Guidelines for diabetes care in Australia.

(ii) Clinical Practice Recommendations of the American Diabetes Association

2. Introduction

In October 1998 the Nurses Amendment (Nurses Practitioners) Act was passed by both houses of the New South Wales Parliament. The Amendment allowed for the Nurse Registration Board to authorize certain registered nurses to practice as Nurse Practitioners and for the Director General of the Department of Health to approve guidelines relating to the functions of Nurse Practitioners, including the prescription of certain substances. The Amendment also prevents an unauthorized person from using the title ‘Nurse Practitioner’ (Adrian and O’Connell 2000).

Nurse Practitioners are registered nurses working at an advanced practice level that have attained appropriate accreditation with the Australian Health Practitioner Regulation Agency (Nursing and Midwifery Board of Australia).

Nurse Practitioners provide expert nursing care in collaboration with other health professionals in a variety of clinical settings (NSW Health 2003a). The Nurse Practitioner assists nursing and medical colleagues in clinical decision making for care and intervention. Despite their expanded role, Nurse Practitioners are nurses, and they approach the provision of patient care with a unique nursing perspective (Patterson and Haddad 1992). This also ensures that Nurse Practitioners avoid simply carrying out tasks that junior doctors are too busy to do (Walsh 1999). The Nurse Practitioner therefore does not attempt to replace or replicate medicine but rather complements and contributes to the specialized health care available to patients.

2.1 Acute Intervention

Patients who are metabolically compromised and require urgent medical review, or those with newly diagnosed type 1 diabetes are seen within 24 hours of referral. The patient will be reviewed, appropriate treatment commenced and monitored, and further appointments arranged as required. An Endocrinologist is available daily for support.

2.2 Ambulatory Stabilisation and Diabetes Education

The majority of patients are treated and given information on an ambulatory basis. Medical staff and other health professionals are actively involved in ambulatory treatment such as initiation of oral hypoglycaemic agents or insulin therapy and titration/stabilisation of treatment, all of which incorporate diabetes education and attention to psychological needs of the patient. In most cases, patients requiring stabilization or commencement of treatment are seen for an initial assessment, adjustment of treatment and provision of self-care information. Further education can then proceed at a pace compatible with the patient’s learning ability and coping strategies. A key component of this ambulatory care programme is continuing stabilization, treatment advice and telephone support.
2.3 Diabetes Complications Assessment

Current diabetes management practices emphasise the early detection and prompt treatment of diabetic complications with the aim of reducing much of the personal and economic burden associated with advanced complications. The service takes the view of support for the local referring general practices that perform the annual diabetes complication screening. The service collates and documents all results and reports received into the patients medical records.

2.4 Gestational Diabetes and Diabetes in Pregnancy

Gestational Diabetes Mellitus (GDM) is a common complication of pregnancy and carries potential risks for mother and child. It is generally accepted that universal screening for GDM, effective treatment and postnatal follow up can reduce these risks. Intensive multi-disciplinary care is also essential in individuals with pre-existing diabetes during pregnancy. The Endocrinology and Diabetes Centre, in conjunction with King Edward Memorial Hospital for Women and Babies (KEMH) provides a comprehensive service involving a multidisciplinary team consisting of Obstetricians, endocrinologists, diabetes nurse specialists and dieticians.

2.5 Diabetes Foot Service

This service provides multidisciplinary foot care treatment to diabetic patients with active foot problems. It incorporates good foot care including debridement and removal of callus, education and special techniques such as application of casts to heal diabetic foot ulcers and Charcots Arthropathy. The Diabetes Foot Service is staffed by a team of expert podiatrists and diabetes nurses.

2.6 Research

The Endocrinology and Diabetes Service is committed to ongoing research. In addition, to maintaining a standard of excellence in clinical care, the service has always aimed to incorporate research into its day to day practice. This philosophy is evidenced by the various abstracts and publications we have produced.

2.7 Quality Control and Safety Measures

Each service provided by the nursing and dietetic staff is documented and recorded in regular meetings where the clinical care of patient are discussed. Any adjustment in diabetes treatment is checked and signed by a Credentialled diabetes educator and/ or the consultant endocrinologist. This forum provides a unique opportunity to educate junior staff as well as ensuring that patient care is optimized. In addition, the Diabetes Service staff has ready access to consult the consultant Endocrinologist and his/her delegates.
3. Committee for the Development of Clinical Guidelines for the Nurse Practitioner Diabetes (NPD)

These Clinical Practice Guidelines have been adapted by Maxine Schlaeppi from those devised by Jane Overland and Belinda Brooks (RPAH), Mark Shah (PMH) and Marina Mickelson (KEMH) incorporating current and relevant nursing and medical literature, and in collaboration with contributions from the following department representatives who have formed the guideline committee:

- Dr Peter G Fegan, Consultant Endocrinologist of Rockingham Endocrinology and Diabetes Service, Head of Department of Medicine Fremantle Hospital
- Mrs Rosemary Macro, Clinical Nurse – Credentialed Diabetes Educator, RGH
- Mr Wayne Kelly, Clinical Nurse Manager, Ambulatory Care, RGH
- Mr Graham Stannard, Pharmacy Department, RGH
- Mr Martin Taylor, Director of Laboratory Services, RGH
- Dr Moss General Practitioner representative,
- Mr Rhys Van Asselt, Consumer representative
- Dr Ken Thong, Medical Officer, RGH

The Nurse Practitioner Diabetes will also operate under the following guidelines:

I. The Australian Diabetes Educators Association Standards of Practice (2003)
II. The Code of Ethics for nurses in Australia (2002)

3.1. Amendments

The above committee shall update and amend these Scope Of Practice guidelines whenever the NPD duties have substantively changed

4. Diagnostic Services

- Diagnostic request forms may be signed by the Diabetes Nurse Practitioner for the appropriate Investigations within laboratory services
- Criteria and indications for diagnostic testing are identified within the specific treatment plan as ratified by the Medical Director of RGH and the Consultant Endocrinologist of the Endocrinology and Diabetes Service, RGH in consultation with appropriate delegates of other departments
- Lines of communication are established to report adverse results to the Consultant Endocrinologist of the Endocrinology and Diabetes Service, or his/her delegate and health care team
- Appropriate investigations may include:
  - Blood tests
  - Urine tests
  - Wound culture
- More advanced studies may be ordered after consultation with the attending medical Officer
5. Prescribing by the Diabetes Nurse Practitioner

The legislative framework for Nurse Practitioners in Western Australia governs the Scope Of Practice. The framework includes provisions allowing Nurse Practitioners in a designated area to:

- Prescribe schedule 1 and 4 medications
- Order routine diagnostic imaging test
- Order routine pathology tests (DOHWA 2003)

Limited prescribing requires legal and professional authorization to independently prescribe a restricted number of medications from a nurse’s formulary in RGH specifically to treat the hyperglycaemia and hypoglycaemia associated with diabetes. This includes oral hypoglycaemic agents, insulin and glucagon. The prescription of medications should be carried out with appropriate client and family education about medications and their side effects.

The Diabetes Nurse Practitioner:
- will use a pre-agreed hospital formulary developed in consultation with the Pharmacy Department
- will use the most recent MIMS/AMH available or MIMS online
- has the authority to order, administer and titrate oral hypoglycaemic agents and insulin Therapy as per section 9 - Formulary
- will document, maintain and update medical records for all medication changes
- may authorise the continuation of existing medications (as per Formulary list) for patients admitted in consultation with the physician or endocrinologist

6. Referral Processes

Following assessment, intervention and if necessary consultation with the Endocrinologist, the DNP may make and arrange appropriate referral to departments or teams within the facilities of SMAHS and other services within the health care system of Western Australia. As part of the referral process consumers are given advice and specific information about follow-up arrangements and referral details that are made for them. Referrals may be made, but not limited to the following services and organizations:
- Dietician
- Social Worker
- General Practitioner
- Psychologist
- RGH Medical Specialists e.g. Endocrinologist, Renal Physician,
- Orthopaedic Surgeon, Vascular Surgeon, Cardiologist
- Metabolism and Obesity Services SCGH
- Non-government Organisations e.g. Diabetes Australia
7.1. Type 1 Diabetes

Diabetes Mellitus is a metabolic disorder of multiple etiology, characterised by chronic hyperglycaemia. Type 1 diabetes is most often associated with a genetic predisposition, the presence of autoimmune markers, progressive beta cell destruction, severe insulin deficiency, and the urgent need for insulin replacement therapy because of the risk of ketoacidosis and death.

The characteristics of type 1 diabetes are as follows:

- Age usually < 30 years at presentation, but may be older
- Blood glucose level usually 10 to 30 mmol/L at diagnosis
- Rapid onset of symptoms including weight loss
- Ketones usually present
- May or may not have a family history of type 1 diabetes

**Diagnosis**

In the majority of people the diagnosis of type 1 diabetes should be made without difficulty. The symptoms of excessive thirst and urination and weight loss should prompt immediate confirmation for:

- Heavy glycosuria
- Probable ketonuria
- Hyperglycaemia (fasting ≥ 7.0 mmol/L; random ≥ 11.1 mmol/L)

In some circumstances type 1 diabetes may be of slower onset and present diagnostic difficulties. If the diagnosis is uncertain, measurement of islet cell antibody markers (GAD, ICA, IA2 and IAA) may be helpful.

**Assessment**

At presentation, the patient with suspected type 1 diabetes should be immediately assessed to determine appropriate management. The table below provides indicators for assessing the severity of the presentation.

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Hyperglycaemic, non-ketotic (Mild)</th>
<th>Hyperglycaemic, ketotic, non-acidotic (Moderate)</th>
<th>Hyperglycaemic, ketotic with acidosis (Severe and life threatening)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyuria</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Polydipsia</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Nausea</td>
<td>No</td>
<td>No</td>
<td>Probable</td>
</tr>
<tr>
<td>Vomiting</td>
<td>No</td>
<td>No</td>
<td>Probable</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>No</td>
<td>No</td>
<td>Probable</td>
</tr>
<tr>
<td><strong>Signs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood glucose level</td>
<td>Raised</td>
<td>Raised</td>
<td>Raised</td>
</tr>
<tr>
<td>Urinary ketones</td>
<td>Absent</td>
<td>Small to Large</td>
<td>Large</td>
</tr>
<tr>
<td>Weight loss</td>
<td>Small</td>
<td>Small to Marked</td>
<td>Marked</td>
</tr>
</tbody>
</table>
Blood pressure  Normal  Normal  Low
Tachycardia  No  No  Yes
Consciousness  Normal  Normal  May be impaired
Kussmaul respirations  Absent  Absent  May be present

Pathology results
Anion gap *
Blood pH (normal 7.35)  Normal > 7.2  Normal  Raised
Serum bicarbonate (normal 23-31)  Normal  slightly abnormal  < 7.2
Electrolytes  Normal  Normal to slightly abnormal  < 15

Anion gap calculation *
1. Anion gap = Na+ - (Cl- + Bicarb) > 12 = acidosis
2. Anion gap = Na+ + K+ - (Cl- + Bicarb) > 17 = acidosis

Assessment Flow Chart

Review History
- Severity of symptoms
- General health and wellbeing
- Infection or intercurrent illness
- Current medications
- Allergies
- Social history

Perform physical examination
- Capillary blood glucose
- Capillary blood ketones
- Urinalysis
- Weight and height
- Blood pressure (assess postural drop)
- Pulse
- Respiration
- Hydration status
- Alertness

Order and review investigations as indicated
- Electrolytes, urea and creatinine
- Serum bicarbonate
- Venous blood gases
- Full blood count
- HbA1c
- C Peptide
- Anti GADs
- Anti Islet cell antibodies
The management of patients with newly diagnosed diabetes can be managed on an ambulatory basis. The following table is a guide to initial management.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Admission necessary</th>
<th>Insulin</th>
</tr>
</thead>
</table>
| **Hyperglycaemic, non-ketotic (Mild)**          | No                  | Adult: approximately 0.25 to 0.4 unit per kg of body weight distributed across 24 hours  
Adolescents: approximately 0.3 to 0.6 unit per kg of body weight distributed across 24 hours (the preferred bias is towards the lower doses and titrate up) |
| **Hyperglycaemic, ketotic, nonacidotic (Moderate)** | No                  | Adult: approximately 0.3 to 0.5 unit per kg of body weight distributed across 24 hours  
Adolescents: approximately 0.5 to 0.7 unit per kg of body weight distributed across 24 hours  
Supplemental doses of insulin should be given until ketones are cleared  
Large ketonuria/ blood ketones >1.5mmol/L initial dose: 4-10 units rapid acting insulin every hour or 4-10 units short acting insulin every 2 hours  
Small-Moderate ketonuria/ blood ketones of 0.6 to 1.5 mmol/L: 4-10 units rapid acting or short acting insulin every 2-6 hours |
| **Hyperglycaemic, ketotic with acidosis (Severe and life threatening)** | Arrange immediate admission. To be managed by inpatient medical team | Insulin infusion to be commenced as an inpatient |

Consult a medical practitioner immediately and arrange admission to hospital for urgent fluid and electrolyte replacement and commencement of insulin infusion.
<table>
<thead>
<tr>
<th>Fluids</th>
<th>Encourage low joule oral fluids</th>
<th>Encourage low joule oral fluids</th>
<th>IV fluid replacement to be commenced as inpatient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrolyte replacement</td>
<td>no</td>
<td>Encourage fluids with potassium (e.g. orange juice) Check electrolytes within 8-16 hours</td>
<td>Replace losses K+ total body deficit Aim K+ &gt; 4.0 mmol/L</td>
</tr>
<tr>
<td>Contact/Observation</td>
<td>Provide details of emergency contact numbers. Arrange review appointment for the following day</td>
<td>Provide details of emergency contact numbers. Phone contact should be maintained 2nd to 4th hourly during the day/evening (and overnight if necessary) until ketones cleared. Arrange review appointment for the following day</td>
<td>Continuous</td>
</tr>
<tr>
<td>Other</td>
<td>Treat any intercurrent infection</td>
<td>(Arrange review by medical practitioner)</td>
<td>Treat any intercurrent infection</td>
</tr>
</tbody>
</table>

**Initial Education**

The degree of information provided to the patient at initial presentation needs to be adjusted according to the clinical status of the patient. During the early management period the following issues will need to be addressed:

- Establish a rapport with the patient and their family
- Acknowledge the psychological impact of the diagnosis on the person and their family
- Explain how the diagnosis has been made and reasons for their symptoms
- Provide current concepts regarding the cause(s) of type 1 diabetes
- Discuss the need for immediate insulin and how it will work
- Assist the patient to give their first insulin injection
- Discuss normal glucose levels and glucose targets
- If ketones are present, discuss their significance
- Practical skills to be covered:
  - insulin administration
  - self blood glucose monitoring
  - Capillary Ketone blood test (essential if ketonuria is present)/ urinalysis for ketones
- Provide basic diet advice including simple advice about alcohol if appropriate
- Give a simple explanation of hypoglycaemia, signs and symptoms and how to treat

**Initial Follow Up**

**Assess response to treatment**

- Assess patient wellbeing
- Check weight
- Review urine or blood ketone levels
- Review blood glucose levels

**Good response:**

- Improvement in symptoms
- Absence of urinary or blood ketones
- Blood glucose levels < 15 mmol/L
Sub-optimal response:
- No or minimal improvement in symptoms
- Persistent urinary or blood ketones
- Blood glucose levels > 15 mmol/L

Adjust insulin therapy
- Individual insulin doses should generally be adjusted by 2 to 4 units
- Larger dose increases (~4 to 10 units) may be required if ketones are present.

Education
- Review monitoring and self injecting techniques
- Continue education
- Be attentive to patient’s concerns and anxiety

Follow up
- Establish time of next contact
- if ketones are present, phone contact should be maintained 4th to 12th hourly until ketones clear. A decision regarding the need for face to face review the following day should be made on an individual basis
- if ketones are absent, arrange to speak to the patient the following day to review blood glucose levels

Review Appointment
- a review appointment should be made for 3 to 5 days time for ongoing stabilisation and continuing education
- insulin doses should be reviewed once or twice a week and generally adjusted by 2 to 4 unit increments to achieve blood glucose levels within the target ranges given below:
  - Before meals: 5 to 7 mmol/l
  - 2 hours after meals: 6 to 8 mmol/l
  - Before bed: 7 to 8 mmol/l
  - HbA1c: <7%

Absence of major hypoglycaemia and minimal mild to moderate Hypoglycaemia.
These are general targets and may need to be individualised.

Ongoing Care

In the first year of diabetes the patient should be reviewed at least every 3 to 4 months. More frequent review will be required if the patient experiences particular difficulties in managing diabetes.
Honeymoon Period
- following initial stabilization, insulin requirements may become quite low requiring significant reduction in insulin dosage. This “honeymoon” phenomenon may continue for approximately 12 months. Thereafter, insulin requirements tend to rise and then plateau.

Review visits should include assessment of:
- general health and wellbeing
- intercurrent medical conditions
- psychosocial issues
- weight
- blood pressure
- dietary management
Annual screening for the long term complications of diabetes should commence once the patient has had diabetes for 1 to 5 years. The patient should also be screened for associated conditions such as Thyroid Disease and Coeliac Disease every 1-2 years.

**Ongoing Assessment and Management of Glycaemic Control Flow Chart**

**Review Glycaemic Control**  
- home blood glucose results  
- hypoglycaemia  
- history of ketonuria

**Perform physical examination**  
- capillary blood glucose  
- weight (+ height in adolescent)

**Order and review investigations**  
- HbA1c every 3 – 4 months

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**Is glycaemic control within target range ?**

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**Yes**

**No insulin adjustment required**

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**No**

**Adjust insulin therapy**  
- Individual doses should generally be adjusted by 2 to 4 units  
- Larger dose adjustments (~4 to 8 units) may occasionally be required if significant hyperglycaemia is present or major hypoglycaemia has occurred  
- Smaller dose adjustments (~0.5 to 2 units) may occasionally be required in very insulin sensitive individuals  
- Type of insulin regimen may need to review if particular difficulties are being experienced with achieving glycaemic control.
Sick Day Management

Patients need to be given the following information.

General Principles
1. Do not omit insulin
2. Maintain hydration,
   a good urine output may be due to hyperglycaemia, therefore it is not a reliable indicator of hydration status Body weight is a better indicator of hydration (1 kg = 1 litre of fluid)
3. Maintain electrolyte balance,
   the electrolytes sodium and potassium are lost via urine, perspiration, vomiting and diarrhoea
4. Increase the frequency of monitoring,
   blood glucose levels should be monitored hourly, to 2 to 4 hourly (as necessary) A urinalysis or capillary blood test for ketones should be performed 1 to 4 hourly if the BGL ≥ 15 mmol/L
5. Maintain contact
   Contact should be made at frequent intervals, or until the condition improves

Consider Hospitalisation
• if the condition deteriorates (e.g. and increase in urinary or blood ketones)
• if abdominal pain or heavy laboured breathing occurs
• if the person is not “coping” at home
• if they look or feel clinically unwell
• if they are unable to tolerate fluids
• if they appear drowsy or confused
• if vomiting persists
• if there is acute weight loss
• if intravenous hydration is necessary
• if there is obvious infection
• if the nature of the intercurrent illness is not known

Insulin Therapy
• do not omit insulin
• they may need to reduce insulin if they have gastro-enteritis
If ketonuria is present:

• patients using a rapid acting insulin analogue: give additional rapid acting insulin (20-30% of the total daily dose) every 1 to 2 hours
• patients using a short acting insulin (~20% of the total daily dose) every 2 to 4 hours
• a decision regarding additional insulin should be made on the level of ketonuria and not the BGL. If the BGL < 10 mmol/L, the patient should be advised to eat carbohydrate or drink sweetened fluids (i.e. normal Coke or lemonade). Consider intravenous dextrose if unable to tolerate food or fluid.
• additional insulin can be given as a stat dose (in between meals) or added to the usual insulin dose if it is due
• continue to repeat the additional insulin doses until ketones have cleared

If Unable to Tolerate Food

1. If the BGL < 10 - 12 mmol/L
   • give about 150 sweetened fluids each (e.g. Coke, Gingerale, lemonade, fruit juice)
   • an additional 150 mls low calorie fluid each hour may be needed for rehydration

2. If the BGL 10 - 12 mmol/L
   • replace fluids according to the amount of fluid lost (i.e. urinary output, diarrhoea and vomiting)
   • give 150 – 300 mls of low calorie fluid each hour (e.g. low calorie soft drinks, soups/broth, gastrolyte, water, mineral water)

Home Emergencies

Hypoglycaemia may occur for many reasons including too much insulin, not enough carbohydrate or delayed or missed meals. Vigorous activity and excessive alcohol consumption may also precipitate hypoglycaemia. Most hypoglycaemic episodes can be treated with 15 grams of any form of simple carbohydrate, followed by 15 grams of complex carbohydrate.
However, if a person with type 1 diabetes were to have an unconscious hypoglycaemic episode at home then a family member or friend who has been trained in its use and indication should administer an injection of glucagon.
Glucagon is a hormone that facilitates the release of glucose from glycogen stores thus raising the BGL. Adults and children weighing over 25 kg should be injected with the full dose (1 IU).
Family members/friends should be advised that if there has not been an improvement in the patient’s level of consciousness, or if there has not been an adequate rise in the blood glucose level within 10-15 minutes, they should telephone for an ambulance as intravenous glucose needs to be administered.
Once the level of consciousness has improved, oral intake of carbohydrate needs to be encouraged. Finally, ongoing monitoring of blood glucose levels is essential for at least 6 hours following administration of glucagon in case hypoglycaemia recurs.
Special Situations

Driving

Patients need to be given the following information:
- it is a legal requirement to inform the Roads and Traffic Authority about the diagnosis of diabetes
- it is their responsibility to ensure that they are safe to drive at all times.

This includes extra blood glucose monitoring prior to driving and carrying a carbohydrate source with them at all times
- refer to the National Road Transport Commission hand booklet (Ausroads)“Assessing Fitness to Drive, Commercial and Private Vehicle Drivers” September, 2003 for further guidelines

Travel

- inform patients that they will need to take medical documentation when they travel, especially on domestic and international flights
- advice regarding adjustment of insulin regimens for changing time zones needs to be made on an individual basis

Surgery or Procedures

- inform patients that they will need individual advice regarding adjustment of insulin regimen for any situations that require modification of their usual meal pattern

Pregnancy

- all women of child-bearing age should be advised to use contraception to prevent pregnancy unless they are actively planning a pregnancy and have achieved optimal glycaemic control
- all women of child-bearing age should be informed of the need to take folic acid (5 mg a day) prior to conception and throughout pregnancy

7.2 Type 2 Diabetes

Diabetes Mellitus is a metabolic disorder of multiple aetiologies, characterised by chronic hyperglycaemia due to defective insulin secretion or insulin action or both. Type 2 diabetes is common and is the predominant form of diabetes. It often goes undiagnosed for many years because the hyperglycaemia develops gradually and at early stages of the disease process it is often not severe enough for the patient to notice any of the classic symptoms of diabetes. Nevertheless, these patients are at risk of developing complications of diabetes and indeed may have evidence of complications at diagnosis.
There are a number of factors known to be associated with a higher risk of developing type 2 diabetes:

- Family history of diabetes
- Ethnicity
- Previous history of gestational diabetes mellitus
- Obesity
- Physical inactivity
- Macrovascular disease
- Hypertension or dyslipidaemia
- Increasing age

**Diagnosis**

Symptoms of hyperglycaemia include:

- Polyuria
- Polydipsia
- Polyphagia
- Unexplained weight loss
- Recurrent infections, particularly skin, urinary tract infection and moniliasis
- Fatigue
- Blurred vision

In people with symptoms of diabetes, the diagnosis can be made based on one abnormal blood glucose value. A diagnosis may be made if the fasting blood glucose level is \( \geq 7.0 \) mmol/L or a random blood glucose level is \( \geq 11.1 \) mmol/L. However, the majority of patients present with no symptoms. Two abnormal values are required in this situation to diagnose diabetes. In equivocal cases an oral glucose tolerance test (OGTT) should be performed.

**Classification of OGTT Results**

<table>
<thead>
<tr>
<th></th>
<th>Normal Impaired Fasting Glucose *</th>
<th>Impaired Glucose Tolerance **</th>
<th>Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fasting Plasma Glucose</strong></td>
<td>(&lt; 5.6 ) mmol/L</td>
<td>( \geq 5.7 ) and (&lt; 7.0 ) mmol/L*</td>
<td>( \geq 7.0 ) mmol/L</td>
</tr>
<tr>
<td><strong>2 hr Plasma Glucose</strong></td>
<td>(&lt; 7.8 ) mmol/L</td>
<td>( \geq 7.8 ) and (&lt; 11.1 ) mmol/L**</td>
<td>( \geq 11.1 ) mmol/L</td>
</tr>
</tbody>
</table>

**Assessment**

In persons with type 2 diabetes, complications can be present at the time of diagnosis. Therefore, the assessment for patients with type 2 diabetes should include assessment for complications in addition to review of glycaemic control.
**Assessment Flow Chart**

**Review History**
- Severity of symptoms
- General health and wellbeing
- Medical/Surgical history
- Current medications
- Infection or intercurrent illness
- Social history
- Diet and exercise history
- Smoking and alcohol history
- Allergies

**Perform physical examination**
- Capillary blood glucose
- Urinalysis (including glucose, ketones, protein and nitrates)
- Weight, height and BMI
- Blood pressure

**Assess for diabetes complications**
- Referral for eye examination
- Foot examination
- Renal assessment
- Macrovascular risk

**Order and review investigations**
- HbA1c
- C Peptide
- Electrolytes, urea and creatinine
- Liver function tests
- Lipids
- Full blood count
- Urinary albumin/creatinine ratio
- Urine microscopy, culture and sensitivity

**Commence treatment**
See management section – page 30

Refer to Nurse Practitioner Guidelines for the Assessment and Management of Diabetes Complications (pages 22-28)
Management

Dietary modification and advice regarding exercise are the cornerstones of the management of type 2 diabetes. The decision to commence glucose lowering medication is based on the degree of hyperglycaemia and the presence or absence of symptoms. In general, the use of oral glucose lowering medication should be considered if despite optimal exercise and meal plan for the individual the fasting blood glucose levels are > 7 mmol/L and/or HbA1c > 7.0%.

<table>
<thead>
<tr>
<th>Normal</th>
<th>Aim for $^4$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fasting</strong></td>
<td>$\leq 6 \text{ mmol/l}$</td>
</tr>
<tr>
<td><strong>Random</strong></td>
<td>4 to 7.8 mmol/l</td>
</tr>
<tr>
<td><strong>HbA1c</strong></td>
<td>$\leq 6 %$</td>
</tr>
</tbody>
</table>

Management goals should be individualised and may need to be modified, especially in elderly or infirm patients $^4$

Metformin is now generally considered to be first line treatment. It should be commenced at a low dose (250 mg to 500 mg bd) and slowly increased to a maximum dose of 1,000 mg tds as required. Dose adjustment may be required if gastrointestinal side effects develop. If renal function is impaired, especially if serum creatinine is greater than 150 μmol/L or Egfr is < 30, medical review is required. Caution should also be used when treating patients with hepatic failure and medical review is again required. The dosage should be kept low in these patients (1,500 mg a day).

Patients taking metformin need to be advised that this medication should be ceased 24-48 hours before major radiology procedures involving contrast media or surgery and that it should not be recommenced for at least 48 hours afterwards. Renal function should be reassessed prior to recommencing metformin. Treatment with other oral glucose lowering medications (sulphonylureas, glitazones, alphaglucosidase inhibitors, non-sulphonylurea insulin secretagogues, weight loss agents) and/or insulin needs to be determined on an individual basis.

Sulphonylureas, especially longer acting agents such as glibenclamide, should be used with caution in the elderly because of increased risk of hypoglycaemia.

Glucose control as measured by HbA1c progressively deteriorates over time. Therefore, drug therapy usually needs to be increased over time to maintain glycaemic control: nearly 50% of patients will require insulin therapy in addition to oral medication within 5 to 10 years of diagnosis of type 2 diabetes (secondary failure). For persons in secondary failure, combining oral glucose lowering medication with insulin minimises the amount of insulin required. It also minimises weight gain and hypoglycaemia.

Note: Due to insulin resistance, patients with type 2 diabetes may require in excess of 100 units of insulin a day
Treatment Flow Chart

Is glycaemic control satisfactory?

Yes

No medication adjustment required

No

Is the patient
- Very symptomatic
- Severely hyperglycaemic
- Pregnant

Yes

Commence insulin therapy*
(∼0.3–0.5 units per kg of body weight)
- Nocte long acting insulin
or
- Bd intermediate + short/rapid acting insulin
or
- Tds short/rapid + nocte long acting insulin
  +/- Metformin
  +/- Sulphonylurea
(In insulin only if pregnant)

No

1st line agent
Eg. Start Metformin

- Encourage healthy diet and exercise
- Assess compliance with medication
- Titrate medication dose if required to maximise tolerated
- Review blood glucose levels
- The timing of review needs to be determined on an individual basis

Is glycaemic control satisfactory?

Yes

No medication adjustment

No

Add 2nd line agent
eg. sulphonylurea

- Encourage healthy diet and exercise
- Assess compliance with medication
- Titrate medication dose if required to maximise tolerated
- Review blood glucose levels
- The timing of review needs to be determined on an individual basis

Is glycaemic control satisfactory?

Yes

No medication adjustment

No

Add 3rd line agent
eg. glitazone or insulin

- Encourage healthy diet and exercise
- Assess compliance with medication
- Titrate medication dose if required to maximise tolerated
- Review blood glucose levels
- The timing of review needs to be determined on an individual basis

* Insulin dosage should be reviewed weekly. In general, individual insulin doses should be adjusted by 2 to 10 units. However, larger increments may be required if poor response or severe insulin resistance.

If commence insulin therapy
(∼0.3 unit per kg of body weight)
- Nocte long acting or
- Bd intermediate + short/rapid or
- Tds short/rapid + nocte long
Special Situations

Driving

= Patients need to be given the following information:

- it is a legal requirement to inform the Roads and Traffic Authority about the diagnosis of diabetes if (i) they are insulin requiring (ii) have “defined hypoglycaemic episodes (iii) end organ complications which may affect driving

- it is their responsibility to ensure that they are safe to drive at all times. This includes extra blood glucose monitoring prior to driving and carrying a carbohydrate source with them at all times if they are on insulin or oral hypoglycaemic agents

- refer to the National Road Transport Commission hand booklet “Assessing Fitness to Drive, Commercial and Private Vehicle Drivers” September, 2003 for further guidelines

Travel

- inform patients that they will need to take medical documentation when they travel, especially on domestic and international flights to cover their blood glucose monitoring kit and any medications they are taking with them

- advice regarding adjustment of insulin regimens for changing time zones needs to be made on an individual basis

Surgery or Procedures

- advise patients taking metformin that this medication should be ceased 24-48 hours before major radiology procedures involving contrast media or surgery and that it should not be recommenced for at least 48 hours afterwards. Renal function should be reassessed prior to recommencing metformin

- advise patients on other oral agents or insulin that they will need individual advice regarding adjustment of their medication for any situation that requires modification of their usual meal pattern

Pregnancy

- all women of child-bearing age should be advised to use contraception to prevent pregnancy unless they are actively planning a pregnancy and have achieved optimal glycaemic control

- all women of child-bearing age should be informed of the need to take folic acid (5mg a day) prior to conception and throughout pregnancy

- all women of child-bearing age should be informed of the need to cease any oral hypoglycaemic agents and be changed onto insulin therapy if blood glucose levels are above 5.1mmols/L fasting and above 6.5mmols/L post prandially during pregnancy
7.3 Assessment and Management of Diabetes Complications

Diabetes Mellitus is associated with a variety of complications which may result in disability or premature death. These complications can be broadly classified as microvascular or macrovascular. Microvascular damage manifests itself as retinopathy, nephropathy and neuropathy. Improvements in glycaemic control can reduce the risk of this damage. However, there is no HbA1c threshold below which microvascular complications will not occur. The macrovascular damage seen in persons with diabetes manifests itself as coronary heart disease, cerebrovascular disease or peripheral vascular disease.

Risk factors for the development of complications include:

- Younger age at onset
- Long duration of diabetes
- Poor glycaemic control
- Family history of complications
- Hypertension
- Smoking
- Dyslipidaemia

Complications Assessment

The early complications of diabetes are not associated with symptoms, so routine screening needs to be done on a regular basis. People with type 2 diabetes should be screened from the time of diagnosis as complications may already be present. Regular complication assessment should continue every one to two years and should be followed up in the general practice setting.

Eye Disease

People with diabetes need regular review looking for the presence of retinopathy, maculopathy, cataract or glaucoma. Timely photocoagulation significantly reduces visual loss in diabetic patients.

| Assessment | • Record history of known eye disease and any laser treatment or surgery |
| | • Measure visual acuity using Snellen Chart |
| | • Arrange for fundal examination through dilated pupils by trained observer* (diabetologist, specialist nurse, ophthalmologist, or optometrist) |
| Prevention and intervention | • Optimise glycaemic control |
| | • Vascular risk factor reduction (cease smoking, optimize blood pressure and lipid control) |
| | • Refer for formal ophthalmic review if maculopathy or retinopathy of moderate or greater severity is noted |

*Pupil dilatation by tropicamide 1%
Renal Disease

People with diabetes need regular review looking for the presence of renal disease, or markers such as microalbuminuria. The prevalence in type 2 diabetes is not well defined, and rates vary between 3 and 16%.

Microalbuminuria can be detected years before standard reagent strips can measure proteinuria. People with Microalbuminuria are at greater risk of developing progressive nephropathy. Microalbuminuria is also an independent marker for risk of cardiovascular disease.

| Assessment | • Measure blood pressure after a minimum of 5 minutes sitting  
| | • Perform urinalysis for protein  
| | • Assess urinary albumin by spot urine albumin creatinine ratio or by timed collection – abnormal screening values should be confirmed by repeated sampling to demonstrate persistent microalbuminuria  
| | • Consider urine culture if suspected infection  
| | • Measure serum creatinine  
| | • Measure full blood count  
| | • Record any history of other renal disease |

| Prevention and intervention | • Optimise glycaemic control  
| | • Strongly discourage smoking  
| | • Target blood pressure is < 130/85 mmHg or 120-130/80 mmHg in younger patients or those with renal disease  
| | • In persons with type 1 diabetes Angiotensin Converting Enzyme inhibitors (ACEI) should be considered when persistent microalbuminuria has been established, even in normotensive individuals *  
| | • In persons with type 2 diabetes, Angiotensin II (A2R) receptor antagonists should be considered when persistent microalbuminuria has been established **  
| | • Arrange for review by medical practitioner if microalbuminuria, overt proteinuria or raised serum creatinine is present  
| | • Advise patients commencing either ACEI or A2R antagonists that serum potassium and creatinine levels should be checked within two weeks of commencing treatment |

* ** ACEI and A2R antagonists are contraindicated in pregnancy. Therefore, they should not be used in women of childbearing years unless reliable contraception is being used.
## Diabetic Foot Disease

People with diabetes need regular review looking for the presence of neuropathy, peripheral disease and evidence of diabetic foot disease. Peripheral neuropathy commonly causes a symmetric decrease in vibratory and tactile sensation. This loss of nerve function can be associated with dysthesia (insensate neuropathy) and hypersthesia (painful neuropathy), as well as loss of deep tendon reflexes. Peripheral vascular disease may cause intermittent claudication or rest pain.

### Assessment

| • Record history of pain, numbness or paraesthesia |
| • Record history of claudication or rest pain |
| • Record history of surgery for peripheral vascular disease |
| • Record history of previous vascular or neuropathic ulceration and/or amputation |
| • Examine the feet for any high-risk characteristics such as corns and callus, boney prominences, poor perfusion etc |
| • Palpate pedal pulses (note: a Doppler should be used if pulses cannot be palpated) |
| • Test ankle reflexes |
| • Test sensation using a monofilament or biothesiometer |
| • Assess footwear and general foot care |

### Prevention and intervention

| • Optimise glycaemic control |
| • Vascular risk factor reduction (cease smoking, optimize blood pressure and lipid control) |
| • Provide or refer for foot care and footwear education |
| • Arrange for review by medical practitioner if significant signs or distressing symptoms of peripheral vascular disease or peripheral neuropathy present |
| • Refer to podiatrist if high-risk foot characteristics present |
| • Refer to Fremantle Hospital Diabetes Centre High Risk Foot Service if evidence of ulceration or Charcots arthropathy |

## Autonomic Neuropathy

People with diabetes may develop autonomic neuropathy.

### Assessment

| • Record signs and symptoms of autonomic neuropathy |
| • Gustatory sweating |
| • Vomiting undigested food several hours after eating |
| • Incomplete bladder emptying |
| • Altered bowel habits |
| • If above present, consider further testing including |
| • Lying and standing blood pressure |

### Prevention and intervention

| • Optimise glycaemic control |
| • Arrange for review by medical practitioner if signs or symptoms of autonomic neuropathy present |
Macrovacular Disease

People with diabetes need regular review for the presence of macrovascular disease as the risk of macrovascular disease is 2-5 times higher in people with diabetes. Predisposing risk factors include hyperglycaemia, hyperinsulinaemia, insulin resistance, smoking, obesity, dyslipidaemia, hypertension and platelet dysfunction.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Prevention and intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Record history of cardiovascular events</td>
<td>• Optimise glycaemic control</td>
</tr>
<tr>
<td>• Record history of cerebrovascular disease</td>
<td>• Vascular risk factor reduction (cease smoking, optimize blood pressure and lipid control)</td>
</tr>
<tr>
<td>• Record family history of vascular disease</td>
<td>• Encourage exercise</td>
</tr>
<tr>
<td>• Record history of vascular investigations</td>
<td>• Promote healthy diet, including reduced saturated fat, low salt</td>
</tr>
<tr>
<td>• Record smoking history</td>
<td>• Promote reduced alcohol intake</td>
</tr>
<tr>
<td>• Listen for carotid bruit and palpate pedal pulses</td>
<td>• Intervention for hypertension if blood pressure &gt; 130/85 mmHg</td>
</tr>
<tr>
<td>• Measure blood pressure after a minimum of 5 minutes sitting</td>
<td>• Advise patient regarding benefits of statin therapy (Heart Protection Study)</td>
</tr>
<tr>
<td>• Order the following investigations:</td>
<td>• Consider commencing Aspirin 100 mg daily</td>
</tr>
<tr>
<td>• Urinary albumin/creatinine ratio</td>
<td>• Arrange for review by medical practitioner for pharmacological management of risk factors when indicated</td>
</tr>
<tr>
<td>• Serum creatinine/urea/electrolytes</td>
<td>• Arrange for review by medical practitioner if cardiovascular investigations are abnormal</td>
</tr>
<tr>
<td>• Lipid profile</td>
<td></td>
</tr>
<tr>
<td>• Consider arranging the following cardiovascular investigations:</td>
<td></td>
</tr>
<tr>
<td>• ECG, echocardiogram, stress ECG</td>
<td></td>
</tr>
</tbody>
</table>
Intervention for Hypertension Flow Chart

- Assess medication compliance
- Provide advice regarding appropriate diet (low salt, limit alcohol)
- Arrange review by medical practitioner of antihypertensive management and possible need for further investigations.

- Provide advice re appropriate diet (low salt, decrease alcohol)
- Discuss with medical practitioner the need for commencing an ACE1 or A2R antagonist*
- Arrange repeat serum creatinine and potassium within 2 weeks of commencement of ACE1
- Arrange ongoing review of blood pressure and pharmacology

* ACE1 and A2R antagonists are contraindicated in pregnancy. Therefore, they should not be used in women of childbearing years unless reliable contraception is being used.
Intervention for Dyslipidaemia Flow Chart

This flow chart is based on the National Heart Foundation guidelines and the values shown below differ from the PBS qualifying criteria for lipid lowering drugs.

Assess risk category

Highest risk
- Existing heart disease
- Existing extracoronary vascular disease

High risk
- Diabetes Mellitus
- Family history of CHD
- Familial hypercholesterolaemia
- Hypertension
- Smoking
- HDL < 1.0
- Microalbuminuria

Initiate therapy if

Total cholesterol > 5.0 or
LDL cholesterol > 3.0 or
Triglyceride > 2.0

Total cholesterol > 6.0 or
LDL cholesterol > 4.0 or
Triglyceride > 4.0 or
TG > 2.0 if HDL < 1.0

Total cholesterol > 7.0 or
LDL cholesterol > 5.0 or
Triglyceride > 8.0

- Encourage physical activity
- Appropriate diet (including sterol margarine if cholesterol elevated, low saturated fat, decreased alcohol intake)
- Discuss with a medical practitioner the need for lipid lowering agent

- Arrange for repeat lipids and medical review within 2 weeks of commencing treatment

Less risk
- No risk factors

Highest risk
- Existing heart disease
- Existing extracoronary vascular disease

High risk
- Diabetes Mellitus
- Family history of CHD
- Familial hypercholesterolaemia
- Hypertension
- Smoking
- HDL < 1.0
- Microalbuminurea

Initiate therapy if

Total cholesterol > 5.0 or
LDL cholesterol > 3.0 or
Triglyceride > 2.0

Total cholesterol > 6.0 or
LDL cholesterol > 4.0 or
Triglyceride > 4.0 or
TG > 2.0 if HDL < 1.0

Total cholesterol > 7.0 or
LDL cholesterol > 5.0 or
Triglyceride > 8.0

- Encourage physical activity
- Appropriate diet (including sterol margarine if cholesterol elevated, low saturated fat, decreased alcohol intake)
- Discuss with a medical practitioner the need for lipid lowering agent

- Arrange for repeat lipids and medical review within 2 weeks of commencing treatment

Less risk
- No risk factors

NOTE: The Heart Protection Study showed that in people with diabetes treatment with Simvastatin 40 mg daily significantly reduced the risk of vascular events irrespective of initial cholesterol level.

* Simvastatin is contraindicated in pregnancy. Therefore they should not be used in women of childbearing years unless reliable contraception is being used
7.4 Gestational Diabetes

Gestational Diabetes (GDM) is carbohydrate intolerance with onset or first recognition during pregnancy. In pregnancies complicated by GDM, the major concern is foetal macrosomia. These large for date babies are at risk of birth trauma, including shoulder dystocia and brachial plexus injury. They are also at risk of hypoglycaemia and other transient metabolic disorders. GDM is also associated with a high risk of subsequent development of maternal diabetes later in life. In recognition of this morbidity and risk, the Australasian Diabetes in Pregnancy Society (ADIPS) has published consensus guidelines for screening and diagnostic criteria for GDM. Universal screening is recommended at 26-28 weeks gestation or earlier if there is clinical concern, especially if risk factors are present.

The changing demographics of women becoming pregnant, and increasing rates of type 2 diabetes in Australian community, have resulted in more women of child bearing age having abnormal glucose tolerance test results. The International Association of Diabetes and Pregnancy Study Groups (IADPSG) with strong Australasian representation have formulated new consensus guidelines in 2010 which have been adopted by ADIPS in 2011.

Recommendations for early screening for DM in pregnancy.

All women should have DM risk assessed, and testing considered, at their first antenatal visit.

1. Women in a high risk group for overt (pre-existing) diabetes or gestational diabetes

Women at high risk (table 1) should have a full 75g glucose tolerance test (GTT). There will be certain circumstances, for example in rural and remote communities, where it will not be possible to perform a formal 2hr GTT. In this situation a fasting or random plasma glucose level should be considered. Women with High risk but normal GTT at booking should be monitored closely. If previous test are normal, a GTT should be repeated at around the usual time of 24-28 weeks gestation. An GTT should be organised at any time during pregnancy if clinically indicated.

Highest risk factors for overt or gestational diabetes

**Table 1.**

<table>
<thead>
<tr>
<th>Risk Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous GDM</td>
</tr>
<tr>
<td>Ethnicity: Asian, Aboriginal, Pacific Islander, Maori, Middle Eastern, African</td>
</tr>
<tr>
<td>Maternal age, ≥ 40 years, family history of type 1DM</td>
</tr>
<tr>
<td>Overweight, BMI &gt; 35kg/m²</td>
</tr>
<tr>
<td>Previous Macrosomia, baby of more than 4500g</td>
</tr>
<tr>
<td>Polycystic ovarian syndrome</td>
</tr>
<tr>
<td>Medications: corticosteroids, antipsychotics</td>
</tr>
</tbody>
</table>

Recommendation: GTT at booking visit

Level of evidence C
Recommendations for routine testing for GDM

All women not known to have DM or GDM should have a 75g 2 hour GTT at 24 – 28 weeks gestation; testing should be performed in the morning after an 8 hour fast. Venous plasma glucose levels should be measured in an accredited pathology laboratory.

Classification of 75g Glucose tolerance Test

<table>
<thead>
<tr>
<th>Abnormal</th>
<th>significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTT (diagnostic test)</td>
<td>GDM</td>
</tr>
<tr>
<td>FBGL ≥ 5.5 mmol/L</td>
<td></td>
</tr>
<tr>
<td>1 hr BGL ≥ 10.0 mmol/L</td>
<td></td>
</tr>
<tr>
<td>2 hr BGL ≥ 8.0 mmol/L</td>
<td></td>
</tr>
<tr>
<td>(1 or more abnormal readings)</td>
<td></td>
</tr>
</tbody>
</table>

ADIPS 1991

CAUTION: about 1% of women with ‘GDM’ are at risk of developing type 1 diabetes.

Type 1 diabetes should be suspected in women who are slim, have minimal or no risk factors for GDM, present with high BGL eg > 20 mmol/L ± significant ketonuria. GAD antibody may be helpful. These women should be followed up for at least 2 years postpartum. Note that, their postpartum GTT may be normal or only show IGT in the first year postpartum.

Ramadan

• Ideally, women should be screened for GDM just before or immediately after Ramadan. However, if screening is required during Ramadan, GCT should be performed in the evening.
• A diagnostic GTT should be performed immediately after Ramadan. In the meantime, women should be advised to avoid simple carbohydrate (soft drinks, fruit juice etc). Random blood glucose levels should be measured at Antenatal Clinic visits.
Treatment targets in GDM
Extrapolating from the Hyperglycaemia and adverse pregnancy outcome study (HAPO) data, and considering recent information about glycaemia in normal pregnancy, the following treatment targets are recommended:

- Fasting BG levels ≤ 5.0 mmol/l
- 1 hour BG level ≤ 7.4 mmol/l
- 2 hour BG level ≤ 6.7 mmol/l

These BG levels are based on self capillary BG levels. Outlying BG levels are likely to be due to dietary or other lifestyle related factors. In general 2 elevated levels, at a given testing time, in 1 week, should be a prompt to consider additional therapy. Level of evidence C/D

Management

<table>
<thead>
<tr>
<th>Treatment Flow Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commence blood glucose monitoring (fasting and 2 hr pp)</td>
</tr>
<tr>
<td>Encourage healthy diet and exercise</td>
</tr>
<tr>
<td>Is glycaemic control satisfactory?</td>
</tr>
<tr>
<td>Fasting &lt; 5.1 mmols/L</td>
</tr>
<tr>
<td>2 hr pp &lt; 6.7 mmols/L*</td>
</tr>
<tr>
<td>Continue current treatment</td>
</tr>
<tr>
<td>Commence Insulin Therapy</td>
</tr>
<tr>
<td>- Short/rapid 1-3 times with meals</td>
</tr>
<tr>
<td>+/-</td>
</tr>
<tr>
<td>- Nocte intermediate</td>
</tr>
<tr>
<td>- Review BGLs – timing of review needs to be determined on an individual basis but usually 1 – 2 weekly</td>
</tr>
<tr>
<td>- Titrate insulin as required to maintain goal BGL’s**</td>
</tr>
</tbody>
</table>

* ADIPS 2011
** Due to severe insulin resistance, a small percentage of women will require in excess of 350 units of insulin a day. These women are likely to require the addition of mane intermediate acting insulin to their treatment regimen.
Diabetes Education and Blood Glucose Monitoring

Initial education should cover the implications of GDM for the mother and her baby, blood glucose monitoring, overview on diet and recommendations regarding exercise and the importance of postpartum follow-up. Women with GDM should also be provided with positive encouragement to minimize their emotional stress. Once diagnosed with GDM, all women need to monitor their BGL fasting (pre breakfast) and 2 hour after meals (timed from the beginning of the meals) for the rest of the pregnancy. Therefore patients should be instructed tin how to obtain a blood glucose meter. They should also be registered with the National Diabetes Supply Scheme (NDSS). Following the ADIPS and KEMH guidelines these women should be given the following BGL target ranges:

Fasting: 3.5 - 5.0 mmol/l
2 hr p.p.: 5.0 – 6.7 mmol/l

HbA1c and fructosamine levels may provide additional information regarding the adequacy of the glycaemic control. In general, HbA1c should be measured at diagnosis and monthly thereafter.

Assessment and Advice

Nutritional advice should be culturally appropriate and individualized to incorporate each patient’s specific needs. The advice should cover both diabetic diet recommendations and specific pregnancy requirements. Adequate dietary intake is important to avoid foetal growth retardation – ketonuria may help detect inadequate carbohydrate intake. Lack of maternal weight gain (particularly in non-obese women) may also indicate excessive restriction of food intake.

Exercise

Women should be advised that a moderate degree of exercise is beneficial, unless there are other medical or obstetric contraindications.

Insulin

At this stage it is not generally accepted practice to use oral anti-hyperglycaemic agents in pregnancy. Therefore, insulin therapy is indicated if the blood glucose levels are not adequately controlled on diet alone. Insulin therapy should also be considered if there is evidence of reduced or accelerated foetal growth on fundal height or ultrasound. Short-acting or rapid-acting insulin given pre-meal (one to three injections/day) should be commenced if 2 hr post prandial BGLs are elevated (>7.0 mmol/l). In general, individual insulin doses of between 4 to 8 units should be commenced, depending on the degree of hyperglycaemia. Pre-bed intermediate insulin should be commenced if fasting BGLs are elevated (>5.5 mmol/L). Frequent dose adjustments and support are often required.

NOTE: All pregnant women requiring insulin therapy are usually delivered at KEMH due to high risk delivery.
Postpartum Management of Women with GDM

Women with GDM are at marked increase risk of future type 2 diabetes and should be advised regarding optimum lifestyle and appropriate follow-up. Some women will continue to have abnormal glucose tolerance in the early postpartum period. Therefore, women should be advised to see their general practitioners 6 -8 weeks post partum to undergo a repeat GTT. GTT’s should be performed annually thereafter.

8. List of Pathology Tests

This section of the guidelines identifies blood and urine pathology tests which can be ordered by the Nurse Practitioner.

8.1 Endocrinology

<table>
<thead>
<tr>
<th>TEST</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cortisol (8am – 9am)</td>
<td>COR</td>
</tr>
<tr>
<td>C-Peptide</td>
<td>CPEP</td>
</tr>
<tr>
<td>Estradiol</td>
<td>E2</td>
</tr>
<tr>
<td>Follicle Stimulating Hormone</td>
<td>FSH</td>
</tr>
<tr>
<td>Free Thyroxine</td>
<td>FT4</td>
</tr>
<tr>
<td>Free Triiodothyronine</td>
<td>FT3</td>
</tr>
<tr>
<td>GAD antibodies</td>
<td>GAD Ab</td>
</tr>
<tr>
<td>Glucose Tolerance Test</td>
<td>GTT</td>
</tr>
<tr>
<td>Glycosylated Haemoglobin A1c</td>
<td>HBA1C</td>
</tr>
<tr>
<td>hCG - quantitative - for pregnancy</td>
<td>HCG (Preg)</td>
</tr>
<tr>
<td>HCG –qualitative - Urine</td>
<td>U Preg SP</td>
</tr>
<tr>
<td>IA2 antibodies</td>
<td>IA2 antibodies</td>
</tr>
<tr>
<td>Insulin Antibodies</td>
<td>INAB</td>
</tr>
<tr>
<td>Insulin</td>
<td>INS π</td>
</tr>
<tr>
<td>Microalbumin/creatinine ratio</td>
<td>ACR</td>
</tr>
<tr>
<td>Parathyroid Hormone</td>
<td>PTH</td>
</tr>
<tr>
<td>Progesterone</td>
<td>PROG</td>
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</tbody>
</table>
### TEST

<table>
<thead>
<tr>
<th>TEST</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proinsulin</td>
<td>PINS</td>
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<tr>
<td>Testosterone</td>
<td>TES</td>
</tr>
<tr>
<td>Thyroglobulin</td>
<td>TG</td>
</tr>
<tr>
<td>Thyroglobulin Antibodies</td>
<td>TGAB</td>
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<tr>
<td>Thyroid Autoantibody</td>
<td>Thyroid Autoantibody</td>
</tr>
<tr>
<td>Thyroid Binding Globulin</td>
<td>TBG</td>
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<tr>
<td>Thyroid Function Test</td>
<td>TFT</td>
</tr>
<tr>
<td>Thyroid Stimulating Hormone</td>
<td>TSH</td>
</tr>
<tr>
<td>Total Triiodothyronine</td>
<td>T3</td>
</tr>
<tr>
<td>TSH receptor antibodies</td>
<td>TRAB</td>
</tr>
<tr>
<td>TPO antibodies</td>
<td>TPOA</td>
</tr>
</tbody>
</table>

π Caution: Some automated immunoassays do not measure aspart, glargine or lispro insulin.

### 8.2 Biochemistry

<table>
<thead>
<tr>
<th>TEST</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alanine Aminotransferase</td>
<td>ALT</td>
</tr>
<tr>
<td>Albumin</td>
<td>Alb</td>
</tr>
<tr>
<td>Aldosterone</td>
<td>Aldo</td>
</tr>
<tr>
<td>Alkaline Phosphatase</td>
<td>ALP</td>
</tr>
<tr>
<td>Anion Gap</td>
<td></td>
</tr>
<tr>
<td>Aspartate Aminotransferase</td>
<td>AST</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>Bicarb</td>
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<tr>
<td>Bilirubin</td>
<td>Bili</td>
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<td>Calcium</td>
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</tr>
<tr>
<td>Chloride</td>
<td>Cl</td>
</tr>
<tr>
<td>Creatinine</td>
<td>Creat</td>
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Version 4 - Dec 2012
<table>
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<tr>
<th>TEST</th>
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<tbody>
<tr>
<td>Creatinine Kinase</td>
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<tr>
<td>Creatinine Spot Urine</td>
<td>U CR SP</td>
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<tr>
<td>Electrolytes</td>
<td>ELP</td>
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<tr>
<td>Ethanol</td>
<td>ETOH</td>
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<tr>
<td>Ferritin</td>
<td>Ferritin</td>
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<tr>
<td>Fructosamine</td>
<td>FRUC</td>
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<tr>
<td>Gamma Glutamyl Transferase</td>
<td>GGT</td>
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<tr>
<td>Glucose</td>
<td>Glu</td>
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<tr>
<td>Glucose (Fasting)</td>
<td>Glu (Fasting)</td>
</tr>
<tr>
<td>Glucose Tolerance Test</td>
<td>GTT</td>
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<tr>
<td>Glucose Tolerance Test (Gestational)</td>
<td>GTT (Gest)</td>
</tr>
<tr>
<td>High Density Lipoprotein Cholesterol</td>
<td>HDL</td>
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<tr>
<td>Homocysteine</td>
<td>Total Plasma Homocysteine</td>
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<tr>
<td>Iron</td>
<td>Iron</td>
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<tr>
<td>Iron Studies</td>
<td>Iron Studies</td>
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<tr>
<td>Ketones</td>
<td>Ketones</td>
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<td>Lactate Dehydrogenase</td>
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<td>Lipid Screen</td>
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<tr>
<td>Low Density Lipoprotein Cholesterol</td>
<td>LDL</td>
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<tr>
<td>Potassium</td>
<td>K</td>
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<tr>
<td>Protein Timed Urine</td>
<td>U PROT TM</td>
</tr>
<tr>
<td>TEST</td>
<td>CODE</td>
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<tr>
<td>--------------------------</td>
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<tr>
<td>Sodium</td>
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<tr>
<td>Triglyceride</td>
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<tr>
<td>Urea</td>
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<td>Uric Acid</td>
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### 8.3 Coagulation

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<tr>
<td>Coagulation Screen</td>
<td>RPA R-CS</td>
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<td>Fibrinogen</td>
<td>FIB</td>
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<td>INR RPA</td>
<td>R-INR</td>
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<tr>
<td>Plasminogen</td>
<td>PLG</td>
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<td>Platelet Function Test</td>
<td>PLT FUN</td>
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<tr>
<td>Thrombin Time</td>
<td>TT</td>
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<td>Von Willebrand factor Screen</td>
<td>VWF Scr</td>
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### 8.4 Haematology

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<tr>
<td>B12</td>
<td>B12</td>
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<tr>
<td>B12 and Folate</td>
<td>B12FOL</td>
</tr>
<tr>
<td>B12, Folate and Iron Studies</td>
<td>B12/FOL/FE</td>
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<tr>
<td>ESR</td>
<td>ESR</td>
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<tr>
<td>FBC RPA</td>
<td>R-FBC</td>
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<tr>
<td>Folate</td>
<td>FOL</td>
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### 8.5 Immunology

<table>
<thead>
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<th>TEST</th>
<th>CODE</th>
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<tbody>
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<td>Anti-transglutaminase antibodies</td>
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<tr>
<td>Coeliac Diagnostic Screen</td>
<td>COELIAC DX</td>
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<tr>
<td>High Sensitive C-Reactive Protein</td>
<td>HS CRP</td>
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<tr>
<td>HIV-1 Viral Load</td>
<td>HIV-1 Viral Load</td>
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### 8.6 Molecular Genetics

<table>
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<tbody>
<tr>
<td>Haemochromatosis</td>
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### 8.7 Serology

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<tr>
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<tr>
<td>Hepatitis A Antibody (Total)</td>
<td>HAV TOT</td>
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<tr>
<td>Hepatitis B Core Antibody</td>
<td>HBV CORE</td>
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<tr>
<td>Hepatitis B Surface Antibody</td>
<td>HBsAb</td>
</tr>
<tr>
<td>Hepatitis B Surface Antigen</td>
<td>HBsAg</td>
</tr>
<tr>
<td>Hepatitis C Antibody</td>
<td>HCV</td>
</tr>
<tr>
<td>Hepatitis D Serology</td>
<td>HDV</td>
</tr>
<tr>
<td>Hepatitis E Serology</td>
<td>HEV</td>
</tr>
<tr>
<td>Hepatitis F Serology</td>
<td>HEPF</td>
</tr>
<tr>
<td>Hepatitis G Serology</td>
<td>HEPG</td>
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<tr>
<td>HIV-1 Diagnostic PCR</td>
<td>HIV-1 PCR</td>
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### 8.8 Microbiology

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<tr>
<td>Blood Culture</td>
<td>CBLD</td>
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<tr>
<td>Mycobacterial Culture</td>
<td>C AFB</td>
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<tr>
<td>Urine MC &amp; S</td>
<td>C UR</td>
</tr>
<tr>
<td>Urine Microscopy only</td>
<td>M UR</td>
</tr>
<tr>
<td>Wound MC &amp; S - Deep</td>
<td>C WD DEEP</td>
</tr>
<tr>
<td>Wound MC &amp; S - Superficial C</td>
<td>WD SKIN</td>
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</table>
9. Formulary

This formulary provides for the poisons and restricted substances that may be possessed, used, supplied or prescribed by Nurse Practitioners under section 17A of the Poisons and Therapeutics Goods Act 1996 and forms part of approved Nurse Practitioner guidelines, in accordance with section 78A (2) (a) of the Nurses Act 1991. Detailed information regarding mode of action, indications, contraindications, precautions, use in pregnancy, adverse reactions, drug interactions, doses and presentations has been included in this section for reference.

9.1 Oral Hypoglycaemic Agents

Poisons Schedule: S4

<table>
<thead>
<tr>
<th>Drug</th>
<th>Trade name</th>
<th>Therapeutic Class</th>
<th>Status</th>
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</thead>
<tbody>
<tr>
<td>Acarbose</td>
<td>Glucobay</td>
<td>Alpha-glucosidase inhibitor</td>
<td>Formulary</td>
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<tr>
<td>Dipeptidyl peptidase-4 inhibitors</td>
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</tr>
<tr>
<td>Saxagliptin</td>
<td>Sitagliptin</td>
<td>Incretin</td>
<td>Formulary</td>
</tr>
<tr>
<td>Vildagliptin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exenatide</td>
<td>Byetta</td>
<td>Incretin</td>
<td>Special access</td>
</tr>
<tr>
<td>Glibenclamide</td>
<td>Daonil</td>
<td>Sulphonylurea</td>
<td>Formulary</td>
</tr>
<tr>
<td>Glimel</td>
<td>Euglucon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gliclazide</td>
<td>Diamicron</td>
<td>Sulphonylurea</td>
<td>Formulary</td>
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<tr>
<td>Diamicron MR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glimepiride</td>
<td>Amary</td>
<td>Sulphonylurea</td>
<td>Formulary</td>
</tr>
<tr>
<td>Glipizide</td>
<td>Minidiab</td>
<td>Sulphonylurea</td>
<td>Formulary</td>
</tr>
<tr>
<td>Metformin</td>
<td>Diaformin</td>
<td>Biguanide</td>
<td>Formulary</td>
</tr>
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<td>Diabex</td>
<td>Diabex XR</td>
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<td>Glucophage</td>
<td>Glucomet</td>
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<td>Glucomet</td>
<td>Novomet</td>
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<tr>
<td>Pioglitazone</td>
<td>Actos</td>
<td>Thiazolidinedione</td>
<td>Special access</td>
</tr>
<tr>
<td>Repaglinide</td>
<td>Novonorm</td>
<td>Meglitinide</td>
<td>Non Formulary</td>
</tr>
<tr>
<td>Rosiglitazone</td>
<td>Avandia</td>
<td>Thiazolidinedione</td>
<td>Special access</td>
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</table>
## 9.2 Insulin Therapy

*Poisons Schedule: S4*

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Status</th>
<th>Approved Indications</th>
</tr>
</thead>
</table>
| Insulin Aspart 100units/mL inject. subcutaneous 5x3mL  
*Brand Name:* NovoRapid Penfill 3mL | Formulary | T1  T2 & Gestational diabetes |
| Insulin Aspart 100units/mL inject. subcutaneous 5x3mL  
*Brand Name:* NovoRapid Flexipen 3mL | Formulary | T1  T2 & Gestational diabetes |
| Insulin Aspart 100units/mL inject. subcutaneous 3x10mL  
*Brand Name:* NovoRapid Vial 10mL | Formulary | T1  T2 & Gestational diabetes |
| Insulin Aspart 30 + Protamine 70%, inject. subcutaneous 5x3mL  
*Brand Name:* NovoMix30 FlexPen | Formulary | T1 & T2 diabetes |
| Insulin Aspart 30% + Protamine 70%, inject. subcutaneous 5x3mL  
*Brand Name:* NovoMix30 Penfill | Formulary | T1 & T2 diabetes |
| Insulin Isophane 100units/mL inject. Subcutaneous 3x10mL  
*Brand Name:* Protaphane 10mL vial | Formulary | T1  T2 & Gestational diabetes |
| Insulin Isophane 100units/mL inject. Subcutaneous 5x3mL  
*Brand Name:* Protaphane InnoLet 3mL | Formulary | T1  T2 & Gestational diabetes |
| Insulin Isophane 100units/mL inject. Subcutaneous 5x3mL  
*Brand Name:* Protaphane Penfill 3mL | Formulary | T1  T2 & Gestational diabetes |
| Insulin Isophane 100units/mL inject. Subcutaneous 10mL  
*Brand Name:* Humulin NPH 10mL vial | Formulary | T1  T2 & Gestational diabetes |
| Insulin Isophane 100units/mL inject. Subcutaneous 5x3mL  
*Brand Name:* Humulin NPH Cartridge 3mL | Formulary | T1  T2 & Gestational diabetes |
| Insulin Lispro 100 units/mL inject. subcutaneous 5x3mL  
*Brand Name:* Humalog Cartridge 3mL | Formulary | T1  T2 & Gestational diabetes |
| Insulin Lispro 100units/mL inject. subcutaneous 3x10mL  
*Brand Name:* Humalog 10mL vial | Formulary | T1  T2 & Gestational diabetes |
<table>
<thead>
<tr>
<th><strong>Product Description</strong></th>
<th><strong>Status</strong></th>
<th><strong>Approved Indications</strong></th>
</tr>
</thead>
</table>
| Insulin Lispro 25 + Lispro Protamine 75 100units/mL inject. subcutaneous 5x3mL  
**Brand Name:** Humalog Mix25 Cartridge 3mL | Formulary | T1, T2 & Gestational diabetes |
| Insulin Lispro 50 + Lispro Protamine 50 100units/mL inject. subcutaneous 5x3mL  
**Brand Name:** Humalog Mix50 Cartridge 3mL | Formulary | T1, T2 & Gestational diabetes |
| Insulin Neutral 30 + Isophane 70 , inject. Subcutaneous 5x3mL  
**Brand Name:** Mixtard 30/70 InnoLet 3mL | Formulary | T1, T2 diabetes |
| Insulin Neutral 30 + Isophane 70 100units/mL inject. subcutaneous 10mL  
**Brand Name:** Mixtard 30/70 10mL vial | Formulary | T1 & T2 diabetes |
| Insulin Neutral 30 + Isophane 70 100units/mL inject. subcutaneous 10mL  
**Brand Name:** Humulin 30/70 10mL vial | Formulary | T1 & T2 & Gestational diabetes |
| Insulin Neutral 30 + Isophane 70 100units/mL inject. subcutaneous 5x3mL  
**Brand Name:** Humulin 30/70 Cartridge 3mL | Formulary | T1, T2 & Gestational diabetes |
| Insulin Neutral 30 + Isophane 70 100units/mL inject. subcutaneous 5x3mL  
**Brand Name:** Mixtard 30/70 Penfill 3mL | Formulary | T1 & T2 diabetes |
| Insulin Neutral 50 + Isophane 50 100units/mL inject. subcutaneous 5x3mL  
**Brand Name:** Mixtard 50/50 Penfill 3mL | Formulary | T1 & T2 diabetes |
| Insulin Neutral HM 100units/mL inject. Subcutaneous 3x10mL  
**Brand Name:** Humulin R 10mL vial | Formulary | T1, T2 & Gestational diabetes |
| Insulin Neutral HM 100units/mL inject. Subcutaneous 3x10mL  
**Brand Name:** Actrapid 10mL vial | Formulary | T1, T2 diabetes |
| Insulin Neutral HM 100units/mL inject. Subcutaneous 5x3mL  
**Brand Name:** Actrapid Penfill 3mL | Formulary | T1, T2 & Gestational diabetes |
| Insulin Neutral HM- SAS 500units/mL inject. subcutaneous 10mL  
**Brand Name:** Actrapid 10mL vial | Formulary | Restricted Special Access Scheme |
### Product Description | Status | Approved Indications
---|---|---
Insulin Neutral HM 100units/mL inject. Subcutaneous 5x3mL  
**Brand Name:** Humulin R Cartridge 3mL | Formulary | *T1 & T2 & Gestational diabetes*

Insulin Glargine HM 100units/ml inject Subcutaneous 5x3ml  
**Brand Name:** Lantus Cartridge 3ml | Formulary | *T1 & T2 diabetes*

Insulin Glargine HM 100units/ml Subcutaneous 5x3ml  
**Brand Name:** Lantus Solarstar 3ml | Formulary | *T1 & T2 diabetes*

Insulin Glulisine HM 100 units/ml inject subcutaneous  
**Brand Name:** Apidra Solarstar 3ml | Formulary | *T1 & T2 diabetes*

Insulin Glulisine HM 100 units/ml inject subcutaneous  
**Brand Name:** Apidra cartridge 3ml | Formulary | *T1 & T2 diabetes*

Insulin Detemir HM 100 units/ml inject subcutaneous  
**Brand Name:** Levemir cartridge 3ml | Formulary | *Only for type 1 diabetes*

Glucagon  
**Brand Name:** GlucaGen Hypokit | Formulary | *May also be purchased non prescription*

### 9.3 Other

**Poisons Schedule:** S4

| Product Description | Status | Approved Indications |
---|---|---|
Glucagon  
**Brand Name:** GlucaGen Hypokit | Formulary | *May also be purchased non prescription*

### 10. Pharmacology

#### 10.1 Oral Hypoglycaemic Agents

**ACARBOSE**

**Mode of action:** Delays intestinal absorption of carbohydrates by inhibition of alphaglucosidase enzymes in the small intestine.

**Uses/Indications:** Type 2 diabetes not controlled by diet/oral hypoglycaemics

**Contraindications:** Severe renal impairment; GI disorders assoc. with malabsorption, inflammatory bowel disease, intestinal obstruction, ileus, major hernia, conditions aggravated by formation of intestinal gas, children < 18 years
Precautions: Monitor hepatic enzymes; hypoglycaemia

Pregnancy: Avoid use; ADEC category B3, Lactation: Very low bioavailability; probably safe.

Adverse Reactions:
Common: flatulence, diarrhoea, abdominal pain and distension.
Infrequent: increase in plasma transaminase concentrations, particularly in underweight people and with high doses.
Rare: ileus, rash, hepatotoxicity, erythema multiforme, anaemia

Drug Interactions:
Charcoal, digestive enzymes: reduces acarbose effect; avoid combined use.
Cholestyramine: enhances acarbose effect; decrease acarbose dosage.
Digoxin: bioavailability of digoxin may increase; give acarbose several hours after digoxin dose and/or adjust digoxin dosage.
Warfarin: may increase or decrease INR; monitor INR.
Also: Hypoglycaemics, Neomycin

Dose: Should be taken with food. Individualise dosage. Usually 50 mg daily 1st week, twice daily 2nd week, three times daily 3rd week; increase after 4-8 weeks to 100-200 mg 3 times daily if necessary; average adult dose 100 mg 3 times daily. Maximum daily dose, 600 mg.

Practice points:
• dosage of other antidiabetic drugs given concomitantly may require adjustment to avoid hypoglycaemia
• monitor plasma transaminase concentrations each month for the first 6 months; decrease dosage if transaminases elevated; monitor weekly until transaminase concentrations return to normal; stop treatment if elevations persist
• hypoglycaemia may occur in combination with sulfonylureas, repaglinide or insulin; give glucose but not sucrose (cane sugar) because of delayed absorption of sucrose
• GI adverse effects:
  • are dose-dependent; increased by taking sucrose
  • can be reduced by starting on low dose and titrating slowly; improve with longer duration of treatment
  • are unlikely to be alleviated by administration of antacid preparations.

Presentation: Glucobay 50mg tab (white), Glucobay 100 mg tab (scored, white)

GLIBENCLAMIDE

Mode of action: Increases pancreatic insulin secretion; may decrease insulin resistance.

Uses/Indications: Sulfonylurea. Type 2 diabetes

Contraindications: Type 1 diabetes, ketoacidosis.

Precautions:
Porphyria: risk of acute attacks.
Intercurrent illness (eg myocardial infarction, coma, infection, trauma): monitor blood glucose and urine ketones; substitute insulin treatment if glycaemic control is not adequate.
Renal impairment: increased risk of hypoglycaemia; avoid use.
**Hepatic impairment**: increased risk of hypoglycaemia; avoid use.

**Elderly**: increased risk of hypoglycaemia; avoid use in the very elderly.

**Surgery**: substitute with insulin treatment before surgery.

**Also**: impaired alertness, adrenal or pituitary insufficiency; genetic metabolic defects; diet; exercise, debilitated.

**Pregnancy**: Avoid use; replace with insulin; ADEC category C.

**Lactation**: Avoid use.

**Adverse Reactions**:

**Common**: hypoglycaemia, weight gain.

**Infrequent**: nausea, diarrhoea, metallic taste, headache, rash

**Rare**: blood disorders (thrombocytopenia, agranulocytosis, aplastic anaemia, haemolytic anaemia), erythema multiforme, exfoliative dermatitis, photosensitivity, hepatotoxicity.

**Drug Interactions**:

**Alcohol**: increases hypoglycaemic effect, masks hypoglycaemic warning symptoms, avoid binge use; take alcohol with food.

**H2 antagonists** (*eg* cimetidine, ranitidine), *sulfonamide antibiotics*, *ketoconazole*, *miconazole*, MAOIs: may increase hypoglycaemic effect; monitor blood glucose and adjust sulfonylurea dosage if necessary.

**Cyclosporin**: may increase plasma cyclosporin concentration and toxicity and possibly increase hypoglycaemic effect of sulfonylurea; monitor plasma cyclosporine and blood glucose concentrations; adjust cyclosporin or sulfonylurea dose if necessary.

**Rifampicin**: increases metabolism of sulfonylurea; decreases hypoglycaemic effect; monitor blood glucose and adjust sulfonylurea dosage.

**Cholestryramine**: impairs intestinal absorption of sulfonylurea; decreases hypoglycaemic effect; give sulfonylurea at least 1 hour before cholestryramine.

**Dose**: 2.5–20 mg daily in 1–2 divided doses; up to 10 mg as single dose. Increase 2.5 mg weekly to max. 20 mg/day if necessary. Take with food to minimise risk of hypoglycaemia.

**Presentation**: Daonil 5 mg tab (scored, white), Glimel 5 mg tab (scored, white)

**GLICLAZIDE**

**Mode of action**: Increases pancreatic insulin secretion; may decrease insulin resistance.

**Uses/Indications**: Sulfonylurea. Type 2 diabetes

**Contraindications**: Ketoacidosis, type 1 diabetes, sulfonamide, sulfonylurea hypersensitivity

**Precautions**:

**Porphyria**: risk of acute attacks.

**Intercurrent illness** (*eg* myocardial infarction, coma, infection, trauma): monitor blood glucose and urine ketones; substitute insulin treatment if glycaemic control is not adequate.

**Renal impairment**: Dosage reduction may be required in severe impairment because of increased risk of hypoglycaemia

**Hepatic impairment**: Avoid use in severe impairment.

**Surgery**: Substitute with insulin treatment before surgery.

**Also in**: Undernourishment, poor general health, adrenal insufficiency, hypoglycaemic risk, alcoholism, hypopituitarism, long-term use, elderly, and children

**Pregnancy**: Avoid use; replace with insulin; ADEC category C.

**Lactation**: Avoid use.
**Adverse Reactions:**
Common: Hypoglycaemia, weight gain
Infrequent: nausea, diarrhoea, metallic taste, headache, rash
Rare: blood disorders (thrombocytopenia, agranulocytosis, aplastic anaemia, haemolytic anaemia), erythema multiforme, exfoliative dermatitis, photosensitivity, hepatotoxicity

**Drug Interactions:**
As for glibenclamide
Also: thiazide diuretics; barbiturates, glucocorticosteroids, oestrogens; insulin, biguanides, salicylates, coumarin derivatives, chloramphenicol, beta-blockers.

**Dose:**
40–320 mg daily in 1–2 divided doses; up to 160 mg as single dose. Take with food to minimise risk of hypoglycaemia.

*Controlled release formulation*, initially 30 mg once daily; increase dose, according to response, by 30 mg once daily at not less than 2-week intervals; maximum daily dose 120 mg.

**Practice points:** 30 mg of the controlled release formulation is equivalent to 80 mg of the conventional tablet.

**Presentation:**
*Diamicron* 80mg tab (scored, white), *Glyade* 80 mg tab (scored, white), *Nidem* 80 mg tab (scored, white), *Gliclazide* (Chem mart, GenRx, Terry White) 80 mg tab (scored, white), *Diamicron MR* 30 mg tab (controlled release, white)

**GLIPIZIDE**

**Mode of action:** Increases pancreatic insulin secretion; may decrease insulin resistance.

**Uses/Indications:** Sulfonylurea. Type 2 diabetes

**Contraindication:** Ketoacidosis, Type 1 diabetes, allergy to sulfonamides, sulfonylurea derivatives, severe renal and hepatic insufficiency; severe thyroid dysfunction; severe or unstable diabetes; infections, febrile conditions; gangrene; severe trauma; major surgery; pregnancy; children

**Precaution:**
Hypoglycaemia
Porphyria—risk of acute attacks.

*Intercurrent illness (eg myocardial infarction, coma, infection, trauma)*—monitor blood glucose and urine ketones; substitute insulin treatment if glycaemic control is not adequate.

*Renal impairment:* Dosage reduction may be required in severe impairment because of increased risk of hypoglycaemia.

*Hepatic impairment:* Avoid use in severe impairment.

*Surgery:* Substitute with insulin treatment before surgery.

**Pregnancy:** Avoid use; replace with insulin; ADEC category C.

**Lactation:** Avoid use.

**Adverse Reactions:**
Common: weight gain
Infrequent: nausea, diarrhoea, metallic taste, headache, rash
Rare: blood disorders (thrombocytopenia, agranulocytosis, aplastic anaemia, haemolytic anaemia), erythema multiforme, exfoliative dermatitis, photosensitivity, hepatotoxicity
**Drug Interactions:**

*Same as for glibenclamide. Also:* NSAIDs and highly protein bound drugs, ketoconazole, miconazole.

**Dose:**

2.5–40 mg daily in 1–2 divided doses; up to 15 mg as single dose. Take with food to minimise risk of hypoglycaemia.

**Presentation:**

*Melizide* 5 mg tab (scored, white), *Minidiab* 5 mg tab (scored, white)

---

**GLIMEPIRIDE**

**Mode of action:** Increases pancreatic insulin secretion; may decrease insulin resistance.

**Uses/Indication:** Sulfonylurea. Type 2 diabetes

**Contraindications:** Type 1 diabetes, ketoacidosis, precoma, coma; dialysis patients.

**Precautions:**

Porphyria: risk of acute attacks.

*Intercurrent illness (eg myocardial infarction, coma, infection, trauma)*: monitor blood glucose and urine ketones; substitute insulin treatment if glycaemic control is not adequate.

Renal impairment: dosage reduction may be required in severe impairment because of increased risk of hypoglycaemia.

Hepatic impairment: avoid use in severe impairment.

Surgery: substitute with insulin treatment before surgery.

Also: prolonged exercise; deficient caloric intake; adrenal, pituitary insufficiency; malnutrition; monitor blood and urine glucose regularly; elderly, debilitated; children.

**Pregnancy:** Avoid use; replace with insulin; ADEC category C., **Lactation:** Avoid use.

**Adverse Reactions:**

*Common:* Hypoglycaemia, weight gain

*Infrequent:* nausea, diarrhoea, metallic taste, headache, rash

*Rare:* blood disorders (thrombocytopenia, agranulocytosis, aplastic anaemia, haemolytic anaemia), erythema multiforme, exfoliative dermatitis, photosensitivity, hepatotoxicity.

**Drug Interactions:**

*As for glibenclamide Also:* sympatholytics including beta-blockers, coumarins

**Dose:** Initially, 1 mg once daily, adjusted according to response in 1 mg steps at 1–2 week intervals up to 4 mg once daily. Take with food to minimise risk of hypoglycaemia

**Presentation:**

*Amaryl* 1 mg tab (scored, pink), *Dimirel* 1 mg tab (scored, pink)

*Amaryl* 2 mg tab (scored, green), *Dimirel* 2 mg tab (scored, green)

*Amaryl* 3 mg tab (scored, yellow), *Dimirel* 3 mg tab (scored, yellow)

*Amaryl* 4 mg tab (scored, blue), *Dimirel* 4 mg tab (scored, blue)
METFORMIN

Mode of action: Reduces hepatic glucose production; increases peripheral utilisation of glucose.

Uses/Indications: Biguanide. Type 2 diabetes in adults not controlled by diet and exercise; adjuvant therapy in insulin dependent diabetes

Contraindications: Uncomplicated insulin regulated type 1 diabetes, diet only regulated diabetes, ketoacidosis, surgery, acute blood loss, severe infection or trauma/shock, radiological studies using IV iodinated contrast materials, impaired renal, heart failure, severe hepatic dysfunction, tissue hypoxia; respiratory failure, pulmonary embolism, pancreatitis, excessive alcohol intake, dehydration, gangrene.

Precautions:

Renal impairment: Increases risk of lactic acidosis; reduce maximum dose in mild impairment, do not use when creatinine clearance is <30 ml/minute. Replace with insulin if possible.

Hepatic impairment: Avoid use; risk of lactic acidosis.

Surgery: Stop metformin 2 days before, during, and for 2 days after, surgery; monitor blood glucose concentrations; replace with insulin as required.

Elderly: Use cautiously, avoid use in very old people, eg >85 years.

Also: High doses, prolonged use, monitor vitamin B12 levels, children

Pregnancy: Usually replaced with insulin; some clinical use; ADEC category C.,

Lactation: Safe to use.

Adverse Reactions:

Common: malabsorption of vitamin B12, nausea, vomiting, anorexia, diarrhoea

Infrequent: rash

Rare: lactic acidosis (often fatal). Caused by metformin accumulation when contraindications are overlooked (eg renal or hepatic impairment, old age, heart failure), or in high risk situations (eg major illness, surgery). Early symptoms include anorexia, nausea, vomiting, abdominal pain, cramps, malaise and weight loss.

Drug Interactions:

Alcohol: increases risk of lactic acidosis; limit alcohol intake; avoid use of metformin in alcohol abuse.

Cimetidine: may increase metformin concentration; monitor patients carefully.

Iodinated contrast media: increase risk of lactic acidosis; stop metformin 2 days before, during, and for 2 days after, administration of contrast media.

Also: diuretics, ACE inhibitors, Ca channel blockers including nifedipine, betablockers, anticoagulants, thyroid derivatives, corticosteroids.

Dose:

500 mg 1–3 times daily; may be increased up to 850 mg 2–3 times daily according to response. Maximum daily dose, 3 g. Take during or immediately after a meal to minimise GI adverse effects. Renal impairment: A reduced maximum dose is suggested based on creatinine clearance: 60–90 mL/minute, 2 g daily, 30–60 mL/minute, 1 g daily

Practice points

• advise patient to immediately report symptoms of loss of appetite, nausea, vomiting, abdominal pain, cramps, malaise, diarrhoea or weight loss.

• slow onset of effect; control may take up to 2 weeks to establish
• monitor plasma creatinine before treatment initiation and at 4–6-month intervals
• increase dosage slowly to limit GI adverse effects; reduce or stop treatment if symptoms persist

**Presentation:**

*Diabex* 500 mg tab (scored, white), *Diaformin* 500 mg tab (scored, white), *Glucohexal* 500 mg tab (scored, white), *Glucomet* 500 mg tab (white), *Glucophage* 500 mg tab (scored, white), *Metformin* (Biochemie) 500 mg tab (white), *Metformin* (Chem mart, GenRx, Terry White) 500 mg tab (scored, white), Diabex 850 mg tab (white), *Diaformin* 850 mg tab (white), *Glucohexal* 850 mg tab (scored, white), *Glucomet* 850 mg tab (white), *Glucophage* 850 mg tab (white), *Metformin* (Biochemie, Chem mart, GenRx, Terry White) 850 mg tab (white), Diabex 1 g tab (scored, white).

**PIOGLITAZONE**

**Mode of action:** Increase the sensitivity of peripheral tissues to insulin; decrease hepatic glucose output.

**Uses/Indications:** Thiazolidinedione. Type 2 diabetes mellitus, combined with metformin or a sulfonylurea when metformin is unsuitable.

**Contraindications:** Ketoacidosis, Type 1 diabetes, Heart failure NYHA Class III and IV

**Precautions:**

*Heart failure:* may increase plasma volume; use with caution in NYHA Class I and II.

*Premenopausal anovulatory state, polycystic ovary disease:* may restore fertility; consider contraception.

*Intercurrent illness (e.g., myocardial infarction, coma, infection, trauma):* monitor blood glucose and urine ketones; substitute insulin treatment if glycaemic control is not adequate.

*Hepatic impairment:* Avoid use when transaminase levels are >2.5 times the upper limit of normal.

*Surgery:* Substitute with insulin treatment before surgery.

*Also:* dialysis, children

**Pregnancy:** Avoid use; no human data; ADEC category B3.

**Lactation:** Avoid use; no human data.

**Adverse Reactions:**

*Common:* oedema, weight gain, headache, arthralgia, dizziness, decrease in haemoglobin and haematocrit, increase in total and HDL cholesterol (rosiglitazone) *Rare:* elevated liver enzymes, hepatocellular injury, heart failure, pulmonary oedema

**Drug Interactions:**

*Insulin:* increased risk of heart failure; use with caution.

*Oral contraceptives*

**Dose:**

*Monotherapy:* 15 to 30 mg once daily, increased to 45 mg once daily if required after 4 weeks. *Combination therapy:* Initially 15 mg once daily. 30 mg once daily recommended dose in combination with sulfonylureas, metformin or insulin. May be taken with or without food.
**Practice points:**

- monitor liver enzymes at the start of treatment, then every 2 months for the first year and periodically thereafter
- check liver enzymes at the first symptoms suggestive of hepatic dysfunction, eg nausea, vomiting, abdominal pain, fatigue, anorexia, dark urine or jaundice
- stop treatment if ALT rises above 3 times the upper limit of normal or if the patient has jaundice

**Presentation:**

Actos 15 mg tab (white), Actos 30 mg tab (white), Actos 45 mg tab (white)

**REPAGLINIDE**

**Mode of action:** Increases pancreatic insulin secretion.

**Uses/Indications:** Type 2 diabetes as monotherapy or combined with metformin or insulin

**Contraindications:** Type 1 diabetes, C-peptide negative, ketoacidosis, coadministration of gemfibrozil, children < 12 yrs

**Precautions:**

- Intercurrent illness (eg myocardial infarction, coma, infection, trauma)—monitor blood glucose and urine ketones; substitute insulin treatment if glycaemic control is not adequate.
- Renal impairment: Lower dosage required in severe impairment; titrate dose carefully in mild and moderate impairment.
- Hepatic impairment: No data in severe impairment- avoid use; titrate dose carefully in mild and moderate impairment.
- Elderly: No data for people >75 years.
- Pregnancy: Avoid use; no data., Lactation: Avoid use; no data.

**Adverse Reactions:**

- Common: Hypoglycaemia, nausea, vomiting, abdominal pain, diarrhoea, constipation
- Infrequent: rash, increase in liver enzymes

**Drug Interactions:**

- Ketoconazole, fluconazole, itraconazole, erythromycin: may increase plasma concentration of repaglinide; avoid combined use.
- Rifampicin, phenytoin: may decrease plasma concentration of repaglinide; avoid combined use.
- Gemfibrozil: increases concentration of repaglinide; co-administration is contraindicated.
- Also: MAOIs, nonselective beta-blockers, ACE inhibitors, salicylates, NSAIDs, alcohol, Ocs, thiazides, steroids, thyroid hormones, metformin, insulin (additive effect).

**Dose:**

- Initially, 0.5 mg 3 times daily; increase every 1–2 weeks according to blood glucose control up to 4 mg 3 times daily. Maximum dose 16 mg daily.
- Changing from another oral antidiabetic drug: Initially, 1 mg 3 times daily. Take immediately before meals. Do not take a dose if you are skipping a meal.
**Presentations:**
NovoNorm 0.5 mg tab (white), NovoNorm 1 mg tab (cream), NovoNorm 2 mg tab (pink)

**ROSIGLITAZONE**

**Mode of action:** Increase the sensitivity of peripheral tissues to insulin; decrease hepatic glucose output.

**Uses/Indications:** Thiazolidinedione. Type 2 diabetes; monotherapy or + sulfonylureas or metformin

**Contraindications:** Ketoacidosis, Type 1 diabetes, Heart failure NYHA Class III and IV

**Precautions:**
*Heart failure:* may increase plasma volume; use with caution in NYHA Class I and II.
*Premenopausal anovulatory state, polycystic ovary disease:* may restore fertility; consider contraception.
*Intercurrent illness (eg myocardial infarction, coma, infection, trauma):* monitor blood glucose and urine ketones; substitute insulin treatment if glycaemic control is not adequate.
*Hepatic impairment:* Avoid use when transaminase levels are >2.5 times the upper limit of normal.
*Surgery:* Substitute with insulin treatment before surgery.
*Also:* switching therapy from troglitazone, children

**Pregnancy:** Avoid use; no human data; ADEC category B3.

**Lactation:** Avoid use; no human data.

**Adverse Reactions:**
*Common:* oedema, weight gain, headache, arthralgia, dizziness, decrease in haemoglobin and haematocrit, increase in total and HDL cholesterol (rosiglitazone)
*Rare:* elevated liver enzymes, hepatocellular injury, heart failure, pulmonary oedema

**Drug Interaction:**
*Insulin:* increased risk of heart failure; use with caution.

**Dose:**
Initially, 4 mg once daily; may be increased to 8 mg daily in 1 or 2 doses if effect is inadequate after 6–8 weeks of treatment.

**Practice points:**
• monitor liver enzymes before the start of treatment, then every 2 months for the first year and periodically thereafter
• check liver enzymes at the first symptoms suggestive of hepatic dysfunction, eg nausea, vomiting, abdominal pain, fatigue, anorexia, dark urine or jaundice
• stop treatment if ALT rises above 3 times the upper limit of normal or if the patient has jaundice

**Presentations:**
Avandia 4 mg tab (orange), Avandia 8 mg tab (red)
EXENATIDE

**Mode of action:** Synthetic analogue of glucagon like peptide 1, enhances glucose dependant insulin secretion and suppresses inappropriate glucagon secretion. It also delays gastric emptying, which reduces the rate of glucose absorption and decreases appetite.

**Uses/Indications:** Incretin. Type 2 diabetes; with metformin and/or sulphonylurea

**Contraindications:** History of Pancreatitis, Cr Cl < 30ml/min

**Precautions:**
- Servere GI disease, eg gastroparesis, dumping syndrome
- Treatment with sulphonylureas may need to reduce doses due to increased hypoglycaemic risk.

**Pregnancy:** Avoid use; limited data; ADEC category C., **Lactation:** Avoid use; no data.

**Adverse Reactions:**
- Common: nausea and/or vomiting, diarrhoea, dyspepsia, GORD, abdominal pain, hypoglycaemia, headache, dizziness, feeling jittery, injection site reactions
- Infrequent: constipation, taste disturbance
- Rare: pancreatitis, allergic reactions, altered renal function, increased serum creatinine concentration, alopecia.

Antibodies: Anti-exenatide antibodies may develop in up to 50% of patients.

**Drug Interaction:**

**Dose:**
- Adult SC initially 5 micrograms twice daily, within 60 min of eating, if tolerated after 1 month increasing to 10 micrograms twice daily.

**Practice points:**
- In comparative trials, more exenatide treated patients withdrew due to adverse effects than did those treated with insulin
- The aim of initial dose titration is to improve GI tolerability; varying administration time within the hour before a meal may also help
- Appetite suppressant effect appears optimal when given 30-60 min before meals
  - Information is lacking on long term safety and on morbidity and mortality outcomes
  - In clinical trials patients with BMI > 25 lost weight
  - Less frequent blood glucose concentration monitoring is required with exenatide than with insulin.

**Presentations:**
- Byetta SC 5 mcg injection, SC 10 mcg injection

DPP4 inhibitors-gliptins

**Mode of action:** Inhibit dipeptidyl peptidase-4 thereby increasing the concentration of the incretin hormones glucagon-like peptide-1 and glucodependant insulinotropic polypeptide; glucose-glucagon production reduced.

**Uses/Indications:** Incretin. Type 2 diabetes

**Contraindications:**
Precautions:

Treatment with an ACE inhibitor – Vildagliptin has been associated with an increased risk of ACE inhibitor –induced angioedema; other DDP4 inhibitors may also have this effect.

Pregnancy: Avoid use; no human data; ADEC category B3, Lactation: Avoid use; no human data.

Adverse Reactions:

Common: Hypoglycaemia (mainly when used with a sulfonylurea), infections (nasopharygitis, upper respiratory tract, UTI), headache

Rare: pancreatitis, hypersensitivity.

Drug Interaction:

Dose:

Saxagliptin 5mg tabs (Pink), Sitagliptin 25mg tab (pink) 50mg tab (light brown) 100mg tab (brown), Vildagliptin 50mg tab (white)

Practice points:

• DPP4 inhibitors appear to be less effective in reducing HbA1c than metformin, sulfonylureas or thiazolidinediones
• effects on diabetes related complications are unknown as there are no trials assessing clinical endpoints such as macrovascular and microvascular outcomes
• The lack of data on long term effects is of concern: DDP4 is found in many tissues including the immune system, in trials there was an increase in infections in patients treated with DDP4 inhibitors, Most clinical trials studied patients for a maximum of only 52 weeks
• Sitagliptin and Vildagliptin seem to have similar efficacy in placebo controlled trials between these drugs.
• In patients taking metformin, efficacy of saxagliptin in reducing HbA1c over 18 weeks was non-inferior to sitagliptin.

• DPP4 inhibitors appear to have no significant effect on weight.

Presentations:

Onglyza, Januvia, Galvus,

10.2 Insulin Preparations

Mode of action:

Increases or restores ability to metabolise glucose by enhancing cellular glucose uptake.

Indications:

Type 1 diabetes
Type 2 diabetes inadequately controlled with diet, exercise and oral antidiabetic drugs and in conditions where oral antidiabetic drugs cannot be used (eg pregnancy, surgery)

Precautions:

Intercurrent illness: increased insulin may be required.
Surgery: monitor blood glucose and urine ketones in the perioperative period; insulin infusion may be required in complex or prolonged surgery.

Pregnancy: Safe to use., Lactation: Safe to use.
Drug interactions:

Drugs which may decrease blood glucose concentration: salicylates (high doses), mefloquine, octreotide, disopyramide, quinine, MAOIs, anabolic steroids, ACE inhibitors, pentamidine, perhexiline.

Drugs which may increase blood glucose concentration: danazol, glucocorticoids, thiazide diuretics (high doses), oral contraceptives (high doses), phenothiazines (chlorpromazine), beta2 agonists (IV salbutamol, terbutaline), nicotinic acid, pentamidine, somatropin, atypical antipsychotics (olanzapine, clozapine, quetiapine).

When introducing or withdrawing a drug that influences blood glucose concentration, close monitoring of blood glucose and adjustment of insulin or antidiabetic drug dosage are required.

Alcohol: decreases blood glucose concentration by inhibiting hepatic glucose output; increases risk of hypoglycaemia; limit alcohol intake and take food with alcohol.

Beta-blockers: may mask some hypoglycaemic warning symptoms and increase incidence and severity of hypoglycaemia but data are conflicting; choose beta1 selective beta-blockers, such as atenolol, which has been shown to be safe and effective in patients with type 2 diabetes.

Adverse effects:

Hypoglycaemia is the most frequent and serious adverse effect; may occur with excessive dosage, delayed or insufficient food, increased physical activity. Warning symptoms include sweating, hunger, faintness, palpitations, tremor, headache, visual disturbance and altered mood.

Also: weight gain, local reactions including erythema, itching, lipodystrophy, lipoatrophy, allergic reactions.

Dose:

Type 1 diabetes

Intensive regimens (basal-bolus): use bolus injections of short or rapid acting insulin before each meal, and intermediate or long acting insulin once or twice daily (before bedtime and breakfast).

Conventional regimens (split-mixed): use a combination of short or rapid acting insulin with intermediate or long acting insulin (usually 30% short acting and 70% intermediate or long acting insulin) once or twice daily. If the dosage is split, about two-thirds of the total daily requirement is given before breakfast and the rest before the evening meal.

Continuous SC insulin infusion: uses a pump which delivers a continuous infusion of short or rapid acting insulin with bolus doses activated by patient before meals.

Type 2 diabetes

Combined with oral antidiabetic drugs, intermediate or long acting insulin is usually given in the evening or at bedtime. Start with low dose (eg 10 units of mixed insulin 30% short acting and 70% intermediate at dinner time); increase dose in 2–4 unit increments.

Monotherapy, regimens combining short acting with intermediate or long acting insulin or biphasic insulins are commonly used; they are given in a single daily dose or 2 divided doses before the morning and evening meals.

Administration instructions:

SC injections may be given in the abdomen (fastest rate of absorption and onset of action), or less commonly in the thighs, upper arms or buttocks. Rotate injection sites in the same general area to avoid lipodystrophy. Pinch skin to reduce risk of injection into a blood vessel.
Use short acting insulin 30 minutes before meals. Use rapid acting insulin immediately before or soon after meals when necessary. Use intermediate and long acting insulins in the morning or in the evening (given with short acting insulin in the same syringe before the evening meal or in a separate injection just before bed).

Gently rotate intermediate and long acting insulin vials and cartridges in hands before use to ensure resuspension.

When mixing insulins, draw up short acting insulin (clear) into the syringe first to avoid contamination with long acting insulin (cloudy).

Store insulin at 2–8°C protected from light; do not freeze; storage of a vial at up to 25°C is acceptable for up to 1 month.

**Practice points:**

- Local adverse reactions often disappear spontaneously; switching to another insulin or allergic desensitisation may be necessary when generalised allergic reactions occur
- Warming insulin to room temperature minimises injection discomfort

**Presentations:**

**Origin**

Available preparations are either purified bovine insulins or human insulins obtained by recombinant DNA technology; initial concern about reduced awareness of hypoglycaemia with human insulin has not been confirmed. *Note:* dosage reduction (by about 10%) may be advised when switching from bovine insulin to human insulin.

Insulin lispro and insulin aspart are rapid acting insulin analogues obtained by recombinant DNA technology; their rapid onset of action allows them to be given immediately before meals; they seem to reduce the frequency of mild and severe hypoglycaemia compared to short acting insulin.

Short acting insulins are soluble insulins; short acting insulins are the only type that can be given IV, eg in diabetic ketoacidosis. Intermediate and long acting insulins have a prolonged duration of action resulting from either complexing insulin with a protein (eg protamine). Mixed insulins (also called biphasic insulins) combine a short or rapid acting insulin in varying proportions (20–50%) with an intermediate acting insulin. The long acting insulin analogue glargine is an insulin analogue obtained by recombinant DNA technology. It is an acidic solution and after injection into the subcutaneous tissue microprecipitates are formed allowing slow release of insulin glargine. Its peakless action is associated with fewer episodes of hypoglycaemia.

**Table of comparative information:**

<table>
<thead>
<tr>
<th>Duration category Insulin type Onset of action (hours)</th>
<th>Time to peak activity (hours)</th>
<th>Duration of action (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid acting insulin analogues, insulin lispro, insulin aspart, insulin glulisine</td>
<td>0.25</td>
<td>4–5</td>
</tr>
<tr>
<td>Short acting neutral</td>
<td>0.5</td>
<td>2–3 6–8</td>
</tr>
<tr>
<td>Intermediate acting Isophane</td>
<td>1–2.5</td>
<td>4–12 16–24</td>
</tr>
<tr>
<td>Mixed with rapid acting insulin</td>
<td>0.25 1</td>
<td>16–18</td>
</tr>
<tr>
<td>Mixed insulins mixed with short acting insulin</td>
<td>0.5–1</td>
<td>2–12 16–24</td>
</tr>
<tr>
<td>Long acting insulin analogues, Insulin glargine, insulin Levemir</td>
<td>1-2</td>
<td>6-18 20-28</td>
</tr>
</tbody>
</table>
10.3 Glucagon Hydrochloride

**Mode of Action:** Facilitates release of glucose from glycogen stores

**Uses/Indications:** Hypoglycaemia (oral hypoglycaemic/insulin induced); insulin coma; GIT diagnostic use (inhibit motility)

**Contraindications:** Phaeochromocytoma; insulinoma; glucagonoma

**Precautions:** Fasting, adrenal insufficiency, chronic hypoglycaemia

**Adverse Reactions:** Nausea, vomiting; secondary hypoglycaemia

**Drug Interactions:** Warfarin; beta-blockers

**Dose:** Admin. SC, IM or IVI; see full PI. Hypoglycaemia. Adults, children > 25 kg: 1mg; < 25 kg: 0.5 mg

**Practice points:**
- if there has not been an improvement in the patient’s level of consciousness or there has not been an adequate rise in the blood glucose level within 10 – 15 minutes, intravenous glucose should be administered
- once the level of consciousness has improved, oral intake of CHO needs to be encouraged
- ongoing monitoring of blood glucose levels is essential for at least 6 hours following administration of glucagon in case hypoglycaemia recurs

**Presentation:**
- Glucagen Hypokit 1 mg (injection) lyophilised powder Pack: 1 IU (+ 1 mL solv. Inprefilled syringe)
- Glucagen 1 mg (injection) lyophilised powder Pack: 1 IU (+ 1 mL solv.)

11. Appendices

**Appendix 1:** American Diabetes Association Clinical Practice Guidelines Recommendations, Introduction, Summary of Revisions for the 2004 Clinical Practice recommendations Diagnosis and Classification of Diabetes Mellitus, Standards of Medical Care in Diabetes, Nutrition Principles and Recommendations in Diabetes, Physical Activity/Exercise and Diabetes, Preventive Foot Care in Diabetes, Hypertension Management in Adults with Diabetes, Dyslipidaemia Management in Adults with Diabetes, Aspirin Therapy in Diabetes, Smoking in Diabetes, Nephropathy in Diabetes, Retinopathy in Diabetes, Gestational Diabetes Mellitus, Tests of Glycaemia in Diabetes, Insulin Administration, Continuous Subcutaneous Insulin Infusion, Hyperglycaemic Crises in Diabetes, Preconception Care of Women with Diabetes

**Appendix 2:** NHMRC diabetes guidelines for Australia

**Appendix 3:** ADIPS consensus guidelines for the Testing and Diagnosis of Gestational Diabetes Mellitus in Australia

12. References


