# Insulin in Type 2 Diabetes Assessment and Management

## Disclaimer

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Background – About Insulin in Type 2 Diabetes Assessment and Management

- Type 2 diabetes is characterised by insulin insensitivity, which is initially compensated for by increased insulin secretion by islet cells in the pancreas.
- The natural progression of type 2 diabetes often means patients will require insulin, especially after a number of years of treatment with oral hypoglycaemic agents.

Assessment

1. Consider starting insulin when glycaemic targets are not achieved, usually indicated by a HbA1c > 53 mmol/mol (7.0%) despite:
   - lifestyle changes, and
   - maximum tolerated doses of other oral hypoglycaemic medications. Target HbA1c must be individualised.

   **Target HbA1c**
   Target HbA1c when on insulin is ≤ 53 mmol/mol (7.0%).
   - Targets may be lower (48 mmol/mol or 6.5%) in some patients:
     - No overt cardiovascular disease
     - Presence of other cardiovascular risk factors
     - Shorter duration of disease
     - Diet-controlled
     - On oral treatment with low risk of hypoglycaemia (metformin, DPP4 inhibitors, SGLT-2 inhibitors and GLP-1 agonists)
     - With a lower baseline HbA1c
   - Targets may be higher in patients if:
     - aged > 65 years.
     - presence of co-morbidities.
     - high risk of hypoglycaemia (as risk of confusion, falls, fractures).
     - renal impairment.
     - alcohol abuse.
     - cognitive impairment.
     Individualise blood glucose targets – for most, fasting blood glucose (FBG) 4 to 7 mmol/L and 2-hour postprandial blood glucose 5 to 10 mmol/L.

2. Follow general principles when starting insulin:
   - Provide **education and support**.
     - Educate patients about the natural history of type 2 diabetes. Moving to insulin does not represent a failure on their part.
     - See also Patient information for Insulin Use
   - Remember the 2 main side-effects of insulin are:
     - weight gain
     - hypoglycaemia
3. Monitor for temporary worsening of complications due to sudden normalisation of glucose levels.  
   Sudden normalisation of blood glucose can cause worsening of diabetic retinopathy and peripheral neuropathy.  
   - Reassure that these usually settle with time.  
   - Arrange retinal screening if pre-proliferative retinal changes present.  
   - Ensure close ophthalmology follow-up.

4. Educate patient about insulin use. Involve:  
   - practice nurse if available.  
   - diabetes educators.

5. Assess fitness to drive every 2 years, or arrange annually for commercial licences.

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Management

Practice Point

Arrange early referral for pregnancy
If a patient with type 2 diabetes is planning pregnancy or already pregnant, early endocrinology referral is essential.

1. Refer for immediate diabetes assessment if:  
   - suspected type 1 diabetes.  
   - metabolic derangement or severe intercurrent illness e.g., pneumonia.  
   - new complications, or severe or complex co-morbidity e.g., renal failure, angina, claudication.  
   - diabetes in pregnancy.

2. Choose insulin type (appendix 1, page 153). All are PBS-listed. Consider:  
   - Hypoglycaemia risk  
     - High hypoglycaemia risk – use long-acting insulin e.g. glargine in preference to NPH (isophane), and a quick-acting analogue e.g. NovoRapid, Fiasp, in preference to regular insulin e.g. Actrapid.  
     - Use caution when adding insulin to sulfonylureas.

   - Suitability of device  
     Choose a suitable device taking into consideration:  
     - poor vision  
     - cognitive impairment  
     - manual dexterity

   Options are NDSS-subsidised reusable pens with 3 mL cartridges, disposable pre-filled pens, syringe and needles, or privately funded pumps. Seek advice from a diabetes educator.

3. Select 1 of 2 insulin schedules:  
   - Basal insulin  
     - Obese patients.  
     - Patients who have high blood glucose overnight and in morning, but lower blood glucose levels during the day when active.
- Patients who require assistance from a carer to administer their insulin injections.
- Simple, once-daily regimen.
- Lower risk of nocturnal hypoglycaemia.

- **Premixed insulin**
  - May be useful for a patient with both fasting and post-prandial hyperglycaemia.
  - Once-daily dose before largest meal.
  - Dose adjustment is more complex with premixed insulins, as both insulin components are adjusted simultaneously, increasing the risk of:
    - **Hypoglycaemia**
      Preventing hypoglycaemia is more important than correcting hyperglycaemia.
    - **Weight gain**
      If weight gain > 2 to 4 kg, consider referral to a dietitian.

4. Aim for safe control of blood glucose rather than rapid decrease.

5. Manage by targeted insulin adjustment:

- **Starting and adjusting basal insulin**
  1. **Continue** oral hypoglycaemic medication at current dose.
  2. **Select** basal insulin (e.g., glargine, isophane) and injecting device.
  3. **Start** basal insulin 10 units once daily (morning or bedtime):
     - Start bedtime insulin if fasting blood glucose (FBG) is high before breakfast.
     - Start morning insulin if FBG is on target but levels rise during the day and pre-dinner BGL is high.

4. **Advise** the patient to **self-monitor**
   - Pre-breakfast blood glucose (BG) – check for morning hypoglycaemia.
   - Pre-evening meal BG – check for hypo or hyperglycaemia.
   - 2 hours post-evening meal BG – check for elevated blood glucose level which may mean another regimen should be used.

5. **Titrate** – “fix the fasting first”:
   - Adjust basal insulin dose to achieve target.
   - Consider:
     - **practitioner-led titration** to achieve target in a shorter time period, but use with caution in older, non-overweight patients, or those with diabetic complications e.g., retinopathy. Avoid hypoglycaemia.

**Practitioner-led titration**
Adjust the insulin dose twice a week until fasting blood glucose (FBG) target is achieved.

<table>
<thead>
<tr>
<th>Mean FBG over previous 2 days (mmol/L)*</th>
<th>Insulin dose adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 10</td>
<td>Increase by 4 units</td>
</tr>
<tr>
<td>8.0 to 9.9</td>
<td>Increase by 2 to 4 units</td>
</tr>
<tr>
<td>7.0 to 7.9</td>
<td>No change or increase by 2 units</td>
</tr>
<tr>
<td>6.0 to 6.9</td>
<td>No change</td>
</tr>
<tr>
<td>4.0 to 5.9</td>
<td>No change or decrease by 2 units</td>
</tr>
<tr>
<td>&lt; 4, or if severe hypoglycaemic episode</td>
<td>Decrease by 2 to 4 units</td>
</tr>
</tbody>
</table>
### Patient-led titration

<table>
<thead>
<tr>
<th>Mean FBG over previous 3 days (mmol/L)*</th>
<th>Insulin dose adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 8.0 mmol/L</td>
<td>Increase by 2 units</td>
</tr>
<tr>
<td>6.0 to 8.0 mmol/L</td>
<td>No change</td>
</tr>
<tr>
<td>4.0 to 6.0 mmol/L</td>
<td>Decrease by 2 units</td>
</tr>
<tr>
<td>&lt; 4.0 mmol/L</td>
<td>Decrease by 4 units</td>
</tr>
</tbody>
</table>

*Do not increase the insulin dose if FBG < 4 mmol/L at any time in the preceding week.

Adapted from RACGP – *Management of Type 2 Diabetes: A Handbook for General Practice: Appendix 2. Guide to Insulin Initiation and Titration*

- **Starting and adjusting premixed insulin**
  1. **Continue** metformin. Consider tapering sulfonylureas as glycaemic control improves.
  2. **Select premixed insulin** (e.g., lispro/lispro protamine, or aspart/protamine) and injecting device.

**Premixed insulin**

Humalog Mix 25 or NovoMix 30 are preferred, as they contain a rapid-acting insulin and are "inject and eat", which are easier for patients.

- Ensure the "Mix 25" or "Mix 30" are clearly written on the prescription. Dispensing errors have occurred with Humalog being given instead of Humalog Mix 25.
- Remind the patient that premixed insulins should be cloudy.

**Degludec**, an ultra-long-acting insulin, is available in Australia as a mixed insulin with Aspart (short-acting component) – tradename Ryzodeg. As Degludec is relatively new, local experience is limited. However it appears to provide stable 24 hour background insulinisation, with a reduced risk of overnight hypoglycaemia. However, because of its longer action, caution should be exercised as it may be a risk for prolonged hypoglycaemia.

3. **Start** premixed insulin 10 units once daily before the evening meal in insulin-naïve patients.

4. **Advise** patient to **self-monitor**
   - Pre-breakfast blood glucose (BG) – check for morning hypoglycaemia.
   - Pre-evening meal BG – check for hypo or hyperglycaemia.
   - 2 hours post-evening meal BG – check for elevated blood glucose level which may mean another regimen should be used.
5. **Titrate:**
   - Adjust premixed insulin dose according to fasting blood glucose (FBG) using **this schedule**. Adjust once or twice a week. Consider dose reduction if overnight hypoglycaemia occurs at any time.

   **Adjusting premixed insulin schedule**

<table>
<thead>
<tr>
<th>Fasting BGL (lowest of 3 consecutive readings, mmol/L)</th>
<th>Insulin dosage adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 10</td>
<td>Increase by 6 units</td>
</tr>
<tr>
<td>8.0 to 9.9</td>
<td>Increase by 4 units</td>
</tr>
<tr>
<td>6.0 to 7.9</td>
<td>Increase by 2 units</td>
</tr>
<tr>
<td>4.0 to 5.9</td>
<td>No change</td>
</tr>
<tr>
<td>&lt; 4.0</td>
<td>Decrease by 2 units</td>
</tr>
</tbody>
</table>

   - If a morning insulin dose is given, adjust the insulin dose according to evening pre-prandial BGL according to the same titration recommendations.
   - Hypoglycaemia should prompt a review of other oral therapy. Which insulin is adjusted depends on regimen and target glucose.
   - The lower limit of the ideal target for premixed insulin is 4.5 mmol/L, higher than basal insulin at 4.0 mmol/L.

6. **Intensify** – once-daily premixed insulin to twice-daily premixed insulin if:
   - FBG is at target but evening pre-prandial blood glucose level is elevated.
   - HbA1c is > target after 3 months despite FBG and evening pre-prandial blood glucose level at target.
   - Halve the current once-daily insulin dose and give the reduced dose twice daily (pre-breakfast and pre-dinner).
   - Monitor pre-dinner BGL and FBG against targets.
   - Once a week, adjust morning and evening insulin doses as needed, using **this schedule**. Pre-breakfast insulin is adjusted according to pre-dinner BGL, and pre-dinner insulin is adjusted according to FBG.

   - **Basal plus insulin intensification schedules**
     1. Continue metformin. Consider tapering sulfonylureas as glycaemic control improves.
     2. Select rapid-acting analogue (NovoRapid, Humalog, Fiasp) insulin and injecting device.
     3. Start rapid-acting insulin 4 units before the largest meal. Continue basal insulin at the current dose.
     4. Advise patient to self-monitor 2 hours after meal.
     5. Titrate – increase rapid-acting (analogue) insulin dose by 2 units every 3 days to achieve target. Consider dose reduction if overnight hypoglycaemia occurs at any time.
### Insulin intensification schedule

<table>
<thead>
<tr>
<th>2-hour post-prandial BGL (mmol/L)</th>
<th>Rapid-acting (prandial) insulin dosage adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 8 (for 3 consecutive days)</td>
<td>No change or increase by 2 units</td>
</tr>
<tr>
<td>6.0 to 7.9</td>
<td>No change</td>
</tr>
<tr>
<td>4.0 to 5.9</td>
<td>No change or decrease by 2 units</td>
</tr>
<tr>
<td>&lt; 4.0 on any day</td>
<td>Decrease by 2 to 4 units</td>
</tr>
</tbody>
</table>


6. **Intensify:**
   - If HbA1c is not at target after 3 months, add a further prandial insulin dose to another meal.
   - Keep the current prandial and basal insulin doses unchanged.
   - Add a new rapid-acting (prandial) insulin to the next largest meal of the day, starting at 10% of the basal insulin dose or 4 units.
   - Increase **new prandial insulin dose** by 2 units every 3 days until post-prandial target is achieved.

6. Refer for **urgent or routine diabetes assessment** if:
   - HbA1c > targets despite insulin adjustment.
   - planning pregnancy.
   - suspected genetic forms of diabetes (non-severe illness) e.g., mature onset diabetes of the young (MODY).
   - Patients who are younger, with a strong family history, in particular without a type 2 diabetes phenotype may need referral.
   - Genetic testing for rare inherited types of diabetes is complex and consideration is best done by an **endocrinologist**.

7. If patient with complex medical and psychosocial needs requires outreach care coordination, consider referral to the **Complex Care Program** (formerly Hospital Admission Risk Program or HARP).

### Referral

- Refer for **immediate diabetes assessment** if:
  - suspected type 1 diabetes.
  - metabolic derangement or severe intercurrent illness e.g., pneumonia.
  - new complications, or severe or complex co-morbidity e.g., renal failure, angina, claudication.
  - diabetes in pregnancy.

- Refer for **urgent or routine diabetes assessment** if:
  - HbA1c > targets despite insulin adjustment.
  - planning pregnancy.
  - suspected genetic forms of diabetes (non-severe illness) e.g., mature onset diabetes of the young (MODY).
• Refer as indicated to a dietitian or seek advice from a diabetes educator.
• If patient with complex medical and psychosocial needs requires outreach care coordination, consider referral to the Complex Care Program (formerly Hospital Admission Risk Program or HARP).

Information

For health professionals

Further information

Australian Diabetes Society – National Evidence-based Guidelines for Management of Type 1 Diabetes in Children, Adolescents and Adults

For patients

• Better Health Health – Diabetes and Insulin
• Diabetes Victoria – Insulin

References

Select bibliography


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