For Healthcare Professionals:

INSULIN ADJUSTMENT GUIDELINE

YOUR GUIDE TO SAFE INSULIN ADJUSTMENT

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INTRODUCTION

This document has been developed to provide safe, practical advice for any healthcare professional (HCP) who works with people who live with diabetes and who require insulin injections. The aim of insulin therapy is to normalise glucose levels and prevent long term complications from poorly controlled glucose levels such as cardiovascular events including myocardial infarction and stroke, sight loss, renal failure or lower limb amputation.

The number of people with diabetes in the UK is rapidly increasing; the majority of these will have type 2 diabetes. There are estimated to be 5.8 million in the UK with diabetes, of which, approximately 1.3 million have yet to be diagnosed. It is predicted that by 2026, over 5 million will have the condition and 90% of these have Type 2 diabetes.[1]

According to NHS Buisness Service Authority the total cost of prescribed items for treating diabetes in England over 2024/25 reached £1.92 billion. Currently around 20 – 30% of all people with diabetes in the UK are insulin treated. It is estimated that over one million people use injectable therapies (includes insulin and Glucagon-Like Peptide-1 Receptor Agonists) to treat their diabetes.[2]

The NHS in England spent £10 billion on diabetes, representing 10% of it budget. The majority of this budget goes towards managing serious, often preventable complications. Over 1 billion annually for diabetes medication with a high percent covering the cost for Insulin and injectable therapy. According to latest reports the cost of diabetes to the UK is estimated at £14 billion in 2021/22 with a growing prediction as new therapies come at a higher cost.[3] During 2017 around £350 million was spent on insulin, and £181 million on diagnostic and monitoring devices.[4]

Type 2 diabetes progresses over time irrespective of efforts to control glucose levels. The proportion of people with type 2 diabetes achieving glycaemic control with monotherapy declines over time due to beta cell failure. Increased survival rates and improvements in clinical management of Type 2 diabetes have resulted in people progressing to Insulin therapy in the UK.[5]

Even using a stepwise algorithm for oral diabetes medication this fails to control glucose excursions after time as suggested by American Diabetes Association (ADA)/European Association for the Study of Diabetes (EASD) or NICE.[6,7] This is when injectable therapies need to be considered.

As more diabetes care is delivered within the primary care setting, primary care teams are becoming more confident and competent at initiating basal insulin, however, an integral part of insulin initiation is insulin adjustment too. This needs to be undertaken in a safe and competent manner to achieve individual target glucose levels for the individual with insulin requiring diabetes.

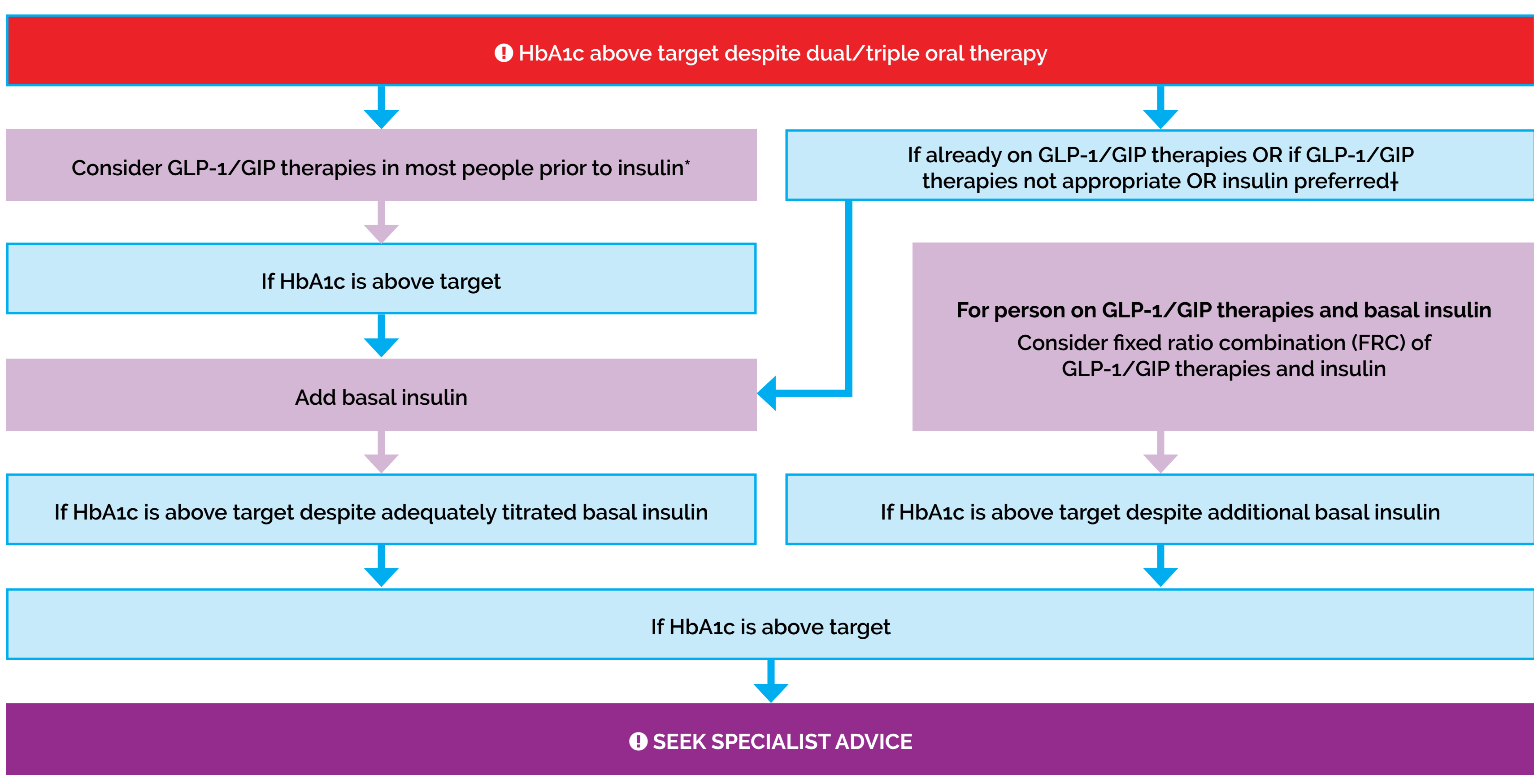
INITIATING INSULIN THERAPIES FOR PEOPLE WITH TYPE 1 DIABETES

When initiating Insulin therapy for Type 1 diabetes the initial total daily dose of insulin in adults is based on the individuals weight and Insulin requirements if requiring intravenous insulin (during an admission at diagnosis. A 0.2 to 0.4 units/kg/day is recommended then 50% bolus Insulin for background Insulin and the remaining 50% of basal Insulin is split for main meals.[6]

When starting insulin therapy for patients with type 1 diabetes, some experience a honeymoon period, during which time they may require fewer units each day. Dose adjustment should be directed by specialist team and clearly advise not to stop Insulin therapy. Once established on a basal bolus regimen, patients with Type 1 diabetes can be considered for a continuous subcutaneous Insulin infusion (CSII) known as a pump with a hybrid closed loop system (HCL) which requires fast acting Insulin and works in combination to an glucose sensor. However, a decision to start an Insulin pump will be based on a localised criteria but supported nationally by NICE. All patients on Insulin need to self-monitor blood glucose levels either by a blood capillary glucose meter or a continuous blood glucose sensor. All patients with type 1 diabetes are eligible to a glucose sensor which can support remote management with their specialist diabetes team.[8]

INTENSIFYING TO INJECTABLE THERAPIES FOR PEOPLE WITH TYPE 2 DIABETES

Consider this algorithm to help you decide your next steps:



* Consider choice of GLP-1/GIP therapies considering persons preference, HbA1c lowering, weight-lowering effect or frequency of injection. If CVD, consider GLP-1/GIP therapies with proven CVD benefit;

‡ Consider insulin as preferred toGLP-1/GIP therapies if symptoms of hyperglycaemia are present, or evidence of ongoing catabolism (polyuria, polydipsia or weight loss)

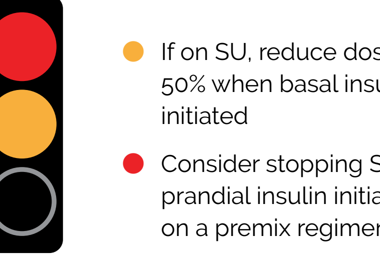
MEDICATIONS TO CONTINUE, REDUCE OR STOP WHEN INTENSIFYING TO INJECTABLES

Consider medication changes as an individualised, person-centred approach to care and treatment review.[7]

METFORMIN (MF)

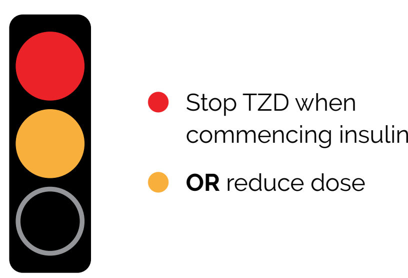
- Continue treatment with metformin

SULFONYLUREA (SU)



- If on SU, reduce dose by 50% when basal insulin initiated
- Consider stopping SU if prandial insulin initiated or on a premix regimen

THIAZOLIDINEDIONE (TZD)

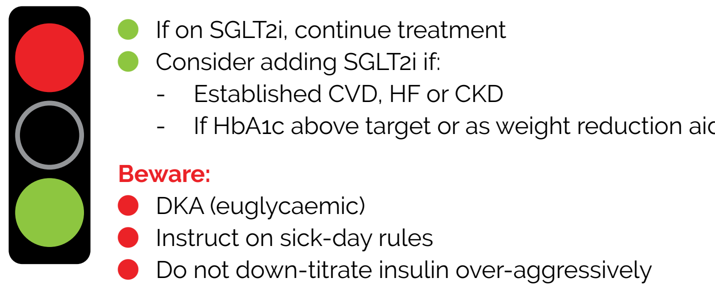


- Stop TZD when commencing insulin
- **OR** reduce dose

DPP-4 INHIBITORS (DPP-4i)

- Stop DPP-4i if GLP-1 RA initiated

SGLT2 INHIBITORS (SGLT2i)



- If on SGLT2i, continue treatment
- Consider adding SGLT2i if:
  - Established CVD, HF or CKD
  - If HbA1c above target or as weight reduction aid

Beware:

- DKA (euglycaemic)
- Instruct on sick-day rules
- Do not down-titrate insulin over-aggressively

Always check individual product-specific guidelines for contraindications and advice in people with CKD

BACKGROUND TO INSULIN THERAPY

It is a hundred years since insulin was discovered and it has saved, and transformed millions of lives ever since. Insulin treatments have evolved and become more complex and now there are over 30 different types of insulin, many with different actions and delivery devices.

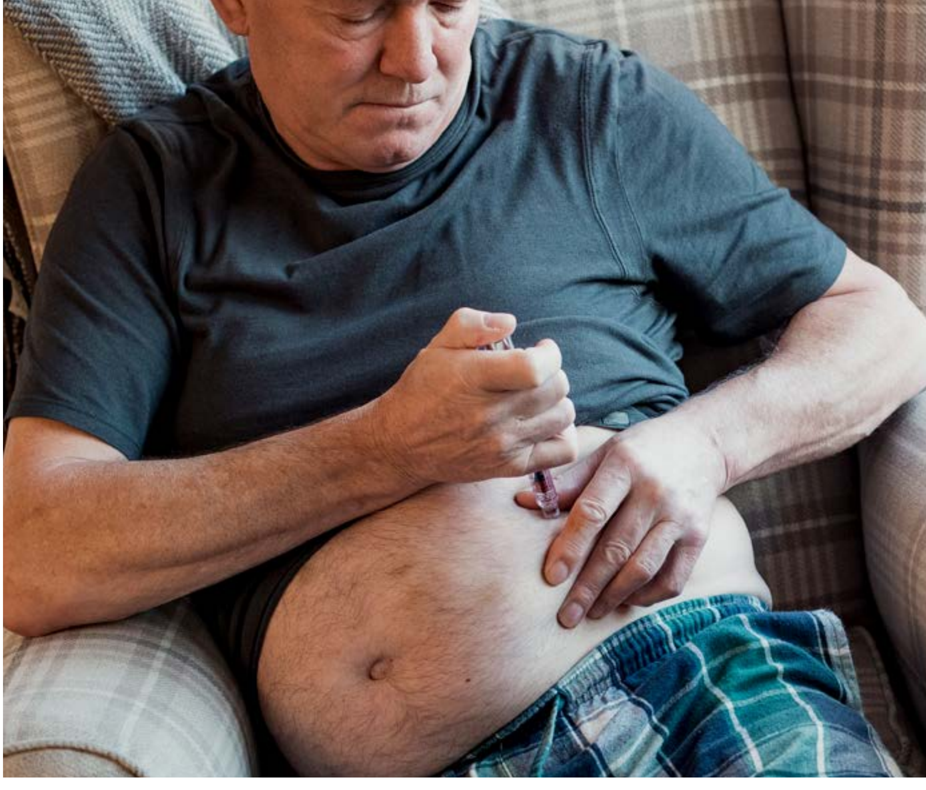
Unfortunately, insulin error is common and preventable. Insulin is one of the most high-risk medications worldwide. Healthcare professionals who handle, prescribe or administer insulin need to receive regular training and demonstrate competence.

All people with type 1 diabetes need insulin to sustain life. Type 1 diabetes is autoimmune in origin where no endogenous insulin is produced **unless the person with type 1 diabetes is on an insulin pump** they will always need to take a combination of an intermediate or long acting insulin as well as a rapid/short acting insulin

Never stop insulin in a person with type 1 diabetes

Many people with type 2 diabetes require insulin. They may take insulin once or more times a day with other oral diabetes treatments or a GLP-1 RA injection. In type 2 diabetes some endogenous insulin may still be being produced however, insulin resistance leads to hyperglycaemia, and especially where there is:

- Suboptimal glycaemic control
- Infection / illness
- Surgery or a fasted procedure



Also people with secondary or type 3c diabetes such as diabetes due to pancreatic damage or post pancreatectomy often require insulin therapy either short-term or permanently. Some individuals who are treated with steroids may require intermittent insulin therapy. Women with gestational diabetes and significant hyperglycaemia often need insulin therapy to manage glucose levels during pregnancy

Insulin errors are common, so it is important that staff are appropriately trained and competent to use insulin

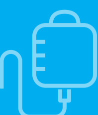
Between 2003 and 2009 the National Reporting Learning System[9] received 16,600 patient safety incidents involving insulin which included:

INSULIN

These are the different types of insulin:

Insulin regimens

Insulin can be given in a variety of regimens depending on the clinical need and preferences of the individual:

ONCE DAILY	TWICE DAILY	BASAL PLUS	BASAL BOLUS-INTERMEDIATE or ULTRA LONG ACTING INSULIN	CONTINUOUS INSULIN PUMP THERAPY	INTRAVENOUS INSULIN INFUSION
e.g Intermediate, long or ultra-long acting insulin. These include Abasaglar, Humulin I, Lantus, Toujeo, Tresiba and Semglee	e.g. NovoMix 30, Humalog Mix 25 or Humulin M3	Offers a basal intermediate, long, or ultra-long acting insulin with a short, rapid, or ultra-rapid acting insulin e.g Apidra, Fiasp, Humalog, Insulin Lispro, Lyumjev, and Trurapi	e.g. Intermediate, long or ultra-acting insulin. these include Abasaglar, Humulin I, Lantus, Toujeo, Tresiba and Semglee	Short acting insulin is given over a 24 hour period via a pump and a cannula. This device is only used in Type 1 diabetes.	Only undertaken in the hospital setting 

The RIGHT Insulin

Lilly DIABETES	novo nordisk®	sanofi	WOCKHARDT	VIATRIS™
• Humulin® I • Humulin® M3 • Humulin® S • Humalog® 100 units/mL • Humalog® 200 units/mL • Humalog® Mix25 • Humalog® Mix50 • Abasaglar® • Lyumjev®	• Actrapid® • Fiasp® • NovoMix® 30 • NovoRapid® • Tresiba® 100 units/mL • Tresiba® 200 units/mL	• Lantus® • Toujeo® • Apidra® • Trurapi®	• Hypurin® Porcine 30/70 • Hypurin® Porcine Isophane • Hypurin® Porcine Neutral (To be discontinued in 2026)	• Semglee®

INSULIN TYPES AND MODE OF ACTION

As you are aware there are many different types of insulins which have different time action profiles. It is important for you to be familiar with the time action profile of the insulins you are administering to people with diabetes. This will enable you to assess the benefits of that particular insulin, or if there are issues such as hypo or hyperglycaemia, you are able to confidently adjust the insulin timing or doses.

The graphic below shows the time action profile of some of the commonly used insulins. You would need to refer to the Manufacturers SmPC for individual insulin information.

Onset: 5-15 mins
Peaks: 0.5-1.5 hours
Duration: 3-5 hours

Onset: 30 mins
Peaks: 2-4 hours
Duration: 6 -8 hours

Onset: 30-60 mins
Peaks: 2-4 hours
Duration: 12-14 hours

Onset: 2 hours
Peaks: 4-8 hours
Duration: 14-16 hours

Onset: 0-2 hours
Peaks: None
Duration: 24-42 hours

- Rapid Acting Analogue
- Short Acting Human
- Intermediate Acting (non analogue)
- Pre-Mixed Human
- Long Acting Analogue

Intensity

2 6 10 14 18 22 → 42

Duration (hours)

ASSESSMENT PRIOR TO INSULIN DOSE ADJUSTMENT SECTION

It is crucial, to ensure safe dose adjustment, that a full assessment is made to try to determine the reason for the hypo/ hyperglycaemia before any adjustment is made.

Always consider:

- Any recent changes to dietary intake – does the individual injecting insulin have carb awareness? If taking MDI are they carb counting and are their ratio:insulin correct?
- Any change in level of physical activity - has the individual injecting insulin taken up any new or extra activities such as going to the gym or have they recently changed work patterns?
- Any recent weight change – either planned or unplanned?
- Any intercurrent illness recently? See 'What to do when you are ill' leaflets.
- Has any oral diabetes medication been missed recently?
- Check injection sites – any lipohypertrophy (ask to examine the sites) See 'Injection Technique Matters: Best Practice in Diabetes Care' leaflet.
- Any issues with self-injections? See 'Injection Technique Matters: Best Practice in Diabetes Care' leaflet.
- Any hypoglycaemia – are they treating appropriately? See 'Diabetes: Why do I sometimes feel shaky, dizzy and sweaty? Hypoglycaemia explained' leaflet.
- Review glucose profile in relation to all the considerations above
- **All leaflets can be accessed and downloaded from our website www.trenddiabetes.online**

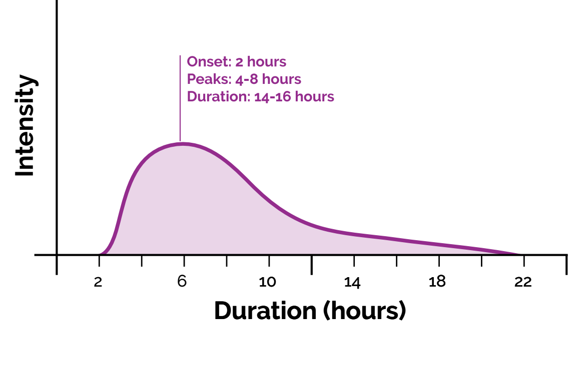
HOW TO ADJUST BASAL INSULIN

Intermediate-acting human insulin

E.g. Humulin I.

- Onset 2 hours
- Peak 4-6 hours
- Duration 14-16 hours

This type of insulin is used in people with type 2 diabetes in combination with oral or non injectable therapies and taken once or twice daily. It is also used in people with type 1 diabetes who also take a short or rapid acting insulin with meals as part of a basal bolus regimen

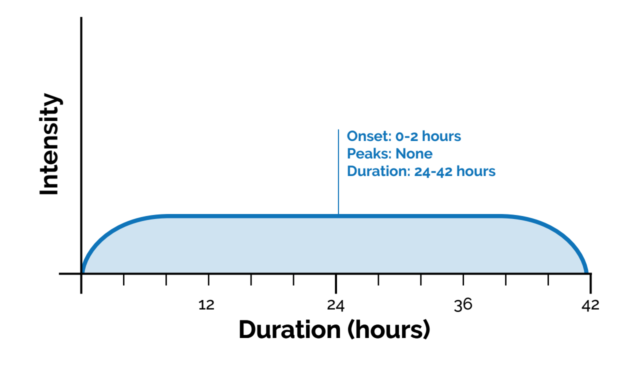


Long-acting insulin analogue

E.g. Abasaglar, Lantus, Semglee, Toujeo, Tresiba

- Onset 2 hours
- Peak None
- Duration 24-36 hours
- The time of action can vary with different products e.g. Toujeo can last up to 36 hours, Tresiba can last up to 42 hours

This type of insulin is used in people with type 2 diabetes in combination with oral or non injectable therapies. It is also used in people with type 1 diabetes who also take a short or rapid acting insulin with meals as part of a basal bolus regimen



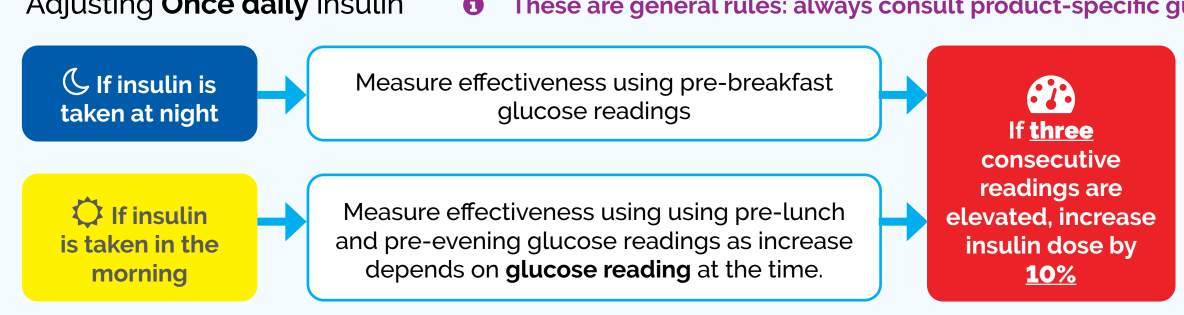
Insulin Adjustment: **Once daily** insulin titration

These are general rules: always consult product-specific guidelines

- Start 10 units (or 0.3 units/Kg) at bedtime or breakfast depending on person's choice
- Continue with other oral and injectable treatments other oral and injectable GLP-1 therapy as appropriate
- Agree glucose targets with the individual
- Monitoring fasting blood glucose daily and at additional times as appropriate
- Titrate insulin dose weekly
- Review the trends in glucose readings before adjusting insulin
- Once fasting target achieved
- Monitor any hypo event and pre/post meal values
  - Recheck HbA1c at 3 months
  - Do not increase doses if hypoglycaemia occurs even if target glucose levels are not achieved - if persistent consider a more flexible regimen

Adjusting **Once daily** insulin

These are general rules: always consult product-specific guidelines - If the person is experiencing hypo/hypers revisit Page 10



- Monitor blood glucose readings before breakfast, lunch, evening meal and supper.
- Consider changing insulin regimen.
- Consider adding in additional GLP-1 therapy to target insulin resistance.
- If these rises cannot be adequately controlled, consider adding rapid insulin before main meal.
- Consider referral to Specialist services at Secondary or Intermediate care and/or dietitian.

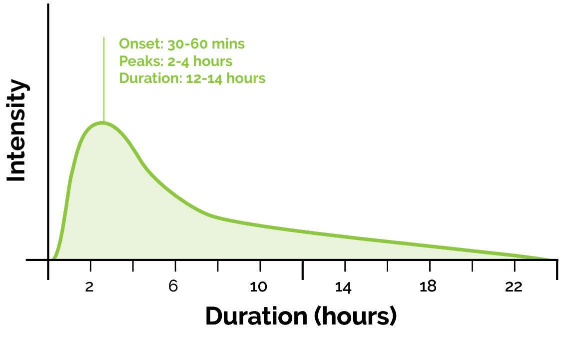
HOW TO ADJUST PRE-MIXED INSULIN

Pre-mixed human insulin

E.g. Humulin M3

- Take 15-30 mins before eating
- Onset within 30-60 mins
- Peak 2-4 hours
- Duration up to 12-14 hours (this will depend on individual insulins)

This insulin is commonly used in people with type 2 diabetes who eat at regular times. It can be used in people with type 1 diabetes who do not want to take a multiple dose (basal bolus) regimen

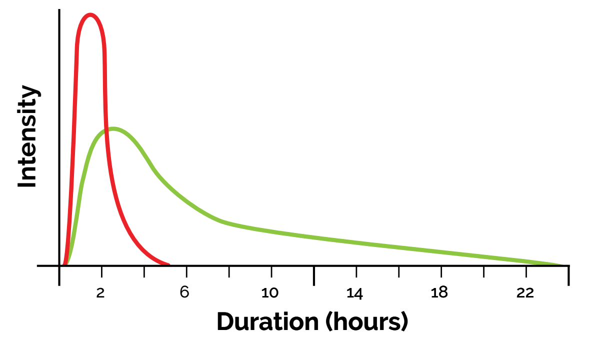


Pre-mixed analogue

E.g. Humalog Mix 25 or 50, NovoMix 30

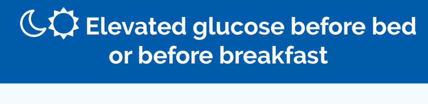
- Pre-mixed insulin contains a mixture of rapid acting insulin and an intermediate or longer acting insulin
- The number given. (e.g. NovoMix 30) indicates the proportion of rapid insulin included in the preparation)
- Needs to be taken up to 15 minutes before or after eating

This insulin is commonly used in people with type 2 diabetes who eat at regular times. It can be used in people with type 1 diabetes who do not want to take a multiple dose (basal bolus) regimen



Adjusting **Twice daily** insulin (pre-mixed or intermediate)

These are general rules: always consult product-specific guidelines



→ **Increase evening insulin dose by 10%**

Elevated glucose before lunch and before evening meal → **Increase morning insulin dose by 10%**

For pre-mixed insulin, need to check not hypo at lunch and pre-bed before increasing doses

Insulin Adjustment: **Twice daily** insulin (pre-mixed or intermediate) titration

These are general rules: always consult product-specific guidelines

- When commencing a twice daily insulin consider **reducing Sulphonylureas**, continue metformin and review other oral treatments and GLP-1 RA therapies
- Use pre-bed and fasting to titrate evening dose
- Agree individual glucose targets with the individual
- Use pre-lunch and pre-evening meal to titrate morning dose
- Aim to titrate insulin doses every 3-4 days initially
- Review the trend in glucose readings before adjusting doses
- Usually change only one dose at a time
- Note that time of greatest risk of hypoglycaemia with premixed insulin is 4-6 hours after dose
- Do not increase dose if hypoglycaemia occurs even if target glucoses are not achieved - if persistent consider a more flexible regimen

In people with type 2 diabetes taking insulin a dose reduction of 20% is recommended , if HbA1c < 64 mmols/mol when a GLP-1 injection is added.

For people with a HbA1c >64 mmols/mol you may still need to consider an insulin dose reduction

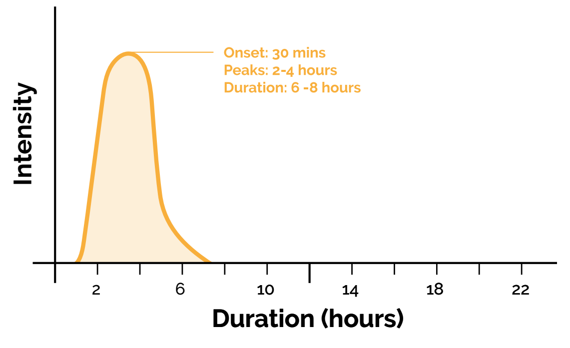
HOW TO ADJUST SHORT/RAPID/ULTRA RAPID INSULIN

Short-acting human insulin

E.g. Humulin S.

- Take 15- 30 minutes before eating
- Peak 2-4 hours
- Duration up to 8 hours

This type of insulin is commonly used to bring down post prandial blood glucose in people with significant hyperglycaemia or as part of a basal bolus regimen in combination with an intermediate or long acting insulin



Rapid-acting analogue insulin

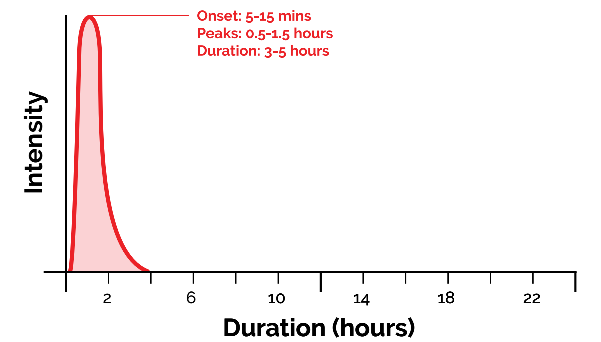
E.g. Apidra, Fiasp, Humalog, Lyumjev, NovoRapid and Trurapi

- Take up to 15 minutes before or after eating eating
- Peaks at 50-90 mins
- Duration 2-5 hours

Ultra rapid/very rapid acting e.g. Fiasp and Lyumjev

- Take with food

These types of insulin are commonly used to bring down post prandial blood glucose in people with significant hyperglycaemia or as part of a basal bolus regimen in combination with an intermediate or long acting insulin.



Adjusting **Basal Bolus** regimen

These are general rules: always consult product-specific guidelines

Elevated glucose before bed or before breakfast → **Increase basal (background) insulin dose by <u>10%</u>**

Elevated glucose before lunch and before evening meal → **Increase mealtime insulin dose by <u>10%</u>**

- Make changes only every 3-4 days unless markedly symptomatic
- Avoid making too many changes at one time

Insulin Adjustment: **Multiple injection therapy** (Basal Bolus) titration

These are general rules: always consult product-specific guidelines

- People who add rapid-acting meal-time insulin to their once-daily insulin regimen can continue their current dose of long-acting insulin, and simply include a dose of rapid-acting insulin before each main meal.
- For those choosing a multiple injection regimen, try starting with one-third of the total daily dose as the basal long-acting insulin then divide the remaining two thirds as rapid or short acting insulin between the three meals.
- Multiple daily injections are known as a basal-bolus regimen and this dosing ratio is recommended for Type 1 diabetes and an intensification option for Type 2 diabetes who are not meeting their targets on basal Insulin alone. The total daily dose (TDD) of insulin is halved approximately 50% basal and 50% bolus then the bolus Insulin is split between 3 main meals. **This regimen will only be successful if the person requiring this insulin is able to count carbohydrate portions**
- Review the trends in glucose readings before adjusting insulin
- Aim to achieve an optimal fasting glucose reading before adjusting the rapid acting insulin doses

Never advise having short/rapid acting insulin before bed as this increases the risk of nocturnal hypoglycaemia

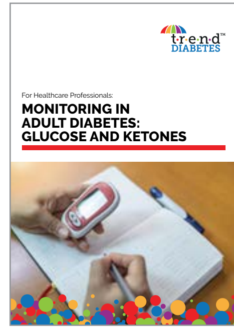
You are always going to adjust the insulin dose that was taken before the problem occurred NOT after. This means you are always looking backwards to see which insulin needs to be adjusted.

Always consider that high glucose readings in the morning could be a result of nocturnal hypoglycaemia especially if the previous pre-bed glucose reading was in the normal range.

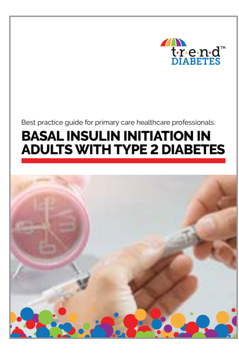
EDUCATION FOR THE PERSON REQUIRING INSULIN THERAPY

It is important that the topics below are covered before commencing insulin therapy but intermittently throughout their journey with their diabetes to reinforce good management.

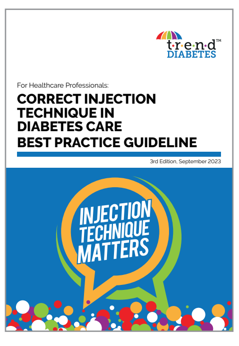
Healthcare Professional Resources:



Effective glucose monitoring including frequency, target



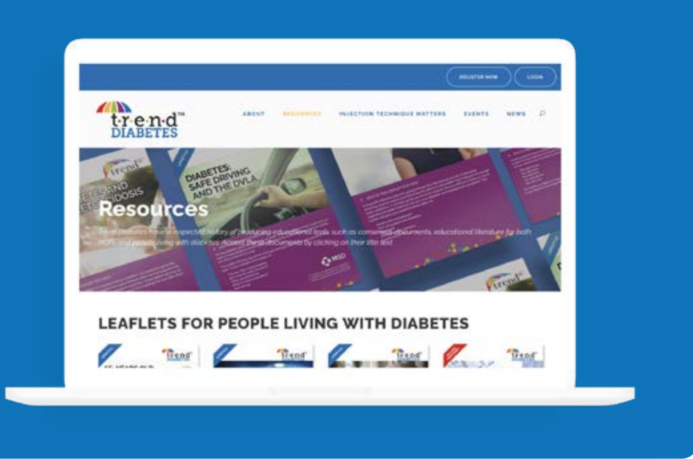
Basel insulin initiation



Correct injection technique

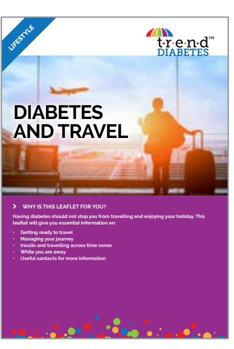
Further resources for Healthcare Professionals and people living with diabetes can be accessed at:

www.trenddiabetes.online

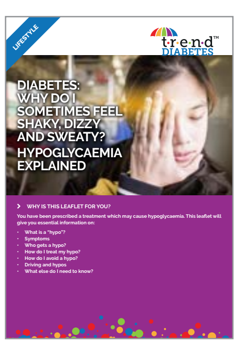


Resources for people with diabetes:

Self-adjustment of insulin

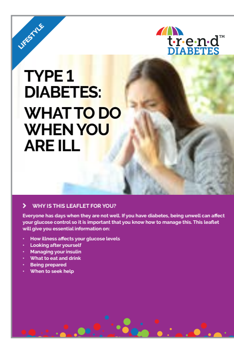


Travel

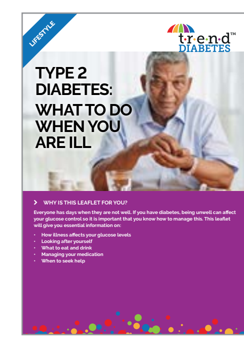


Treatment of hypoglycaemia

Driving regulations



Sick day rules (Type 1 diabetes)



Sick day rules (Type 2 diabetes)

Injection Technique Matters: Best Practice in Diabetes Care

Key things to remember for injectable medication

SUMMARY

The key to effective insulin management is:

- Knowing the insulins and their action profiles
- Having glucose profiles to inform decisions and,
- Understanding situations where treatment may need to be adjusted

Always consider:

- **Reviewing injection technique inc. palpating for lipohypertrophy**
- **Dietary intake & physical activity or illness before adjusting doses**
- **Never adjust insulin doses unless you have received training and are competent to do so. If in doubt seek specialist advice**

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