Leicestershire Diabetes Guidelines: Insulin Therapy

These guidelines are designed for use by those trained and competent in insulin initiation and management in patients with Type 1 and Type 2 diabetes

2013
This guidance has been developed in line with the National Institute for Health and Care Excellence (NICE) recommendations that:

“Trained healthcare professionals initiate and manage therapy with insulin within a structured programme that includes dose titration by the person with diabetes”

(Quality Standards in Diabetes 2011). The clinical guidance given is based on NICE Guidance (CG 66)

Specific therapies not as yet formally approved by NICE or not on the Leicestershire Medicines Formulary are included in the guidance for information only and this is indicated in the text.

The guidance is designed to enable HCPs to gain information on elements of insulin initiation and management on a single page to facilitate ease of access.

This work is based on the previous excellent guidelines developed by Heather Daly, Nurse Consultant and Professor Melanie Davies.

Many thanks to Shehnaz Jamal for developing the new format of the guidance and also to Professor Melanie Davies, Dr Rob Gregory, Dr Ian Lawrence, Helen Atkins, Judith Leonard, and the Senior Diabetes Specialist Dietitians for their expert clinical and practical advice.

June James - Nurse Consultant in Diabetes
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Background

There are 3 million people with diabetes in the United Kingdom

- 8% of these people will have Type 1 diabetes and these people will require insulin within 24 hours after diagnosis and continue it life long
- 50% of the remaining 92% with Type 2 diabetes will require additional insulin therapy within 6 years of diagnosis
Indications for Insulin Initiation and Management in Adults

Consider starting insulin in

<table>
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<th>People with Type 2 diabetes (T2DM)</th>
<th>People with Type 1 diabetes (T1DM)</th>
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<tr>
<td>• If there is failure to reach glycaemic targets using diet and non insulin therapies (NICE CG 66, 87)</td>
<td>• In Type 1 diabetes Insulin needs to be started within 24 hours of diagnosis</td>
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<tr>
<td>• If the individual is symptomatic e.g. rapid weight loss, polyuria, nocturia</td>
<td>• If the patient is severely ketotic and or vomiting, pregnant, or a child urgent referral / telephone contact to the specialist team or acute on call medical team is required</td>
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<td>• If the individual has Gestational Diabetes (these women need to be managed in specialist care) T: LRI 0116 258 6403 LGH 0116 258 4855</td>
<td>• T: LRI 0116 258 5545 or hospital switchboard (0300 3031573) and ask to speak to a diabetologist or paediatrician or acute on call medical team</td>
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<td>• In steroid induced diabetes (see “Insulin and steroid “ section (page 20)</td>
<td>• Out of hours may well be the on call medical team who deal with this</td>
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<td>• If the patient is post myocardial infarction</td>
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<tr>
<td>• If the individual is intolerant to non-insulin therapies</td>
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<tr>
<td>• If the individual has acute neuropathies such as femoral amyotrophy</td>
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Where and when to initiate insulin

• Insulin therapy can be initiated in the community or hospital setting but it needs to be initiated by an appropriately trained and competent health care professional (See appendix 1 for TREND-UK competency document)

• Insulin can be initiated in a group session or in a one to one consultation

• There should be protected time for initiation and follow up

• Appropriate equipment and educational material including information on where to seek advice and on going support should be available

• Different insulin regimens and delivery devices should be tailored to the individual’s clinical need and preferences

Allaying fears of starting insulin

To allay some of these fears in T2DM it is important to introduce the possible progression to insulin soon after diagnosis

• Healthcare professionals initiating insulin should be trained and competent (An integrated Career and Competency Framework and www.trend-uk.org TREND-UK)

• Discussion on the need to start insulin should be approached sensitively and should be tailored to an individual’s level of understanding and language

• The benefits and challenges of using insulin must be discussed with the individual

• The decision to start insulin must be done in agreement with the individual and / or their family or carer

• The choice of regimens should be made in accordance with the patient’s clinical needs and preferences

• Insulin initiation should be part of a structured care and education plan including appropriate follow up

• Individuals commencing insulin should have a dietary review

Barriers to starting insulin

These often centre on an individual’s prior understanding of the use of insulin and can include:

• Fear of injections

• Fear of hypoglycaemia

• Concerns about potential weight gain

• Concerns about the individual’s job (e.g. those who drive for a living, taxis, lorries or if the patient is a member of the armed forces)

• Cultural issues
Glucose Lowering Therapies - Algorithm for T2DM

**HbA1c > 48mmol/mol (6.5%) after trial of lifestyle interventions**

**Metformin (with dose titration)**

**HbA1c > 48mmol/mol (6.5%)**

**HbA1c < 58mmol/mol (7.5%) monitor for deterioration**

**Metformin + Sulphonylurea**

**HbA1c > 58mmol/mol (7.5%)**

**Consider substituting a DPP-4 inhibitor or SGLT-2 inhibitor or Thiazolidinedione (Pioglitazone) for the Sulphonylurea if there is a significant risk of hypoglycaemia (or its consequences) or a Sulphonylurea is contraindicated or not tolerated**

**Add Insulin particularly if the person is markedly hyperglycaemic**

**Insulin + Metformin + Sulphonylurea**

**HbA1c < 58mmol/mol (7.5%) Monitor for deterioration**

**Increase insulin dose and intensify regimen over time. Consider DPP-4 or SGLT-2 or Pioglitazone with insulin if blood glucose control is inadequate with high dose insulin (be aware of risk of bladder cancer and heart failure in patients on Pioglitazone).**

**Consider Sulphonylurea here if:**
- Not overweight (tailor the assessment of body weight associated risk according to ethnic group)
- If Metformin is not tolerated or is contraindicated
- A rapid therapeutic response is required because of hyperglycaemic symptoms (excess thirst/ frequent urination/ modest weight loss)

**HbA1c < 48mmol/mol (6.5%)**

**HbA1c < 48mmol/mol (6.5%) monitor for deterioration**

**Consider adding a DPP-4 inhibitor or SGLT-2 or Pioglitazone or if the patient is obese (BMI > 30) consider early use of a GLP-1 agonist**

**Glucagon-Like Peptide-1 receptor agonists (GLP-1 agonists)**
- Can be used in very obese patients and those intolerant of Metformin and Sulphonylureas
- Can be used in combination with a single oral agent
- Lixisenatide, Exenatide and Exenatide extended release can be used with basal insulins
- Insulin Lisemir can be used in addition to Liraglutide

**Sodium Glucose Co-Transporter 2 inhibitors (SGLT-2 inhibitors)**
These are a new class of oral drugs for the treatment of Type 2 Diabetes. They inhibit glucose re-absorption in the proximal renal tubules providing an insulin independent mechanism to lower blood glucose.

Please check [http://leicestershire.formulary.co.uk](http://leicestershire.formulary.co.uk) for preferred choices and traffic light status’
Use of Oral and Non - Insulin Therapies in Combination with Insulin

Often the treatment of people with Type 2 diabetes over time will result in individuals requiring a combination of non insulin therapies and insulin. Lifestyle changes and diet are a key factor in management throughout an individual’s treatment plan and individuals are usually commenced on Metformin as monotherapy from 6 weeks unless there is contraindication or there are other management or clinical issues. If glycaemic control is not optimised then various options are given for consideration with the introduction of insulin recommended usually as third line treatment unless the individual has osmotic symptoms. The algorithm shown on page 6 gives examples where combination therapy may be appropriate.

Factors influencing the choice of insulin regimen T2DM

The individuals lifestyle consider:

- Usual meal times
- Does the patient work shifts?
- Is travel involved in their daily work?
- Do they drive a taxi or hold an HGV license? (consider driving restrictions)
- Is the number of injections per day an issue?
- Are they at risk of hypoglycaemia?
- Will dexterity be a problem?
- Is weight an issue?
- Health beliefs and culture

Factors influencing the choice of insulin regimen T1DM

The individuals lifestyle consider:

- Usual meal times
- Does the patient work shifts?
- Is travel involved in their daily work?
- Do they drive a taxi or hold an HGV license? (consider driving restrictions)
- Is the number of injections per day an issue?
- Are they at risk of hypoglycaemia?
- Will dexterity be a problem?
- Is weight an issue?
- Health beliefs and culture
- In Type 1 patients a basal bolus regimen is usually commenced in the majority of individuals. This would however depend on the individual patients preference and convenience
- In the early weeks and months following the diagnosis of T1DM the amounts of insulin required are often very small (honeymoon phase)

Which insulin should be used initially for T2DM

Animal insulin is no longer used for insulin starts

Begin with human NPH insulin injected at bed-time or twice daily according to need such as Insuman Basal, Humulin I or Insulatard

Consider, as an alternative, using a long-acting insulin analogue such as Insulin Detemir, Insulin Glargine if:

- The person needs assistance from a carer or healthcare professional to inject insulin, and use of a long-acting insulin analogue (Insulin Detemir, Insulin Glargine) would reduce the frequency of injections from twice to once daily, or
- The person's lifestyle is restricted by recurrent symptomatic hypoglycaemic episodes, or
- The person would otherwise need twice-daily NPH insulin injections in combination with oral glucose-lowering drugs, or
- The person cannot use the device to inject NPH insulin

Consider twice daily pre - mixed (biphasic) human insulin (particularly if HbA1c ≥ 75 mmol/mol or 9%)

Consider pre-mixed preparations that include short-acting insulin analogues, rather than pre-mixed preparations that include short-acting human insulin preparations, if:

- A person prefers injecting insulin immediately before a meal, or
- Hypoglycaemia is a problem, or
- Blood glucose levels rise markedly after meals

Consider initiation of pre - mixed insulin if the A1c is high particularly above 75 mmol/mol or 9%

This would however depend on the individual patients preference and convenience.
Use of Oral and Non - Insulin Therapies in Combination with Insulin

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<th>Use with Insulin</th>
<th>Contraindications</th>
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| **Metformin**                  | Normal and overweight people with Type 2 diabetes can be continued on Metformin as there is evidence that this combination is insulin sparing and has other benefits including weight management glycaemic control and cardiovascular disease (CVD) | Do not use Metformin if the individual is:  
  • Intolerant of Metformin  
  • In heart failure  
  • Do not start if eGFR is less than 45 mls/min  
  • Discontinue if eGFR is < 30 mls/ min |
| **Sulphonylureas (SU)**        | Continue with regular dose reviews if the individual is on a daily isophane or analogue insulin. Otherwise the dose is usually halved or discontinued | Use with caution / do not use in vulnerable people that are at risk of hypoglycaemia, e.g. elderly, dementia, those with deteriorating renal function and those who live alone. |
| **DPP-4 Inhibitors (DPP-4Is)** | DPP-4Is licensed for use with insulin are: Sitagliptin (Januvia), Linagliptin (Tradjenta) and Saxagliptin (Onglyza). LMSG recommends Sitagliptin and Linagliptin as preferred choice. | DPP-4Is are contraindicated in women of child bearing age considering pregnancy* |
| **Acarbose**                   | Not recommended in combination with Insulin | Do not use if there is a history of heart failure / bladder cancer / bone fractures or if the patient has macroscopic haematuria.* |
| **Pioglitazone**               | Caution as there is a risk of fluid retention and weight gain | |
| **Glucagon-like peptide-1 receptor agonists. (GLP-1 Agonists)** | Requires careful monitoring particularly if GLP-1 agonists are commenced after insulin initiation, in these cases the insulin dosage is normally halved when the GLP-1 is commenced. Lixisenatide and Exenatide are short acting GLP-1s and affect post prandial blood glucose. Bydureon and Liraglutide are long acting and predominate affect fasting glucose. Lixisenatide is first line choice on the Leicestershire Medicines Formulary leicestershire.formulary.co.uk (Refer to manufacturers instructions for each individual product for use with insulin) | Do not use if there is a history of acute pancreatitis  
  • Use in CKD patients varies according to specific GLP-1. (e.g. Lixisenatide can be used in patients whose eGFR > 30 mls/min)  
  • Type 1 diabetes  
  • Severe gastrointestinal disease  
  • Pregnancy. |
| **Sodium glucose co-transporter 2 SGLT-2** | NICE has recommended that Dapagliflozin*, (Forxiga) can only be used as mono therapy or as part of combination therapy alongside Metformin or insulin. (Ref: NICE TA288) | Do not use if eGFR is less than 60mls/Min If used with insulin and an SU the dose of the SU should be lowered to reduce the risk of hypoglycaemia.* It is not recommended for use in combination with Pioglitazone or DPP-4s and GLP-1s see formulary: http://leicestershire.formulary.co.uk  
*Please review individual manufacturers guidance on use in pregnancy |

**Sodium glucose co-transporter 2 inhibitors (SGLT-2 inhibitors)**

These are a new class of oral drugs for the treatment of Type 2 diabetes. They inhibit glucose re-absorption in the proximal renal tubules providing an insulin independent mechanism to lower blood glucose.
Section 1: Introduction to Insulin

Background

There are over 20 different types of insulin; these fall into four main types:

- **Rapid acting**
- **Short acting**
- **Intermediate acting**
- **Long acting**

The right insulin regimen is required to address both basal, i.e. fasting and pre-prandial glucose levels and post-prandial (post meal) excursions.

**Rapid acting insulin analogues:**
Such as NovoRapid (Aspart) and Humalog (Lispro) and Apidra (Glulisine) have advantages in terms of convenience can be injected with food, or indeed, post prandial. They are better at controlling post prandial glucose with less need for snacks and have a lower risk of hypoglycaemia.

**Short acting non-analogue insulins:**
Addresses post-prandial glucose excursions, either used alone or in combination as a mixed insulin. The disadvantages are that some have to be injected 20 - 30 minutes before a meal. Patients may need to snack between meals and there is a risk of hypoglycaemia.

**Intermediate acting insulin:**
A traditional isophane, given twice daily such as Humulin I, Insuman Basal and Human Insulatard addresses basal hyperglycaemia. Intermediate-acting insulin has a longer life span than rapid or short-acting insulin but is slower to reach a peak. Cloudy insulin always contains some intermediate acting insulin.

**Long acting insulin analogues:**
Insulin Glargine (Lantus), Insulin Detemir (Levemir) and Insulin Degludec (Tresiba) have the advantage of greater predictability, potentially less weight gain, and lower risk of hypoglycaemia, particularly at night compared to intermediate acting insulin. They can be given as a basal insulin or in a Basal Bolus regimen.

**Mixed insulins:**
Such as NovoMix 30, Insuman Comb 15 and Humalog Mix 25 will contain a proportion of rapid or short acting and intermediate acting insulin Mixed Insulin contain a mixture of isophane which is intermediate acting insulin and short or rapid acting insulin the number given. (e.g. NovoMix 30 indicates the proportion of short or rapid insulin include in the preparation.)

**Targets of therapy T2DM**

Agree individual glycaemic targets with the patient and where possible in line with NICE guidance. NICE recommends:

- An HbA1c value of 48 mmol/mol (6.5%) in patients with newly diagnosed and on up to two different classes of glucose lowering therapy
- In patients on more than two glucose lowering medications the target HbA1c is 58 mmol/mol (7.5%)
- Aim for a pre-breakfast or fasting glucose level of <5.5mmol/l and pre-prandial levels at other times of the day at <6mmol/l
- Aim for post-prandial (i.e. 2 hours after a main meal) <8mmol/l but this will depend on the individual, (e.g. in the elderly or end of life care these targets may not be appropriate).

**Titrating doses - key principles**

- Review trends in capillary blood glucose (CBG) readings rather than individual / random results. Using the monitoring diary or electronic meter memory to establish if patterns exist at different times of the day
- Consider any comments discussed or recorded in the monitoring diary. Are they related to the CBG readings (e.g. eating patterns, changes in activity)
- View the blood glucose results in relation to the type of insulin and timing of injections
- Is the problem dose related or does it indicate that the regimen is not meeting that person’s needs?
- Generally, increases are made in 10% increments
- Prevention of hypoglycaemia takes precedence and generally where no other cause can be found a 20% reduction in insulin dose is required with careful monitoring
- Deterioration in renal function may lead to a risk of hypoglycaemia in insulin users so doses need regular monitoring and titration
- Look for other presenting factors (i.e. renal function, adrenal function, thyroid or significant change in lifestyle or diet).
Actions of Insulin

Metformin can be continued in combination with all insulin regimens, as outlined here, in patients with Type 2 diabetes:

**Rapid-acting Insulin Action e.g. NovoRapid, Humalog, Apidra**

Rapid-acting insulin begins working very quickly inside the body, usually within 5 - 15 minutes. This type of insulin should be taken just before eating. It peaks between 30 and 90 minutes and its duration is typically between 3 and 5 hours. As the activity of rapid-acting insulin starts and finishes so quickly, it is recommended to be taken with food or straight after eating, therefore it is less likely to lead to hypoglycaemia compared with other insulin preparations.

! Be aware doses may need reducing 1 hour before planned exercise and subsequent doses within a 24hr period.

**Short-acting Insulin Action e.g. Soluble Human Insulin: Actrapid, Humulin S, Insuman Rapid**

Short-acting insulin begins working in the body between 30 and 60 minutes after injection. Typically, short-acting insulin peaks between 2 and 4 hours, and its duration is typically 6 - 8 hours. As a result of its relatively short lifespan, short-acting insulin may need be injected several times during the day.

! Can put patients at risk of hypos late in the morning or early hours of the night (2am) depending on the timing of the dose.

**Intermediate-acting insulin Action e.g. Humulin I, Human Insulatard, Insuman Basal**

This type of insulin is cloudy and has a longer lifespan than short-acting insulin but it is slower to start working. Intermediate-acting insulin is usually starts working within 2 - 4 hours after injection, peaks somewhere between 4 and 8 hours and remains working for approximately 16 hours. Occasionally this insulin is given twice daily.

! Re-suspension of intermediate acting insulin is critical. If this is not done glycaemic control can be erratic.

**Long-acting Insulin Action e.g. Glargine (Lantus), Detemir (Levemir), Insulin Degludec (Tresiba)**

This type of insulin starts working within 2 hours and provides a continuous level of insulin activity for up to 24 - 36 hours depending on the specific preparation - please refer to the manufacturers guidance for individual products. Insulin Degludec (Tresiba) can last for up to 42 hours.
Example of Insulin Regimens

**Insulin Regimen: Basal Bolus e.g. Intermediate and short acting**

- Twice daily basal bolus
- Basal bolus using B.D. insophane and prandial insulin - 4 injections per day
  - 3 analogue rapid / short + 1 non-analogue intermediate acting insulin

**Insulin Regimen: Twice daily pre - mixed insulin**

This includes conventional mixtures of short-acting and isophane insulin, e.g. Insuman Comb 15, Comb 25, Comb 50 and Humulin M3. The most commonly used ratio is 30 / 70. Insulin analogue mixtures are available with a percentage of short-acting insulin of 25%, 30% and 50%. Short-acting insulin analogue mixtures such as Novomix 30, HumalogMix 25 and Humalog Mix 50, are now available.

These analogue preparations may have particular advantages in terms of patient convenience (no need to wait before eating) and control of post-meal glucose.

If an individual has a higher HbA1c, head to head studies have shown greater efficacy if pre - mixed regimens are used and particularly evident in those with a less high BMI

**Pre-mixed Analogues e.g. NovoMix 30, Humalog Mix 25, Humalog Mix 50**

**Pre-mixed Human insulin e.g. Humulin M3, Insuman Comb 15, Comb 25, Comb 50**

The peak of action varies with individual products
Different Insulin Formulation and Concentration

U100 strength insulin is the preparation most commonly used in the UK, this delivers 100 units of insulin in 1ml. However a low volume concentration is now available. (See Leicestershire Medicines Formulary http://leicestershire.formulary.co.uk)

**Insulin Degludec (Tresiba)**

A U200 strength long acting analogue insulin, **Insulin Degludec (Tresiba)** is now available. This delivers the correct amount of insulin in units but in half the volume.

- The U200 insulin preparation is available in an insulin Flex Touch pen only. This device can be used to dial up to 160 units.
- Insulin Degludec (Tresiba) is also available in the traditional U100 strength insulin for people on smaller doses (up to 80 units) and is available in a cartridge or a Flex Touch pen device. Be aware the packaging is similar!

The National Patient Safety Agency (NPSA) advise to always write the word ‘strength’ in when prescribing U200 insulin (e.g. U200 strength Insulin Degludec).

- If patients dial up this insulin by “counting the clicks” they should be advised that each click accounts for 2 units of insulin

* Please note this preparation has been sanctioned by NICE and can be found on the Leicestershire Medicines Formulary (http://leicestershire.formulary.co.uk)

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**U 500 insulin**

U500 strength insulin e.g. Humulin R is sometimes used in people who are insulin resistant and require the equivalent or more than 300 units of U100 strength insulin per day.

This product is not licensed in the UK but is still sometimes prescribed. It:

- Is soluble
- Is five times (5x) more concentrated than U100 insulin
- Is normally injected three times a day
- Must be prescribed by a Diabetes Specialist on an named patient basis
- An independent nurse or pharmacist prescriber or Diabetes Specialist Nurse, can adjust the dosage (local guidance only)
- Can be used in an insulin pump

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**Warning !**

Insulin should NEVER be drawn up from an insulin cartridge or pre-filled pen using a syringe as the dose given would not be accurate.

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Always check that the correct strength of Degludec (Tresiba) is prescribed
Section 2: Potential Insulin Regimens for Type 2 Diabetes:

Basal insulin with Oral Hypoglycaemic agents

1. Insulin regimen: Once-daily basal insulin in combination with oral hypoglycaemic agent

Either long-acting insulin analogue, Insulin Glargine (Lantus), Insulin Detemir (Levemir) or Insulin Degludec (Tresiba) or isophane insulin (Humulin I, Insulatard, Insuman Basal) with continued oral hypoglycaemic agents.

- Once-daily basal insulin in combination with oral hypoglycaemic agent to include either a Sulphonylurea or a prandial glucose regulator with Metformin if tolerated.
- Evidence suggests that conventional isophane insulin when used in this regimen is best administered either in the evening or before bed.
- Basal insulin analogues including Insulin Glargine, Insulin Detemir or Degludec have been suggested for use once a day in combination with oral agents as they have particular advantages in terms of nocturnal hypoglycaemia.
- Once a day insulin analogues are designed to work throughout a 24 hour period with a ‘peakless’ action. The length of action varies with each of these, refer to manufacturers guidelines.
- Pre - breakfast (fasting) blood glucose readings are a good indicator of their effectiveness, but remember that some individuals may require a BD dose of a long acting analogue, e.g. BD dosing more likely with Detemir. 30% of patients in the 4T study required a second dose of insulin Detemir. (Ref: Holman R et al 2009, NEJM 361:1736-1747)
- The ‘peakless’ insulins are not effective in lowering meal-time (prandial) rises in blood glucose. If this cannot be adequately controlled with long-acting insulin and oral hypoglycaemic agents, short acting insulin will need to be added.
- Basal insulin analogues should not be mixed in syringes with other insulins.
- Should ideally be injected at approximately the same time every day.
- Your choice of oral hypoglycaemic agent, particularly the insulin secretagogue (SU), may be important if choosing this regimen. Always continue Metformin in the normal and overweight patients at the current dose unless contra-indicated or not tolerated. Always check for symptoms of Metformin intolerance in patients. Pioglitazone can be continued when commencing basal insulin.
- Continue previous Sulphonylurea at unchanged dose. For ease of therapy one may wish to consider a change to once-daily Glimepiride titrated up to a dose of 4 - 6 mg or Gliclazide MR. This is a good choice if ease of administration is an issue. If weight or hypoglycaemia is an issue consider an SGLT-2 or DPP-4 with basal insulin.
- The insulin cannot be drawn up and left for injection later. (RCN)

Advantages

- The 4T study indicates that in patients with Type 2 diabetes and a baseline HbA1c < 8.5% a once daily basal insulin regimen is effective and safe with a lower risk of hypoglycaemia and weight gain.
- It is simple and easy for early facilitation to insulin
- Potentially less weight gain
- Potential for less risk of hypoglycaemia
- Relatively easy regimen for healthcare professionals to support
- Useful for symptom relief if tight control is not a major issue

Disadvantages

- Individuals may not achieve optimal control and may require a BD dose
- The regimen may not offer optimum control of post-meal (post-prandial hyperglycaemia)
- Some individuals may require a more intensified insulin regimen
**Once-daily basal insulin in combination with oral hypoglycaemic agent**

### Simple approach to initiation of Insulin therapy

- Use 10 units once daily usually given at bedtime (9 - 10pm) or with evening meal for isophane
- You may need to consider a higher dose in people with insulin resistant Type 2 diabetes depending on their weight
- Most individuals will ultimately require between 0.5 - 0.7 units of insulin per kilogram of weight, so in an individual weighing 100kg a daily dose of 50 - 70 units may be required
- Long-acting analogues may be given morning or evening at a time suitable for the patient, but it ideally should be consistent from day to day
- There is some debate regarding the use of analogue versus non analogue insulin. Data suggests that analogues are more effective at lowering plasma glucose and have a lower rate of nocturnal hypoglycaemia compared with non analogue insulin
- Consideration should be given to transfer to an analogue insulin if the individual is experiencing hypoglycaemia
- Group starts for introducing insulin therapy are a cost effective way of using resources also individuals may benefit from group interaction and receive consistent training in dose titration

### Titration of doses

**Basal Insulin Regimen**

- Aim for fasting plasma glucose level 5.5mmol/l - 6.0mmol/l, increase insulin Glargine or Insulin Detemir dose 2 units every 3 days until agreed targets are reached and there is no nocturnal hypoglycaemia
- Although basal analogues are designed to work throughout a 24 hour period, this may vary between 16 - 42 hours
- If the insulin is taken in the morning consider that raised fasting glucose levels may be due to inappropriate diet and or the insulin running out rather than inadequate dosage

NB raised fasting glucose levels may also be due to nocturnal hypoglycaemia!

**Remember:**

- Use three consecutive self-monitored fasting glucose levels (before breakfast) to adjust doses
- Wait 3 - 4 days between dose adjustments
- Reduce the dose if fasting glucose falls below 4 or an unexplained hypoglycaemic episode was experienced. The amount of decrease needs to be at least 2 - 4 units or 20%, whichever is greater
- You may need to advise blood glucose testing during the night if you suspect nocturnal hypoglycaemia (3am)

### Indication for change of regimen

- Fasting glucose levels are at target but if post-prandial glucose levels remain high despite maximum tolerated oral agents, it may be appropriate to stop these and change to a formal basal bolus regimen. (See relevant guidances)
- Control remains suboptimal
- Recurrent unresolved hypoglycaemia
- Patient’s preference or need for greater flexibility with regard to lifestyle (e.g. exercise, employment)

### Choice of oral hypoglycaemic agent

Your choice of oral hypoglycaemic agent, particularly the insulin secretagogue (SU), may be important if choosing this regimen.

- Always continue Metformin in the normal and overweight patients at the current dose unless contra-indicated or not tolerated
- Always check for symptoms of Metformin intolerance in patients
- Continue previous Sulphonylurea at unchanged dose unless you are giving a pre-mixed regimen or prandial insulin then discontinue the Sulphonylurea. Or consider DPP-4 or SGLT-2 in combination with insulin if weight or ‘hypo’ is an issue

### “Basal plus” regimens

A basal plus regimen is sometimes required in individuals to improve glycaemic control – this would comprise of a once daily intermediate/long acting insulin with a prandial dose of fast acting insulin given with either the main meal or the meal that produces the greatest post prandial glucose excursion. The starting dose of the prandial insulin is usually 10% of the total daily dose of the basal insulin and is limited to a dose of between 4 and 6 units
Twice daily pre-mixed insulin

2. Twice daily pre-mixed insulin

Either conventional short-acting and isophane insulin (e.g. Insuman Comb 15, Comb 25, Comb 50, Humulin M3) or analogue mixed insulin, (e.g. NovoMix 30, Humalog Mix 25 or Humalog Mix 50).

The advent of short-acting insulin analogue mixtures means that this regimen is now available as fast acting in the analogue insulins, either as: NovoMix 30 with 30% short-acting insulin analogue or Humalog Mix 25 (25% short acting insulin analogue), or Humalog Mix 50 (50% short acting insulin analogue).

The particular choice of which pre-mixed insulin is used may be influenced by:

- Choice of insulin injection device
- Perceived convenience for individuals
- Potential for weight gain and risk of hypoglycaemia

**Advantages**

- This regimen is relatively easy to teach and simple for the patient to understand
- It has potential for better post-prandial glucose control
- Is more effective in lowering HbA1c than basal insulin alone
- Particularly if the patient has a higher HbA1c (>9%), as most head-to-head studies have shown greater efficacy if pre-mixed and particularly in those patients with not such a high BMI

**Disadvantages**

- There is less flexibility (i.e. unable to adjust the short or basal component of insulin independently)
- Patients may not achieve optimal glycaemic control
- Time delay of injection with conventional mixture (need to inject 20-30 minutes before a meal)
- The need for snacks between meals (with the new analogue mixture the delay in injection time is not required and the need for snacks may be reduced)
- Titration may get complicated and difficult to teach
- Increased risk of hypoglycaemia and weight gain (Early data from the 4T study - Ref: Holman R et al 2009, NEJM 361:1736-1747)

**Simple approach Initiation of insulin therapy in Type 2 diabetes**

Before breakfast and before evening meal:

- Use 10 units BD. Consider a lower starting dose in some circumstances, (e.g. frail, elderly or ‘slim’ patients)
Indication for change of Regimen

If glycaemic targets are not reached after titration, change may be required. For example:

- If control remains suboptimal (HbA1c targets or fasting blood glucose or both)
- Hypoglycaemia (particularly during the night)
- Excessive weight gain despite continued Metformin
- Patients’ preference or lack of flexibility with the regimen for patients to undertake lifestyle (e.g. erratic job or exercise)
- If before the evening meal dose blood glucose remains high but further titration causes mid-morning hypoglycaemia.

There are several options:

1. Continue premixed insulin and add in rapid / short acting insulin at lunchtime if high blood glucose before evening meal.
2. Stick to pre-mix twice a day but change the proportions of insulin (e.g. Humalog Mix 50).
3. Offer the patient free mixing of insulin. However, the disadvantage of this is that it is complicated to explain and teach to patients, accuracy is an issue, and the patients would need to move away from a pen device back to a needle and syringe.
4. Basal Plus
5. Once you add prandial insulin whether in pre-mix or as once daily prandial, you should discontinue the Sulphonylurea. You should make sure that the basal insulin has been adequately titrated.

With the basal plus you tend to add the first injection of prandial insulin to the largest meal or the meal that produces the greater post prandial glucose excursion and the starting dose is 10% of the total daily dose of basal insulin limited to a minimum of 4 and a maximum of 6 units.

Titration of doses

- Morning dose of insulin titrated against pre-lunch and pre-evening meal blood glucose tests: suggest 2 unit increments or 10% increase with a target glucose of < 6mmol/l before lunch and before evening meal.
- Evening dose titrated against pre-bed and pre-breakfast test. Titrate by 2 unit increments or 10% increments to try to achieve a before breakfast blood glucose of 5.5mmol/l - 6mmol/l. Beware of before bed tests of < 6mmol/l: aim for a before bed test between 6mmol/l and 8mmol/l.
- Watch carefully for the risk of nocturnal hypoglycaemia.
- In patients with Type 2 diabetes and BMI >19, Metformin therapy should be continued at the maximum tolerated dose, as long as there is no contra-indication, (e.g. eGFR <30ml/min, unstable heart failure). (It is important to check that the person has no symptoms of intolerance of Metformin therapy).

Alternative approaches to insulin initiation for advanced practitioners

The approach to insulin therapy is continuously changing. Recent evidence suggesting a more proactive and calculated dose and titration may be appropriate for those experienced in insulin management. To adopt this approach see the Leicestershire Diabetes website for education / training details e.g. the EDEN project. www.leicestershirediabetes.org.uk

An accredited Masters level training module on insulin initiation and management is available. See www.leicestershirediabetes.org.uk for details.
Basal Bolus Regimen

3. Basal Bolus Regimen

- At least four injections of insulin per day
- Short-acting non-analogue or a rapid-acting analogue before each meal (either once or twice daily isophane or long acting insulin analogues, e.g. Glargine, Detemir or Tresiba)
- Often used in people with Type 1 diabetes
- Rarely a first choice in patients with Type 2 diabetes
- Useful for patients who require flexibility on a daily basis, with irregular lifestyles, varied mealtimes or irregular eating patterns or shift work

Advantages

- Offers optimum flexibility in terms of diet and activity
- Reduces the risk of hypoglycaemia
- Potential for better metabolic control if used optimally
- Closely mimics normal insulin physiology
- Potential for the best control of basal and postprandial hyperglycaemia
- Potential for better weight management and lifestyle choice

Disadvantages

- Requires multiple insulin injections
- More complicated to support and teach
- Requires more regular glucose testing

Simple approach to transfer to basal bolus insulin therapy

- If already taking once or twice daily basal insulin - continue this and simply add quick acting insulin or quick acting analogue before each main meal
- If taking premixed insulin, calculate how the present dose of pre-mixed insulin is divided into short and long acting, and use this to influence decision.
- Or change to: See next page for options

An example of someone in whom this may be useful is an active, motivated person with an erratic lifestyle to improve glycaemic control.
**Change to: Option 1**

**Basal bolus regimen with basal analogue (Glargine, Detemir, Tresiba)**

- Add up the total daily dose of the existing pre-mixed insulin regimen and then common practice is to reduce this dose by 20%
- In some circumstances it may not be appropriate to take off 20%, (e.g. very poor glycaemic control or symptomatic of high blood glucose)
- Give 50% of the total daily dose as a basal insulin
- Divide remainder to cover meals with a rapid acting insulin dependant on their eating habits

**Example:**
Insuman Comb 25 or Humulin M3 50 units am, 50 units pm.
Total daily dose = 100 units - 20% = 80 units.
Give 40 units as basal insulin remainder given as 12 - 14 units of quick acting insulin with each meal dependant on eating habits.

---

**Change to: Option 2**

**Basal bolus regimen with twice daily intermediate insulin (Humulin I, Insuman basal, Insulatard)**

- Add total daily dose of premixed insulin. Usually take off 20%
- In some circumstances it may not be appropriate to take off 20%, (e.g. very poor glycaemic control or symptomatic of high blood glucose).
- Give 50% as basal insulin divided into two equal doses
- Divide remainder to cover meals with quick acting insulin dependant on their eating habits

**Example:**
Insuman Basal or Humulin I: 50 units am, 50 units pm.
Total daily dose = 100 units - 20% = 80 units.
50% of dose divided into two injections of intermediate insulin. 20 units am and 20 units pm.
Remainder given as quick acting insulin with 12 - 14 units each meal dependant on eating habits.

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**Titration of doses**

- Adjust the basal insulin (long acting) to achieve satisfactory pre-breakfast blood glucose levels, waiting 3 - 4 days between adjustments
- Although basal analogues are designed to work throughout a 24 hour period, this may vary between 18 - 24 hours
- If the insulin is taken in the morning consider that raised fasting glucose levels may be due to inappropriate diet and or the insulin running out rather than inadequate dosage
- Also need to rule out nocturnal hypoglycaemia which can manifest as raised fasting glucose levels
- Offer dietary advice on role of carbohydrates portion size, timing of meals and snacks
- Reduce the dose if blood glucose is too low during the night or pre-breakfast blood glucose result is ≤ 5mmol/l on more than one occasion or < 4.5mmol/l on one occasion.
- Adjust the short / rapid acting insulin to achieve satisfactory blood glucose levels 2 hours after the meal or before the next meal

---

**Indication for change of regimen**

- Difficulty in giving multiple injections
- More regimented lifestyle, where patient does not require the flexibility
- If post prandial blood glucose readings are raised consider using a basal plus regimen (See page 14)
Section 3: Lifestyle Factors

Hypoglycaemia

Hypoglycaemia “Hypo” is the most common side effect of insulin treatment and impacts on an individual’s well being, quality of life and lifestyle. (See page 21 & 22, for specific advice on hypoglycaemia, prevention treatment and hypos and driving).

Driving

Patients do not have to give up driving but do need to plan in advance before getting behind the wheel.

- **The Law:** Insulin users must inform the DVLA when commenced on insulin - ensure the patient knows it is their responsibility (www.dft.gov.uk/dvla)
- Insurance- For your car insurance to be valid, you MUST inform your insurance company as soon as you are diagnosed with diabetes. If your insurance company asks about diabetes you must tell them that you have it.
- Blood glucose levels should always be more than 6 mmol/l (local guidance) the DVLA recommend 5 mmol/l, always test before driving due to risk of hypos
- Advise patient to carry easily accessible glucose treatments in the car (e.g. Lucozade, glucose tablets)
- **By Law** individuals must inform the DVLA if they have had more than one episode of disabling hypoglycaemia (requiring the assistance of another person) and be advised not to drive
- Give ‘Safe Driving and DVLA’ leaflet (www.leicestershirediabetes.org.uk)

Monitoring

- Self Blood Glucose Monitoring (SBGM) is recommended in people on insulin therapy
- Those unable to perform SBGM may require more frequent HbA1c testing (See monitoring glycaemic control guidelines)
- All people with Type 1 diabetes should be issued with ketostix

Weight Management

Generally people gain weight on insulin treatment mainly due to improved glycaemic control. Consider:

- Early discussion of the likelihood of weight gain
- Discussion of weight management strategies
- Referral to weight management clinic
- If there is unexplained weight loss or gain, consider referral to dietitian / specialist dietitian

Employment

- Diabetes is covered by the Disability Discrimination act 1995
- Certain occupations are limited for those on insulin, e.g. Emergency services, Armed forces
- Shift patterns and activity levels will need to be considered
- Further information is available from Diabetes UK Careline 0845 120 2960

Alcohol

- Government guidelines on alcohol intake are the same for people on insulin as they are for those not on insulin
- Alcoholic beverages have different effects on blood glucose levels
- The risk of delayed hypoglycaemia needs to be discussed with the patient
Where alcohol intake exceeds recommended levels, people need appropriate advice to minimise risks.

Exercise

Physical activity is a key element in the prevention and management of Type 2 diabetes.

- Regular physical activity improves blood glucose control and can positively affect lipids, blood pressure, cardiovascular events, mortality, and quality of life
- All types of activity including regular walks or gym workouts will have an effect on glycaemic control
- If the individual takes strenuous exercise and is insulin treated, the dose of insulin may need to be reduced over the next 24 hour period
- Exercise should be undertaken regularly to have continued benefits. Most people with Type 2 diabetes can perform Exercise safely (Practical Diabetes September 2013, Volume 30, Issue 7 - http://onlinelibrary.wiley.com/doi/10.1002/pdi.v30.7/issuetoc)

See Exercise and Sports section on: www.leicestershirediabetes.org.uk/611.html
Lifestyle Factors

**Travel**

Insulin use does not restrict travel opportunities, but planning is required

- Consider destination, climate, illness, time changes and zones, inactivity, mode of travel, availability and storage of supplies. (See page 33)
- Carry adequate identification. A supporting letter from a healthcare professional on headed paper may be necessary

**Healthy eating**

Attention should be paid to the role of carbohydrate and insulin action on blood glucose levels.

- Additional snacks are not automatically required and should be tailored to the individuals needs
- Care must be taken to ensure that advice given about changing eating habits is not detrimental to the individuals weight management goals
- Consider referring to the diabetes specialist dietitians

Some healthcare professional find it useful to compile a checklist to document advice given when initiating and managing insulin. An example of one can be found on the Leicestershire website: [www.leicestershirediabetes.org.uk](http://www.leicestershirediabetes.org.uk)

**Special occasions and cultural issues**

- Patients may need additional advice to manage these situations, especially around feasting and fasting
- Ramadan advice should be given 2 months before - if the patient says they feel hypo at anytime during the fast, they should break the fast. Test blood glucose levels every 4 hours (Ref: Looking after diabetes during Ramadan: A guide for patients [www.leicestershirediabetes.org.uk](http://www.leicestershirediabetes.org.uk))
- Cultural awareness and sensitivity are essential
- Participation in events does not have to be restricted

Further information is available from:

- [www.leicestershirediabetes.org.uk](http://www.leicestershirediabetes.org.uk)
- Diabetes UK website - [www.diabetes.org.uk](http://www.diabetes.org.uk)
- Servier - 0753 662744

**Insulin and steroid use**

Steroid therapy is sometimes used in people with other long-term conditions such as COPD and is frequently used in palliative care for symptom control.

- The impact of steroids is to increase blood glucose, which can cause additional hyperglycaemic symptoms
- Once-daily steroid therapy taken in the morning tends to cause a late afternoon or early evening rise in glucose levels which can be managed by isophane insulin (e.g. Human Insulatard, Humulin I or Insuman Basal).

(Please see algorithm Appendix 3 for managing patients on once daily steroid in end of life care)
Hypoglycaemia “Hypos”

Patients who are injecting insulin may be at risk of hypos.

**A hypo is when blood glucose levels drop to below 4mmol/L**

Some but not all patients will experience symptoms such as sweating, palor, trembling and headaches but people with a long duration of diabetes may not have any symptoms of hypoglycaemia. If early signs of hypoglycaemia are missed the symptoms may worsen and the individual may lose cognitive function.

**Identifying those at risk**

These include all insulin, Sulphonylurea (e.g. Gliclazide, Glipizide, Glimepiride) and prandial regulator users (Nataglinide, Repaglinide) Other non - insulin therapies when added to a Sulphonylurea and / or insulin can increase the risk of hypoglycaemia

Patients who are at particularly high risk include those who also have one or more of the following:

- Poor appetite / erratic eating pattern
- Weight loss
- Renal deterioration
- Liver impairment / carcinoma
- Dementia
- The elderly

They may look pale, become confused, have behaviour change, become very drowsy, and lose consciousness. Sweating, fits, and skin colour change in a drowsy or unconscious person may be due to hypoglycaemia.

**Causes of Hypo**

A number of situations can cause a hypo, people particularly at risk include those with:

- Impaired renal function
- Too much insulin
- Specific glucose lowering therapies including SU, whether used alone or in combination with other diabetes treatments
- Delayed or missed meals or fasting
- Eating less starchy foods than usual
- Unplanned or strenuous activity
- Drinking too much alcohol or drinking alcohol without food

Sometimes there is no obvious cause, but treatment should always be carried out immediately, as advised.

**Symptoms Hypos**

Some individuals, particularly those with long duration diabetes and / or persistent hypoglycaemia may not experience any symptoms. Early signs and symptoms of a hypo include:

- Sweating heavily
- Feeling anxious
- Trembling and shaking
- Tingling of the lips
- Hunger
- Going pale
- Palpitations

Symptoms may vary from person to person, particularly in the older patient, symptoms include:

- Slurring of words
- Behaving oddly
- Being unusually aggressive or tearful
- Having difficulty in concentrating

**If the hypo is not treated at this stage, the person may become unconsciousness**

**Hypos during End of Life**

Hypoglycaemia can be troublesome for individuals at any time and particularly during end of life care. Every effort should be made to avoid this side effect. (See Appendix 2 for glycaemic control during end of life care)

Factors that should be considered at this time are:

- Do not aim for tight control in these individuals, blood glucose reading between 6 - 15mmol/l are acceptable
- Aim for symptomatic relief
- Tailor insulin therapy to clinical needs
- Rationalisation of glucose-lowering treatment for diabetes
- Involve an experienced community dietitian
- Early identification of risk factors for hypoglycaemia
- Treat pain effectively
- Assess impact of weight loss
- Assess influence of nutritional deficits
- Assess influence of opiates / other pain killers on appetite
- Consider community DSN support if appropriate

Do not assume if the patient is comatose that it is due to the end of life primary condition.
‘Hypos’ and driving

Complications with diabetes can affect ability to drive as well as risk of hypos and accidents. See previous section on driving (page 19)

- Blood glucose levels should always be more than 6 mmol/l (local guidance), the DVLA recommend at least 5 mmol/l always test before driving due to risk of hypos whilst driving
- Plan for long journeys and take regular breaks and test 2 hourly
- Patient Advice: If you a have a hypo whilst driving
  1. Stop car as soon as possible
  2. Remove keys
  3. Move to the passenger seat if safe
  4. Treat the hypo
- Give patient “Safe Driving and DVLA leaflet”
- Advise patient to carry easily accessible glucose treatments in the car
- Advise patients not to drive for at least 45 minutes following a hypo

Informing the DVLA

- **By Law** Group 1 driver (car/motorcycle) who has had two or more episodes of hypoglycaemia requiring assistance from another person at any time (including when sleeping) in a year, must inform the DVLA, and be advised not to drive. In these cases the Licence will be withdrawn for 1 year following the first episode.
- **By Law** Group 2 driver (bus/lorry) with one or more episode(s) of hypoglycaemia requiring the assistance of another person in the previous 12 months must inform the DVLA and be advised not to drive. They must also tell the DVLA if they or their medical team feels you are at high risk of developing hypoglycaemia. [www.dvla.gov.uk/dvla](http://www.dvla.gov.uk/dvla)

What are a doctor’s responsibilities?

When any doctor is aware that a patient is not fit to drive, they should advise the person not to drive and to notify the DVLA. If a doctor becomes aware that someone in their care does not notify the DVLA, or refuses to do so, the doctor is allowed under General Medical Council guidelines to notify the DVLA. It would be good practice to confirm this conversation in writing to the person concerned so that there is no doubt about the advice. This should be documented in the notes. The doctor may also want to inform the patient that their insurance is no longer valid. It is up to the DVLA to revoke/renew a licence. If the doctor has concerns but are not sure if the person is fit to drive, they should advise the individual to notify the DVLA and document this in the notes.
Treating Hypoglycaemia

Is patient conscious and able to swallow?

Yes

Give one of the following:

• 150 ml of non-diet cola (small can)
• 200 ml of pure smooth orange juice (small carton)
• 100 ml of Lucozade Original
• 4 glucotabs
• 5 to 6 dextrose tablets

If after 5 minutes, the blood glucose level is still less than 4 mmol/l, repeat the treatment.

Once the blood glucose is above 4 mmol/l, give a starchy snack like a banana or glass of milk or 2 biscuits unless a meal will be eaten in the next 1 to 2 hours.

No

Patients on PEG feeds:

You should stop the feed and insert one of the following:

• 30ml undiluted Ribena
• 150 ml non-diet cola
• 100 ml Lucozade Original into the feeding tube.

Repeat this procedure every 5 minutes until the blood glucose is above 4 mmol/l.

Is patient conscious and not able to swallow?

Yes

If unconscious:

Put the patient in the recovery position and maintain airway - do not put glucose in the mouth. Give 1mg glucagon intra-muscularly if available and carer trained.

If glucagon is not available or is ineffective, and IV access is available, give 75-80ml of 20% glucose (over 10-15 minutes). If not available, call paramedics.

Note: glucagon may not be effective in people with liver disease

No

After an episode of hypoglycaemia:

Review management plan with patient and relatives to clarify/confirm goals of diabetes management

If conscious (usually after about 10 minutes), give one of the following:

• 150ml non-diet cola
• 100ml Lucozade

Follow with a starchy snack such as a banana or 2 slices of bread.
Section 4: Managing Insulin During Illness in Type 1 and Type 2 Diabetes

Advice given to people with Type 2 diabetes for managing Insulin doses during illness

- **Person with diabetes treated with Insulin**
  - **Feeling unwell?**
    - **Type 2 diabetes**
      - Test blood glucose
        - **Blood glucose less than 4 mmol/L** treat as hypo
          - Take your insulin as normal
            - Take carbohydrates as meal replacement and sip sugar-free liquids (at least 100ml/hour) if you are able. You need food, insulin and fluids to avoid dehydration and serious complications
          - **Blood glucose between 4 - 11 mmol/L**
            - Take carbohydrates as meal replacement and sip sugar-free liquids (at least 100ml/hour) if you are able.
            - You need food, insulin and fluids to avoid dehydration and serious complications
          - **Blood glucose more than 11 mmol/L**
            - Take your prescribed insulin as above

- **Blood glucose**
  - **11-17 mmol/L** Add 2 extra units to each dose
  - **17- 22 mmol/L** Add 4 extra units to each dose
  - **More than 22 mmol/L** Add 6 extra units to each dose

*Take your prescribed insulin as above

- **Blood glucose between 4 - 11 mmol/L**
  - **Test blood glucose every 4-6 hours**
  - **Blood glucose more than 11 mmol/L**
    - **Blood glucose less than 11 mmol/L**
      - **Blood glucose less than 4 mmol/L treat as hypo**
        - As your illness resolves, adjust your insulin dose back to normal

version 3 30/11/2013 S.J

Adapted from Trend- UK, MSD
Advice given to people with Type 1 diabetes for managing Insulin doses during illness

- **Feeling unwell?**
  - **Type 1 diabetes**
    - Test blood glucose and ketones
      - Blood glucose more than 11 mmol/L and either no ketones or trace urine ketones (less than 1.5 mmol/L on blood ketone meter)
        - Take carbohydrates as meal replacement and sip sugar-free liquids (at least 100ml/hour) if you are able
      - Blood glucose more than 11 mmol/L and ketones present (more than 1.5 mmol/L on blood ketone meter or +/++ on urine ketones)
        - Take your insulin as normal
        - Take carbohydrates as meal replacement and sip sugar-free liquids (at least 100ml/hour) if you are able
      - Blood glucose less than 11 mmol/L and no ketones
        - Take your prescribed insulin as above
        - Once you have given the initial increased dose contact your GP or Diabetes Specialist Nurse for advice if you still feel unsure about adjusting your insulin doses. If you are taking more than 50 units in total daily, you should double the adjustments. All adjustments are incremental and should be reduced gradually as the illness subsides.
        - This algorithm has been adapted from DAFNE guidelines
      - Blood glucose less than 4 mmol/L treat as hypo
        - Test blood glucose every 4-6 hours
        - As your illness resolves, adjust your insulin dose back to normal
    - Blood glucose more than 11 mmol/L
      - Test blood glucose and ketones every 4-6 hours
      - Blood glucose less than 11 mmol/L treat as hypo
      - Blood glucose more than 4 mmol/L, treat as hypo

**Blood glucose concentrations and insulin dose adjustments**

<table>
<thead>
<tr>
<th>Blood glucose</th>
<th>Insulin dose*</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-17 mmol/L</td>
<td>Add 2 extra units to each dose</td>
</tr>
<tr>
<td>17-22 mmol/L</td>
<td>Add 4 extra units to each dose</td>
</tr>
<tr>
<td>More than 22 mmol/L</td>
<td>Add 6 extra units to each dose</td>
</tr>
</tbody>
</table>

*Take your prescribed insulin as above

Once you have given the initial increased dose contact your GP or Diabetes Specialist Nurse for advice if you still feel unsure about adjusting your insulin doses. If you are taking more than 50 units in total daily, you should double the adjustments. All adjustments are incremental and should be reduced gradually as the illness subsides.

This algorithm has been adapted from insulin self adjustment advice for people on basal insulin regimiem. The Intermediate Diabetes Service, Enfield Community Services SEH-MHT, 2010.

**Total daily insulin dose**

- **Give an additional 10% of rapid acting or mixed insulin every 4 hours**
  - Up to 14 units: 1 unit
  - 15 - 24 units: 2 units
  - 25 - 34 units: 3 units
  - 35 - 44 units: 4 units
  - 45 - 54 units: 5 units
- **Give an additional 20% of rapid acting or mixed insulin every 2 hours**
  - Up to 14 units: 2 units
  - 15 - 24 units: 4 units
  - 25 - 34 units: 6 units
  - 35 - 44 units: 8 units
  - 45 - 54 units: 10 units

*If you take more than 54 units or if you are unsure how much to alter your dose, contact your specialist team or GP. N.B. This algorithm has been adapted from DAFNE guidelines

- **Yes - repeat process**
- **No**
  - Blood glucose more than 1 mmol/L, treat as hypo
  - Test blood glucose and ketones every 4 hours
  - Test blood glucose and ketones every 2 hours
  - Blood glucose more than 1 mmol/L and ketones present?
General Principles of Managing Sick Days

Introduction

When a person with diabetes is unwell, it is likely that their blood glucose levels will rise and the signs and symptoms of hyperglycaemia may still occur even if the person is not eating.

If someone does not know how to manage their diabetes during periods of illness, it can lead to other serious conditions such as diabetic ketoacidosis (DKA) in people with Type 1 diabetes and hyperglycaemic hyperosmolar state (HHS) in those with Type 2 diabetes. The correct advice for care during inter-current illness may prevent this happening.

General principles of managing diabetes during inter-current illness

When managing a person with diabetes during inter-current illness the aims are to:

• Continue to manage the person’s diabetes and blood glucose levels
• Ensure the person receives sufficient carbohydrate intake and address dehydration with fluid replacement.
• Test for and manage any ketones present in the body
• Recognise whether the person requires additional medical attention

Food and fluid replacement

If the individual is unwell and unable to eat their usual meals, it is important that they continue to eat or drink some carbohydrate (starchy or sugary foods) as a source of energy. The individual should try to take two to three servings from the list provided approximately four to five times a day. They should also be encouraged to drink at least 4 - 6 pints (2.5 - 3.5 L) of sugar-free fluid in 24 hours (at least 100 mL each hour) in order to avoid dehydration.

Table 2: Food Alternatives (UHL NHS Trust 2009)

<table>
<thead>
<tr>
<th>Type of food alternative</th>
<th>Amount*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lucozade™ Energy</td>
<td>50 mL</td>
</tr>
<tr>
<td>Fruit juice‡</td>
<td>100 mL</td>
</tr>
<tr>
<td>Cola (NOT diet)†</td>
<td>100 mL</td>
</tr>
<tr>
<td>Lemonade (NOT diet++)</td>
<td>150 - 200 mL</td>
</tr>
<tr>
<td>Milk</td>
<td>200 mL</td>
</tr>
<tr>
<td>Soup*</td>
<td>200 mL</td>
</tr>
<tr>
<td>Ice cream*</td>
<td>50 g</td>
</tr>
<tr>
<td>Complan®</td>
<td>-</td>
</tr>
<tr>
<td>Drinking chocolate +</td>
<td>-</td>
</tr>
<tr>
<td>Ovaltine® or Horlicks®</td>
<td>-</td>
</tr>
</tbody>
</table>

* each serving provides approximately 10g of carbohydrate
‡ sugar quantities may vary wildly according to brand

However, if the individual starts vomiting or is unable to keep fluids down, urgent medical advice should be immediately sought.

Sick days for Insulin pump users

Insulin pump users can rapidly develop diabetic ketoacidosis (DKA) if their insulin pump fails. If a person’s blood glucose level rises rapidly they should:

• Monitor for blood or urine ketones (pump users are more likely to get euglycaemic ketosis)
• Check the pump to ensure that it is working properly
• Check to see if the pump tubing is blocked or disconnected
• Check that the cannula is in the correct place and is secure

All pump users should be advised to carry an insulin pen device with them containing quick-acting insulin that is in date for use in emergencies. Insulin pump users will be under specialist diabetes care and will have an emergency contact telephone number to use should any issues arise. (Ref: TREND-UK career and competency doc 3rd edition)

Sick pregnant women and children

• Seek urgent specialist advice / or admit

See pre-pregnancy planning a for women with diabetes and Gestational diabetes antenatal care patient information leaflets on www.leicestershirediabetes.org.uk
Managing Sick Days when on Insulin treatment

Sick Day Management - T2DM

Specific advice on insulin management with or without combined use with glucose lowering therapies

<table>
<thead>
<tr>
<th>Drug class</th>
<th>General recommendations for carers and healthcare professionals on the authors’ experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>General advice for all people with diabetes</td>
<td>Blood glucose levels should be tested if a meter is available. If it is not available, be mindful of the symptoms of hyperglycaemia.</td>
</tr>
<tr>
<td>Biguanides (Metformin)</td>
<td>The person should continue to take their medication while the blood glucose level is normal or high unless they are feeling severely unwell (e.g. vomiting, diarrhoea or fever) or are dehydrated, in which case, Metformin should be temporarily stopped. The dose should be restarted once the person is feeling better. Metformin should also be stopped in individuals where the severity of their illness requires hospitalisation or confinement to bed.</td>
</tr>
<tr>
<td>Sulphonylureas (Glibenclamide, Gliclazide, Glimipiride, Glipizide, Tolbutamide)</td>
<td>The person should continue to take their medication while the blood glucose level is normal or high. If they are unable to eat or drink, they may be at risk of hypoglycaemia (low blood glucose levels) and the medication may need to be reduced or stopped temporarily.</td>
</tr>
<tr>
<td>Meglitinides (Nateglinide, Repaglinide)</td>
<td>The person should continue to take their medication while the blood glucose level is normal or high. If they are unable to eat or drink, they may be at risk of hypoglycaemia (low blood glucose levels) and the medication may need to be reduced or stopped temporarily.</td>
</tr>
<tr>
<td>Thiazolidinediones (Pioglitazone)</td>
<td>The person should continue to take their medication while the blood glucose level is normal or high. Medical advice should be sought if the person experiences unusual shortness of breath or localised swelling as this may be a sign of possible heart failure, particularly in the elderly.</td>
</tr>
<tr>
<td>Glucagon-like peptide-1 (GLP-1) receptor agonists, (Exenatide extended release (Bydureon) Exenatide (Byetta) twice daily, Lixisenatide (Lyxumia), Liraglutide once daily)</td>
<td>The person should continue to take their medication while the blood glucose level is normal or high. Medical advice should be sought if the person is vomiting, dehydrated or experiencing severe abdominal pain. Severe abdominal pain may indicate pancreatitis.</td>
</tr>
<tr>
<td>Sodium glucose co-transporter 2 (SGLT-2) inhibitors (Dapagliflozin)</td>
<td>As this agent has only recently become available, the authors have limited clinical experience of using the drug during intercurrent illness recommend that readers refer to Summary of Product Characteristics. There is a risk of UTI and genital tract infection in people using SGLT-2s. Be aware of postural hypotension particularly in the elderly.</td>
</tr>
</tbody>
</table>

Section 5: Insulin Administration and Devices

Introduction

Insulin always has to be injected and so every device needs to be used with a needle. Sharps injuries are common and can affect the user, carer or healthcare professional administering the insulin. The UK market supports patient choice with many different devices available that can be used to administer insulin. These include:

- Insulin syringes
- Insulin pen devices
- Insulin pumps

As you know that there are over 20 different types of insulin. It is therefore imperative that you choose and use the right type of insulin and device.

Having made the decision to start insulin the following points may influence choice of regimen and devices.

Practical points for consideration

Having made the decision to start insulin the following points may influence choice of regimen and devices. The choice and type of delivery system used will depend on the individual person’s:

- Preference
- Manual dexterity
- Visual capacity
- Lifestyle
- Type of insulin used to effectively treat their diabetes
- Eating patterns
- Occupation
- Agreed frequency of injections
- Ability to grasp technique

Choice may be influenced by availability of insulin (e.g. 10 ml vials for use with syringe, 3ml cartridges for use with pens or pre-loaded disposable pens, or the need for low volume insulin such as Insulin Degludec, (U200) or Humulin R (U500) in those on high doses) (See page 12)

Structured education

All patients should have been offered comprehensive structured education programmes there is evidence that these programmes are best delivered in groups and facilitate peer support

- People with Type 2 diabetes should already have attended the DESMOND Education Programme. If not please refer.
- People with Type 1 diabetes, may benefit from attending the DAFNE course which focusses on dose titration and carbohydrate counting
- Leicester City patients can refer to the Intermediate Community Diabetes Service (ICDS insulin Management Groups) for advice and support in dose titration of insulin for both Type 1 and Type 2
Insulin delivery devices: Syringes

Syringes are suitable for people:

- Who want to mix two insulins together in one device
- Who inject high doses
- Who want a back up device
- Who require third party injections
- Who need to be reassured by seeing the dose delivered
- Using a vial of insulin and a syringe requires the user or their carer to have good eyesight
- Who have ability to read measurements on the syringe
- Who need to be reassured by seeing the dose delivered
- Using a vial of insulin and a syringe requires the user or their carer to have good eyesight
- Who have ability to read measurements on the syringe

It is important that an insulin syringe is always used for insulin injections as the use of an intramuscular injection syringe leads to a risk of a 10 fold overdose of insulin.

In the UK, U100 insulin is mostly available for use in people with Diabetes. This means that there are 100 units per 1ml of insulin. U100 insulin syringes therefore provide the correct unit markings for U100 insulin. Insulin syringes always have a needle attached - these come in different lengths. Other insulin strengths are available for those requiring large doses. (see page 12)

Table 4: Insulin

<table>
<thead>
<tr>
<th>Insulin Type</th>
<th>Manufacturer</th>
<th>Source</th>
<th>Delivery System</th>
<th>Taken</th>
<th>Onset</th>
<th>Peak</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid-acting analogue</td>
<td>NovoRapid Novo Nordisk</td>
<td>Analogue</td>
<td>Vial, cartridge, prefilled pen</td>
<td>Just before / with / just after food</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humalog Lilly</td>
<td>Analogue</td>
<td>Vial, cartridge, prefilled pen</td>
<td>0-15 mins before, or soon after, a meal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apidra Sanofi-Aventis</td>
<td>Analogue</td>
<td>Vial, cartridge (two types), prefilled pen (two types)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U100 insulin syringes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-acting Insulin</td>
<td>NovoRapid Novo Nordisk</td>
<td>Insulin pen</td>
<td>15–20 mins before food</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actrapid Novo Nordisk</td>
<td>Analogue</td>
<td>Vial</td>
<td>30 mins before food</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humulin S Lilly</td>
<td>Human</td>
<td>Vial, cartridge</td>
<td>20–45 mins before food</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humulin Bovine Insulin</td>
<td>Wockhardt UK</td>
<td>Bovine</td>
<td>As advised by your healthcare team</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin glargine U100</td>
<td>Sanofi-Aventis</td>
<td>Analogue</td>
<td>Pen cartridge, prefilled pen</td>
<td>45–60 mins before food</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analogue mixture</td>
<td>NovoMix 30 Novo Nordisk</td>
<td>Analogue</td>
<td>Cartridge, prefilled pen</td>
<td>Once a day, any time of low risk day</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin glargine U200</td>
<td>Sanofi-Aventis</td>
<td>Analogue</td>
<td>Cartridge, prefilled pen</td>
<td>Once a day, any time of low risk day</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin detemir U100</td>
<td>Novo Nordisk</td>
<td>Analogue</td>
<td>Cartridge, prefilled pen</td>
<td>Once a day, any time of low risk day</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin detemir U200</td>
<td>Novo Nordisk</td>
<td>Analogue</td>
<td>Cartridge, prefilled pen</td>
<td>Once a day, any time of low risk day</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin degludec U100</td>
<td>Novo Nordisk Analogue</td>
<td>Pen cartridge touch pen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin degludec U200</td>
<td>Novo Nordisk Analogue</td>
<td>Insulin pen only (touch pen)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Times are approximate and may vary from person to person. This is a guide only.*
Types of Insulin Delivery Devices: Pumps

Insulin delivery devices: Insulin Pumps

Insulin pumps are usually recommended as a treatment by consultants for patients with Type 1 diabetes. Pumps are the most accurate, precise, and flexible insulin delivery system currently available. In some pump users this tool can be effective in optimising blood glucose control. An Insulin Pump is a small programmable device that holds an insulin cartridge / reservoir and delivers a continuous flow (basal rate) of insulin to the body through a thin plastic tube inserted in the body.

A pump is programmed to automatically deliver small pulses of insulin over 24 hours to keep blood glucose in the desired ranges between meals and overnight. Extra insulin is then given by the patient at the touch of a button to cover meal times.

Most infusion sets are worn in the abdominal area and a tiny flexible tube called a cannula is inserted easily into the skin. Patients generally refill their insulin reservoir and change their infusion sets every 2 - 3 days.

Benefits

The benefits of using pump control in patients

- A pump can help patients avoid hyperglycaemia, (high blood glucose) which in the long term can cause diabetic complications.
- Fewer fluctuations in blood glucose levels during the course of the day
- A person managing their diabetes with an insulin pump can more easily adapt their treatment to changes in their daily routine, for example through travel or variable working hours, exercise
- Less nocturnal hypoglycaemia, which in the long term can cause diabetic complications
- Pump therapy can also help prevent nocturnal hypoglycaemia
- Improved long term control (HbA1c and weight)

Disadvantages

- The pump may fail
- The cannula may become blocked or disconnected
- A supply of insulin pens should be kept just in case the pump fails
- More expensive
- Doesn’t suit everyone

Emergencies

All pump users should be advised to carry an insulin pen device with them containing quick-acting insulin that is in date for use in emergencies

Specialist care

Insulin pump users will be under specialist diabetes care and will have an emergency contact telephone number to use should any issues arise.
(Ref: TREND-UK career and competency doc 3rd edition)

Diabetes Specialist Nurses specialising in Pump therapy are based at the Leicester Royal Infirmary. Tel: 0116 258 5545

Who can use insulin pumps

Insulin pumps can be used in children and adults

- When a child under 12 is struggling with multiple daily injections insulin pump therapy maybe considered
- If long term blood glucose levels (HbA1c) managed with multiple injections, continue to cause severe hypos
- HbA1c levels have remained high on multiple injection therapy even after regular support from healthcare professionals including NICE recommended Structured Education Programmes (i.e. DAFNE)

See NICE guidance http://www.nice.org.uk/TA151

Insulin pump therapy is NOT generally recommended for patient with Type 2 diabetes
## Types of Insulin Delivery Devices

### Insulin delivery devices: Pens

- Insulin pens are a very useful way to carry and administer insulin. They allow users to administer insulin when they are on the go or whenever it suits them.
- Insulin pens are either disposable one-shot devices or they have replaceable cartridges of insulin.
- The tip of insulin pens include a fine, short needle and so users can turn a dial to select the correct dosage.
- Insulin pens come in 2 types of delivery systems:
  - Pre-filled pens which are disposed of when empty
  - Pens where the insulin is given via a cartridge
- The type of insulin cartridge used will determine the type of pen needed as different insulin manufacturers have different fittings on their pen. (See example opposite)

#### Table 5: Insulin Pens

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Name</th>
<th>Dosage (Min–Max)</th>
<th>Insulin Used in Pen</th>
<th>Pen Needles Used</th>
<th>Appearance</th>
<th>Colour</th>
<th>Material</th>
<th>Cartridge or Prefilled</th>
<th>Redial</th>
<th>Carring Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novo Nordisk</td>
<td>FlexPen</td>
<td>1–60 units</td>
<td>NovoRapid, Levemir, NovoMix 30</td>
<td>BD Micro-Fine +, NovoFine, NovoFine Autocover</td>
<td>Blue or grey</td>
<td>Plastic</td>
<td>Prefilled</td>
<td>Yes</td>
<td>Available from Novo Nordisk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FlexPen</td>
<td>1–60 units</td>
<td>All Novo Nordisk BD Micro-Fine +, Penfine universal click</td>
<td>3ml penfill cartridges</td>
<td>Penfine universal click</td>
<td>Unifine Pentips</td>
<td>Zip case</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Autopen</td>
<td>1–21 units</td>
<td>Lilly 3ml cartridges Unifine Pentips</td>
<td>BD Micro-Fine +, Penfine universal click</td>
<td>Unifine Pentips</td>
<td>Orange trim</td>
<td>see manual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanofi-Aventis</td>
<td>OptiSet</td>
<td>1–80 units</td>
<td>Lantus, Apidra</td>
<td>BD Micro-Fine +, Dark blue or Plastic</td>
<td>Dark blue</td>
<td>Hard case</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eli Lilly</td>
<td>KwikPen</td>
<td>1–60 units</td>
<td>Humalog, Humalog Mix25</td>
<td>BD Micro-Fine +, Penfine universal click</td>
<td>Slate blue</td>
<td>Plastic</td>
<td>Prefilled</td>
<td>Yes</td>
<td>Soft case available</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HumaPen</td>
<td>0.5–30 units</td>
<td>Lilly 3ml cartridges from Humalog</td>
<td>BD Micro-Fine +, Penfine universal click</td>
<td>Rainforest green</td>
<td>Metal</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humulin I</td>
<td>1–60 units</td>
<td>Humulin I BD Micro-Fine +, Unifine Pentips</td>
<td>Beige</td>
<td>Plastic</td>
<td>Prefilled</td>
<td>Yes</td>
<td>Soft case available</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novo Nordisk</td>
<td>NovoPen 1</td>
<td>1–35 units</td>
<td>All Novo Nordisk BD Micro-Fine +, NovoFine, NovoFine Autocover</td>
<td>Blue with green Metal</td>
<td>Blue</td>
<td>-</td>
<td>Soft pouch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NovoPen 3</td>
<td>1–35 units</td>
<td>All Novo Nordisk BD Micro-Fine +, NovoFine, NovoFine Autocover</td>
<td>Blue with Metal</td>
<td>Blue</td>
<td>-</td>
<td>Soft pouch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pennfine universal click, Unifine Pentips</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Insulin pen devices alleviate some user error in insulin measurement and reduce the need for dexterity and good eyesight.**

**Some pens have a memory function so the user can be reminded as to how much insulin they last took and when, (e.g. the NovoPen Echo).**

**Some pens ‘dial up’ in increments of 1 Unit and others in 0.5 Unit increments, (e.g. Luxura HD, NovoPen4, NovoPen Junior Cartridges).**

- Be aware that different manufacturers use a different type of cartridge and so their pens only take their make of insulin.

---

Injecting Insulin

**Injecting: Direct Subcutaneous**

Direct subcutaneous insulin injection remains the most common form of delivery, using a needle and syringe.

Insulin syringes are available in a number of needles lengths.

- The capacity of the syringe should be chosen depending on the dosage of insulin required
- The markings down the side of the syringe shows how many units of insulin are in the syringe

**Injection sites**

The most common injection site are the:

- Stomach
- Thigh
- Buttocks
- Arms

(Diagrams kindly supplied by Beckton Dickinson Ltd)

**Injection sites should be checked regularly**

Injection sites should be checked regularly

- Encourage the practice of rotating place if injecting within a chosen site
- Rotating injection sites may result in differing rates of absorption between sites and needs to be taken into consideration, (e.g. insulin is absorbed more quickly from the abdomen than the thighs)

Lipohypertrophy can effect the absorption of insulin and lead to erratic glycaemic control - if a patient stops using a "lumpy" injection site, blood glucose levels should be monitored closely as a reduction in insulin may be required to avoid hypoglycaemia.
How to inject

- Dial or draw up the correct dose of insulin as per chosen device
- Remember to agitate insulin if required
- Choose injection site (see diagram on opposite page)
- No pinch required for 4mm, 5mm or 6mm needles
- Pinch up subcutaneous fat for 8mm needles and above (see diagram opposite)
- Insert needle directly into raised area at 90°
- Depress plunger or button to deliver insulin as per manufacturers instructions
- Hold needle in place for 10 seconds then remove
- Change insulin pen needle every time they inject
- Give patient the “Safe use of insulin and you” booklet and passport/insulin safety cards and discuss content with them

Storing insulins syringes, insulin pens and Cartridges

- The pen currently being used can be kept at room temperature for up to 4-8 weeks depending on the individual preparation
- The insulin vial that is in current use may be kept at room temperature for 28 days/1 month, insulin remaining in the vial after this should be disposed of
- Spare vials, pre-filled pens and cartridges that are not in use can be stored in the fridge
- Insulin is affected by extremes of temperature (i.e. very hot or freezing). Avoid keeping in contact with direct heat or sunlight or risk of freezing (e.g. in the hold of an aircraft).

Remember that between injections some insulin particles separate and to ensure correct concentration/consistency these Insulin needs to be mixed by inverting 20 times or rolling prior to injecting them.
Section 6: Insulin Safety - Safe use of Insulin

Common Insulin Errors

- Wrong syringe
- Wrong insulin
- Incorrect insulin name
- Omitted doses
- Use of “U” when prescribing insulin can lead to dose error (see section The Right Dose opposite)
- Inaccurate transcription or documentation
- Inappropriate timing of injection or meals

The incorrect insulin product was described in 2,201 incidents over a six year period (NPSA)

The Right Insulin

There are over 20 different types of insulin. The packaging of insulin is often very similar and so are insulin names. This table shows some insulin names that are often confused:

<table>
<thead>
<tr>
<th>Insulin</th>
<th>with</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humalog</td>
<td>Humalog Mix 25 or</td>
</tr>
<tr>
<td></td>
<td>Humalog Mix 50</td>
</tr>
<tr>
<td>Humulin S</td>
<td>Humulin I or</td>
</tr>
<tr>
<td></td>
<td>Humulin M3</td>
</tr>
<tr>
<td>Humalog</td>
<td>Humulin I or</td>
</tr>
<tr>
<td></td>
<td>Humulin S or</td>
</tr>
<tr>
<td></td>
<td>Humulin M3</td>
</tr>
<tr>
<td>NovoRapid</td>
<td>NovoMix 30</td>
</tr>
<tr>
<td>Levemir</td>
<td>Lantus</td>
</tr>
<tr>
<td>Hypurin Porcine Neutral</td>
<td>Hypurin Porcine 30 / 70 Mix</td>
</tr>
</tbody>
</table>

The Right Dose

- Insulin comes in vials for use with insulin syringes and pumps, in cartridges for insulin pens or pre-filled pens
- Each should be clearly labelled with the name of the insulin
- Patient should be advised to keep a record of the amount of insulin units they are taking
- There are 2 different designs of insulin cartridge so not all cartridges can be used in all insulin pens. If the individual uses cartridges they need to know which pen is right and safe for them to use
- Pre-filled pens should contain an individual's prescribed insulin
- Advise the individual to check the name of the insulin is correct with their Pharmacist before they leave the pharmacy
- If insulin is prescribed using the letter “U” after the dose needed instead of writing the word “units” in full, the “U” can be mistaken for an “0”. This can lead to a risk of you having an overdose of insulin. (e.g. 40 units instead of 4)
- If someone else administers the individual’s insulin always ask them to check the dose

The Right Time

- Healthcare professionals should discuss with patients when they need to take their insulin
- Advise patients if they are admitted to hospital and they are well enough: ask to keep insulin with them so they can self manage their diabetes - this is really important if an insulin pump is used
- Advise patients if they can’t give or keep their own insulin, don’t be afraid to ask staff when they need it

In 2010 the National Patient Safety Agency (NPSA) issued a ‘Rapid Response Report’ stating that:

"A training programme should be put in place for all healthcare professionals (including medical staff) expected to prescribe, prepare and administer insulin"

A free e-learning module on the safe use of insulin is available at [www.nhsiq.nhs.uk](http://www.nhsiq.nhs.uk)

Ref: Safe use of Insulin and you leaflet
The safe use of insulin and patient safety information

In 2011, the NPSA issued a 2nd 'Rapid Response Report' stating that:

1. Adult patients on insulin therapy should receive a patient information booklet and an "Insulin Passport" to help provide accurate identification of their current insulin products and provide essential information across healthcare sectors.

2. When prescriptions of insulin are prescribed, dispensed or administered, healthcare professionals should cross-reference available information to confirm the correct identity of insulin products

A shorter easy to read version of the NPSA information booklet is now freely available and has been recommended by the NPSA for patient use. (See opposite) This booklet has been translated in to 8 languages and is also available in large print on the Leicestershirediabetes.org.uk website: www.leicestershirediabetes.org.uk/583.html

Insulin Safety: Sharps

Safe Disposal of Sharps

- Prescribe the patient a "sharps disposal box"

There is national guidance for disposal of sharps (See www.leicestershirediabetes.org.uk) guidance should include advice around:

- Prescribing and disposal of sharps boxes
- Do not dispose of sharps in general refuse to prevent needle stick injuries
- Your CCG / prescribing lead will have local guidelines on sharps disposal
- See New European guide for sharps - www.Fit4diabetes.com

What should you do if you have a sharps injury?

- Encourage the wound to gently bleed ideally whist holding it under running water
- Wash the wound using plenty of soap and running water
- Don’t scrub the wound
- Don’t suck the wound
- Dry the wound and cover it with a waterproof plaster or dressing
- Seek urgent medical advice e.g. from Occupational Health
- Always report the injury to your manager / employer

Sharps Injury: The Cost

Initial cost of a sharp injury is estimated as

- £1540 for Hepatitis B
- £235 For Hepatitis C
- £932 for HIV positive

The psychological costs to the healthcare professional are not so easily measured but can include:

- Depression
- Anxiety, Inability to work
- Relationship problems

Remember:

- Never re-sheath an insulin syringe or pen needle
- Never draw insulin from a pen cartridge or device using a syringe
- Always keep a sharps bin at the point of care
Help and support

Supporting literature is available from:

- Leicestershire Diabetes Website - for healthcare professionals, carers and people with diabetes
  www.leicestershirediabetes.org.uk
- Diabetes UK
  Tel: 0845 120 2960
  website: www.diabetes.org.uk
- NovoCare Customer Care centre
  Tel: 0845 600 5055
  Website: www.novonordisk.co.uk
- Lilly Diabetes Care UK
  Tel: 01256 315000
  www.lilly.co.uk
- Sanofi-Aventis Customer Service
  Tel: 0845 606 6887

Supporting Documents

- Leicestershire Diabetes Website - for healthcare professionals, carers and people with diabetes
  www.leicestershirediabetes.org.uk
- Leicestershire diabetes guidelines
  www.leicestershirediabetes.org.uk
- www.TREND-UK.co.uk
- 4T Study Ref: Holman R et al 2009, NEJM 361:1736-1747
- Safe Use of insulin - e-learning access to the e-learning is either on the eUHL website or through www.nhsiq.nhs.uk
- Insulin passports www.nrlc.npsa.nhs.uk/resources?EntryId45=130397
- Driving and hypos leaflet www.leicestershirediabetes.org.uk
- DVLA - www.dvla.gov.uk/dvla
## 5.8. INJECTABLE THERAPIES

For the safe administration and use of insulin and GLP-1 receptor agonists you should be able to:

<table>
<thead>
<tr>
<th>Competency statements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Unregistered practitioner</strong></td>
</tr>
<tr>
<td>- Describe the effect of insulin on blood glucose levels.</td>
</tr>
<tr>
<td>- Be aware of local sharps disposal policy.</td>
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<tr>
<td>- Show an understanding of the ongoing nature of the therapy.</td>
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<tr>
<td>- Administer insulin competently where supported by local policy.</td>
</tr>
<tr>
<td>- Report identified problems appropriately.</td>
</tr>
<tr>
<td><strong>2. Competent nurse</strong></td>
</tr>
<tr>
<td>- Actively seek and participate in peer review of one’s own practice.</td>
</tr>
<tr>
<td>- Demonstrate basic knowledge of insulin and GLP-1 receptor agonists (e.g. drug type, action, side-effects) and administration devices used locally.</td>
</tr>
<tr>
<td>- Demonstrate a high level of competency in the safe administration of insulin or GLP-1 receptor agonists.</td>
</tr>
<tr>
<td>- Demonstrate and be able to teach the correct method of insulin or GLP-1 receptor agonist self-administration, including:</td>
</tr>
<tr>
<td>- Correct choice of needle type and length for the individual.</td>
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<tr>
<td>- Appropriate use of lifted skin fold, where necessary.</td>
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<tr>
<td>- Site rotation.</td>
</tr>
<tr>
<td>- Storage of insulin.</td>
</tr>
<tr>
<td>- Single use of needles.</td>
</tr>
<tr>
<td>- Examine injection sites at least annually for detection of lipohypertrophy.</td>
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<tr>
<td>- Identify correct reporting system for injectable therapy errors.</td>
</tr>
<tr>
<td>- Complete the ‘Safe use of insulin’ e-learning module (NHS Diabetes, 2010).</td>
</tr>
<tr>
<td>- Describe circumstances in which insulin use might be initiated or altered and make appropriate referral.</td>
</tr>
<tr>
<td>- Report concerns related to blood glucose or HbA1c results in a timely and appropriate fashion.</td>
</tr>
<tr>
<td><strong>3. Experienced or proficient nurse</strong></td>
</tr>
<tr>
<td>- Demonstrate a broad knowledge of different insulin types (i.e. action, use in regimens).</td>
</tr>
<tr>
<td>- Demonstrate a broad knowledge of GLP-1 receptor agonists (e.g. drug type, action, side-effects).</td>
</tr>
<tr>
<td>- Assess individual patients’ self-management and educational needs and meet these needs or make appropriate referral.</td>
</tr>
<tr>
<td>- Support and encourage self-management wherever appropriate.</td>
</tr>
<tr>
<td>- Initiate insulin or GLP-1 receptor agonist therapy where clinically appropriate.</td>
</tr>
<tr>
<td>- Recognise when injection therapy needs to be adjusted.</td>
</tr>
<tr>
<td>- Recognise the potential psychological impact of insulin or GLP-1 receptor agonist therapies and offer support to the person with diabetes or their carer.</td>
</tr>
<tr>
<td>- Recognise signs of needle fear/needle phobia and offer strategies to help manage this.</td>
</tr>
</tbody>
</table>
Appendix 2

End of Life Diabetes Management - Algorithm for Glycaemic Control

Discuss changing the approach to diabetes management with patient and/or family if not already explored. If the patient remains on insulin ensure the diabetes specialist nurses (DSNs) are involved and agree monitoring strategy.

Type 2 diabetes
Diet controlled or Metformin treated

Stop monitoring blood sugars

Type 2 diabetes on other tablets and/or insulin / or GLP1 Agonist*

Stop tablets and GLP1 injections
Consider stopping insulin depending on dose

If insulin stopped:
• Urinalysis for glucose daily - If over 2+ check capillary blood glucose
• If blood glucose over 20 mmols/l give 6 units rapid acting insulin *
• Recheck capillary blood glucose after 2 hours

If insulin to continue:
• Prescribe once daily morning dose of isophane insulin^ or long acting insulin Glargine (Lantus*) based on 25% less than total previous daily insulin dose

Check blood glucose once a day at teatime:
• If below 8 mmols/l reduce insulin by 10-20%
• If above 20 mmols/l increase insulin by 10-20% to reduce risk of symptoms or ketosis

Continue once daily morning dose of insulin Glargine (Lantus*) with reduction in dose

Type 1 diabetes always on insulin

If patient requires rapid acting insulin* more than twice consider daily isophane insulin^ or Glargine (Lantus*)

Key
# Bydureon (Exenatide ER) Byetta (Exenatide)/Victoza (Liraglutide), Lyxumia (Lixisenatide)
* Humalog/Novorapid/Apidra
^ Humulin I /Insulatard/ Insuman Basal

• Keep tests to a minimum. It may be necessary to perform some tests to ensure unpleasant symptoms do not occur due to low or high blood glucose.
• It is difficult to identify symptoms due to “hypo” or hyperglycaemia in a dying patient.
• If symptoms are observed it could be due to abnormal blood glucose levels.
• Test urine or blood for glucose if the patient is symptomatic.
• Observe for symptoms in previously insulin treated patient where insulin has been discontinued.

For queries relating to the diabetes flowchart please contact the Diabetes Specialist Nurses
For queries relating to palliative care please contact the Palliative Care Team

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Appendix 3

End of Life Diabetes Management - Managing Glucose Control on Once Daily Steroids

No known diabetes
- Check random glucose before starting on steroids to identify patients at risk
- Random capillary blood glucose over 8 mmol/l needs further checking with venous blood
- Random venous glucose over 7.8 mmol/l means at risk of developing diabetes with steroid therapy
- Random venous glucose over 11 mmol/l needs a second check to confirm pre-existing unknown diabetes

Known Diabetes
- Reassess glucose control and current therapy

Sulphonylurea treated (Gliclazide)

- Test before evening mealtime
- If develops repeated high readings (urine glucose>2+ or blood glucose >15mmol/l) add Gliclazide 40mg with breakfast
- Increase morning dose by 40mg increments
- Aim blood glucose 6-15 mmol/l or <1+ glycosuria before evening meal

- If no hypoglycaemia symptoms, day or night and taking less than 320mg/day
- Adjust balance of twice daily doses of Gliclazide by giving up to a max 240mg in morning dose plus 80mg pm
- Aim blood glucose 6-15 mmol/l or <1+ glycosuria before evening meal

Insulin controlled

- Morning dose will need to increase according to glucose reading before evening meal
- Aim blood glucose 6-15 mmol/l before evening meal unless patient has "hypo" before meals despite mid-meal snacks

Basal bolus insulin
- Breakfast & lunchtime rapid acting insulin may need to increase to avoid high readings before lunch or evening meal
- Aim blood glucose 6-15 mmol/l before lunch and evening meal unless patient has "hypo" before meals despite mid-meal snacks or has long gaps between meals

- If glucose above 15 mmol/l before evening meal
  - Increase dose
  - Review daily until stable increasing dose as necessary
- If glucose 10 - 15 mmol/l before evening meal
  - Consider increasing dose depending on risk of hypoglycaemia
  - Review daily until stable increasing dose as necessary

- If glucose above 15 mmol/l before lunch or evening meal
  - Increase breakfast or lunchtime dose
  - Review daily until stable increasing dose as necessary
- If glucose 10 - 15 mmol/l before lunch or evening meal
  - Consider increasing breakfast or lunchtime dose depending on risk of hypoglycaemia
  - Review daily until stable increasing dose as necessary

- Assuming no hypoglycaemia, pre meal time glucose is above 10mmol/l and increase in dose is needed
  - Increase dose by 2-5 units if dose below 20 units
  - Increase dose by 5-10 units if dose 20-50 units
  - Increase dose by 10-20 units if dose 50-100 units
  - Review daily until stable increasing dose as necessary

- If steroids are reduced or discontinued: review any changes made and consider reverting to previous therapy or doses
- If unsure at any stage about next steps or want specific advice on how to meet with patients needs or expectations please contact the Diabetes Specialist Team

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