Aim(s) and objective(s)
This document aims to provide guidance on good clinical practice in managing glycaemic control in adult patients with Type 1 Diabetes

Author(s)
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User group
Consultant Diabetologists, Diabetes Specialist Nurses, Dietitians, GPs and Practice Nurses. This guideline is not to be used in paediatric patients i.e. less than 16 years

This guideline is not intended to serve as a protocol or standard of care. This is best based on all clinical data available for an individual case and may be subject to change as scientific knowledge and technology advances and patterns of care evolve. Adherence to guideline recommendations will not ensure a successful outcome in every case, nor should it be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same result. Ultimately a judgement must be made by the appropriate healthcare professional(s) responsible for a particular clinical procedure or treatment plan following discussion with the patient, covering the diagnostic and treatment options available. It is advised that any significant departure from the guideline should be documented in the patient's medical record at the time the decision is taken.

Guideline

DIAGNOSIS AND TREATMENT INITIATION

Diagnosis
All adult people with suspected Type 1 Diabetes should be referred urgently (same day) to their local diabetes out-patient service. Such referrals should be made by telephone to consultants or DSNs or by urgent fax. If out with normal working hours they should be referred to the local medical receiving unit for further assessment and management.

All people should be assessed and receive appropriate ongoing follow-up from a multidisciplinary team (MDT) including Diabetes Specialist Nurse, Dietician, Podiatrist and Consultant Diabetologist.

Initiating Insulin at Diagnosis
An out-patient or home based programme for the initial management and education of people with Type 1 Diabetes is usually appropriate and cost effective. However in the event that the person is unwell, vomiting and unable to take fluids and normal diet they should be referred as an emergency the local medical assessment unit.

In the absence of an on-call diabetologist or diabetes specialist nurse, local protocols for the emergency receiving units within Lanarkshire should be available to facilitate discharge (after initial assessment, including initiation of insulin) and early out-patient management e.g. over a week-end period, prior to formal review by the diabetes multi-disciplinary team (MDT).
Choice of insulin and insulin regime
When considering which insulin regime to prescribe the individual\'s needs, beliefs and lifestyle must be considered, as the aim of treatment is to achieve optimal well-being.

1. Intensive insulin therapy (i.e. basal bolus regime with multiple daily injections (MDI) or continuous subcutaneous insulin infusion (CSII therapy)) if delivered with education and as part of a comprehensive support package results in better glycaemic control than twice daily insulin regimens and should be first line therapy for most people with Type 1 Diabetes.

Bolus, quick acting (meal-time) insulin:
- use unmodified (\'soluble\') insulin first line (Humulin S®)
- use rapid-acting insulin analogues (Apidra®, Humalog®, Novorapid®):
  - where nocturnal or late inter-prandial hypoglycaemia is a problem
  - to avoid need for snacks between meals, while maintaining blood glucose control

Basal insulin (typically once daily):
- use isophane (NPH) insulin first line (Humulin I®, Insulatard®).
- use long-acting insulin analogues (Lantus®, Levemire®) when:
  - nocturnal hypoglycaemia is a problem on isophane (NPH) insulin
  - fasting blood glucose levels on isophane insulin show marked day to day variability with no identifiable lifestyle cause

Note - twice daily basal insulin (NPH or analogue) results in improved glycaemic control in patients who follow the DAFNE (Dose adjustment for Normal Eating) regime.

2. Twice-daily insulin regimes Biphasic pre-mixed insulin (Humulin M3®) or pre-mixed analogues (Humalog Mix 25®, Humalog Mix 50®, Novomix 30®) - in those prone to hypoglycaemia at night, may be more suitable for those people who feel adherence to an MDI regime isn\'t practical for them or for people who require assistance with insulin administration e.g. from community nurses.

Calculating starting dose of insulin
The approximate daily insulin requirement for people with Type 1 Diabetes is 0.5 units/kg body weight. Some people, particularly those overweight with sedentary lifestyle, will require up to 1 unit/kg.

For example
Total daily dose (TDD) of insulin: 0.5units x 72kg person = 36 units
For safety at the start (to avoid hypoglycaemia) this is reduced by 40% - total daily dose (TDD) for a 72kg person to be 36 units x 40% = 22 units

Basal Bolus Regime
Generally, in patients with established Type 1 Diabetes, 30 -60% of the total daily insulin dose (TDD) should be given as basal insulin, either isophane (NPH) insulin or long acting analogue insulin, usually as a single injection at bed time or split pre-breakfast and pre bed.
If being combined with rapid acting analogue insulin in the basal bolus regime NPH insulin should be administered twice daily in two equal doses. This basal option is particularly suitable in females planning pregnancy.
Long acting analogue insulin, especially Lantus® is usually given once daily in combination with rapid acting analogue insulin in the basal bolus regime.
The rest of the TDD will be given in divided doses of rapid acting analogue insulin (e.g. Apidra®, Humalog®, Novorapid®) or soluble insulin (e.g. Humulin S®) pre-meals. The use of rapid acting analogue insulin may be associated with better patient satisfaction/convenience, but the evidence of improved glycaemic control or fewer hypoglycaemic episodes compared to soluble insulin isn’t convincing.

When commencing a basal bolus regimen in a recently diagnosed Type 1 Diabetes person the starting basal insulin dose should be 30% of the TDD and then the rest of the TDD should be given divided as three pre-prandial doses of short acting insulin taken prior to breakfast, lunch and evening meal, the split of doses reflecting the reported individual’s eating pattern.

For example
TDD starting 22 units - give 6 -8 units Lantus® pre bed and 4 -6 units Humalog® three times daily pre-meals.

If a person has presented with diabetic ketoacidosis or other significant intercurrent illness the appropriate initial subcutaneous starting insulin doses will be higher and such people should be reviewed by a consultant diabetologist for advice on the starting subcutaneous insulin dose.

Twice daily Regime
For twice daily regimens the most frequently used options are a premixed fixed combination of short and intermediate acting insulin (e.g. Humulin M3® or a rapid acting analogue insulin mix (e.g. Novomix 30® or Humalog Mix 25®).

For example
Daily insulin requirements = 0.5 units/kg body weight
Total daily dose insulin at start - 0.5 units x 72kg = 36 units
Reduce by 40% ‘for safety’ 36 units x 40% = 22 units (round up to nearest unit)
Split the dose 50:50 before breakfast and evening meal. i.e. 11 units at each injection.
Round up to nearest even number of units for ease of administration = 12 units.
In general the final insulin dose required will be nearer to 60:40 divide. This will become more apparent when titrating insulin. The above calculation is suggested at the outset for simplicity.

Insulin Devices (including CSII)
The majority of people will use refillable or disposable insulin pen devices for insulin administration, with the appropriate pen needles. When selecting pen devices any cost differences of prefilled pens versus reusable pens should be considered (the more cost effective option being selected) if the person can manage each device equally well. Table 1 summarizes current pen devices available for commonly prescribed insulin. All pen devices take 3ml cartridges whether reusable or prefilled and all devices are available on prescription.
Table 1 - Pen devices for commonly prescribed insulin

<table>
<thead>
<tr>
<th>Pen Name</th>
<th>Insulin</th>
<th>Dose Range</th>
<th>Reusable/ Prefilled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clickstar®</td>
<td>Apidra®, Lantus®</td>
<td>1-80 units</td>
<td>Reusable</td>
</tr>
<tr>
<td>Solostar®</td>
<td>Apidra®, Lantus®</td>
<td>1-80 units</td>
<td>Prefilled</td>
</tr>
<tr>
<td>Humapen Savvio®</td>
<td>Humalog®, Humulin S®, Humulin I®, Humulin M3®, Humalog Mix 25®, Humalog Mix 50®</td>
<td>1-60 units</td>
<td>Reusable</td>
</tr>
<tr>
<td>Humapen Luxura HD®</td>
<td>Humalog®, Humulin S®, Humulin I®, Humulin M3®, Humalog Mix 25®, Humalog Mix 50®</td>
<td>0.5-30 units</td>
<td>Reusable</td>
</tr>
<tr>
<td>Humapen Memoir®</td>
<td>Humalog®, Humulin S®, Humulin I®, Humulin M3®, Humalog Mix 25®, Humalog Mix 50®</td>
<td>1-60 units</td>
<td>Reusable</td>
</tr>
<tr>
<td>Kwikpen®</td>
<td>Humalog®, Humulin I®, Humulin M3®, Humalog Mix 25®, Humalog Mix 50®</td>
<td>1-60 units</td>
<td>Prefilled</td>
</tr>
<tr>
<td>Novopen 4®</td>
<td>Novorapid®, Levemir®, Insultard®, Novomix 30®</td>
<td>1-60 units</td>
<td>Reusable</td>
</tr>
<tr>
<td>Novopen Junior/Demi®</td>
<td>Novorapid®, Levemir®, Insultard®, Novomix 30®</td>
<td>0.5-35 units</td>
<td>Reusable</td>
</tr>
<tr>
<td>Flexpen®</td>
<td>Novorapid®, Levemir®, Novomix 30®</td>
<td>1-60 units</td>
<td>Prefilled</td>
</tr>
<tr>
<td>Innolet®</td>
<td>Levemir®</td>
<td>1-50 units</td>
<td>Prefilled</td>
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ONGOING MANAGEMENT OF GLYCAEMIC CONTROL

All people with diabetes within NHSL should have access to structured group education programmes to support self management of diabetes. For Type 1 Diabetes within the first 6-12 months of diagnosis most education and support will be delivered on a one to one basis depending on the needs of the individual person by DSNs or dietetic staff usually based in acute sites. The following guidance is relevant for patients with Type 1 Diabetes either prior to being offered DAFNE (Dose Adjustment For Normal Eating) type education (structured education, recommended at least 6 months from diagnosis but usually after 12 months) or for those patients opting not to attend structured group education. To support insulin management all patients with Type 1 Diabetes should receive carbohydrate recognition and counting education.
GENERAL ADVICE ON INSULIN DOSE ADJUSTMENT

• People should be educated to adjust their own insulin
• Insulin may need adjusting for exercise, meal composition, patterns in blood sugar levels, during illness and weight loss or gain episodes
• Do not adjust dose on a “single” out of range blood glucose. The exception to this would be night time hypos (low blood glucose) when the basal overnight insulin should be reduced the following day (i.e. isophane NPH insulin, long acting analogue insulin or pre-evening meal pre-mixed insulin)
• Adjust according to blood glucose pattern over at least 48 hours and then monitor to judge the effect before further adjustment
• Blood glucose target range should be set for each individual, the ‘optimal’ range in Table 2 below is a guide
• Dose adjustment is individual and should to be monitored closely by self-monitoring blood glucose

Table 2 - Insulin dose adjustment and blood glucose target range

<table>
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<tr>
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<tbody>
<tr>
<td><strong>BASAL BOLUS REGIMEN (MDI - 4 OR 5 INJECTIONS DAILY)</strong></td>
<td></td>
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</tr>
<tr>
<td>Before Breakfast</td>
<td>Reduce bedtime basal insulin dose by 10-20%</td>
<td>OPTIM AL</td>
<td>Increase bedtime basal insulin by 10% if blood glucose risen overnight by &gt;3 mmol/L</td>
<td>Increase bedtime basal insulin by 20% if blood glucose risen overnight by &gt;3 mmol/L</td>
</tr>
<tr>
<td>Before Lunch</td>
<td>Reduce Pre-breakfast bolus insulin dose by 10-20%</td>
<td>OPTIM AL</td>
<td>Increase morning bolus insulin by 10% if blood glucose risen from breakfast</td>
<td>Increase morning bolus insulin by 20% if blood glucose risen from breakfast</td>
</tr>
<tr>
<td>Before Evening Meal</td>
<td>Reduce Lunchtime bolus insulin dose by 10-20%</td>
<td>OPTIM AL</td>
<td>Increase lunchtime bolus insulin by 10% if blood glucose risen from lunch</td>
<td>Increase lunchtime bolus insulin by 20% if blood glucose risen from lunch</td>
</tr>
<tr>
<td>Before Supper/Bedtime</td>
<td>Reduce Evening meal bolus insulin dose by 10-20%</td>
<td>OPTIM AL</td>
<td>Increase evening meal bolus insulin by 10% blood glucose risen from evening meal</td>
<td>Increase evening meal bolus insulin by 20% blood glucose risen from evening meal</td>
</tr>
</tbody>
</table>

| **PREMIXED INSULIN REGIMEN (TWICE DAILY INJECTIONS)** | | | |
| Before Bed and Before Breakfast | Reduce Evening meal insulin by 10-20% | OPTIM AL | Increase Evening meal insulin by 10% | Increase Evening meal insulin by 20% |
| Before Lunch and Before Evening Meal | Reduce morning insulin by 10-20% | OPTIM AL | Increase morning insulin by 10% | Increase morning insulin by 20% |
HbA1c TARGETS AND GLYCAEMIC CONTROL MONITORING

Despite compelling evidence that improved glycaemic control reduces risks of microvascular and macrovascular complications in people with Type 1 Diabetes, the SIGN guideline 116 concluded no evidence was identified on outcomes associated with treatment to specific targets. Thus, there are several HbA1c targets recommended by different authorities, varying between 48-58 mmol/mol (6.5-7.5%). Targets can also vary for an individual even over a very short period of time depending on a variety of clinical and non-clinical circumstances and hence the individual's HbA1c target should be agreed with healthcare professionals.

All able people with Type 1 Diabetes should monitor their capillary blood glucose levels regularly for their safety. If a person is unable to do this for themselves then a family member or community nurse should be involved with that person's care.

The frequency of blood glucose monitoring recommended will depend on individual circumstances. For example a person using an intensive insulin regime such as DAFNE with variable lifestyle may require to test their blood glucose level 4-6 times daily as compared to a person with stable glucose control on a twice daily regime with regular sedentary daily routine who may only check their blood glucose level 1-2 times daily on average.

Furthermore, people using intensive insulin regimes requiring frequent blood glucose monitoring such as DAFNE or CSII should have access to blood ketone test strips on repeat prescription as an alternative to urine ketone test strips. This aids the person's self management and may avoid diabetic ketoacidosis and hospital admission.

References

Further Reading
Hypoglycaemia and its management
Blood glucose values less than 4 mmol/L should not be ignored (i.e. the cause should be investigated) and remedial treatment taken. See NHSL Diabetes MCN Guideline on Hypoglycaemia

Sick day Rules and Preventing Ketoacidosis
NHSL Diabetes MCN Diabetes and Intercurrent Illness Guideline

Education Programmes
Patient education and subsequent empowerment to self manage their condition is essential for day to day living with Type 1 Diabetes. DAFNE (Dose Adjustment For Normal Eating) is a structured education programme available to patients with Type 1 Diabetes in NHSL. Please refer to the NHSL Diabetes MCN guideline on self management of type 1 diabetes for further details of this programme.

Peer Review and Consultation
Consultant Diabetologists throughout Lanarkshire and the Diabetes Specialist Nurse group

Diabetes MCN endorsement
May 2014

Review Date
May 2017