St Helens & Knowsley Teaching Hospitals
Adult Inpatient Diabetes Management Guidelines
2014-2016 v24

Title Adult Inpatient Diabetes Management Guidelines 2014-2016

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Purpose Inpatient diabetes management guidance, for non-specialists

Reference see also Pan Mersey Diabetes Guidelines 2014-16v19.

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Evidence-base See Introduction and Topics & full NICE guidance.

Approval by: St Helens & Knowsley Hospitals Clinical Effectiveness Council.

Target population: All staff & students involved in the inpatient management of people with diabetes in St Helens & Knowsley Hospitals

Training needs: All of those using the document are offered specific (specialist) training relating to use of the document – please contact Prof Hardy’s secretary on 01744-646497


IMPORTANT NOTE

These guidelines should be used in conjunction with the Pan Mersey Diabetes Guidelines 2014-16, v19, which deal with the chapters in red on contents page (previously included in the St Helens & Knowsley Guidelines) – see Internet or Pan Mersey Medicines Management Group website.
Introduction

The aim of these recommendations is to provide brief guidance for non-experts on common topics encountered by those caring for people with diabetes.

The first 17 sections of this guide are to be found in the Pan Mersey Diabetes Guidelines 2014-16v19. Subsequent sections are inpatient-oriented and do not apply to those community-oriented guidelines.

A tension exists between ease of reference and discussion of the evidence base for a recommendation. Professionals delivering care to people with diabetes should read these recommendations in conjunction with current NICE guidance. For detailed discussions of the evidence underpinning diabetes management in the UK, see:

*NICE guidance – see www.nice.org.uk*

Important Notes

- Pragmatically, much management of Type 1 & Type 2 has been harmonised using the more up to date Type 2 guidance (the Type 1 guidance is 6 years old and dated; both are under review by NICE.

- These recommendations are for guidance only. Clinicians should always use their knowledge, experience and expertise to best manage patients’ individual needs and preferences.

- Drugs should be prescribed and monitored as per data sheet recommendations, or current best practice unless experience and the patient’s best interests dictate otherwise.

- Don’t use ‘U’ or ‘IU’ – state ‘units’ and only use insulin delivery devices (syringes or ‘pens’) specifically designed for insulin administration.

- Management of adults with diabetes undergoing surgery and elective procedures is subject of separate national guidance see:

  [www.diabetes.nhs.uk/our_work_areas/inpatient_care/](http://www.diabetes.nhs.uk/our_work_areas/inpatient_care/) (note we continue to recommend GKI as opposed to Variable Rate Insulin Infusion (VRII))

- Fluid therapy for adult surgical patients is described in British Consensus Guidelines (GIFTASUP).
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Topic 17: In-hospital Care of People with Diabetes

On Admission to Hospital

- All patients with known diabetes should have blood glucose checked within 30 minutes of arrival at hospital AND all patients with known diabetes should have a documented foot examination as part of their initial assessment.

- Don’t use PRN insulin. Don’t use ‘u’ or ‘iu’ - state ‘units’. Always deliver via a specific insulin syringe or insulin pen delivery device NEVER by ordinary syringes.

Exemplar Prescriptions

√ ACTRAPID VIAL, 12 UNITS, SC, 20 min Pre-lunch
√ NOVOMIX 30 FLEXPEN, 32 UNITS, SC, 15 min Pre-breakfast

- If the person knows how to manage their diabetes and is able and wants to do so, it is much better to let them do it – they usually know their diabetes.

- Use Inpatient Diabetes Chart. If BMs mostly 4-12, do QDS twice weekly. If unstable or unsure, do QDS daily (pre-breakfast, pre-lunch, pre-tea, pre-bed and wake patient if resting/sleeping at test time). Monitoring only useful if ACTION is taken to address persistent problems.

- Blood ketones checked on finger prick sample is available on A&E, 1b, 1c, 1e, & 4e; for other wards, send a venous sample to the lab. Routine ketone checks unnecessary; check if insulin-treated & BM >15 mM – urgent medical assessment if ≥ 3.0 mmol/l.

- If patients BMs are generally outside the range 4-12, then ACTION is needed. Refer to Diabetes Specialist Team and make appropriate changes to treatment:

- Increasing OHAs rarely works for inpatient hyperglycaemia – use INSULIN

Stable

- If eating & BMs 4-12, continue present treatment
- If Type 2 & not eating & BMs 4-12, continue present treatment (hypo risk).
- If Type 1 (or doubt) & not eating & BMs 4-12, use GKI (Topic 18a)

Unstable

- If eating & BMs > 12, use IV insulin infusion pump (Topic 18b) to get control & TDS Soluble Insulin (e.g. Actrapid) (Topic 19a) to maintain it.
- If not eating & BMs > 12, use IV insulin infusion pump (Topic 18b) & GKI (Topic 18a) when BMs 4-12.

- Refer all patients admitted with DKA, recurrent or severe hypoglycaemia, new Type 1 diabetes or diabetic foot ulceration to the Specialist Diabetes Team without delay.

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Topics 17-25, Page 4 of 18
**Topic 18a: Glucose Potassium Insulin Infusion (GKI) and TDS Soluble Insulin**

GKI is an extremely efficient method for MAINTAINING blood glucose.

*See Topic 17 for when to use*

**Standard GKI**

Add 16 units soluble insulin (e.g. Actrapid) and 10 mmol potassium chloride (KCL) 500 ml to 10% dextrose & infuse at 80 ml/hr. New bags needed every 6 hr - as dictated by glucose and U&E taken 5 hr after a bag was started (i.e. 1 hr before new bag):

<table>
<thead>
<tr>
<th>Plasma Glucose</th>
<th>Soluble Insulin added to new bag</th>
<th>Plasma K</th>
<th>KCL in new bag (pre-mixed bags)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-12</td>
<td>Same as last bag</td>
<td>3.5-5.0</td>
<td>10 mmol</td>
</tr>
<tr>
<td>&lt;4</td>
<td>4 units less</td>
<td>&lt; 3.5</td>
<td>20 mmol</td>
</tr>
<tr>
<td>&gt; 12</td>
<td>4 units more</td>
<td>&gt; 5.0</td>
<td>0 mmol</td>
</tr>
</tbody>
</table>

1-2 hourly BMs alert staff to unusual insulin sensitivity or resistance. They are unnecessary once the patient is clearly stable on a particular regimen. Continue long-acting insulins, such as Insulin Glargine or Insulin Detemir. Note: In insulin resistant states (e.g. post-DKA) higher insulin doses may be required.

**Converting to Subcutaneous Insulin**

**PLEASE NOTE:** You MUST continue GKI for 30-60 minutes AFTER first injection of soluble insulin (alone or in a mixture).

**TDS Soluble Insulin**

Whether T1DM or T2DM, & usually diet, tablet or insulin-treated, if sugars are unstable or high & patient is eating, TDS soluble insulin (e.g. Actrapid) is useful to establish blood glucose control short-term. Aggressive dose titration is essential to achieve control. **If rapid correction is desirable, use IV insulin infusion by pump.**

**TYPICAL STARTING DOSE**

- Frail elderly: 8 units TDS
- Average man or woman: 16 units TDS
- Large men or obese patients: 24 units TDS

Give insulin TDS 30 min. before meals and monitor BMs. **Adjust often and aggressively until BMs largely 4-12 mM. If in doubt ask Diabetes Specialist Team.**

e.g. Start 16 units TDS, BMs 10-15, increase to 24 units TDS & so on.

Adult Inpatient Diabetes Management Guidelines 2014-16
**Topic 18b: Intravenous Insulin Infusion by pump**

*Intravenous Insulin Infusion Pump. See Topic 17 for when to use*

IV insulin is the quickest and most effective way to control blood sugar in inpatients. GKI is better for maintaining stable sugars in those unable to eat. GKI is cautioned in ACS because the fluid load may be associated with increased risk of heart failure and an adverse outcome.

Make up a 50 ml syringe with 50 units of soluble insulin (e.g. ACTRAPID) in 49.5 ml of 0.9% saline. This makes a concentration of 1 unit per ml.

Hourly blood glucose measurements are done to reduce the very real risk of hypoglycaemia. If blood glucose is not measured hourly during stabilisation, then this protocol is not safe.

After first 24 hours (or less) once patient has been stabilised it is anticipated that they will have been switched to a GKI (see Topic 18a). Continue long-acting insulins, such as Insulin Glargine (Lantus) or Insulin Detemir (Levemir).

**Insulin Starting Point**

Start IV insulin at 0.1 units / kg / hour (i.e. 7 units / hour for 70 kg patient). Monitor BMs hourly.

**Insulin Infusion Adjustment**

<table>
<thead>
<tr>
<th>Bedside Capillary Blood Glucose (mmol/l)</th>
<th>Insulin Infusion Adjustment (units per hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 4.0</td>
<td><strong>Stop insulin &amp; give 100ml 20% dextrose IV stat. Resume after 30 min at half previous rate if IV insulin infusion still required (i.e. not switched to GKI or TDS soluble insulin)</strong></td>
</tr>
<tr>
<td>4.0 – 12.0</td>
<td><strong>Stop insulin pump and switch to GKI (or TDS soluble insulin if eating).</strong></td>
</tr>
<tr>
<td></td>
<td><strong>For Acute Coronary Syndrome (Topic 21) to maintain BG 4.0-12.0, using IV insulin infusion, once readings between 4.0-12.0, continue present infusion rate and adjust (as per boxes above or below) if BG moves out of 4.0-12.0 range.</strong></td>
</tr>
<tr>
<td>&gt; 12.0</td>
<td><strong>If higher than the last test, increase by 2 units / hour. If same as the last test, increase by 1 unit / hour. If lower than the last test, keep at the same rate</strong></td>
</tr>
</tbody>
</table>

**Converting to Subcutaneous Insulin**

**PLEASE NOTE:** You MUST continue IV insulin pump for 30-60 minutes AFTER first injection of soluble insulin (alone or in a mixture).
Management of adults with diabetes undergoing surgery and elective procedures has been addressed by UK national guideline (2011). It is strongly recommended that you follow the link below and study these guidelines.


Note we continue to recommend GKI (topic 18a) not Variable Rate Insulin Infusion (VRII)).

**Emergency surgery**

Stop usual diabetes treatments and use GKI (Type 1 & Type 2 DM). If the patient usually takes a long-acting insulin analogue (Detemir (Levemir) or Glargine (Lantus)) this should be continued alongside GKI. If at all possible, every effort should be made to stabilise diabetes before surgery. Aim to maintain blood glucose 4-12 mmol/l.

**Elective surgery**

Key points:

- Routine overnight admission for preoperative management should not be required.
- Management of elective patients should be with modification to their usual diabetes treatment if fasting is minimised (no more than one missed meal) as the routine use of IV insulin (GKI) is not recommended.
- Poor preoperative glycaemic control is associated with adverse outcomes post-surgery and where possible should be optimised before surgery.

**Pre-operative assessment**

All patients with diabetes in whom elective surgery (necessitating a period of starvation) is planned should attend for pre-op assessment ASAP (before being listed for surgery).

If glycaemic control is sub-optimal, the risks of proceeding should be balanced against the urgency of the procedure.

Consider referral to the Diabetes Specialist team if HbA1c > 69 mmol/mol (8.5%), or the patient has hypo unawareness or autonomic neuropathy, or is at high cardiovascular risk.

Minimise starvation time by prioritising patients on the operating list (patients expected to miss more than one meal should have a GKI (Topic 18a)) – use pre-op bloods if healthy, no new medications and eGFR > 60 and K+ 3.5-5.0 mmol/L.

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### Topic 19b: Peri-operative insulin adjustment for short starvation period - no more than ONE missed meal

<table>
<thead>
<tr>
<th>Insulins</th>
<th>Day prior to admission</th>
<th>Day of surgery Patient for AM surgery</th>
<th>Day of surgery Patient for PM surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Once daily (evening)</strong> (e.g. Glargine, Detemir, Insulatard, Humulin I, Insuman Basal)</td>
<td>No dose change</td>
<td>Check blood glucose on admission</td>
<td>Check blood glucose on admission</td>
</tr>
<tr>
<td><strong>Once daily (morning)</strong> (e.g. Glargine, Detemir, Insulatard, Humulin I, Insuman Basal)</td>
<td>No dose change</td>
<td>No dose change Check blood glucose on admission</td>
<td>No dose change Check blood glucose on admission</td>
</tr>
<tr>
<td><strong>Twice daily</strong> (e.g. Novomix 30, Humalog Mix 25, Insuman Comb 25, Humulin M3, twice daily Detemir)</td>
<td>No dose change</td>
<td>Halve the usual morning dose. Check blood glucose on admission. Leave the evening meal dose unchanged</td>
<td>Halve the usual morning dose. Check blood glucose on admission. Leave the evening meal dose unchanged</td>
</tr>
<tr>
<td><strong>Twice daily – separate injections of short acting</strong> (e.g. animal neutral, novorapid, Humulin S) and <strong>intermediate acting</strong> (e.g. animal isophane, Insulatard, Humulin I)</td>
<td>No dose change</td>
<td>Calculate the total dose of both morning insulins and give half as intermediate acting only in the morning. Check blood glucose on admission. Leave the evening meal dose unchanged</td>
<td>Calculate the total dose of both morning insulins and give half as intermediate acting only in the morning. Check blood glucose on admission. Leave the evening meal dose unchanged</td>
</tr>
<tr>
<td>3, 4, or 5 injections daily</td>
<td>No dose change</td>
<td>Basal bolus regimens: omit the morning and lunchtime short acting insulins. Keep the basal unchanged. Premixed AM insulin: Halve the morning dose and omit lunchtime dose. Check blood glucose on admission</td>
<td>Take usual morning insulin doses(s). Omit lunchtime dose. Check blood glucose on admission</td>
</tr>
<tr>
<td><strong>Continuous Subcutaneous Insulin Infusion (CSII or insulin pump therapy)</strong></td>
<td>No dose change</td>
<td>Use GKI (continue until the patient is able to resume self-management of CSII – stop GKI 30-60 minutes after CSII is recommenced)</td>
<td>Use GKI (continue until the patient is able to resume self-management of CSII – stop GKI 30-60 minutes after CSII is recommenced)</td>
</tr>
</tbody>
</table>

For longer starvation periods – MORE THAN ONE missed meal USE GKI (Topic 18a).

For advice, contact the diabetes team.
**Topic 19c: Peri-operative adjustment of non-insulin medication for short starvation period - no more than ONE missed meal.**

<table>
<thead>
<tr>
<th>Insulins</th>
<th>Day prior to admission</th>
<th>Day of surgery Patient for AM surgery</th>
<th>Day of surgery Patient for PM surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metformin (*procedure not requiring use of contrast media)</td>
<td>Take as normal</td>
<td>Take as normal</td>
<td>Take as normal</td>
</tr>
<tr>
<td>Sulphonylurea (e.g. Gliclazide, Glipizide)</td>
<td>Take as normal</td>
<td>Once daily AM: omit Twice daily: omit AM</td>
<td>Once daily AM: omit Twice daily: omit AM and PM</td>
</tr>
<tr>
<td>Pioglitazone</td>
<td>Take as normal</td>
<td>Take as normal</td>
<td>Take as normal</td>
</tr>
<tr>
<td>DPP-IV inhibitor (e.g. Stiagliptin, Linagliptin)</td>
<td>Take as normal</td>
<td>Omit on day of surgery</td>
<td>Omit on day of surgery</td>
</tr>
<tr>
<td>GLP-1 analogue (e.g. Exenatide, Liraglutide)</td>
<td>Take as normal</td>
<td>Omit on day of surgery</td>
<td>Omit on day of surgery</td>
</tr>
<tr>
<td>Meglitinide (Repaglinide or Nateglinide)</td>
<td>Take as normal</td>
<td>Omit morning dose if NBM</td>
<td>Give morning dose if eating</td>
</tr>
<tr>
<td>Acarbose</td>
<td>Take as normal</td>
<td>Omit morning dose if NBM</td>
<td>Give morning dose if eating</td>
</tr>
<tr>
<td>SGLT2 Inhibitors (e.g. Dapagliflozin, Canagliflozin, Empagliflozin)</td>
<td>Take as normal</td>
<td>Omit on day of surgery</td>
<td>Omit on day of surgery</td>
</tr>
</tbody>
</table>

*If contrast medium is to be used, metformin should be omitted on the day of surgery and for the following 48 hours. Restart metformin after 48 hours if eGFR is stable.

**For longer starvation periods – MORE THAN ONE missed meal USE GKI (Topic 18a).**

For advice, contact the diabetes team.
**Topic 19d: Peri-operative monitoring of Diabetes and management of hyper & hypoglycaemia in patients undergoing surgery with a short starvation period (one missed meal)**

Monitor capillary blood glucose on admission and hourly during the day of surgery (more frequently if not within target). Aim for blood glucose 4-12 mmol/L.

**Peri-operative hyperglycaemia**

If blood glucose > 16 mmol/L pre or post surgery check for ketones. If capillary blood ketones > 3 mmol/l or urinary ketones > +++ cancel surgery, follow DKA guidelines (Topic 22a) and contact medical on call team.

**Pre-operative hyperglycaemia:** BM > 12.0 & blood ketones < 3.0 or ketonuria < +++

- **Type 1 diabetes:** give subcutaneous rapid acting analogue insulin (i.e. NovoRapid, Humalog or Apidra). Assume that 1 unit of insulin will reduce blood glucose by 3 mmol/l BUT wherever possible take advice from the patient about the amount of insulin usually required to correct a high glucose. Recheck blood glucose after 1 hour. If surgery cannot be delayed use IV insulin pump (Topic 18b), switching to GKI (Topic 18a) when blood glucose < 12 mmol/L.

- **Type 2 Diabetes:** give 0.1 units/kg of subcutaneous rapid acting analogue insulin and recheck blood glucose after 1 hour to ensure it is falling. If surgery cannot be delayed use IV insulin pump (Topic 18b), switching to GKI (Topic 18a) as above.

**Post-operative hyperglycaemia:** BM > 12.0 & blood ketones < 3.0 or ketonuria < +++

- **Type 1 diabetes:** give subcutaneous rapid acting analogue insulin (i.e. NovoRapid, Humalog or Apidra). Assume that 1 unit of insulin will reduce blood glucose by 3 mmol/l BUT wherever possible take advice from the patient about the amount of insulin usually required to correct a high glucose. Recheck blood glucose after 1 hour to ensure it is falling. Consider giving further subcutaneous insulin after 2 hours if BM remains > 12.0.

- **Type 2 Diabetes:** give 0.1 units/kg of subcutaneous rapid acting analogue insulin and recheck blood glucose after 1 hour to ensure it is falling. Consider giving further subcutaneous insulin after 2 hours if BM remains > 12.0.

**Pre-operative hypoglycaemia (see topic 24)**

If hypoglycaemic pre-surgery give 100ml 20% dextrose by IV infusion over 10-15 mins and repeat BM after 15 minutes.
**Blood Glucose in AMI and ACS**

Robust evidence to guide optimal management of hyperglycaemia in patients admitted to hospital for an acute coronary syndrome (ACS) is lacking. Whilst avoiding sustained hyperglycaemia appears of benefit, the optimal regimen to achieve this is not clear. Additionally, hypoglycaemia may be particularly detrimental, as may be the fluid load associated with GKI.

Until new evidence resolves this issue we recommend the following:

- Treat **sustained** hyperglycaemia. Aim to keep blood glucose levels 4.0-12.0 mmol/litre, while avoiding hypoglycaemia.

- If eating use TDS soluble insulin (e.g. actrapid) (most patients), preceded by IV insulin infusion if severely hyperglycaemic (> 16 mmol/l).

- If not eating, consider a dose-adjusted insulin infusion to achieve and maintain blood glucose 4.0-12.0 mmol/L with regular monitoring of blood glucose levels (see Topic 18b: Intravenous Insulin Infusion Pump), or GKI if no cardiac failure.

**Tests for Diabetes**

Identifying patients with hyperglycaemia after ACS who are at high risk of developing diabetes: offer all patients with hyperglycaemia after ACS and without known diabetes:

- HbA1c (refer to Diabetes Specialist Team as outpatient if ≥ 48 mmol/mol (6.5%))

Do not routinely offer oral glucose tolerance tests to patients with hyperglycaemia after ACS.

**Acute Stroke**

There is no specific national guidance on managing hyperglycaemia in acute stroke, but the principles outlined above for AMI and ACS might reasonably be applied to acute stroke.
1. All patients with diabetes should have a documented foot examination on admission to hospital as part of their initial assessment.

2. All patients with diabetic foot ulceration should have detailed description (with measurements and ideally photograph) of ulcers within 4 hours of detection.

3. All patients with foot ulceration that is not healing or appears infected to have antibiotics within 6 hr of admission.

4. All inpatients with diabetic foot ulceration to be referred to specialist diabetes team within 24 hr of admission.

5. All inpatients with diabetic foot ulceration to be seen by specialist diabetes foot team within 72 hr of admission.

**Referrals**

- Predominantly neuropathic ulceration below the malleoli - refer to Diabetes Foot Ulcer Clinic (Dr Srinivas-Shankar – see Topic 24).
- Predominantly ischaemic ulceration, intermittent claudication or ischaemic rest pain - refer to Vascular Team.
- Traumatic ulceration & in-growing toenails - refer to General Surgery.
- Ulceration on or above the malleoli - refer to Dermatology Clinic.
- Critical ischaemia should be referred urgently to Vascular Surgeons.

**Antibiotics**

Not all foot ulceration requires antibiotics – if in doubt start antibiotics and seek expert review.

Level B – use antibiotics. First line antibiotics for diabetic foot ulceration is guided by current edition of hospital antibiotic policy – please consult this policy for guidance.

See Hospital Antibiotic Policy for details and consider early IP referral to Hospital Diabetes Team and/or Surgeons / Vascular Surgeons for Inpatient Management of limb-threatening infections.
**Management of Adult Diabetic Ketoacidosis (DKA)**

**Diagnosis**
Usually some of: polyuria, polydipsia, thirst, weight loss, vomiting, dehydration, drowsiness, abdominal pain, hyperventilation

AND…

- pH < 7.3,
- BG > 11 mM,
- HCO$_3$ < 15 mM, Ketonaemia ≥ 3 mM

**Management**

**USE DKA FLOWCHART (see 22b)**

**Treatment**
Start fluids immediately DKA confirmed (gases + BG [capillary sample may be unreliable – use venous blood]). Start insulin once gas machine result confirms serum K$^+$ >3.5 mmol/l. If serum K$^+$ < 3.5 mmol/l, withhold insulin until K$^+$ > 3.5 (see below). If planning treatment delay (for any reason), discuss immediately with Senior.

**Clinical**
Confirm diagnosis, seek cause, assess CVS/RS/CNS. Refer HDU if age<25 or >65 yr, pregnant, heart or kidney failure, serious co-morbidities, ketonaemia >6 mM, HCO$_3$ <5 mM, pH <7.1, admission K$^+$ <3.5 mM, GCS <12, O$_2$ sat <92%, anion gap > 16, systolic BP <90, or heart rate <60 or >100. Continue long-acting insulins (e.g.Glargine) at usual dose and time.

**Laboratory**
BG, U&E, blood gases, MSSU, urinalysis, (low threshold for CXR & blood cultures), ECG. Blood ketones–use finger prick & ketone meter.

**General**
Add Enoxaparin 40 mg o.d. Check & monitor GCS & EWS.

**Fluids**
Fluid replacement depends on hydration & CV status. Use 0.9% saline. Typically, give the first litre over 1 hr, then 1 L over 2 hr and 1 L over 4 hr. Adjust rate & volume of fluids to hydration status.

**Potassium**
Await K+ result before using added KCL. Use 0.9% saline pre-constituted bags – don’t add KCI yourself. If K+ > 5.5 mM use bag with nil KCI; if K+ 3.5-5.5 mM use bag with 40 mmol KCl per litre; if K+ <3.5 mM, consult senior & halt insulin infusion for 30 mins. Monitor ECG if ≥ 20 mmol of KCl infused per hour (Trust policy – max infusion rate = 20 mmol/hr).

**Insulin**
Use ACTRAPID. Start IV infusion pump (50 units ACTRAPID in 49.5ml 0.9% saline i.e. 1 unit/ml) at 0.1 units/kg/hour (i.e. 7 units/hr for 70 kg). If BG fall < 3 mM/hr or blood ketones not falling, increase insulin infusion by 1 unit/hr each hour until these goals are achieved.

**Bicarbonate**
Bicarbonate should not be used in the management of DKA (Level A).

**GKI**
When BG 4-12 mM, stop insulin pump & use GKI (typical insulin starting dose 24 Units, with hourly BM monitoring) (Topic 18A) or resume diet and insulin.

**Monitoring**
Hourly capillary BG & ketones; U&E & serum bicarbonate 2 hourly x 6 hr, then 4 hourly; venous pH at 6 hr. Senior review within 12 hr of admission.

**Aftercare**
Review CVS/CNS daily. Assess for complications. Re-education - refer all DKA patients to Diabetes Specialist Team without delay (Topic 24).
Topic 22b: Flowchart for Mx of Adult Diabetic Ketoacidosis (DKA)

See Intranet / Diabetes for eCopy. Colour printed copies of this form are available in A&E and on AMU.
**Topic 23: Management of Hyperosmolar Hyperglycaemic State (HHS) [formerly “HONK”]**

**Diagnosis**

Usually dehydrated & unwell.

AND...

- BG > 30 mM, pH > 7.3, HCO₃ > 15 mM, Ketonaemia < 3 mM
- Serum Osmolality > 320 (where Osm = 2 x Na + BG + Urea)

**Management**

**Clinical**

Confirm diagnosis, seek cause, assess CVS/CNS (including cognition).

**Laboratory**

BG, U&E, Gases, Bld Ketones, Lactate, MSSU, urinalysis, ECG, CXR & blood cultures.

**Treatment**

**DON’T DELAY TREATMENT** (after diagnosis established).

**General**

Refer all patients to HDU/ICU. Low threshold for: NGT / antibiotics. Foot care – high risk of ulceration. Give Enoxaparin 40 mg daily until discharge.

**Fluids**

Fluid replacement depends on hydration & CV status. Usual losses = 100-220ml/kg. Replace half in first 12 hr & half in 2nd 12 hr. Use 0.9% saline. Start infusion at 1L/hr (0.45% saline rarely needed). Aim for BG fall of 4-6 mmol/l per hour & osmolality fall of 3-8 mOsm/kg/hr; fall of plasma sodium should not exceed 10 mmol in 24 hrs.

**Potassium**

Await K+ result before using added KCL. 0.9% Saline - use pre-constituted bags – don’t add KCl yourself. If K+ > 5.5 mM use bag with nil KCl; if K+3.5-5.5 mM use bag with 40 mmol KCl per litre; if K+ <3.5 mM, consult senior & halt insulin infusion for 30 minutes. Monitor ECG if ≥ 20 mmol of KCl infused per hour (Trust policy – max infusion rate = 20 mmol/hr).

**Insulin**

DO NOT start insulin initially if blood ketones < 3mmol/l. Start insulin when BG no longer falling with fluids alone. Use ACTRAPID IV infusion via pump (50 units ACTRAPID in 49.5 ml 0.9% saline i.e. 1 unit/ml) at 0.05 units/kg/hour (i.e. 3.5 units per hour for 70 kg man). Aim to reduce BG by no more than 5 mM per hour. If glucose not falling on infusion, increase by 1 unit/hour. Use infusion at outset if ketones > 3mmol/l.

**GKI**

When BG 4-12 mM, stop insulin pump & use GKI (see Topic18A). It may be necessary to continue saline infusion as well as GKI until dehydration corrected.

**Monitoring**

Monitoring should include hourly BG, U&E and osmolality for first 6 hours, then 2 hourly if response satisfactory. Review should cover all aspects of clinical management at frequent intervals.

**Aftercare**

Review CVS/CNS & feet daily. Assess for complications. Re-education - refer all HHS patients to Diabetes Specialist Team (Topic 25) without delay.
Hypoglycaemia typically manifests as hunger, sweating, tremulousness, headache, with or without confusion and reduced conscious level and blood sugar typically < 4.0 mM. Some patients fit during hypoglycaemia and some develop (reversible) hemiparesis.

1. All patients to be given quick acting carbohydrate within 15 minutes of low blood sugar detection.

2. All patients who have received quick acting carbohydrate for hypoglycaemia should have capillary blood glucose monitored every 15 minutes for at least 45 minutes or until blood glucose normal.

3. If blood glucose still low after 45 minutes, care MUST be escalated to a doctor or Diabetes Nurse Specialist.

4. Cause of low blood sugar should be discussed with patient before discharge.

**Oral Treatment**

Approximately 15-20g of quick-acting carbohydrate (e.g. 4 Glucotabs or 5 Dextrose tablets or half a glass of lucozade or sugary (3 spoons) tea,). See above re monitoring. Unless the person is about to eat a meal, they should then have 15-20g of long-acting carbohydrate (such as a sandwich or two slices of toast).

A rapidly absorbable sugary solution is available (DEXTROGEL) and may be used instead of other quick-acting carbohydrate in semiconscious patients (who can still protect airway) if parenteral treatment and emergency help is not available (not in unconscious patients).

**If Patient can’t take Carbohydrate by mouth**

If intravenous glucose (or dextrose) is used, then use 20g of 20% (100 ml) dextrose by IV infusion over 10-15 min.

1 mg of glucagon may be given IM or IV where IV glucose is unavailable. Glucagon may cause headache and vomiting (especially in young – consider 0.5 mg in teenagers).

Sulphonylurea-induced hypoglycaemia may require prolonged treatment and supervision – refer to specialist diabetes care.

**Subsequent Management**

Severe hypoglycaemia is often recurrent – after one episode people are particularly susceptible to further episodes over the next few days or more and may have reduced hypoglycaemia awareness. After an episode of severe hypoglycaemia:

→ referral to the Hospital Specialist Diabetes Team is recommended.
Background

Insulin pumps are small (about the size of a pager) external devices that are often used in type 1 Diabetes to improve blood glucose control and reduce hypoglycaemia. Rapid-acting insulin (e.g. NovoRapid) is infused subcutaneously at pre-programmed rates set by the patient or specialist team. Insulin is delivered via a cannula, usually sited in the abdominal wall, which is changed every 2-3 days. Basal (background) insulin is provided by a continuous infusion of rapid-acting insulin with boluses to cover meals.

Important

As insulin pumps only administer rapid-acting insulin, discontinuation of pump therapy, without alternative provision of insulin, can result in DKA. Inform the Diabetes Team if a patient using an insulin pump is admitted.

Education

Patients receive intensive education in pump use. Inpatients should be allowed to self-manage if stable and well enough to do so. Pump settings should only be adjusted by the patient or a member of the Diabetes Team.

Unwell patients

If the patient is not well enough to self-manage, or is unconscious / incapacitated, the pump should be removed (and safely stored) with insulin administered via a different route; typically IV insulin (Topic 18b), GKI (Topic 18a) or basal-bolus therapy. A pump should NEVER be discontinued without immediate substitution of insulin via another route and only restarted when the patient is well and able to self-manage (contact the Diabetes Team for advice).

DKA

If a patient using a pump is admitted with DKA, the pump should be removed (and safely stored) & the patient treated with IV insulin / fluids etc. as per Topic 22a. When the patient is well and able to self-manage, insulin pump therapy can be restarted with a new cannula, giving set and reservoir.

Restarting pump

When returning from IV insulin to s.c insulin pump therapy, IV insulin should not be discontinued until the pump has been running for 30-60 minutes and a mealtime bolus has been given.

Hypoglycaemia

For patients able to self-manage, give 15-20g quick acting carbohydrate orally (Topic 24). Follow-up with long-acting carbohydrate may not be needed, but infusion rates may need adjusting, particularly if hypoglycaemia is recurrent (contact the Diabetes Team for advice). For unconscious / incapacitated patients use IV dextrose (100ml 20%). Remove the pump if hypoglycaemia is persistent AND recommence insulin when blood glucose has returned to normal – via insulin pump if patient well and able to self-manage, or GKI / sub-cutaneous injections. This is important to prevent DKA.

Radiological tests

Insulin pumps must be suspended and removed prior to MRI, and not taken into the scanning room (removal for CT also advised). Pumps can be safely suspended / removed for up to 1 hour without alternative insulin but should be restarted immediately following the investigation.
Surgery  
See topic 19b. Contact the diabetes team for advice.

**Topic 26:**  Contacting Specialist Diabetes Services for Inpatients

The Diabetes Specialist Team provides management support (advice and consultations) for secondary care teams providing a range of services for inpatients with diabetes (e.g. surgical patients). This includes diabetes nurse specialist review, specialist registrar review and consultant review (all accessed via referral form).

Hospital inpatients should be referred by phone. Please indicate whether IP or OP review is required (use form for OP referrals). Written consultant-consultant referrals (if phone impractical) should be faxed to relevant consultant secretary.

There is also ongoing diabetes specialist care for the small number of patients admitted to hospital with diabetes-related problems that require ongoing specialist input (e.g. medical management of severely infected diabetic foot ulcers).

**Consultant Advice:** the Diabetes Consultants can be contacted through their secretaries, who typically know whether they are available to take a call and will connect you.

Dr Sumudu Bujawansa – Linda.Sankey2@sthk.nhs.uk or 01744 646497
Dr Srinivas-Shankar – Thea.McCarten@sthk.nhs.uk or 01744-646502
Dr Sid McNulty – Linda.Sankey2@sthk.nhs.uk or 01744-646497
Dr Niall Furlong – Colette.Case@sthk.nhs.uk or 01744-646500
Mrs Jan Cardwell (Nurse Consultant) Colette.Case@sthk.nhs.uk or 01744-646500
Prof. Kevin Hardy – Linda.Sankey2@sthk.nhs.uk or 01744-646497

**Email:** The diabetes consultants are accessible by email using the district INTRANET.

**Letter:** slower than telephone and email but available for those who prefer it.