1. Introduction

1.1 This document sets out the University Hospitals of Leicester (UHL) guidelines for the management of Diabetic Ketoacidosis (DKA) in adults. It is based on the Joint British Diabetes Societies (JBDS) guideline 'The Management of Diabetic Ketoacidosis in Adults', (2nd edition) published in 2013.

1.2 There are some key recommendations that were included in the 1st edition of the JBDS Management of DKA (2010) which may differ from historic guidance, these include:

a) Use of venous rather than arterial blood sampling if possible

b) Monitoring of blood ketone levels (using a near patient "finger prick" testing kit) – if available

c) Use of 10% glucose when blood glucose level < 14mmol/l alongside crystalloid fluid replacement

d) Continuation of long acting analogue insulin (if patient normally uses one)

e) Fixed rate insulin infusion (FRII) based on patient's weight rather than variable (sliding scale) rate

1.3 Changes included in this current version of UHL guidance for the Management of Diabetic Ketoacidosis in Adults taken from the JBDS (2013) include:

a) If patients are already on NPH insulin (Humulin I®, Insulatard® or Insuman Basal®) these insulins should be considered for continuation, in the same way that long acting analogue insulins are continued [see 1.2d above]

b) A maximum initial rate of 15 units per hour of insulin is recommended

c) Criteria for resolution of DKA have changed, it is now

- pH > 7.3
- Bicarbonate (HCO_3^-) > 15.0 mmol/L **and**
- Blood ketone level < 0.6 mmol/L (rather than < 0.3 mmol/L)

d) Patients presenting with newly presenting type 1 diabetes should be initiated on background basal insulin (Levemir®) alontgside the FRII. See Section B (covering the 60 mins-6 hours time period), Action 4. Diabetes team should be involved.

1.4 The fundamental principles in the management of DKA are:

- replacement of fluid deficit
- insulin treatment
- monitoring and maintaining electrolyte / potassium balance in a safe environment.
- avoiding complications of treatment

1.5 Previous audit of DKA management at UHL has highlighted the potential risks of **hypoglycaemia** and/or **hypokalaemia**. At particular stages of the management pathway extra care is therefore recommended.

These risks should be assessed throughout the entire management of DKA however the times when they are considered particularly relevant are highlighted in the treatment pathway below (Section 3) with a warning triangle. 

These include:

- When blood glucose level drops to < 14 mmol/L. If there is a delay in starting the 10% glucose infusion, hypoglycaemia becomes a risk.
- When blood ketones < 0.6 mmol/L. If there is a delay in stopping the fixed rate intravenous insulin infusion (in favour of either variable rate insulin infusion or s/c insulin regimen) hypoglycaemia is a risk.
- At the 1-hour potassium level check, assess the need to add potassium to IV fluid regimen. Audit shows previously some patients who required potassium did not receive it at this point in treatment and became hypokalaemic.

1.6 DKA can be complex condition to manage. Mortality associated with DKA is largely preventable if correctly managed. The commonest causes of death associated with DKA are:

a) Cerebral oedema – especially in children and adolescents
b) Hypokalaemia
c) Adult Respiratory Distress Syndrome (ARDS)
d) Co-morbid conditions (e.g. pneumonia)
e) Acute MI
f) Sepsis

1.7 Caution: patients with type 1 diabetes who are unwell are at risk of developing DKA particularly if:

- NBM
- Insulin doses are inadequate or omitted.

If a patient with type 1 diabetes deteriorates in hospital then refer for urgent medical review via Nerve Centre or escalate via Medical SpR on-call for urgent review.

1.8 A risk of euglycaemic DKA has recently been identified with the use of the class of oral hypoglycaemic agents 'SGLT-2 inhibitors. If any patient on an SGLT-2 inhibitor (dapagliflozin, canagliflozin, empagliflozin) appears unwell, please consider DKA, even if the blood glucose level is not significantly elevated.

2. Scope

This guideline applies to all adult inpatients with diabetes and to all healthcare professionals who are responsible for the clinical management and / or care of these patients.

Usually DKA will be diagnosed and managed within the Emergency Department and LRI Acute Care Bay (ACB) on medical admissions ward. However, occasionally patients develop DKA whilst an inpatient and this could occur in any ward area within UHL. Were this to occur please refer to Section 3.4 below for advice regarding provision of care.

3. Recommendations, Standards and Procedural Statements

3.1 Definitions

3.1.1 **Diabetic ketoacidosis (DKA)** is defined as the accumulation of ketone bodies in the blood of patients with diabetes mellitus, which results in metabolic acidosis. This is indicative of acute metabolic decompensation and is a medical emergency.

3.1.2 **Diagnosis of DKA** may be confirmed by:

- Ketonaemia ≥ 3.0 mmol/L **or** significant ketonuria (more than 2+ on standard urine sticks)
- Blood glucose > 11.0 mmol/L **or** known diabetes mellitus
- Bicarbonate (HCO_3^-) < 15.0 mmol/L **and / or** venous pH < 7.3

3.1.3 **Resolution of DKA** is defined as:

- pH > 7.3
- Bicarbonate (HCO_3^-) > 15.0 mmol/L **and**
- Blood ketone level < 0.6 mmol/L

3.2 Establishing the diagnosis of DKA

3.2.1 The diagnostic criteria for DKA are as follows, all three of the following should be present:

- Significant ketonuria (≥ 2+) or blood ketone > 3mmol/L
- Blood glucose > 11mmol/L or known diabetes mellitus
- Bicarbonate < 15mmol/L and/or venous pH < 7.3

3.2.2 The presence of one or more of the following may indicate severe DKA and may require admission to HDU/ITU and insertion of venous central line.

Immediate senior/anaesthetic review should be considered if:

a) Blood ketones greater than 6mmol/L
b) Bicarbonate less than 5mmol/L
c) Venous / arterial pH less than 7.0
d) Hypokalaemia (less than 3.5mmol/L) on admission
e) GCS less than 12 or abnormal AVPU or NEWS* >6
f) Oxygen saturation less than 92% (assuming normal respiratory baseline)
g) Systolic BP less than 90mmHg
h) Pulse greater than 100 or less than 60 bpm
i) Anion gap greater than 16 N.B. Anion gap = (Na + K) – (Cl + HCO3)

Note* **The Medical Early Warning System (NEWS) should be recorded when a patient arrives in a clinical area and appropriate action taken according to NEWS score.**

3.3 Specialconsiderations

3.3.1 Serious complications may arise during the management of DKA as a result of treatment. These include:

a) Hypo or hyperkalaemia

b) Hypoglycaemia

c) Cerebral oedema

d) Pulmonary oedema

3.3.2 It is critical that the patient and treatment are regularly monitored and reviewed as per the guidelines in order to minimise the risk of these complications.

3.3.3 Groups of patients in whom extra caution is required in their care and management, particularly regarding fluid balance include:

a) Young people aged 16-25 years

b) Elderly (>70yrs)

c) Pregnant (liaise with Obstetricians and Diabetes team regarding provision of care and management – gestation less than 24 weeks admit to medicine. For gestation greater than 24 weeks traditionally admitted to Labour ward but may be appropriate to be looked after on AMU with daily obstetric input – discuss with obstetric team)

d) Cardiac or renal failure

e) Other serious co-morbidities

3.3.4 Risk of euglycaemic DKA has been identified with use of SGLT-2 inhibitors (dapagliflozin, canagliflozin, empagliflozin). See 1.8 above

3.4 Provision of care for patients with DKA

3.4.1 Adult patients with suspected DKA admitted to the LRI Emergency Department (ED) should have the diagnosis confirmed and their treatment initiated in ED. Patients should then be transferred to the Acute Care Bay (ACB) on medical admission ward, LRI or if clinically indicated, to ITU. If patients require stepdown from ACB to a medical ward this should be to the diabetes ward only (unless clinical condition suggests alternative ward is more appropriate and this should be discussed and documented by either Diabetes SpR, Diabetes specialist in-reach team or medical SpR on-call).

3.4.2 If a patient with DKA is admitted to ED or ACB then the SpR or Consultant should be informed and the patient should be reviewed by a senior member of the team immediately if the NEWS indicates or directly after clerking and initiation of treatment by a junior member of the team if NEWS does not indicate immediate senior review is required.

3.4.3 Patients who develop DKA in other LRI ward areas should have their treatment initiated according to this guideline by the ward team, they should be reviewed by the Diabetes SpR or Medical SpR on-call as soon as possible and transfer to ACB should be arranged. If DKA develops in a patient on a Diabetes ward (LRI) then an assessment can be made by the Diabetes SpR regarding whether the patient requires transfer to the ACB or whether treatment can be managed by the Diabetes ward team.

3.4.4 If DKA develops in a ward area at GGH or LGH then treatment should be initiated by the ward team and the patient should then be reviewed by the Diabetes SpR or

Medical SpR on-call (depending on availability at each site) and a decision made regarding the appropriate area for the patient to be managed. In normal working hours (Mon-Fri, 9-5pm) there is both a Diabetes SpR and a Diabetes Consultant available to review/discuss cases. Both are contactable via LRI switch board.

3.4.5 If DKA develops outside of the ED or ACB then once immediate treatment has been initiated by the ward team senior medical review should be sought as above. Referral for senior review should be made within the first hour of establishing the diagnosis and initiating treatment.

3.5 DKA care pathway

The following table details the DKA Care pathway divided into timed sections.

This pathway should be followed once the diagnosis of DKA has been established

(See Section 3.2).

Section A	**Immediate management 0-60 minutes**
Section B	**60 minutes-6 hours**
Section C	**6-12 hours**
Section D	**12-24 hours**
Section E	**Conversion to subcutaneous insulin and safe discharge**

DKA Care Pathway

Section A (0-60 mins)

Aims

Time = 0 mins at time intravenous (iv) fluids are commenced. If access problems, involve critical care support immediately.

- Commence IV 0.9% sodium chloride
- Give 10 units soluble insulin (e.g. Actrapid®) stat either i/m or s/c if likely to be delay of longer than 15 mins from diagnosis, in starting iv insulin (See Action 1 below)
- Commence IV fixed rate insulin
- Establish appropriate monitoring (hourly capillary blood glucose and blood ketones plus 2 hourly potassium by venous blood gas)
- Clinical and biochemical assessment of patient
- Review IV fluid regimen based on patient's clinical and biochemical assessment and blood glucose levels

Action 1 – intravenous (iv) access, initial investigations and stat dose of insulin

- Assess Airway, Breathing, Circulation and **NEWS**
- Site Large bore iv cannula
- Commence fluid replacement (for Regimen see Action 2 below)
- Give 10 units soluble insulin (e.g. Actrapid®) stat either i/m or s/c if there is likely to be a delay of longer than 15 minutes from diagnosis in starting iv insulin. If fixed rate IV insulin can be started within 15 mins, omit this stat i/m or s/c insulin dose.
- Clinical assessment (RR, Temp, BP, Pulse, O_2 sats, NEWS score, GCS, full clinical examination including patient's feet)
- Assessment of fluid status, monitor input / output – essential to avoid fluid overload
- Initial investigations (blood ketones, capillary blood glucose, venous plasma glucose, U&E, venous blood gases, FBC, ECG, CXR, urine dip and if indicated, MSU for culture)
- Blood cultures if clinically indicated
- Cardiac monitoring & Pulse oximetry
- Consider precipitating causes and treat appropriately
- Establish usual medication for diabetes **and** perform pregnancy test if appropriate

Action 2 – restoration of circulating volumes and potassium replacement

If systolic BP < 90mmHg (systolic hypotension likely due to low circulating volume but caution in young and elderly or if other cause such as heart failure present).

- Give 500ml 0.9% sodium chloride – over 15mins
- Repeat if BP remains low whilst awaiting senior input

DKA Care Pathway
When systolic BP > 90 mmHg follow regimen in the table below which gives a guide for previously fit and well 70kg individual. A slower infusion rate should be considered in young (16-25yrs), elderly patients (>70yrs) and those with renal / cardiac failure. (CVP line may be considered in such groups.) **Assessment of fluid balance to avoid fluid overload should be part of the on-going management in all patients.**

 Assess potassium levels. Add potassium to IV fluids if required as risk of hypokalaemia

	Fluid	**Volume over time**	**Rate** (ml/hr)
1st Litre	0.9% sodium chloride *	1000ml over 1 hr	1000
2nd Litre	0.9% sodium chloride +/- potassium chloride	1000ml over next 2 hr	500
3rd Litre	0.9% sodium chloride +/- potassium chloride	1000ml over next 2 hr	500
4th Litre	0.9% sodium chloride +/- potassium chloride	1000ml over next 4 hr	250
5th Litre	0.9% sodium chloride +/- potassium chloride	1000ml over next 4 hr	250
6th Litre	0.9% sodium chloride +/- potassium chloride	1000ml over next 6 hr	166

* potassium chloride may be required here if more than 1 litre of sodium chloride has been given to fluid resuscitate

Potassium level in first 24hrs (mmol/L)	**Potassium replacement in mmol/L of infusion solution**
Over 5.5	Nil
3.5 - 5.5	20 mmol per 500ml fluid
Below 3.5	Discuss with SpR / Consultant as additional potassium may need to be given

10% Glucose infusion  Check blood glucose levels, as risk of hypoglycaemia if 10% glucose not started when capillary blood glucose falls below 14 mmol/L

If capillary blood glucose <14mmol/L then sodium chloride +/- potassium infusion continued with 10% glucose should be given in addition at rate of 125ml/hr. NB: rate of sodium chloride infusion will need changing when 10% glucose infusion used in addition (see eg below).

For example, if a patient is requiring 0.9% sodium chloride 250ml/hr and their blood glucose level falls to 8mmol/L then protocol recommends that 10% glucose is commenced in addition to 0.9% sodium chloride. 10% glucose should be given at a rate of 125ml/hr and therefore in order to avoid fluid overload the rate of NaCl would need reducing to 125ml/hr to maintain a total fluid input of 250ml/hr (125ml/hr 0.9% NaCl + 125ml/hr 10% glucose).

Regular review of cardiovascular status is critical

DKA Care Pathway

Action 3 – commencement of IV fixed rate insulin infusion

If weight unknown – estimate weight

If pregnant use present weight – discuss with diabetes team and obstetricians if uncertain

N.B. Do not delay initiation of IV insulin

If a patient normally uses NPH [intermediate acting] insulin (Humulin I®, Insulatard® or Insuman Basal®) or long acting analogue insulin (Lantus®, Abasaglar®, Levemir®, Toujeo® or Tresiba®) subcutaneously then continue this at usual time and dose as well as above IV regimen.

Commence insulin infusion at the following rate of 0.1unit/kg/hr[$].

Intravenous insulin infusion is made up as 50 units of Human Soluble insulin diluted to 50ml with normal saline and given at a rate determined by the patient's weight (0.1unit/kg/hr).

Weight (kg)	**iv insulin rate in unit/hour (based on 0.1unit/kg/hr)**
55	5.5 units / hour
60	6.0 units / hour
65	6.5 units / hour
70	7.0 units / hour
75	7.5 units / hour
80	8.0 units / hour
85	8.5 units / hour
90	9.0 units / hour

[$]N.B. A **maximum** initial rate of 15 units per hour of insulin is recommended

Action 4 – senior review

It is most important that patients with DKA are reviewed by a medical SpR/Consultant immediately if NEWS indicates or once immediate management has been initiated if seen initially by a junior member of the team. It is the role of the junior medical team and the nursing staff to request a senior medical review.

In patients who develop DKA outside of ED or ACB the ward team should refer to the on-call SpR for Medicine or Diabetes SpR (depending on availability) within 1 hour of diagnosing DKA and initiating immediate treatment.

Use of bicarbonate

Administration of bicarbonate is not recommended routinely. Its use should only be considered in those patients with severe DKA requiring discussion/involvement of the critical care team. Such patients are likely to require initial management on ITU/HDU.

See Section 3.2.2 for indicators of severe DKA.

DKA Care Pathway

Section B (60 mins-6 hours)

Aims

- Clear the blood of ketones and suppress ketogenesis
- Achieve rate of fall of blood ketones of 0.5mmol/hr or rise in bicarbonate of 3mmol/L/hr
- Fall in blood glucose by 3mmol/L/hr until level is below 11 mmol/L
- Maintain serum potassium in normal range
- Avoid hypoglycaemia
- **Ensure that senior review by SpR or Consultant been undertaken**

Action 1 – reassess the patient and monitor

- Review hourly initially, to ensure adequate progress in reducing ketones and/or glucose levels is being made
- Consider urinary catheter if incontinent or not passed urine
- Consider NGT if reduced conscious level or persistent vomiting
- If oxygen sats falling then perform arterial blood gas, repeat CXR and give O_2
- Ensure regular vital signs and NEWS charting and review
- Ensure accurate fluid balance charting (minimum urine output 0.5ml/kg/hr)
- Cardiac monitoring for those with severe DKA
- Assess risk for VTE and give LMWH as per UHL guidelines (see ref section)

Action 2 – review metabolic parameters

- Venous blood gas – pH, bicarbonate, potassium – at time 0mins, 60mins, 120mins and 2hrly thereafter
    - Potassium may need checking hourly if outside reference range this should be done by venous blood gas analysis rather than lab testing
    - **Monitor and replace potassium as it may fall rapidly (See Section A, Action 2)**
- Blood ketones – hourly
- Capillary blood glucose – hourly
    - if meter reads "HI" for either ketones or glucose then venous blood should be sampled in lab or using blood gas analyser
- Review whether blood ketones are falling satisfactorily (at least 0.5 mmol/hr) – if not then check infusion pump is working, connected and correct insulin residual volume present. If no issues with infusion pump then increase infusion rate by 1unit / hr increments hourly until ketones are falling satisfactorily
- If blood ketones are not available use venous bicarbonate to monitor progress – check rising by at least 3mmol/L/hr – if not then increase insulin infusion as above.

DKA Care Pathway
• If neither blood ketones or venous bicarbonate are available use capillary blood glucose and increase iv insulin as above if blood glucose not falling by at least 3mmol/L/hr • When capillary blood glucose falls below 14mmol/L commence 10% glucose at 125ml/hr alongside 0.9% sodium chloride fluid replacement regimen, adjusting the fluid rate as appropriate (see example below) *For example, if a patient is requiring 0.9% sodium chloride 250ml/hr and their blood glucose level falls to 8mmol/L then protocol recommends that 10% glucose is commenced in addition to 0.9% sodium chloride. 10% glucose should be given at a rate of 125ml/hr and therefore in order to avoid fluid overload the rate of NaCl would need reducing to 125ml/hr to maintain a total fluid input of 250ml/hr (125ml/hr 0.9% NaCl + 125ml/hr 10% glucose).*  Risk of hypoglycaemia if 10% glucose not started when capillary blood glucose falls below 14mmol/L.
Action 3 – identify and treat precipitating factors
Hypophosphatemia
Routine supplementation with phosphate is not recommended. If there is evidence of significant respiratory or skeletal muscle weakness then phosphate measurement and subsequent replacement may be considered if found to be low. There is a separate UHL guideline regarding phosphate replacement (see reference section).
Action 4 – for those with newly diagnosed type 1 diabetes initiate long-acting (Levemir®) insulin (with involvement of diabetes team wherever possible).
Prescribe and administer Levemir® insulin at a minimum dose of 0.25 units/kg s/c at initiation. The total dose can be given either once daily or split to twice daily. This will help to mitigate against rebound ketones when IV insulin stopped. A simple guide to recommended doses prior to discharge is as follows based on weight: < 50kg – 5 units of Levemir insulin BD 50-80kg – 10 units of Levemir insulin BD > 80kg – 15 units of Levemir insulin BD This is a starting dose and is likely to require titration with involvement of the Diabetes Team. If a patient is discharged without review by the diabetes team (eg at weekend) ensure referral is made for urgent contact and review by diabetes team within 48 hrs of discharge.

DKA Care Pathway
Section C (6-12 hours)
Aims • Ensure satisfactory clinical and biochemical improvement • Continue intravenous fluid replacement • Continue intravenous insulin administration • Assess for complications of treatment (fluid overload, cerebral oedema) • Continue to treat precipitating causes • Avoid hypoglycaemia
Action 1 – reassess the patient and monitor vital signs
• If not improving as desired (see above Section B), seek senior advice and contact the on-call Diabetes SpR, if within normal working hours. If out of hours contact the on-call SpR for Medicine • Ensure electronic referral (via ICE) is made to diabetes team– see Appendix B
Action 2 – review biochemical and metabolic parameters

• At 6 hours – venous pH, bicarbonate, potassium, blood ketones and glucose
  ○ Resolution of DKA defined as blood ketones < 0.6 mmol/L, venous pH > 7.3
• Do not use bicarbonate as surrogate marker at this stage
  ○ NB Hyperchloraemic acidosis can occur secondary to high volumes of 0.9% sodium chloride. This can cause renal vasoconstriction and cause oliguria. However there is no evidence that hyperchloraemic acidosis causes a significant morbidity or prolongs length of stay
• Do not rely on clearance of urinary ketones to indicate resolution of DKA as these will still be present when DKA resolved
• **If DKA resolved go to Section E**  risk of hypoglycaemia if fixed rate insulin infusion not switched to variable rate insulin infusion or s/c insulin regimen when blood ketones < 0.6 mmol/L. (See Appendix A for advice on switching to s/c insulin).
• **If DKA not resolved refer back to Section B Action 2**

DKA Care Pathway

Section D (12-24 hours)

By 24 hours ketonaemia and acidosis should have resolved.

Aims

- Ensure that clinical and biochemical parameters are improving or normalised
- Continue iv fluids if not eating and drinking
- If patient not eating and drinking and blood ketones are normal (< 0.6 mmol/L) change to UHL IV variable rate insulin regimen (details on green insulin prescribing and monitoring chart)
-  risk of hypoglycaemia if fixed rate insulin infusion not switched to variable rate insulin infusion when blood ketones < 0.6 mmol/L. Note: substrate fluid of 5% glucose will be required if patient is switched to variable rate insulin infusion
- Re-assess for complications of treatment
- Continue to treat precipitating factors
- When patient eating and drinking normally transfer to subcutaneous regimen (Appendix A)

Action 1 – reassess the patient and monitor vital signs

Action 2 – review biochemical and metabolic parameters

- 12 hours – venous pH, bicarbonate, potassium, blood ketones, glucose •
- Assess for resolution of DKA
    - Resolution of DKA defined as blood ketones < 0.6 mmol/L, venous pH > 7.3
    - Do not use bicarbonate as surrogate marker at this stage
        - NB Hyperchloraemic acidosis can occur secondary to high volumes of 0.9% sodium chloride

If DKA resolved go to Section E

If DKA not resolved refer to back to Section B Action 2 and seek senior specialist opinion from on-call diabetes SpR urgently, if within normal working hours.

If out of hours contact the on-call SpR for medicine.

DKA Care Pathway
Section E (24 hours onwards)
By now patients should be eating and drinking normally and back onto normal subcutaneousinsulin
Action 1 – conversion to subcutaneous insulin
Convert to an appropriate subcutaneous insulin regimen when biochemically stable and patient eating and drinking. • For those newly diagnosed with type 1 diabetes, this should be managed by the diabetes team, but if not available (out of hours or at weekend) see Appendix A. • For patients who have previously been on s/c insulin, see guidance in Appendix A
Action 2 – referral to specialist diabetes team via ICE if not already done – see Appendix B
• A newly diagnosed individual with Type I diabetes should be seen by a member of the specialist team prior to discharge • If this is not possible e.g. patient admitted and discharged (on subcutaneous insulin) over a weekend then the discharging team should ensure that the patient attends the Diabetes Clinic on the next working day. • This can be arranged by the ward team telephoning the Diabetes Specialist Nurse Helpline (ext. 4919) at the beginning of the day and they will advise where and when patient should attend. • Alternatively the on-call diabetes SpR can be reached via LRI switchboard

4. Education and Training

4.1 It is expected that all registered staff working in the Emergency Department (ED), LRI admissions (Acute Care Bay [ACB],) and the Diabetes Wards (LRI) have a responsibility to understand the management of DKA and up-date their knowledge. They will be supported by the Diabetes Team but staff would be expected to have undertaken Insulin Safety training (accessed via HELM) and familiarised with this guidance.

4.2 All clinical staff working in any location within UHL would be expected to seek senior advice if they were presented with a patient with DKA and they did not feel adequately trained to manage the clinical case.

5. Monitoring and Audit Criteria

Outcome measures will be to benchmark the incidence of DKA against equivalent national and regional data for admissions. To assess adherence to the guidelines, outcome measures and effectiveness, audit will be performed periodically. As a minimum we will aim to look at time to resolution of DKA, time to conversion to subcutaneous insulin and length of stay. This audit will be undertaken by the Diabetes Team.

Data relating to the use of intravenous insulin will be audited on a yearly basis as part of the National Diabetes Inpatient Audit. This data is submitted centrally, analysed and fed back to the Trust.

Monitoring and audit will be led by the Chair of the Inpatient Diabetes Steering Group.

6. Supporting Documents and Key References

UHL guidelines for:

- Management of Hypophosphatemia (available on the UHL intranet)
- The Management of Diabetic Ketoacidosis in Adults, Joint British Diabetes Societies (JBDS), (2nd edition) published 2013

7. Key Words

Diabetic ketoacidosis

DKA

Ketosis

Ketone

Diabetes

Type 1

DEVELOPMENT AND APPROVAL RECORD FOR THIS DOCUMENT			
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10/05/16	2	Elizabeth Hackett	Amended in line with national guidance (JBDS, 2013) Most significant amends are included in section 1.3 of guidance Diabetes team contact details also amended
17.5.19	3	PGC	

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Appendix A

Conversion to subcutaneous insulin

Where possible the conversion to subcutaneous insulin should be managed by the specialist diabetes team, especially for those with newly diagnosed type 1 diabetes (see point 5 below). Where this is not possible the following points give some guidance:

1. Restarting subcutaneous insulin for patients on an established insulin regimen

Previous regimen should be restarted (if patient was on a long / intermediate acting insulin, this should already have been continued as part of the routine DKA management protocol.) The guidance below covers the both scenarios of long acting or intermediate acting insulin having been continued, or not. (See 2a and 2b below).
There should be a 30-60 min overlap between administration of subcutaneous dose (of mixed insulin or mealtime 'bolus' insulin) and discontinuation of iv insulin infusion. This is because the half life of iv insulin is only 3-4 mins and subcutaneous insulin may take considerably longer to be absorbed.

So the chain of events is:

- DKA resolved
- Patient starts eating and drinking
- Restart subcutaneous insulin (see below for timings)
- Stop IV insulin 30-60mins after s/c insulin

2. Patients on Basal Bolus regimen

a) **If long acting or intermediate acting (aka NPH) insulin has been continued** then give injection of fast acting (meal time) insulin with next meal and discontinue iv insulin infusion 30 mins later.

b) **If long acting or intermediate acting (aka NPH) insulin has been stopped** do not stop iv insulin until some form of background/long acting insulin has been given.
For example if basal insulin is usually given at bed-time but you wish to re-start subcutaneous insulin in morning, give ½ basal dose at breakfast with usual rapid acting insulin. Stop iv insulin infusion 30 mins later and continue with usual insulin regimen (e.g. normal meal time doses of rapid acting insulin plus the next full dose of long acting insulin may be given as usual).

3. Patients on twice daily mixed insulin

Re-introduce subcutaneous insulin before breakfast or evening meal and discontinue iv insulin infusion 30 mins after subcutaneous dose given.

4. Patient on Continuous Subcutaneous Insulin Infusion (CSII)

Restart normal basal rate if CSII pump has been disconnected. Stop iv insulin infusion when meal bolus is given (with 30 minute overlap). Do not recommence CSII at bed-time. CSII pump may be continued at the basal rate during the treatment of DKA and in such instances, disconnect the iv insulin infusion 30 mins after meal time bolus given via CSII.

5. Newly diagnosed type 1 diabetes

According to the UHL DKA management pathway, initiation of a long acting subcutaneous basal insulin (Levemir®) should have occurred in Section B, Action 4. Ideally this should be managed with help from a specialist diabetes team. However if team not available and s/c insulin has not yet been started it is recommended:

Prescribe and administer Levemir® insulin at a minimum total dose of 0.25 units / kg s/c. The total dose can be given either once daily or split to twice daily. This will help to mitigate against rebound ketones when IV insulin stopped.

A simple guide to recommended doses prior to discharge is as follows based on weight:

< 50kg – 5 units of Levemir insulin BD

50-80kg – 10 units of Levemir insulin BD

> 80kg – 15 units of Levemir insulin BD

This is a starting dose and is likely to require titration with involvement of the Diabetes Team. If a patient is discharged without review by the diabetes team (eg at weekend) ensure referral is made for urgent contact and review by diabetes team within 48 hrs of discharge.

Appendix B

Referral guidelines for the Diabetes Specialist Team

- Electronic referrals to Diabetes Specialist Nurses are made via ICE (patient will be seen within 24hours of receiving referral, as long as this falls within normal working hours)
- The Diabetes Specialist Nurses may also be contacted via the 'Diabetes Nurse Helpline' on x4919
- Referral to the on-call Diabetes SpR may be made via the LRI switchboard.

Both available Mon-Fri (9am-5pm). **There is no out of hours diabetes on-call team.**

Diabetes referral criteria are detailed on ICE