A. General comments

Children or young people in DKA should be initially stabilized in the resuscitation area in A&E. A bed should be arranged in the High Dependency Unit (HDU) at Wythenshawe Hospital, or nearest available HDU bed. Transfer, with a medical or nursing escort, should be arranged once the child is clinically stable.

Inform Dr. Clare Wilkins or Consultant on call as soon as possible, even if you feel confident of your management. Throughout the episode of DKA the registrar must be in close supervision of the patient and in communication with the consultant.

In this protocol the IV fluids are very carefully calculated to try and reduce the risk of cerebral oedema, it is essential that the fluids are infused through a pump, (NOT directly from bag with partially opened valve).

Remember – CHILDREN CAN DIE FROM DKA.

They can die from-

- **Cerebral oedema.** This is unpredictable, occurs more frequently in younger children and newly diagnosed diabetics and has mortality of around 25%. The causes are not known but these guidelines aim to minimise the risk by achieving a slow correction of the metabolic abnormalities. The management of cerebral oedema is covered later.

- **Hypokalaemia.** This is preventable with careful monitoring and management.

- **Aspiration pneumonia.** Use a nasogastric tube in semiconscious or unconscious children.

These are general guidelines for management. Treatment may need modification to suit the individual patient. These guidelines do not remove the need for frequent detailed reassessments of the individual child’s requirements.

These guidelines are intended for the management of children who have:

- hyperglycaemia (blood glucose > 11mmol/l)
- pH < 7.3
- bicarbonate < 15mmol/l

and who are:

- more than 3% dehydrated
- and/or vomiting
- and/or drowsy
- and/or clinically acidotic.

Children who are 5% dehydrated or less and not clinically unwell usually tolerate oral rehydration and subcutaneous insulin. Discuss this with Dr. Clare Wilkins or the Consultant on call.
B. Emergency management on arrival in the Emergency Department

1. General resuscitation: A,B,C
   - **Airway:** Ensure that the airway is patent and, if the child is comatose, insert an airway. If comatose or has recurrent vomiting, insert a nasogastric tube, aspirate and leave on open drainage.
   - **Breathing:** Give 100% oxygen by face-mask.
   - **Circulation:** Insert intravenous cannula and take blood samples (see below). Cardiac monitor for T waves (peaked in hyperkalaemia).

   **Only if shocked** (poor peripheral pulses, poor capillary filling with tachycardia and/or hypotension), give **10ml/kg 0.9% Sodium chloride** as a bolus, and repeat as necessary to a total of **30ml/kg**. *(There is no evidence to support the use of colloids or other volume expanders in preference to crystalloids.)*

2. Confirm the diagnosis:
   - **History:**
     - polyuria
     - polydipsia
   - **Clinical:**
     - acidotic respiration
     - dehydration
     - drowsiness
     - abdominal pain/vomiting
   - **Biochemical:**
     - high blood glucose on finger-prick test (>11mmol/l)
     - glucose and ketones in urine
     - Blood pH<7.3 and/or HCO₃ <15mmol/l
     - Finger-prick blood ketones > 3mmol/l (not available at TGH at present)

3. Initial investigations:
   - blood glucose
   - urea and electrolytes (electrolytes on blood gas machine give a guide until laboratory results available)
   - blood gases (venous blood gives very similar pH and pCO₂ to arterial)
   - CRP, FBC and PCV (leucocytosis is common in DKA and does not necessarily indicate sepsis)
   - Test urine for ketones, as near patient blood tests for ketones are not yet available at TGH.
   - ± other investigations only if indicated e.g. CXR, CSF, throat swab, blood culture, urinalysis, culture and sensitivity etc.

   **Remember** – DKA may rarely be precipitated by sepsis, and fever is **not** part of DKA.
C. Full clinical assessment and observations

Assess and record in the notes so that comparisons can be made by others later;

1. Degree of dehydration:
   - mild, 3% dehydration is only just clinically detectable
   - moderate, 5% - dry mucous membranes, reduced skin turgor
   - severe, 8% - as above with sunken eyes, poor capillary return
   - + shock – severely ill with poor perfusion, thready rapid pulse (hypotension is not likely and is a very late sign)

   Over-estimation of degree of dehydration is dangerous

   Therefore do not use more than 8% dehydration in calculations

2. Conscious level:

   Institute hourly neurological observations including Glasgow Coma Score (see Appendix 1) whether or not drowsy on admission.

   If in coma on admission, or there is any subsequent deterioration,
   - consider transfer to PICU/HDU if available
   - consider instituting cerebral oedema management  (if high level of suspicion, start treatment prior to transfer).

   Coma is directly related to degree of acidosis, but signs of intra cranial pressure suggest cerebral oedema.

3. Full examination:

   Look particularly for evidence of:
   - cerebral oedema – headache, irritability, slowing pulse, rising blood pressure, reducing conscious level (NB. examine fundi but papilloedema is a late sign)
   - infection
   - ileus

   WEIGH THE CHILD. If this is not possible because of the clinical condition, use the most recent clinic weight as a guide, or an estimated weight from centile charts.

4. Does the child need to be on PICU?

   All children in DKA need 1:1 nursing care and should be transferred to the high dependency unit at Wythenshawe hospital or the nearest available HDU bed.

   Discuss with PICU consultant and consider PICU if:
   - severe acidosis (pH < 7.1) with marked hyperventilation
   - severe dehydration with shock
   - depressed sensorium with risk of aspiration from vomiting
   - very young (under 2 years)
   - staffing levels on the ward are insufficient to allow adequate monitoring
5. **Observations to be carried out:**

Ensure full instructions are given to senior nursing staff, emphasising the need for:

- strict fluid balance, including details of fluid given before arrival on ward (catheterisation may be required in young/sick children)
- measurement of volume of all urine passed, and test for ketones
- hourly capillary blood glucose measurements (These may be inaccurate with severe dehydration/acidosis but are useful for documenting trends. Do not rely on any sudden changes but check with a venous laboratory measurement.)
- (hourly blood ketone levels may be a more sensitive measure of suppression of ketogenesis during treatment - not available at TGH)
- hourly BP and basic observations (heart rate, respiratory rate and temperature).
- hourly or more frequent neurological observations initially.
- report immediately to medical staff, even at night, symptoms of headache or change in either conscious level or behaviour
- cardiac monitor, reporting any changes in the ECG trace, particularly T wave changes
- twice daily weights can be helpful in assessing fluid balance

**D. Management**

1. **Fluids** 

   It is essential that all fluids given are documented carefully, particularly fluid given in the Emergency Department and on the way to the ward as this is where most mistakes occur. Ensure all calculations make sense and document them.

   **b) Volume of fluid** - By this stage, the circulating volume should have been restored. If not, give a further 10ml/kg of 0.9% Sodium chloride (to a maximum of 30ml/kg) over 30 minutes. Discuss with the consultant if the child has already received 30 ml/kg.

   Otherwise, once circulating blood volume has been restored, calculate fluid requirements as follows:

   \[
   \text{Requirement} = \text{deficit} + \text{maintenance} - \text{resuscitation fluid}
   \]

   \[
   \text{Deficit (mls)} = \% \text{dehydration} \times \text{weight in kg} \times 10
   \]

   To avoid overzealous fluid replacement, which may be a risk factor for cerebral oedema. For most children use 5% to 8% dehydration to calculate fluids.

   **Maintenance requirements:**

<table>
<thead>
<tr>
<th>Weight</th>
<th>Fluids/kg/24hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 12.9kg</td>
<td>80mls/kg/24hrs</td>
</tr>
<tr>
<td>13 – 19.9kg</td>
<td>65mls/kg/24hrs</td>
</tr>
<tr>
<td>20 – 34.9kg</td>
<td>55mls/kg/24hrs</td>
</tr>
<tr>
<td>35 – 59.9kg</td>
<td>45mls/kg/24hrs</td>
</tr>
<tr>
<td>adult (&gt;60kg)</td>
<td>35mls/kg/24hrs</td>
</tr>
</tbody>
</table>

   NB: Neonatal DKA will require special consideration and larger volumes of fluid than those quoted may be required, usually 100-150ml/kg/24hours

   - NB APLS maintenance fluid rates over-estimate requirement, particularly at younger ages.
   - Add calculated maintenance (for 48 hours) and estimated deficit, subtract the amount already given as resuscitation fluid, and give the total volume evenly over the next 48 hours i.e.

   \[
   \text{Hourly rate} = \frac{48 \text{ hour maintenance} + \text{deficit} - \text{resuscitation fluid given}}{48}
   \]
Example

A 20kg 6 year old child who is 8% dehydrated and has had 20 ml/kg sodium chloride for resuscitation will require:

\[ 8 \text{ (\% dehydration)} \times 20 \text{ (weight in kg)} \times 10 = 1600\text{mls deficit} \]

\[ \text{plus } 55\text{mls} \times 20\text{kg} = 1100\text{mls maintenance for each 24 hours} \]

\[ = 1100\text{mls} \]

\[ \text{minus } 400\text{mls resuscitation fluid} \]

\[ = 3800\text{mls} \]

Total volume to be infused over 48 hours = 3400mls over 48 hours = 71mls/hr.

Do not include urinary losses in the calculations at this stage

b) Type of fluid

Initially use 0.9% Sodium chloride with 20 mmol Potassium chloride in 500ml, and continue this sodium concentration for at least 12 hours.

Once the blood glucose has fallen to 14 mmol/l add glucose to the fluid.

A bag of 500ml 0.9% Sodium chloride with 5% glucose and 20mmol Potassium chloride should be available in POAU.

After 12 hours, if the plasma sodium level is stable or increasing, change to 500ml bags of 0.45% Sodium chloride with 5% glucose and 20mmol potassium chloride.

If the plasma sodium is falling, continue with Sodium chloride 0.9% (with or without glucose depending on blood glucose levels). Some have suggested that Corrected Sodium levels give an indication of the risk of cerebral oedema. If you wish to calculate this, go to:

Corrected sodium levels should rise as blood glucose levels fall during treatment. If they do not, then continue with Sodium chloride 0.9% and do not change to 0.45% Sodium chloride.

Check U&Es 2 hours after resuscitation is begun and then at least 4-hourly. Electrolytes on the blood gas machine can be helpful for trends while awaiting laboratory results.

c) Oral fluids

In severe dehydration, impaired consciousness and acidosis, do not allow fluids by mouth. A nasogastric tube may be necessary in case of gastric paresis.

Oral fluids (fruit juice, oral rehydration solution) should only be offered after substantial clinical improvement has occurred and there is no vomiting.

When good clinical improvement occurs before the 48 hour rehydration programme has been completed, oral intake may commence but the intravenous fluids must be reduced to take account of the oral intake.

2. Potassium

Once the child has been resuscitated potassium should be commenced immediately with rehydration fluid unless anuria is suspected. Potassium is mainly an intracellular ion, and there is always massive depletion of total body potassium, although initial plasma levels may be low, normal or even high. Levels in blood will fall once insulin is commenced.

Therefore, there should be 20 mmol Potassium chloride in every 500ml bag of fluid. Standard potassium-containing fluids must be used. Strong potassium chloride is not available in A&E.

Check U&Es 2 hours after resuscitation is begun and then at least 4-hourly.

Use a cardiac monitor and observe frequently for T wave changes.
3. Insulin

Once rehydration fluids and potassium are running, blood glucose will start to fall. There is some evidence that cerebral oedema is more likely if insulin is started early. Therefore DO NOT start insulin until intravenous fluids have been running for at least an hour. However, insulin is essential to switch off ketogenesis and reverse the acidosis.

**Continuous low-dose intravenous infusion** is the preferred method. There is no need for an initial bolus.

Make up a solution of 1 unit/ml of human soluble insulin (e.g. Actrapid) by adding 50 units (0.5ml) insulin to 50ml 0.9% Sodium chloride in a syringe pump. An insulin syringe must be used to measure the 50 units of Actrapid. Attach this using a Y-connector to the intravenous fluids already running. All lines must include an antisyphon device. Do not add insulin directly to the fluid bags.

The solution should then run at 0.1 units/kg/hr (0.1ml/kg/hr). There are some paediatricians who believe that 0.05 units/kg/hour is an adequate dose. There is no firm evidence to support this.

- Once the blood glucose level falls below 14mmol/l, change the fluid to contain 5% glucose (generally 0.9% Sodium chloride with glucose and potassium, see 1b above for type of fluid). DO NOT reduce the insulin. The insulin dose needs to be maintained at 0.1 units/kg/hour to switch off ketogenesis.

- Some suggest also adding glucose if the initial rate of fall of blood glucose is greater than 5-8mmol/l per hour, to help protect against cerebral oedema. There is no good evidence for this practice, and blood glucose levels will often fall quickly purely because of rehydration.

- DO NOT stop the insulin infusion while glucose is being infused, as insulin is required to switch off ketone production. If the blood glucose falls below 4 mmol/l, give a bolus 2ml/kg of 10% glucose and increase the glucose concentration of the infusion. Insulin can be temporarily be reduced for 1 hour.

- If needed, a solution containing approximately 10% glucose with 0.45% Sodium chloride can be made up by adding 50ml 50% glucose to a 500ml bag of 0.45% Sodium chloride/5% glucose with 20 mmol potassium chloride.

- Once the pH is above 7.3, the blood glucose is down to 14 mmol/l, and a glucose-containing fluid has been started, consider reducing the insulin infusion rate, but to no less than 0.05 units/kg/hour.

- If the blood glucose rises out of control, or the pH level is not improving after 4-6 hours consult senior medical staff and re-evaluate (possible sepsis, insulin errors or other condition) and consider starting whole protocol again.

For children who are already on long acting insulin (especially Glargine (Lantus)) the usual dose can be continued in addition to the intravenous infusion, in order to shorten length of stay after recovery from DKA.

For children on continuous subcutaneous insulin infusion (CSII) pump therapy, stop the pump when starting DKA treatment.

4. Bicarbonate:

This is rarely, if ever, necessary. Continuing acidosis usually means insufficient resuscitation or insufficient insulin. Bicarbonate should only be considered in children who are profoundly acidotic (pH < 6.9) and shocked with circulatory failure. Its only purpose is to improve cardiac contractility in severe shock. Discuss the use of bicarbonate with the consultant.

If it is to be used, give a half-correction over 60 minutes, using 8.4% sodium bicarbonate as follows: half-correction (mls 8.4% sodium bicarbonate) = 0.3 x weight in kg x base deficit.
5. Phosphate:

There is always depletion of phosphate, another predominantly intracellular ion. Plasma levels may be very low. There is no evidence in adults or children that replacement has any clinical benefit and phosphate administration may lead to hypocalcaemia.

6. Anticoagulant prophylaxis:

There is a significant risk of femoral vein thrombosis in young and very sick children with DKA who have femoral lines inserted. Therefore consideration should be given to anticoagulating these children with a daily dose of Tinzaparin 50units/kg/day.

Children who are significantly hyperosmolar might also require anticoagulant prophylaxis – discuss with consultant.

E. CONTINUING MANAGEMENT

- Urinary catheterisation should be avoided but is useful in the child with impaired consciousness.

- Documentation of fluid balance is of paramount importance. All urine needs to be measured accurately and tested for ketones. All fluid input must be recorded (even oral fluids).

- If a massive diuresis continues fluid input may need to be increased. If large volumes of gastric aspirate continue, these will need to be replaced with 0.45% Sodium chloride plus 10mmol Potassium chloride per 500ml bag.

- Check biochemistry, blood pH and laboratory blood glucose 2 hours after the start of resuscitation and then at least 4-hourly. Review the fluid composition and rate according to each set of electrolyte results.

- If acidosis is not correcting, consider the following:
  - insufficient insulin to switch off ketones
  - inadequate resuscitation
  - sepsis
  - hyperchloraemic acidosis
  - salicylates or other prescription or recreational drugs. Resuscitation may have been inadequate or there may be sepsis or insulin activity may be inadequate.

Insulin management once ketoacidosis resolved:

Continue with intravenous fluids until the child is drinking well and able to tolerate food. Do not expect urine ketones to have disappeared completely before changing to subcutaneous insulin.

Discontinue the insulin infusion 60 minutes (if using soluble or long-acting insulin) or 10 minutes (if using Novorapid or Humalog) after the first subcutaneous injection to avoid rebound hyperglycaemia.

The dose of subcutaneous insulin is determined by previous treatment in “old” patients.

For new patients:

a) Primary school age or younger start on twice daily pre-mixed Novomix 30 insulin. Initial doses should be calculated as 0.3 units per kilogram in the morning and 0.2 units per kilogram in the evening.

b) Senior school age children should be stated on a basal-bolus regime (unless learning or social difficulties). Initial doses should be calculated as 0.2 units/kg of Glargine in the evening and 0.1 units/kg of Novorapid with meals.
F. Cerebral oedema

The signs and symptoms of cerebral oedema include:

- headache and slowing of heart rate
- change in neurological status (restlessness, irritability, increased drowsiness, incontinence)
- specific neurological signs (e.g. cranial nerve palsies)
- increasing BP and decreased oxygen saturation
- abnormal posturing

More dramatic changes such as convulsions, papilloedema and respiratory arrest are late signs associated with extremely poor prognosis.

Management:

If cerebral oedema is suspected inform consultant immediately.

The following measures should be taken immediately while arranging transfer to PICU:

- exclude hypoglycaemia as a possible cause of any behaviour change
- give hypertonic (2.7%) Sodium chloride (5mls/kg over 5-10mins) (not currently available at TGH) or mannitol 0.5 -1g/kg stat (= 2.5 - 5mls/kg of 20% mannitol over 20 minutes). This needs to be given as soon as possible if warning signs occur (e.g. headache or pulse slowing).
- restrict intravenous fluids to 1/2 maintenance and replace deficit over 72 rather than 48 hours
- the child will need to be moved to PICU (if not already there)
- discuss with PICU consultant. Do not intubate and ventilate until an experienced doctor is available.
- once the child is stable, exclude other diagnoses by CT scan - other intracerebral events may occur (thrombosis, haemorrhage or infarction) and present in the same way
- a repeated dose of mannitol should be given after 2 hours if no response
- document all events (with dates and times) very carefully in the medical records.

G. OTHER COMPLICATIONS

- Hypoglycaemia and hypokalaemia – avoid by careful monitoring and adjustment of infusion rates. Consideration should be given to adding more glucose if blood glucose is falling quickly even if still above 4 mmol/l.
- Systemic infections – antibiotics are not given as a routine unless a severe bacterial infection is suspected.
- Aspiration pneumonia – avoid by nasogastric tube in vomiting child with impaired consciousness.

Other associations with DKA require specific management:

Continuing abdominal pain is common and may be due to liver swelling, gastritis, bladder retention or ileus. Beware of appendicitis and consider a surgical opinion once DKA is stable. A raised amylase is common in DKA.

Other problems are pneumothorax ± pneumomediastinum, interstitial pulmonary oedema, unusual infections (e.g. TB, fungal infections), hyperosmolar hyperglycaemic non-ketotic coma, ketosis in type 2 diabetes.

Discuss these with the consultant on-call.
# APPENDIX 1

## GLASGOW COMA SCALE

<table>
<thead>
<tr>
<th>Best motor response</th>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>extensor response to pain</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>abnormal flexion to pain</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>withdraws from pain</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>localises pain</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>responds to commands</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eye opening</th>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>to pain</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>to speech</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>spontaneous</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Best verbal response</th>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>incomprehensible sounds</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>inappropriate words</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>appropriate words but confused</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>fully orientated</td>
</tr>
</tbody>
</table>

Maximum score 15, minimum score 3.

Modified verbal response score for younger children:

<table>
<thead>
<tr>
<th>2-5 years</th>
<th>&lt; 2 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = none</td>
<td>1 = none</td>
</tr>
<tr>
<td>2 = grunts</td>
<td>2 = grunts</td>
</tr>
<tr>
<td>3 = cries or screams</td>
<td>3 = inappropriate crying or unstimulated screaming</td>
</tr>
<tr>
<td>4 = monosyllables</td>
<td>4 = cries only</td>
</tr>
<tr>
<td>5 = words of any sort</td>
<td>5 = appropriate non-verbal responses (coos, smiles, cries)</td>
</tr>
</tbody>
</table>
Appendix 2. Algorithm for the Management of Diabetic Ketoacidosis

**Clinical Signs**
- assess dehydration
- deep sighing respiration (Kussmaul)
- smell of ketones
- lethargy, drowsiness

**Biochemical Signs**
- ketones in urine or blood
- elevated blood glucose (>11mmol/l)
- acidaemia (pH<7.3)
- take blood also for electrolytes, urea
- perform other investigations if indicated

**Confirm Diagnosis**
Diabetic Ketoacidosis
Call Senior Staff

**Clinical History**
- polyuria
- polydipsia
- weight loss
- abdominal pain
- weakness
- vomiting
- confusion

**Shock**
Reduced peripheral pulse volume
Reduced conscious level
Coma

**Resuscitation**
- Airway + N/G tube
- Breathing (100% O2)
- Circulation (10ml/kg of 0.9% Sodium chloride repeated until circulation restored, max 3 doses)

**Dehydration > 5%**
Clinically acidic
Vomiting

**Intravenous therapy**
- calculate fluid requirements
- correct over 48 hours
- 0.9% Sodium chloride for at least 12 hours
- add Potassium chloride 20 mmol every 500 ml
- insulin 0.1unit/kg/hour by infusion after first hour of fluids.

**Dehydration < 5%**
Clinically well
Tolerating fluid orally

**No improvement**

**Observations**
- hourly blood glucose
- neurological status at least hourly
- hourly fluid input:output
- electrolytes 2 hours after start of intravenous therapy, then 4-hourly
-1-2 hourly blood ketone levels (if available)

**blood glucose < 14 mmol/L**

**Intravenous therapy**
- add 5% glucose to Sodium chloride
- change to 0.45% Sodium chloride + dextrose 5% after 12 hours
- continue monitoring as above
- consider reducing insulin 0.05unit/kg/hour, but only when pH>7.3

**Insulin**
start subcutaneous insulin then stop intravenous insulin 1 hour later

**Improvement**
- clinically well, drinking well, tolerating food
- blood ketones < 1.0 mmol/l or pH normal
- urine ketones may still be positive

**Neurological deterioration**
Warning signs:
headache, irritability, slowing heart rate, reduced conscious level, specific signs raised intra-cranial pressure

**Exclude**
hypoglycaemia
is it cerebral oedema?

**Management**
- give 5ml/kg 2.7% Sodium chloride or mannitol 0.5 - 1.0g/kg
- call senior staff
- restrict intravenous fluids by 1/2
- move to ITU
- CT Scan when stabilised

**Re-evaluate**
- fluid balance + intravenous therapy
- if continued acidosis, may require further resuscitation fluid
- check insulin dose correct
- consider sepsis

**Shock**
Reduced peripheral pulse volume
Reduced conscious level
Coma

**No improvement**

**Intravenous therapy**
- add 5% glucose to Sodium chloride
- change to 0.45% Sodium chloride + dextrose 5% after 12 hours
- continue monitoring as above
- consider reducing insulin 0.05unit/kg/hour, but only when pH>7.3

**Management**
- give 5ml/kg 2.7% Sodium chloride or mannitol 0.5 - 1.0g/kg
- call senior staff
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**Insulin**
start subcutaneous insulin then stop intravenous insulin 1 hour later

**Improvement**
- clinically well, drinking well, tolerating food
- blood ketones < 1.0 mmol/l or pH normal
- urine ketones may still be positive
NOTES ON THESE GUIDELINES

These guidelines, with minor local adaptations, are from the BSPED recommended DKA guidelines, 2009 (Julie A Edge, Oxford, November 2009).

These guidelines for the management of Diabetic Ketoacidosis were originally produced by a working group of the British Society of Paediatric Endocrinology and Diabetes. Modifications have been made in light of the ESPE/LWPES consensus statement on diabetic ketoacidosis in children and adolescents (Archives of Disease in Childhood, 2004, 89: 188-194) and recent guidelines produced by the International Society for Paediatric and Adolescent Diabetes (Paediatric Diabetes, 2007: 8: 28-43).

These guidelines are believed to be as safe as possible in the light of current evidence. However, no guidelines can be considered entirely safe as complications may still arise. In particular the pathophysiology of cerebral oedema is still poorly understood.


The following changes have been made since the last version (2004):

1) Recommendation to use capillary blood ketone measurement during treatment (not available at TGH).
2) Reduction in the degree of dehydration to be used to calculate fluids.
3) Reduction in the maintenance fluid rates.
4) Change in the recommendations for PICU/HDU – more emphasis on safe nursing on general wards.
5) Continuation of Normal saline for first 12 hours of rehydration.
6) Delay in insulin until fluids have been running for an hour.
7) Option to continue insulin glargine during treatment.
8) Reminder to stop pump therapy during treatment.
9) Reminder to consider anticoagulant prophylaxis in young children, especially those with femoral lines.
10) Interpretation of blood ketone measurements if pH not improving.
11) Option to use hypertonic saline instead of mannitol for the treatment of cerebral oedema.

Dr Clare Wilkins                               Louise Hopewell
Paediatric Consultant                      Diabetes Specialist Nurse

Issue Date February 2010; Review Date December 2012

These guidelines replace the DKA guidelines dated June 2007