Southwest Paediatric Diabetes Regional Network

Integrated Care Pathway for

**Children and Young People with Diabetic Ketoacidosis**

Definition of Young People: Young Adults are also at risk of Cerebral Oedema and we would recommend that this guideline is also used for patients up to the age of 25 years.

Revised 2009, 2011 and 2015: Based on NICE Guidelines (NG18) 2015 and British Society of Paediatric Endocrinology and Diabetes Guideline 2015

* This is the official patient care record and should be filed in patient notes.
* All professionals involved must document any intervention carried out.
* Write your name clearly next to your signature.
* Any deviation from the care plan must be documented.



**If you are not experienced in managing children in DKA, ask for senior help now.**

**PATIENT DETAILS:**

|  |  |
| --- | --- |
| Patient identification sticker: | ADMISSION DATE: |
| NAME: | ADMISSION TIME: |
| HOSPITAL NUMBER: | ADMISSION SOURCE: |
|  | TIME PATIENT FIRST SEEN IN A/E or WARD: |



**ABBREVIATIONS USED**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| BP | *Blood Pressure* | FBC | *Full blood count* | K | *Potassium* |  |
|  |  |  |  |  |  |  |
| CNS | *Central Nervous System* | GCS | *Glasgow coma scale* | KCl | *Potassium Chloride* |  |
|  |  |  |  |  |  |  |
| Creat | *Creatinine* | Hb | *Haemoglobin* | kg | *Kilograms* |  |
|  |  |  |  |  |  |  |
| CRP | *C-reactive protein* | HbA1c | *Glycosylated Hb* | MSU | *Mid-stream urine* |  |
|  |  |  |  |  |  |  |
| CRT | *Capillary Refill Time* | HCO3 | *Bicarbonate* | Na | *Sodium* |  |
|  |  |  |  |  |  |  |
| CSF | *Cerebrospinal fluid* | HDU | *High Dependency Unit* | NG Tube | *Nasogastric Tube* |  |
|  |  |  |  |  |  |  |
| CXR | *Chest X-ray* | HR | *Heart Rate* | PICU | *Paediatric Intensive Care Unit* |  |
|  |  |  |  |  |  |  |
| DKA | *Diabetic Ketoacidosis* | Hrs | *Hours* | Pt | *Patient* |  |
|  |  |  |  |  |  |  |
| ECG | *Electrocardiogram* | ITU | *Intensive Therapy Unit* | s/c | *Subcutaneous* |  |
|  |  |  |  |  |  |  |
| ENT | *Ear, Nose and Throat* | IV | *Intravenous* | U + Es | *Urea and Electrolytes* |  |

Patient details or hospital sticker

**Rapid Emergency Assessment** (fill all boxes)

**Airway** Patent? (If drowsy/coma: NG tube)

**Y / N**

**Y / N**

**Breathing** Resp rate /min O2 Saturation % Acidotic Pattern?

**Circulation** Pulse /min Capillary refill secs BP

/

**Y / N**

Shock?

Dehydration % Assume degree of dehydration based on pH

Mild - Moderate (5%) **[pH ≥7.1]**

Severe (10%) **[pH < 7.1**]

/15

**Disability** GCS (p6) or AVPU (**A**lert, responds to **V**oice or **P**ain or **U**nresponsive)

**Initial blood tests** Venous/Capillary (circle)

pH Bicarbonate

Bedside GlucoseBlood Ketones

**Manage patients as DKA using this pathway if they have**:

**Acidosis: pH <7.3 or bicarbonate <18 and ketonaemia: blood beta-hydroxybutyrate >3mmol/l. Blood glucose is usually (but not invariably) >11mmol/l**

**AND Have one or more of the following: >5% dehydrated, nausea or vomiting, abdominal pain, impaired consciousness, acidotic respiration.**

If child is hyperosmolar (>320mosmol/kg) [Calculate osmolality by 2(Na+K)+glucose+urea] with marked hyperglycaemia (>30mmol/l) and little or no acidosis (pH>7.25, HCO3 >15) this is a **Hyperglycaemic Hyperosmolar State (HHS)** and requires **DIFFERENT** treatment. Discuss with consultant. (See Appendix 3 and ISPAD guideline, 2014).

**Patients with hyperglycaemia without these features:**

**Usually tolerate oral rehydration and s.c. insulin. They require regular monitoring to confirm improvement and a reduction in blood ketone levels.** If unsure, discuss with consultant.

**Children with DKA should be cared for with one-to-one nursing, either on a high-dependency unit, or on a general paediatric ward**

**If any of the following present consider local ITU/Bristol PICU: pH <7.1, marked hyperventilation, severe dehydration with shock, depressed conscious level, age <2yrs**

**Record management decision here (circle): Clinical plan:**

**DKA pathway or s.c. insulin**

**Admit to:**

**Ward or HDU/ITU or PICU**

Y / N

For DKA: Consultant informed of admission?

If ‘No’ please say why:

**Signed: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Mandatory Investigations**

**For newly-diagnosed patient, add these:**

Blood Ketones □ U&Es, Creatinine □ Thyroid function, coeliac screen □

Blood Gas □ Venous Lab Glucose □ Anti-thyroid Antibodies □

HbA1c □ Anti-GAD, Anti-IA2 antibodies □

C-Peptide □

*Depending on clinical suspicion of infection, consider: FBC, CRP, Urine culture, Blood culture, CXR, Throat swab, Lumbar puncture*

**Further History & Examination (if ill, resuscitate first – page 5)**

**History** (use extra sheets as needed)

Polyuria / Bed-wetting? Polydipsia? Weight loss?

Vomiting / Abdominal pain? Headache? Recent infection?

Other symptoms:

**Drug history**

Usual insulin regime: Adherence?

Other medications: Allergies?

**Family history** (including diabetes) / **Social history**

**Previous medical history**

**Medical Examination (additional to Rapid Emergency Assessment findings above)**

General status:

Cardiovascular: Respiratory/ENT:

Abdomen: CNS:

Signed\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Patient details or hospital sticker

**Management of DKA: Resuscitation**

**If patient very ill (drowsy, shocked, marked hyperventilation), call for senior help immediately**

**A Establish airway Seek urgent anaesthetic review if unable to protect airway**

**If child comatose: Insert NG tube on free drainage**

**B Give O2 100% via face mask with reservoir bag** (only omit if child very well)

**C Establish IV access, take initial bloods** (consider 2nd cannula for later blood samples)

**Commence cardiac monitoring (peaked T waves may indicate hyperkalaemia)**

**Children and young people with a pH of 7.1 or above have mild or moderate DKA**

**Children and young people with a pH of less than 7.1 have severe DKA**

**Weight:** Actual kg or Recent clinic weight kg (date:\_\_\_\_\_\_\_\_\_) or

Estimated kg 1 – 5 years: Weight (kg) = (Age x 2) + 8

6 – 12 years: Weight (kg) = (Age x 3) + 7

Over 12 years: Use 50th centile weight for age

**DO NOT give an intravenous fluid bolus to children and young people with mild or moderate DKA**

**DO NOT ROUTINELY give an intravenous fluid bolus to children and young people with severe DKA**

**ONLY if shocked (poor peripheral pulses, poor CRT with tachycardia, and/or hypotension) give 10 ml/kg 0.9% sodium chloride**

**Volume of fluid bolus = \_\_\_\_\_\_ (Weight in kg) x 10 = \_\_\_\_\_\_\_\_ ml**

**Action: First fluid bolus given. Signed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_ Time \_\_\_\_\_\_\_\_\_\_**

**Was there a clinical response to the initial bolus? Yes No**

**DO NOT give more than one intravenous fluid bolus of 10 ml/kg 0.9% sodium chloride without discussion with the responsible senior paediatrician**

**Action: Second fluid bolus given. Signed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_ Time \_\_\_\_\_\_\_\_\_\_**

**Discuss the use of inotropes with PICU if a child or young person with DKA is in hypotensive shock**

**D Consider if Cerebral Oedema present** (may be present at diagnosis or develop within first 12 hours)

**Early manifestations: headache, agitation / irritability, unexpected fall in heart rate, rise in blood pressure**

**Additional signs: Deterioration in conscious level (record modified GCS – see below)**

**Abnormal breathing pattern**

**Oculomotor palsies**

**Abnormal posturing**

**Pupillary inequalities or dilatation**

**If concerns inform senior staff immediately: Signed:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Patient details or hospital sticker

**Glasgow Coma Score (GCS) Maximum score 15, minimum score 3**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Best** | 1=none | **Best** | 1=none | **Modification (2-5yrs)** |
| **Motor** | 2=extensor response to pain | **Verbal** | 2=incomprehensible sounds | 1=none |
| **Response** | 3=abnormal flexion to pain | **Response** | 3=inappropriate words | 2=grunts |
|  | 4=withdraws from pain |  | 4=appropriate words but confused | 3=cries or screams |
|  | 5=localises pain |  | 5=fully orientated | 4=monosyllable |
|  | 6=responds to commands |  | **Modification (<2yrs)** | 5=words of any kind |
|  |  |  | 1=none |  |
| **Eye** | 1=none |  | 2=grunts |  |
| **Opening** | 2=to pain |  | 3=inappropriate crying/unstimulated screaming |  |
|  | 3=to speech |  | 4=cries only |  |
|  | 4=spontaneous |  | 5=appropriate non-verbal responses |  |

**Cerebral Oedema: Management**

* Check blood glucose (exclude hypoglycaemia as cause of any neurological signs / symptoms)
* Secure airway, give 100% oxygen
* **Give Hypertonic Saline (2.7 or 3.0%) 5ml/kg IV or Mannitol 2.5-5.0ml/kg** of 20% solution (whichever most readily available) over 10-15mins. Give as soon as possible if warning signs occur
* Arrange transfer to PICU
* Recalculate IV fluid using 50% of usual maintenance requirement and replace deficit over 72 not 48 hours
* Once patient stable arrange CT scan to exclude other causes (haemorrhage, thrombosis, infarction)
* A repeated dose of Mannitol may be required after 2hours if no response
* Document all events (with dates and times) very carefully in medical records

**Additional Early Management Measures**

**Persistent Vomiting**

If vomiting continues prescribe either:

* Omeprazole 500micrograms/kg (max. 20mg) IV injection OD if aged <12 years, or 40mg OD if > 12 years
* Ranitidine 1mg/kg IV injection TDS

**Bicarbonate**

**Do not give intravenous sodium bicarbonate to children and young people with DKA**

**Sepsis**

DKA may rarely be precipitated by sepsis, and fever is not part of DKA. Suspect sepsis if any of the following:

* Fever or hypothermia
* Hypotension
* Refractory acidosis
* Lactic acidosis

**Anti-coagulant prophylaxis**

There is a significant risk of femoral vein thrombosis in young and very sick children with DKA who have femoral lines inserted.

* Consider anticoagulating these children with a single daily s.c. injection of Dalteparin Sodium (Fragmin)

100 units/kg (maximum 5000units).

* Children who are significantly hyperosmolar might also require anticoagulant prophylaxis (discuss with your local consultant).

**Management of DKA**

1. **Fluids**

**Caution** over-rapid or excessive fluids may increase risk of cerebral oedema. Aim to rehydrate slowly over at least 48 hours.

**Volume of fluid** Weight kg

1. **Daily maintenance fluid requirement in DKA treatment**

* **Weight less than 10kg, give 2ml/kg/hour**
* **Weight between 10 and 40kg, give 1ml/kg/hour**
* **Weight more than 40kg give a fixed volume of 40ml/hour**

***Note1:*** *APLS maintenance fluid rates overestimate*

***Note 2:*** *Neonatal DKA will require special consideration and larger volumes of fluid than those quoted may be required, usually 100-150 ml/kg/day*

1. **Dehydration deficit**

It is not possible to accurately clinically assess the degree of dehydration

% dehydration x Weight x 10 = fluid deficit (ml)

* **Assume a 5% fluid deficit in mild to moderate DKA (indicated by a blood pH of 7.1 or above)**
* **Assume a 10% fluid deficit in severe DKA (indicated by a blood pH below 7.1)**

*(e.g.10kg child who is 5% dehydrated: 5 x 10 x 10 = 500ml deficit)*

**3. Fluid Calculation**

Calculate the fluid deficit (5% or 10% depending on severity of acidosis) divide over 48hours and add to the hourly maintenance fluid requirement.

**Hourly rate = (deficit / 48 hrs) + maintenance per hour**

Do not include continuing urinary losses in the calculations at this stage

**Record your fluid calculation here:**

Deficit (% dehydration x weight x 10) ml\*

Divide by 48 to give even replacement over 48hrs ml/hour

+

Maintenance fluid rate ml/hour

Total hourly fluid rate for 48 hours **=** ml/hour

**Signed** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*\*If more than 20ml/kg resuscitation fluid given by intravenous bolus subtract any additional bolus volumes from the calculated fluid deficit e.g. if 30ml/kg boluses given subtract 10ml/kg from the deficit.*

**Type of Fluid**

**Use 0.9% sodium chloride + 20mmol KCl/500ml until blood glucose levels are less than 14mmol/l**

Corrected sodium levels should rise as blood glucose levels fall during treatment. Some have suggested that corrected sodium levels give an indication of the risk of cerebral oedema. If you wish to calculate this, go to:

<http://www.strs.nhs.uk/resources/pdf/guidelines/correctedNA.pdf>

If corrected sodium levels do not rise, discuss with the on call consultant.

If the child is becoming hypernatraemic, this is not generally a problem, and is protective against cerebral oedema

Patient details or hospital sticker

**Oral Fluids**

* Do not give oral fluids to a child or young person who is receiving intravenous fluids for DKA until ketosis is resolving and there is no nausea or vomiting.
* If oral fluids are given before the 48 hour rehydration period is complete the IV infusion need to be reduced to take account of the oral intake

**Fluid losses**

* If a massive diuresis continues for several hours fluid input may need to be increased.
* If large volumes of gastric aspirate continue, these will need to be replaced ml for ml with 0.45% sodium chloride with KCl

1. **Potassium**

* Following resuscitation, commence potassium immediately in rehydration fluid unless anuria is suspected or there are peaked T waves on ECG
* If initial K+ level >6.5, especially if biochemical evidence of renal impairment, temporarily omit KCl but re-check frequently (e.g. after 1-2 hours) and add KCl to IV fluids as soon as K+ level falling
* There is always massive depletion of total body K, although initial plasma levels may be low, normal, or even high. Levels in the blood will fall once insulin is commenced.
* Therefore ensure that **every** 500ml bag of fluid contains **20 mmol** potassium chloride (**40 mmol/l**)
* Use a cardiac monitor and observe frequently for T wave changes.
* If hypokalaemia develops (K<3mmol/l):
  + Consider temporarily suspending insulin infusion.
  + Discuss urgently with PICU as a central line is needed for K solutions >40mmol/l.

**Action: Confirm that initial rehydration fluid prescribed contains 20mmol KCl in every 500ml bag of fluid**

**Signed:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **Date:** \_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_ **Time:** \_\_\_\_:\_\_\_\_

1. **Insulin Infusion**

* Do not give an insulin bolus. Insulin can be run via same cannula as fluids using Y-connector.
* Prepare insulin infusion: 50 units Actrapid (or other rapid-acting insulin) in 50ml 0.9% sodium chloride.
* **Do not start insulin infusion until correction of shock is complete and IV fluids have been running for at least 1-2 hours.**
* The recommended rate of infusion (that aims to switch off ketogenesis) is 0.05-0.1unit/kg/hour.

**Action: Insulin infusion commenced at 0.05units/kg/hour**

**Signed: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_ Time: \_\_\_\_:\_\_\_\_**

* **If blood ketones are not falling after 6-8 hr, increase the insulin infusion to 0.1unit/kg/hour**.

**Insulin notes for patients with pre-existing diabetes:**

Those already on long-acting insulin (especially Glargine (Lantus)), can generally continue this at the usual dose and time throughout the DKA treatment, in addition to the IV insulin infusion, in order to shorten length of stay after recovery from DKA.

For children on insulin pump therapy, **stop the pump** when starting DKA treatment.

Patient details or hospital sticker

1. **Monitoring**
2. **Nursing Observations**

**Ensure full instructions are given to nurse responsible including:**

Strict fluid balance including oral fluids and urine output, using fluid balance charts (urinary catheterization may be necessary in young/sick children)

Hourly capillary blood glucose measurements

Capillary blood ketone levels every 1-2 hour

Hourly BP and basic observations

Hourly level of consciousness initially, using the modified Glasgow coma score

Half-hourly neurological observations including the modified Glasgow coma score and heart rate, in children < 2 years of age and in those with a pH <7.1 (at increased risk of cerebral oedema)

If consciousness reduced, NG tube - free drainage until child conscious

Report **immediately** to medical staff:

* symptoms of headache, or slowing of heart rate, or any change in either conscious level or behaviour
* any changes in ECG trace
* Urine output poor (<1.5ml/kg/hour) or excessive (>2.5ml/kg/hour)

Urine output poor (<1.5ml/kg/hour) or excessive (>2.5ml/kg/hour)

1. **Medical Reviews**

**Repeat Lab blood tests and blood gases**

At 2 hours after starting treatment and then at least every 4 hours carry out and record the results of the following blood tests on the flow sheet (p11):

* **glucose (Laboratory measurement)**
* **blood pH and pCO2**
* **plasma sodium, potassium and urea**
* **blood ketones (beta-hydroxybutyrate**)

**A doctor should carry out a face to face review at the beginning of treatment and then at least every 4 hours and more frequently if:**

* child is aged under 2 years
* has severe DKA (pH<7.1)
* there are any other reasons for special concern

**At each face to face review assess the following:**

* Clinical status, including vital signs and neurological status
* Results of blood investigations
* ECG trace (especially signs of hypokalaemia, including S-T segment depression and prominent U-waves)
* Cumulative fluid balance record
* Provide an update on progress to the child or young person and their family and carers (as appropriate)

Patient details or hospital sticker

**5. Ongoing Management**

* Continue with 0.9% sodium chloride containing 20mmol KCl in 500ml until blood glucose levels have fallen to 14 mmol/l.
* If the blood glucose rises out of control, or the pH level is not improving after 6-8 hours consult senior medical staff and re-evaluate (possible sepsis, insulin errors or other condition), and consider starting the whole protocol again.
* **If the blood ketone level is not falling after 6–8 hours, increase the insulin dosage to 0.1units/kg/hour**.

**Once the blood glucose has fallen to 14 mmol/l add glucose to the fluid and review the insulin infusion rate, as follows:**

**If blood ketone levels are less than 3 mmol/l**

Change the fluid to contain 5% glucose; use 500 ml bags of 0.9% sodium chloride with 5% glucose and 20mmol potassium chloride in 500ml (available from Pharmacy).

Reduce to or maintain insulin infusion at a rate of 0.05units/kg/hr **Signed:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**If ketone levels are above 3 mmol/l**

Maintain the insulin infusion rate at 0.05 to 0.1units/kg/hour to switch off ketogenesis

Change the fluid to contain 10% glucose rather than 5% glucose, in order to prevent hypoglycaemia when the higher dose of insulin is continued

Use 500 ml bags of 0.9% sodium chloride with 10% glucose and 20 mmol potassium chloride in 500mol; to make up this fluid see Appendix 1. **Signed:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**DO NOT** **stop the insulin infusion while glucose is being infused, as insulin is required to switch off ketone production**.

Once the pH is above 7.3, ketones are below 3, the blood glucose is down to 14 mmol/l, and a glucose-containing fluid has been started, reduce the insulin infusion rate, to 0.05 units/kg/hour.

**If the blood glucose falls below 6 mmol/l:**

* Increase the glucose concentration of the intravenous fluid, and
* If there is persisting ketosis, continue to give insulin at a dosage of at least 0.05 units/kg/hour

**If the blood glucose falls below 4 mmol/l:**

* Give a bolus of **2 ml/kg of 10% glucose** and increase the glucose concentration of the infusion. Insulin can temporarily be reduced for 1 hour.

**If acidosis is not correcting, consider the following:**

* Insufficient insulin to switch off ketones
* Inadequate resuscitation
* Sepsis
* Salicylate or other prescription or recreational drugs
* Once all these causes of acidosis have been excluded, and if ketones are falling gradually, then residual acidosis is likely to be due to hyperchloraemia. This can be left to resolve on its own, and does not require any treatment

**Use near-patient ketone testing to confirm that ketone levels are falling adequately**.

* If blood ketones are not falling, then check infusion lines, the calculation and dose of insulin and consider increasing insulin infusion rate.

Patient details or hospital sticker

**6. Insulin Management once Ketoacidosis Resolved**

Consider stopping intravenous fluid therapy once blood ketones are less than 1.0mmol/l AND oral fluids are tolerated without nausea or vomiting.

**DO NOT change from intravenous insulin to subcutaneous insulin unless the blood ketones are less than 1.0mmol/l** and the child or young person with DKA is alert and is tolerating oral fluids without nausea or vomiting.

Start subcutaneous insulin at least 30 minutes before stopping intravenous insulin to avoid rebound hyperglycaemia.

Subcutaneous insulin should be started according to the local protocol for the child with newly diagnosed diabetes, or the child should be started back onto their usual insulin regimen at an appropriate time (usually when they are ready to eat and food is available).

If returning to insulin pump therapy, restart the pump at the usual basal rate for 2 hours before stopping intravenous insulin. Change the cartridge and infusion set and insert the cannula into a new subcutaneous site.

**7. Other Complications**

**Hypoglycaemia and hypokalaemia** – avoid by careful monitoring and adjustment of infusion rates. Consideration should be given to adding more glucose if BG 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 child with impaired consciousness

**8. Education and Follow-up**

After a child or young person with known diabetes has recovered from an episode of DKA, discuss with them and their family members or carers (if appropriate) the factors that may have led to the episode.

Patient details or hospital sticker

**Results Flow Sheet:** Aim to check bloods at the time intervals shown

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Time from Start** | **Date & Time (24:00)** | **Glucose** | **pH** | **Base Excess** | **HCO3** | **Blood Ketones** | **Na+** | **K+** | **Urea** |
| 0 (Baseline) |  |  |  |  |  |  |  |  |  |
| + 2hrs |  |  |  |  |  |  |  |  |  |
| + 6hrs |  |  |  |  |  |  |  |  |  |
| + 10hrs |  |  |  |  |  |  |  |  |  |
| + 14hrs |  |  |  |  |  |  |  |  |  |
| + 18hrs |  |  |  |  |  |  |  |  |  |
| + 22hrs |  |  |  |  |  |  |  |  |  |
| + 26hrs |  |  |  |  |  |  |  |  |  |
| + 30hrs |  |  |  |  |  |  |  |  |  |
| + 34hrs |  |  |  |  |  |  |  |  |  |
| +38hrs |  |  |  |  |  |  |  |  |  |
| + 42hrs |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

**Other results**

FBC:

CRP:

OTHER:

**Appendix 1**

**How to make up special Intravenous Fluids**

**The following fluid is generally available from Pharmacy**

**500ml bag of 0.9% sodium chloride / 5% glucose containing 20 mmol potassium chloride (Baxter: FKB 2486)**

**But this may not be available on every ward. If you need to make it up, please do so as below, rather than waiting for pharmacy:**

Remove 50ml from a bag of Sodium Chloride 0.9% with 20mmol K in 500ml

Draw up 50ml of Glucose 50% using a syringe and add to the above bag which will make the Glucose concentration 5%

**Mix well before administration**

**Glucose 10% & Sodium Chloride 0.9% with 20mmol K in 500ml is not available and MUST be made up if required:**

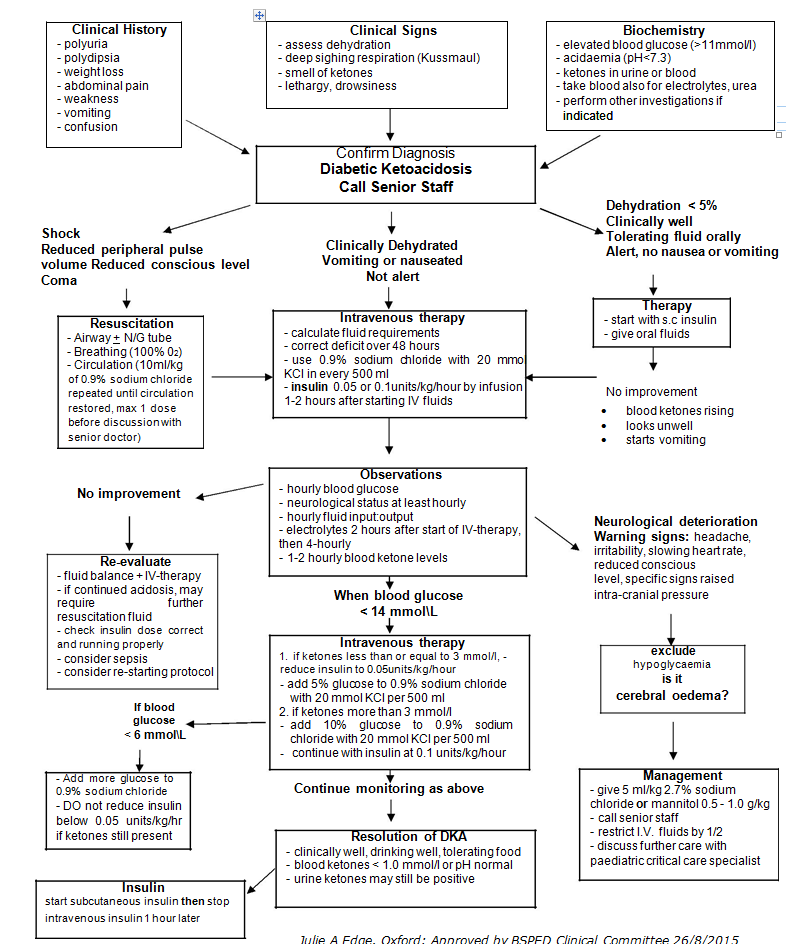
Remove 50ml from a bag of Glucose 5% & Sodium Chloride 0.9% with 20mmol K in 500ml (FKB2486)

Draw up 50ml of Glucose 50%using a syringe and add to the above bag which will increase the Glucose concentration to 10%

**Mix well before administration**

**Appendix 2**

**Algorithm for the Management of Diabetic Ketoacidosis**

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**Appendix 3**

**Initial management of Hyperosmolar Hyperglycaemic State (HHS)**

**Definition**

Feature which differentiate it from other hyperglycaemic states such as DKA are:

* Hypovolaemia
* Marked hyperglycaemia (40 mmol/L or more)
* No significant hyperketonaemia (<3 mmol/L) or acidosis (pH>7.3, bicarbonate >15 mmol/L)
* Osmolality usually 320 mosmol/kg or more

This picture usually occurs in Type 2 diabetes, especially where there are learning difficulties or other factors preventing proper hydration. It has a high mortality rate.

**Goals of treatment**

The goals of treatment of HHS are to treat the underlying cause and to gradually and safely:

* Normalise the osmolality
* Replace fluid and electrolyte losses
* Normalise blood glucose

Other goals include prevention of arterial or venous thrombosis and other potential complications e.g. cerebral oedema/ central pontine myelinolysis

**Fluid therapy**

The goal of initial fluid therapy is to expand the intra and extravascular volume and restore normal renal perfusion. The rate of fluid replacement should be **more rapid** than is recommended for DKA.

* Give an initial bolus should be of 20 mL/kg of isotonic saline (0.9% NaCl)
* Assume a fluid deficit of approximately 12–15% of body weight.
* Additional fluid boluses should be given, if necessary, to restore peripheral perfusion.
* Thereafter, 0.45–0.75% NaCl with potassium should be administered to replace the deficit over 24–48 hours.
* The goal is to promote a gradual decline in serum sodium concentration and osmolality.
* As isotonic fluids are more effective in maintaining circulatory volume, isotonic saline should be restarted if perfusion and hemodynamic status appear inadequate as serum osmolality declines.
* Serum sodium concentrations should be measured frequently and the sodium concentration in fluids adjusted to promote a gradual decline in corrected serum sodium concentration.
* Mortality has been associated with failure of the corrected serum sodium concentration to decline with treatment, which may be an indication for haemodialysis.
* Although there are no data to indicate an optimal rate of decline in serum sodium, 0.5 mmol/L per hour has been recommended for hypernatremic dehydration.

If there is a continued rapid fall in serum glucose ( *>*5 mmol/l per hour) after the first few hours, consider adding 2.5 or 5% glucose to the rehydration fluid. Failure of the expected decrease of plasma glucose concentration should prompt reassessment and evaluation of renal function.

Unlike treatment of DKA, replacement of urinary losses is recommended. The typical urine sodium concentration during an osmotic diuresis approximates 0.45% saline; however, when there is concern about the adequacy of circulatory volume, urinary losses may be replaced with a fluid containing a higher sodium concentration.

**Insulin therapy**

* Blood glucose levels will fall with fluid alone and insulin is NOT required early in treatment.
* Insulin administration should be initiated when serum glucose concentration is no longer declining at a rate of at least 3 mmol/l per hour with fluid administration alone.

**Potassium**

Patients with HHS also have extreme potassium deficits; a rapid insulin-induced shift of potassium to the intracellular space can trigger an arrhythmia. Therefore Potassium MUST be included in all fluids.

**For further information see ISPAD Guidelines 2014 Chapter 11**