

Clinical Guideline

WATCH – DIABETIC KETOACIDOSIS (DKA) MANAGEMENT

SETTING	Wales and West Acute Transport for Children (WATCH)
FOR STAFF	WATCH Team, South West and South Wales District General Hospital medical and nursing teams.
PATIENTS	Children presenting to District General Hospitals with Diabetic Ketoacidosis (DKA)

GUIDANCE

This guideline details key immediate management advice for patients presenting with DKA in the regions served by WATCH; it does not replace or supersede national guidance from the National Institute for Health and Care Excellence (NICE), the British Society for Paediatric Endocrinology and Diabetes (BSPED), the All-Wales Diabetic Ketoacidosis in Children Integrated Care Pathway or the Southwest Integrated Care Pathway for the Management of Children and Young People with Diabetic Ketoacidosis.

Key Points:

Please refer all children under the age of 2 years to WATCH as well as those with

- Hypotension/shock (*The use of inotropes **must be discussed** with the WATCH Consultant if child is in hypotensive shock which is not responsive to fluids)
- A presenting pH < 7.0
- Decreased conscious level

Potential pitfalls to avoid:-

- Capillary refill is unreliable due to the metabolic acidosis and should not be used as an indicator of the presence of shock
- Shock (hypotension +- weak peripheral pulses) is an unusual presenting feature of DKA and should lead the treating team to consider additional pathology (e.g. sepsis)
- Risk of causing **cerebral oedema** by over rehydration, correcting serum sodium too quickly or starting insulin prior to initiating IV fluids
- Chasing an osmotic diuresis can result in administering fluid replacement too quickly – do not replace urinary losses
- Neonates presenting with DKA require different fluid treatment approaches and should therefore be discussed with the on service Neonatal Consultant.

RELATED DOCUMENTS	NICE Diabetes (type 1 and type 2) in children and young people: diagnosis and management (NG18 2015 updated 2020) BSPED Interim Guidelines for the Management of Children and Young People under the age of 18 years with Diabetic Ketoacidosis 2020 Southwest Paediatric Diabetes Regional Network Integrated Pathway for Children South Thames Retrieval Service Guideline for Diabetic Ketoacidosis
AUTHORISING BODY	WATCH Governance Group
SAFETY	Call the WATCH team for advice and support
QUERIES	0300 0300 789

DKA – IMMEDIATE MANGEMENT ADVICE

PRINCIPLES OF THERAPY		INITIAL FLUID RESUSCITATION									
<ul style="list-style-type: none"> Treat shock if present SLOW correction of Keto-acidosis (insulin + dextrose) and other metabolic derangements SLOW rehydration over 48 hours Replacement of K⁺ Continuous careful monitoring Consider antibiotics if there is sepsis or refractory hypotension <p>Main risk of death is from cerebral oedema – patients require regular review</p>		<p>Shocked Patients (Hypotensive and weak pulses)</p>	<p>Non shocked patients</p>								
		<p>20mL/kg fluid bolus over 15 minutes and reassess</p> <ul style="list-style-type: none"> If shock persists consider further boluses (10mL/kg aliquots) up to a total of 40mLs/kg – if still shocked consider inotropes* <p>Do Not Subtract This Volume From Calculated Fluid Deficit</p>	<p>10mL/kg fluid bolus over 60 minutes</p> <p>Subtract This Volume From Calculated Fluid Deficit</p>								
CALCULATING % OF DEHYDRATION											
Presenting pH < 7.1	<p>Severe DKA Assume 10% fluid deficit (10% dehydration)</p>	<p>Fluid deficit = $\frac{\% \text{ dehydration} \times \text{Weight (Kg)} \times 10}{48}$ REHYDRATE OVER 48 HOURS</p>									
Presenting pH > 7.1	<p>Mild to Moderate DKA Assume 5% fluid deficit (5% dehydration)</p>										
MAINTENANCE FLUID REQUIREMENTS		INSULIN INFUSION (ACTRAPID)									
<table border="1"> <thead> <tr> <th>Weight</th> <th>Hourly fluid rate</th> </tr> </thead> <tbody> <tr> <td>For the first 10 kg</td> <td>4mLs/kg</td> </tr> <tr> <td>For each kg between 10 – 20kg</td> <td>2mLs/kg</td> </tr> <tr> <td>Each additional kg > 20 kg to a maximum weight of 80kg</td> <td>1mL/kg</td> </tr> </tbody> </table>	Weight	Hourly fluid rate	For the first 10 kg	4mLs/kg	For each kg between 10 – 20kg	2mLs/kg	Each additional kg > 20 kg to a maximum weight of 80kg	1mL/kg	<p>50 units in 50mL 0.9% NaCl Run at 0.05 - 0.1mL/kg/hr = 0.05 - 0.1units/kg/hr</p> <p>Starting dose 0.05 units/kg/hr 1-2 hrs after beginning I.V fluid therapy</p> <p>DO NOT BOLUS INSULIN (Stop insulin pump if normally on insulin pump therapy)</p>		
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Each additional kg > 20 kg to a maximum weight of 80kg	1mL/kg										
(Neonatal DKA requires special consideration please discuss before calculating fluids)											
CORRECTED SODIUM (NA ⁺ CORR) CALCULATION											
<p>Calculate initial corrected sodium at presentation and then monitor trend every 2 hours</p> <p>Calculating Corrected Sodium³ = Plasma Na⁺ + (0.4 x (Glucose - 5.5mmol))</p>											
ADJUSTING TOTAL FLUID RATE USING NA ⁺ CORR											
<ul style="list-style-type: none"> If Na⁺ corr. rises > 5mmol/L in 4-8 hours = excess fluid loss / insufficient replacement = increase fluid rates If Na⁺ corr. falls > 5mmol/L in 4-8 hours = excess fluid gain / too rapid replacement = reduce fluid rates <p>(Suggested adjustments for fluid infusion rates are for < 10kg = 0.5mL/kg/hour and for > 10kg = 1mL/kg/hour)</p> <p>(If Na⁺ is less than 120mmol/L or there is evidence of seizure, more rapid correction is indicated – consider Hypertonic Saline dose – Senior Review and discuss with WATCH)</p>											
CEREBRAL OEDEMA											
<p>Risk factors for cerebral oedema</p> <ul style="list-style-type: none"> Younger age pCO₂ < 2kPa at presentation pH < 7.1 at presentation Rapid falls in corrected sodium NaHCO₃ therapy or raised serum urea 	<p>Risk of cerebral oedema is greatest in first 24 hours. Presume if:</p> <ul style="list-style-type: none"> Patient has a reduced level of consciousness (i.e. GCS less than 15) Acute confusion Abnormal posturing Pupillary inequality / dilatation Abnormal respiratory pattern 	<p>Management of Suspected Cerebral Oedema</p> <ul style="list-style-type: none"> Recheck blood glucose Use osmotherapy: e.g. 2.5 - 5ml/kg 3% saline Restrict fluids to ½ maintenance rates and replace deficit over 72 hrs Urgent senior review (if not already present) If no response to HTS arrange CT head to exclude other causes Discuss further management with WATCH 									

<p>FLUID INFUSION CALCULATIONS</p>	<p>Maintenance fluids are calculated using the standard (Holliday-Segar) formula:</p> <ul style="list-style-type: none"> • 100mL/kg/day (4mL/kg/hour) for the first 10kg of body weight • 50mL/kg/day (2mL/kg/hour) for the each kg between 10 and 20 kg • 20mL/kg/day (1mL /kg/hour) for additional kg above 20kg to a maximum of 80kg
	<p>General Principles:</p> <ul style="list-style-type: none"> • Initially use 0.9% sodium chloride OR PlasmaLyte 148. • Do not use glucose-containing fluids until glucose is < 14mmol/L, and then use 0.9% sodium chloride OR PlasmaLyte 148 with 5% Glucose. • Continue with 0.9% sodium chloride or PlasmaLyte 148 throughout intravenous fluid therapy. • Add 20 mmol/L K⁺ to all fluid bags unless serum K⁺ >5.5 mmol/L or anuric or ECG changes consistent with hyperkalaemia are present. • Do not routinely supplement phosphate unless < 0.3 mmol/L. • Monitor urine output – do not replace unless continued excessive diuresis. • Monitor nasogastric losses – large volumes (> 5mL/kg/hour) should be replaced (mL for mL) Standard replacement fluid 0.45% Sodium Chloride with 10mmol Potassium per 500mL bag (if hypokalaemic consider 20mmol in each 500mL bag)
	<p>ALWAYS recheck the fluid calculation; errors occur frequently</p> <p>Total hourly fluid rate = Total Deficit / 48 in mL + calculated hourly maintenance in mL</p>
<p>KETOACIDOSIS</p>	<ul style="list-style-type: none"> • Start insulin at 0.05 units/kg/hour 1-2 hours after beginning intravenous fluid therapy. • If blood ketone level is not falling after 6-8 hours, increase insulin dose to 0.1units/kg/hour. • Reduce to or maintain insulin infusion at 0.05units/kg/hour once blood ketones are < 3mmol/L. • 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 not already at this rate. • 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. • Do not use urine ketones to guide therapy as they remain elevated for 24-48 hours following correction of ketonaemia. • If blood ketones are not falling, check infusion lines, calculations and consider increasing insulin infusion rate (after discussion with WATCH Consultant and where possible Endocrine Consultant).
<p>MONITORING THERAPY</p>	<p>Avoid rapid falls in plasma osmolality to reduce cerebral oedema</p> <ul style="list-style-type: none"> • Hourly GCS and neuro-observations (1/2 hourly in children < 2 years or with severe DKA) and hourly blood glucose. • Hourly fluid balance should be calculated and recorded - <ul style="list-style-type: none"> • Urinary catheters are not routinely indicated but may be placed to assist in hourly fluid balance in sick / young children. • A nasogastric tube should be inserted in initial assesment phase – leave on free drainage • 2 hourly venous/arterial gas (not capillary), electrolytes including corrected sodium, phosphate and blood ketones • Septic screen indicated and antibiotics should be considered if sepsis suspected