LRI Children's Hospital

Diabetes in Childhood Guideline

Staff relevant to:	Medical and Nursing staff working within UHL Children's Hospital
Team approval date:	May 2024
Version:	4
Revision due:	May 2027
Written by: Reviewed by:	J Greening, P Sundaram, S Kapoor, A Subbarayan & P Sundaram, K Sparrow
Trust Ref:	C10/2019

Introduction and Who Guideline applies to

These guidelines are designed to be used by health care professionals and various staff members involved in looking after patients with diabetes. Diabetes could be the primary reason for their admission or associated comorbidity. This will help in managing common conditions which we come across on a regular basis. Please also see information about the various team members of diabetes team and their contact details.
Please ensure that all the patients with diabetes (New diagnosis, DKA, Elective admissions for any procedures, telephone queries) are notified to diabetes team via paediatricdiabetesteam@uhl-tr.nhs.uk

Contact details of the Diabetes Team:

1. Consultants- Dr James Greening, Dr Prem Sundaram, Dr Sonal Kapoor, Dr Anbu Subbarayan: Extension 15027
2. Paediatric Diabetic Specialist Nurses (PDSNs) 8am-4pm: Extension 16796 (answer phone available)
3. Children's Specialist Diabetes Dietitians 8am-4pm: Extension 15400
4. Out of hours & Bank Holidays: Contact on call consultant for *East Midlands Network Paediatric Endocrine Consultant* via switchboard.

Contents

1. Diabetic Ketoacidosis (DKA) Management in Children

Introduction

NICE guidance NG18 applies to all individuals <18 years and does not make explicit recommendation's for the group aged 16-18 years who may be managed by either Adult or Paediatric medical teams. The BSPED special interest group remained of the opinion that where young people aged 16-18 years are managed by adult medical teams because of local arrangements, it is appropriate for them to be managed using local adult guidelines that the teams are familiar with rather than using potentially unfamiliar paediatric guidelines. Where individuals aged 16-18 are managed by Paediatric teams the Paediatric guidelines should be followed.

1.1 Diagnose DKA in children and young people who have

- **Acidosis** (blood pH < 7.3 or plasma bicarbonate < 15 mmol/l)
- **Ketonaemia** (blood ketones or beta- hydroxyl butyrate ≥3.0 mmol/l)
- **Hyperglycaemia** (blood glucose > 11 mmol/l) Children and young people with known diabetes may develop DKA with normal blood glucose level

This guideline is intended for management of children and young people who have in addition to the biochemical features

- clinical dehydration
- Acidotic respiration
- Abdominal pain, nausea and /or vomiting
- Drowsiness

Please see **appendix 1** for initial management of Hyperglycaemic Hyperosmolar State (HHS)

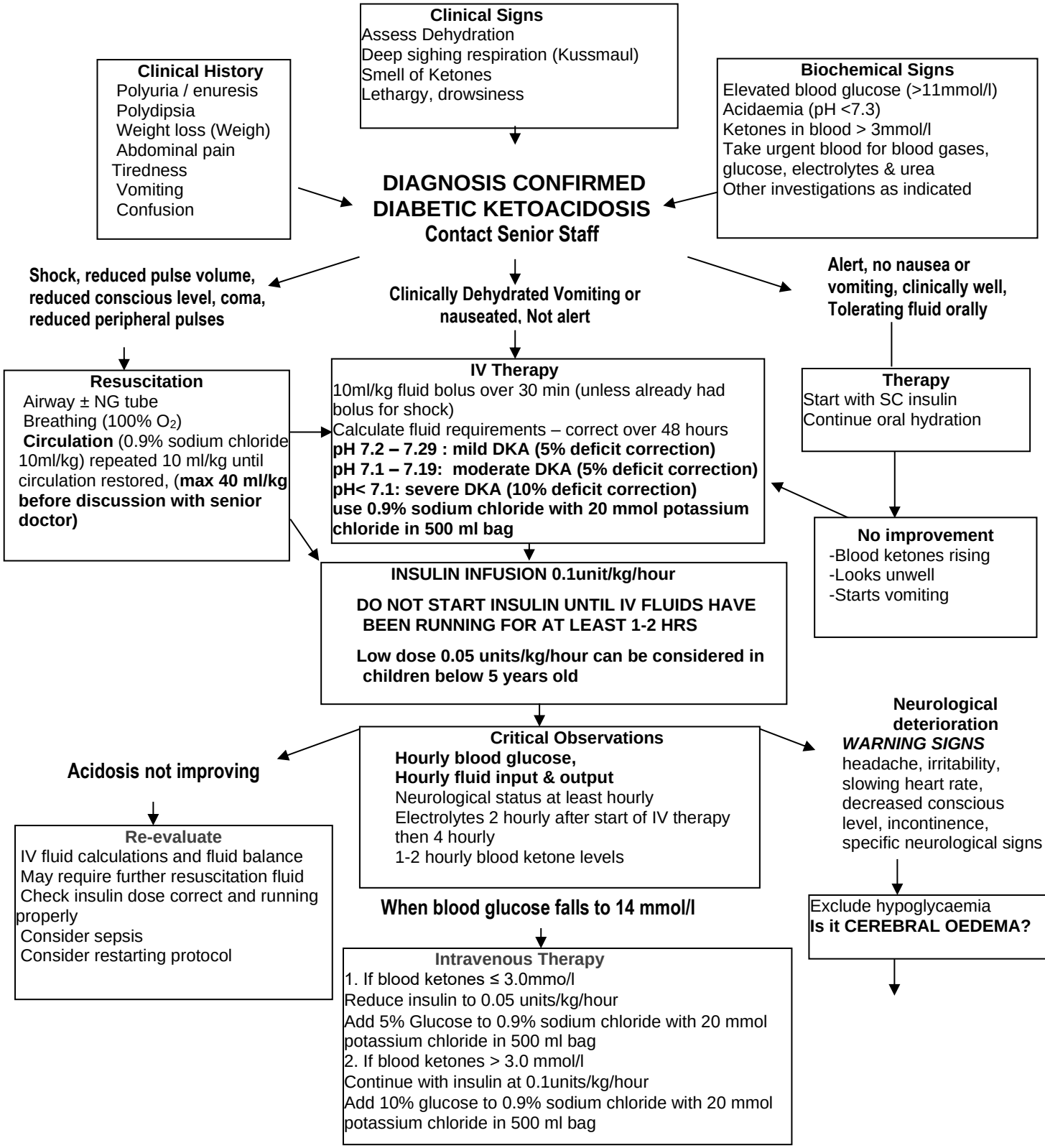
Please click on the following link to be directed to the BSPED Paediatric DKA Calculator https://dka-calculator.co.uk/

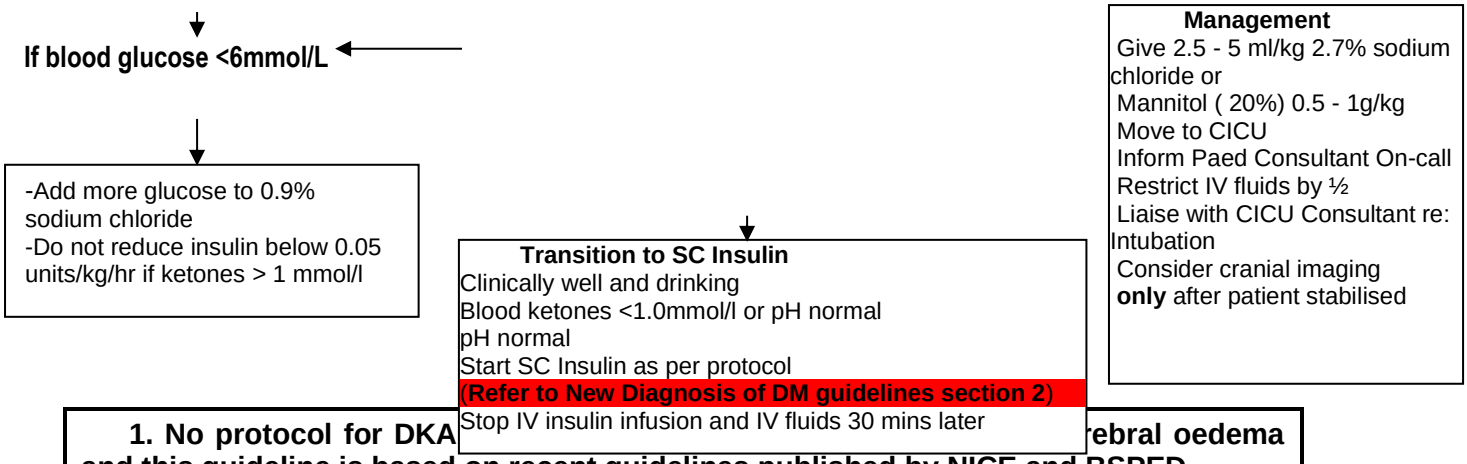
Severity of DKA	pH	Bicarbonate	Percentage of dehydration
Mild DKA	7.2 – 7.29	< 15 mmol/l	5%
Moderate DKA	7.1 – 7.19	< 10 mmol/l	5%
Severe DKA	< 7.1	< 5 mmol/l	10%

1.2 Classification of DKA (updated Oct 2022 based on NICE & BSPED guidelines)

pH or bicarbonate (whichever is worse) levels can be used for classifying DKA.

1.3. Flowchart - Paediatric Management of Diabetic Ketoacidosis (DKA) (Updated Oct 2022 based on recent NICE and BSPED guidelines)





1. No protocol for DKA ebral oedema and this guideline is based on recent guidelines published by NICE and BSPED

2. The Consultant on call must be informed of children with DKA

3. Paediatric diabetic consultants, Diabetes Specialist Nurses and Dietician like to be informed as soon as possible about all diabetic admissions (Monday –Friday 0800-1600 ext: 16796)

4. If out hours advice is needed, please contact switchboard asking for the East Midlands Paediatric Consultant Endocrine On Call.

5. Remember if child is on an insulin pump to stop it during DKA Management

NB Children who are alert, not clinically dehydrated, with no nausea or vomiting, do not always require IV fluids even if their ketones are high. They can be managed with oral rehydration and subcutaneous insulin, but need regular monitoring to ensure they are improving and ketone levels are falling.

Children and adolescents who develop DKA as defined above should be managed in an area where the nurses have experience and knowledge of specialist treatment and where vital signs, neurological status and laboratory results can be monitored and evaluated frequently.
DKA will be managed in the following wards depending on their severity and age of the child.

Ward 14 – children above 5 years with mild DKA (pH 7.2 – 7.29) dependant on nurse to patient ratio

Ward 12 - children less than 5 years with mild DKA (pH 7.2 – 7.29) and children with any age with moderate DKA (pH 7.1 to 7.19). Children with Severe DKA (pH < 7.1) can be managed in ward 12 provided they are stable.

CICU – Consider admitting direct to CICU if there is

(a) Severe acidosis pH<7.1 with marked hyperventilation
(b) Severe dehydration with shock
(c) Depressed sensorium with risk of aspiration from vomiting

1.4 EMERGENCY ASSESSMENT

General Resuscitation

Airway

- Ensure airway patent; in coma, insert an airway

- If consciousness reduced or recurrent vomiting , insert NG tube, aspirate and leave on open drainage

- **Urgent CICU and /or anaesthetic review if reduced level of consciousness and unable to protect airway**

Breathing

- Oxygen 100% by face mask

Circulation

- Insert IV cannula and take blood samples

- Cardiac monitor for T waves

- Measure blood pressure and heart rate

- **Give 10 ml/kg of 0.9% Sodium Chloride as IV fluid bolus over 15 minutes if shocked** (tachycardia, poor peripheral pulses, prolonged capillary refill and/or hypotension) (based on resuscitation council guidelines)

- **Bolus given to treat shock should not be subtracted from fluid calculation**

Initial fluid bolus

- All children and young people with mild, moderate and severe DKA **who are not shocked and are felt to require IV fluids** should receive 10 ml/kg 0.9% sodium chloride bolus over 30 minutes. **This should be subtracted from calculated fluid deficit**.

- **Give 10 ml/kg 0.9% sodium chloride as a bolus for children who are shocked. Further boluses of 10 ml/kg can be given if required up to a total of 40 ml/kg at which stage inotropes should be considered.**

- Bolus given to treat shock should not be subtracted from total fluids.

Initial Investigation

- Blood glucose

- Urea and electrolytes

- Blood gases (venous or capillary)

- Near patient blood ketones

- Other investigations if indicated – FBC, throat swab, blood culture, urine culture if suspecting sepsis

- Newly diagnosed patients – HbA1c, Free T4, TSH, coeliac disease screen, diabetic antibodies (GAD65, IA2, Islet cell antibodies, ZnT8 antibodies)

DKA may be precipitated by sepsis. Suspect sepsis if there is fever or hypothermia, hypotension, refractory acidosis or lactic acidosis

1.5 FULL CLINICAL ASSESSMENT

Conscious level

- Hourly neuro observation from admission
- If reduced conscious level on admission
    - Seek urgent anaesthetic review if the airway cannot be protected
    - Discuss with paediatric consultant on call
    - Discuss with CICU to decide appropriate care settings (HDU or CICU)
    - If cerebral oedema suspected go to page 9 for management of cerebral Oedema

Targeted history and Examination

Characteristic history – polydipsia, polyuria, nocturia, weight loss, tiredness, thrush
Full examination – looking for evidence of

- Cerebral Oedema – headache, irritability, bradycardia, hypertension, reduced conscious level (Papilledema is a late sign)
- Infection
- Ileus

Assessment of conscious level, GCS score (and examine pupils & retinal fundi)

Glasgow Coma Scale						
	1	2	3	4	5	6
Eyes	Does not open eyes	Opens eyes in response to painful stimuli	Opens eyes in response to voice	Opens eyes spontaneously	N/A	N/A
Verbal	Makes no sounds	Incomprehensible sounds	Utters inappropriate words	Confused, disoriented	Oriented, converses normally	N/A
Motor	Makes no movements	Extension to painful stimuli	Abnormal flexion to painful stimuli	Flexion / Withdrawal to painful stimuli	Localizes painful stimuli	Obeys Commands
Paediatric Glasgow Coma Scale						
Eyes	Does not open eyes	Opens eyes in response to painful stimuli	Opens eyes in response to voice	Opens eyes spontaneously	N/A	N/A

Verbal	No verbal response	Infant moans to pain	Infant cries to pain	Infant is irritable and continually cries	Infant coos or babbles (normal activity)	N/A
Motor	No motor response	Extension to pain	Abnormal flexion to pain for an infant	Infant withdraws from pain	Infant withdraws from touch	Infant moves spontaneously or purposefully

1.6 MANAGEMENT

Fluid Replacement

Document all fluids given carefully

Children with shock should be resuscitated with bolus of 10ml/kg of 0.9% Sodium Chloride

Other children will have received initial fluid bolus of 10 ml/kg as a part of routine management

Weight:

- Patient's actual weight on admission should be used rather than estimated weight.
- if weighing not possible , use recent clinic weight or estimated weight from centile chart
- To avoid excessive amounts of fluid in overweight and obese children, consider using maximum weight of 75kg

Please click on the following link to be directed to the BSPED Paediatric DKA Calculator https://dka-calculator.co.uk/

Fluids

Total fluid Hourly rate = {(Deficit – Initial bolus) / 48 hr} + Maintenance per hour

Deficit

- it is not possible to accurately clinically assess the degree of dehydration
- Assume fluid deficit based on blood pH
- Bolus given for shock should not be subtracted.
- 10 ml/kg bolus given for routine care should be subtracted.

Assume 5% fluid deficit in children and young people with mild DKA
(Blood pH 7.2-7.29 &/or bicarbonate <15mmo/l)
Assume 5% fluid deficit in children and young people with moderate DKA
(Blood pH 7.1-7.19 &/or bicarbonate <10 mmol/l)
Assume 10% fluid deficit in children and young people with severe DKA
(Blood pH <7.1 &/or bicarbonate <5mmol/l)
Use pH or bicarbonate for classification (Choose the worst category)

Calculation of Deficit = estimated % dehydration x body weight (kg) X 10 (amount in mls)

Maintenance

- Maintenance fluid calculated using Holliday –Segar formula (APLS formula)
- Neonatal DKA may require large volumes of fluid i.e. 100- 150 ml/kg/day

Weight	Maintenance fluid
< 10 Kg	100ml/kg/day
10 – 20 Kg	1000 mls + 50 ml/kg for the next 10 to 20 kg
>20 Kg	1500 mls + 20 ml/kg/day for each additional kilogram above 20 kg up to a max of 75 kg

Resuscitation fluid

- Do not subtract fluid bolus given for management of shock
- Bolus given for routine management should be subtracted from the fluid calculation

Examples:

75 Kg, 15 year old who has pH 7.21 (<u>mild DKA, 5% deficit</u>) will receive a fluid bolus of 10 ml/kg (800 ml) over 60 minutes. Fluid calculation for maximum 75 kg

Deficit (5%) 5 X 75 X 10	=	3750
Subtract `initial bolus	=	3750 – 750 = 3000 to be replace over 48 hours
	=	62.5 ml/hr
Maintenance		10 X 100 = 1000 ml
		10 X 50 = 500 ml
		55 X 20 = 1100 ml
	=	2600 ml
	=	108 ml/hr
Total fluids	=	62.5 ml/hr
	+	108 ml/hr
	=	170.5 ml/hr

20 kg 6 years old boy has a pH of 7.15 (<u>moderate DKA, 5% deficit</u>), will receive a fluid bolus of 10ml/kg (200ml) over 60 minutes as part of his initial management.

Deficit (5%) 5 X 20 X10	=	1000 ml
Subtract initial bolus	=	1000 – 200 to be replaced over 48 hours
	=	16.6 ml/hr
Maintenance		10 X100 = 1000 ml/day for first 10 kg
		10 X 50 = 500 ml/day for next 10 kg
	=	1500 ml per day
	=	62 ml/hr
Total fluids	=	16 ml/hr (deficit)
	+	62 ml/hr (maintenance)
	=	78 ml/hr

A 14 year old 50 kg girl with pH 6.8 (<u>severe DKA, 10% deficit</u>) and has received 30 ml/kg of 0.9% sodium chloride for shock. Do not subtract bolus given for shock from fluid calculation.

Deficit (10%) 10X 50 X10	=	5000
Deficit over 48 hours	=	104 ml/hr
Maintenance		10 X 100 = 1000 ml (for first 10kg)
		10 X 50 = 500 ml (for 10 – 20 kg)
		30 X 20 = 600ml (> 20 Kg)
	=	2100 ml
	=	87 ml/hr
Total fluids	=	104 ml/hr
	+	87 ml/hr
	=	191 ml/hr

Type of fluid

Use 0.9% sodium chloride with 20 mmol potassium chloride in 500ml (KCl 40 mmol/L) until blood glucose < 14 mmol/l.
Corrected Na level should rise as blood glucose levels fall during treatment
Calculate corrected Na levels Corrected Na = measured Na + (Glucose - 5.5)/ 3.5
Corrected sodium levels should be calculated on lab sodium levels.
If corrected Na levels fall during treatment discuss with consultant on call.
If rise in corrected Na > 5 mmol/l in 4-8 hours, it suggest too much fluid loss or insufficient replacement. Consider increasing fluid rate.
If there is a fall in corrected Na level by more than 5 mmol/l in 4-8 hours, it suggests too much fluid gain or too rapid replacement. Consider reducing the fluid rate.

Oral fluids

Do not give oral fluids until ketosis is resolving and there is no nausea or vomiting
Nasogastric tube may be necessary for gastric paresis.
If oral fluids are given before the completion of 48 hour rehydration, IV fluids need to be reduced.

Fluid losses

Do not give additional IV fluids to replace urinary loss.
If large NG aspirates replace them with 0.45% sodium chloride with 10mmol KCl in 500ml bag.

Potassium

Total body potassium is always depleted in DKA (probably by 3-6mmol/kg).
All fluids (except initial bolus) should contain 40 mmol/L of potassium chloride unless there is evidence of renal failure.
Ensure every 500 ml bag of fluid has 20 mmol of potassium chloride (40 mmol/L).
When the potassium is above the upper limit of normal range at presentation, it is recommended that potassium is only added to intravenous fluids after patient has passed urine or the potassium is fallen within the normal range.
If child develops hypokalaemia (K < 3 mmo/l);
Consider reducing insulin infusion.

Discuss with CICU about central venous catheter to give potassium solution > 40 mmol/l
Consider oral potassium supplement if there is delay in getting central line. Please check BNFc for oral dose.

Insulin

- There is some evidence that cerebral oedema is more likely if insulin is started early
- **Start intravenous insulin infusion 1-2 hours after starting the 10 mls/kg fluid bolus**
- **If patient received 10mls/kg for treatment of shock, start IV insulin infusion 1-2 hrs after starting the IV maintenance fluids**
- Do not give bolus dose of insulin

If available use pre-filled syringes containing 50 units of soluble insulin (Actrapid) in 50 ml 0.9% sodium chloride

- A solution of **Soluble (Actrapid) Insulin 1 unit / ml made up in 0.9%sodium chloride** should be given by electronic syringe pump

(Make up solution by drawing up 49.5 mls 0.9% Sodium Chloride into a 50ml syringe and then injecting exactly 50 units of Actrapid insulin into the 0.9% Sodium chloride in the syringe, mix well and use syringe pump via extension tubing to 3-way tap and into the main infusion line)

- **Recommended initial insulin dose = 0.1 units / kg / hour** (to the nearest round figure)
- **Children below 5 years with mild to moderate DKA can be started on lower dose insulin infusion 0.05 units/kg/hour**
- Children on continuous subcutaneous insulin infusion pump therapy, stop the pump when starting intravenous infusion
- Children with known diabetes on long acting insulin, you can continue this at the usual dose and time during DKA treatment as it will help to resolve ketosis faster.

1.7 Clinical observations and monitoring

Careful frequent documented clinical monitoring to detect warning signs of complications is of paramount importance

Nursing Observations

- Hourly pulse rate, respiratory rate, BP
- Hourly neuro observation.
- ½ hourly neurological observations in children below 2 years and patients with pH below 7.1
- Strict fluid balance, input and output chart. (Urinary catheter may be necessary in young/sick children).

- Hourly capillary blood glucose
- Check capillary blood ketones 1-2 hourly
- Check U+E 2 hours after resuscitation then 4 hourly
- ECG monitoring may be helpful in the initial assessment of severe DKA for T-wave measurement
- Twice daily weight
- Report immediately to medical staff, if symptoms of headache or slowing of heart rate or change in conscious level or behaviour

Medical reviews

At 2 hours and at least 4 hourly

- Lab glucose
- Blood gas
- Urea and electrolytes

Face –to –face review with doctor at start of treatment and then at least 4 hourly or more frequently in children < 2 years or patients with severe DKA

- Clinical status including vitals and neurological status
- Blood results
- ECG trace
- Fluid balance

1.8 CONTINUING MANAGEMENT

Continue with 0.9% sodium chloride with 20 mmol potassium chloride in 500 ml until blood glucose is fallen to14 mmol/l
If blood ketone is not falling within 6-8 hours, consider increasing the insulin dose to 0.1units/kg/hour or greater

Once blood glucose has fallen to 14 mmol/l, add glucose to the IV fluids

If ketone levels are less than 3 mmol/l (blood glucose ≤14 mmmo/l)
Change IV fluids to 0.9% sodium chloride with 5% glucose and 20 mmol potassium chloride in 500 ml bag
Reduce or maintain at an insulin infusion rate of 0.05 units/kg/hour

If ketone levels are above 3 mmol/l (blood glucose ≤ 14 mmol/l)
Change IV fluids to 0.9% sodium chloride with 10% glucose and 20 mmol potassium chloride in 500 ml bag
Maintain the insulin infusion rate (0.05 to 0.1 units/kg/hour) to switch off ketogenesis

If blood glucose is below 6 mmol/l

Increase glucose concentration in IV fluids
If persisting ketosis, continue insulin dose at least 0.05 u/kg/hour

If blood glucose is below 4 mmol/l
Give a bolus of 10% glucose IV, 2 ml/kg stat
Increase glucose concentration in fluids
Insulin can be temporarily reduced for 1 hour

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

Blood glucose	**Blood ketones**	**Insulin infusion**	**IV Fluids**
> 14 mmol/l	>3.0 mmol/l	Maintain 0.05-0.1 units/Kg/hr	0.9% sodium chloride with 20 mmol potassium chloride in 500 ml bag
> 14 mmol/l	< 3.0 mmol/l	Maintain 0.05-0.1 units/Kg/hr	0.9% sodium chloride with 20 mmol potassium chloride in 500 ml bag
< 14 mmol/l	> 3.0 mmol/l	0.1 unit/kg/hr	0.9% sodium chloride with 10% Glucose and 20 mmol potassium chloride in 500 ml bag
< 14 mmol/l	< 3.0 mmol/l	0.05 units/kg/hour	0.9% sodium chloride with 5% Glucose and 20 mmol potassium chloride in 500 ml bag
<6 mmol/l	> 1.0 mmol/l	0.05 units/kg/hour	0.9% sodium chloride with 10% Glucose and 20 mmol potassium chloride in 500 ml bag
< 4 mmol/l	n/a	Stop for 1 hour	Give 10% Glucose bolus 2 ml/Kg stat Increase glucose concentration 0.9% sodium chloride with 10% Glucose and 20 mmol potassium chloride in 500 ml bag
< 14 mmol/l	< 1.0 mmol/l	Stop infusion after 30 min	Clinically well, drinking well, pH normal Start SC insulin

BICARBONATE IN DKA

There is evidence that BICARBONATE confers no clinical benefit and it may be unsafe in childhood onset DKA.
Do not give intravenous bicarbonate to children and young people with DKA
Fluid and insulin replacement without bicarbonate corrects ketoacidosis.

If acidosis is not correcting, consider the following

- Inadequate resuscitation
- Insufficient insulin to switch off ketones
- Fluid calculation error
- Sepsis
- Hyperchloraemic metabolic acidosis
- Salicylate of recreational drugs over dose

If blood ketones are not falling, check:

- Infusion lines/ cannula site
- Fluid calculation
- Insulin dose
- Reassess the patient and look for shock

Consider increasing insulin infusion rate

Once other causes of acidosis are excluded, and if ketones are falling gradually the residual acidosis is due to hyperchloraemic acidosis.

Hyperchloraemic metabolic acidosis during DKA management:

Hyperchloraemic metabolic acidosis may occur following the administration of large amounts of chloride containing fluids given during the management of DKA. The acidifying effect of chloride can mask the resolution of ketoacidosis if base deficit alone is used to monitor progress as there may appear to be a continuing base deficit with continued low bicarbonate due to the chloride component rather than due to ketosis.

Direct monitoring of ketones and calculation of the component of the base deficit due to chloride will help differentiate whether persisting acidosis is due to ongoing ketosis that may need additional treatment (adjustment to insulin infusion or fluids) or due to hyperchloraemia. Acidosis due to hyperchloraemia will correct spontaneously and doesn't need specific treatment. Acidosis due to hyperchloraemia need not delay the transition to oral fluids and subcutaneous insulin. It needs differentiating from ongoing ketosis.

Base excess due to Chloride = (Sodium – Chloride) – 32 (ISPAD formula)

ANTICOAGULANT PROPHYLAXIS

Give anticoagulant prophylaxis in very sick children with severe DKA who have femoral lines inserted or young women taking oral contraceptive pills following discussion with intensive care specialist.
Dose: 100 units/kg/day as a single daily dose of Dalteparin

1.9 COMPLICATIONS

Cerebral Oedema

Suspect cerebral oedema if they have any of these early manifestations

- Headache
- Agitation or irritability
- Unexpected fall in heart rate

- Increased blood pressure

If cerebral oedema is suspected, treat immediately with one of the following

- Hypertonic saline (2.7% sodium chloride) 2.5 – 5 ml/kg over 10 -15 minutes or
- Mannitol (20%) 0.5 – 1 gram/kg (2.5 – 5 ml/kg) over 10 – 15 minutes

If child or young people develop any of these signs

- Deterioration in the level of consciousness
- Abnormalities of breathing pattern, respiratory pauses or drop in O2sats
- Oculomotor palsies
- Abnormal posturing
- Pupillary inequality or dilatation

Treat immediately for cerebral oedema if any of the above signs

- Hypertonic saline (2.7% sodium chloride) 2.5 – 5 ml/kg over 10 -15 minutes or
- Mannitol (20%) 0.5 – 1 gram/kg over 10 – 15 minutes or
- If there is no response to mannitol within 30 minutes then consider hypertonic saline

Further management

- Inform paediatric and CICU consultant and transfer to CICU
- Exclude **hypoglycaemia**
- Restrict fluid to ½ maintenance rates
- Nurse with child's head elevated
- Do not intubate and ventilate unless experienced doctor is available
- Once child is stable, consider CT scan head to rule out other intra cerebral events (thrombosis, hemorrhage or infarction)
- Mannitol dose can be repeated after 2 hours if no response
- Document all events very carefully in medical records

If no improvement after use of one agent (hypertonic saline or mannitol) consider using the other agent. i.e. if hypertonic saline has been given twice then consider giving Mannitol

Other complications:

Hypoglycaemia and hypokalaemia – avoid by careful monitoring and adjustment of infusion rates

Systemic Infections – Antibiotics are not given as a routine unless a severe bacterial infection is suspected

Aspiration pneumonia – can be prevented by nasogastric tube insertion in vomiting child with impaired consciousness

Other associations with DKA require specific management e.g. continuing abdominal pain (due to liver swelling/gastritis/bladder retention but beware appendicitis), pneumothorax ± pneumomediastinum, interstitial pulmonary oedema, unusual infections (e.g. TB, fungal infections), hyperosmolar hyperglycaemic non - ketotic coma, ketosis in type 2 diabetes.

1.10 TRANSITION TO SUBCUTANEOUS INSULIN INJECTIONS

- **Please refer to "Diabetes Newly Diagnosed with NO evidence of DKA" (section 2) guidelines**

- Oral fluids should be introduced only when substantial clinical improvement has occurred (mild acidosis / ketosis may still be present) and there is no nausea or vomiting

- Do not change IV insulin infusion to subcutaneous insulin until ketosis is resolving (blood ketones below 1 mmol/l) and child is alert and tolerating fluids without nausea or vomiting

- Stop both the IV fluid and insulin infusion simultaneously 30 minutes after the first subcutaneous injection of (long acting and rapid acting) is given and child has had a meal.

- Children and young people on insulin pump, restart the pump at least 60 minutes before stopping intravenous insulin infusion. Change insulin infusions set and insert cannula into a new subcutaneous site.

- **Please use Paediatric insulin chart for insulin prescription**

Contact details:

1. Consultants- Dr James Greening, Dr Prem Sundaram, Dr Anbu Subbarayan: Extension 15027
2. Paediatric Diabetic Specialist Nurses (PDSNs) 8am-4pm: Extension 16796 (answer phone available)
3. Children's Specialist Diabetes Dietitians 8am-4pm: Extension 15400
4. Out of hours & Bank Holidays: Contact on call consultant for *East Midlands Network Paediatric Endocrine Consultant* via switchboard.
5. Email for non-urgent queries – paediatricdiabetesteam@uhl-tr.nhs.uk

References:

BSPED Guideline for the Management of Children and Young People under the age of 18 years with Diabetic Ketoacidosis - 2021. https://www.bsped.org.uk/media/1959/dka-guidelines.pdf

ISPAD CLINICAL PRACTICE CONSENSUS GUIDELINES, ISPAD Clinical Practice Consensus Guidelines 2018: Diabetic ketoacidosis. https://www.ispad.org/page/ISPADGuidelines2018

Nice Guideline (NG18) Diabetes (type 1 and type 2) in children and young people: diagnosis and management. Last updated June 2022
https://www.nice.org.uk/guidance/ng18/chapter/Recommendations#diabetic-ketoacidosis

2. Management of Newly Diagnosed patient with Diabetes not in DKA

2.1 DIAGNOSIS:

(Confirmed by doctor using below guidelines)

History of: Polyuria (usually nocturia ± enuresis)
Polydipsia
± Weight Loss
Glycosuria

Blood Glucose (BG) > 11 mmol/l (confirm from a lab sample
Ensure the following bloods are done at diagnosis:
FBC, HbA1c, U/E, Free T4, TSH
Thyroid antibodies, Coeliac disease screen
GAD65 antibodies, IA2, ZnT8and Islet cell antibodies

EXPLAIN to parents and child in simple terms the following:

Thirst (polydipsia)-	Hyperglycaemia (high blood glucose) causes polyuria (excessive urinating) that increases thirst (the body's way of stopping you becoming dehydrated)
Pancreas failure -	In diabetes the immune system mistakes islet cells of the pancreas as foreign and destroys them causing insulin deficiency and poor glucose control.
High blood glucose-	Is due to insulin deficiency. Insulin controls blood glucose levels; however in diabetes the pancreas gland is not producing enough insulin.
Diagnosis -	Is made from history and tests done today. Hyperglycaemia, Glycosuria +/- ketonuria /ketonaemia confirms the diagnosis.
Polyuria -	Passing lots of sugar (glucose) in the urine. The word 'diabetes' means 'a fountain'.
Why? -	The causes of diabetes are multifactorial, including inheriting an increased risk of developing the condition, other reasons for the development of diabetes are a matter for research and we don't yet know the reason. We do know that it is nothing that the child with diabetes or the family has done that has caused the development of diabetes.
How often? -	The incidence of T1 Diabetes varies greatly between different countries, and between different ethnic populations. Annual incidence rates for childhood T1DM (0–14 yrs. age group) per 100,000 in England is approximately 25.

Is it serious? -	Yes it is a serious condition that is permanent, but with regular blood glucose monitoring and daily injections of insulin we can manage the condition. Now that the child has started insulin their condition is going to improve quickly.

Referral to the Diabetes team:

Inform the diabetes team of the diagnosis and patient details on Extension 16796
(Answer phone available)
Emails about all the patients should be sent to **paediatricdiabetesteam@uhl-tr.nhs.uk**

2.2 Insulin Regime

Remember you can use every injection time as a teaching session. Encourage the child or family to perform injections themselves.

Insulin Regime:

The starting doses of the total daily insulin are as follows:

Calculate the total daily dose of insulin required according to child's weight.

Weight of child	**Total daily dose**
< 20 Kg	0.5 units/kg/day
20-30 Kg	0.6 units/kg/day
>30 Kg	0.7 units/kg/day

All patients should be started on a Multiple Dose Injections/ Basal Bolus regime.

Basal Bolus insulin regime involves one injection in the morning or evening of long acting insulin and rapid acting insulin with food.

Prescribe long acting insulin that is equal to 40% of the total daily dose of insulin**.** This dose must be given at the same time of day every day. For reasons of practicality, morning or evening is usually suggested.

With each subsequent meal (breakfast, lunch and dinner) a separate injection of rapid acting insulin is given. The patient will initially be on 'fixed doses' of rapid acting insulin whilst awaiting review from the Diabetes team. Please see the proportions outlined below.

Basal Bolus Insulin Regime			
Type of insulin			
Fast acting insulin (Trurapi Novorapid or Humalog or Apidra)	20% of the total daily dose of insulin with breakfast	20% of the total daily dose of insulin with lunch	20% of the total daily dose of insulin with dinner
Long acting Insulin (Glargine (Lantus) or Degludec or Levemir).			40% of the total daily dose

Example: If total daily dose of Insulin is 10 units
4 units should be given as Long Acting insulin and

2 units of Fast acting insulin to be prescribed with each meal.

Please give the long acting insulin ASAP and do not wait until the evening or the morning of next day. The diabetes team will decide on the timing when they review.

2.3 Correction dose of Insulin:

Fast acting insulin should be given as soon as possible to correct the high blood glucose using the flowchart and the table below.

If the child wants to eat, their meal time insulin dose should be added. If the patient has a meal within 2 hours from the initial correction dose then give only their meal-time dose. Do not add extra correction dose unless pre-meal blood glucose is higher than the previous one.

Additionally, the following should be used for pre-meal corrections on the ward.

CORRECTIONS FOR CHILDREN WEIGHING < 20KG

Blood Glucose RANGE mmol/L	Units fast acting i.e. NOVORAPID / TRURAPI
8.1-14	0.5
14.1-22	1
22.1-30	1.5
30.1 and above	2

CORRECTIONS FOR CHILDREN 20-30KG

Blood Glucose RANGE mmol/L	Units fast acting i.e. NOVORAPID / TRURAPI
8.1-12	0.5
12.1-16	1
16.1-20	1.5
20.1-24	2
24.1-28	2.5
28.1 and above	3

CORRECTIONS FOR CHILDREN WEIGHING>30 KG

Blood Glucose RANGE mmol/L	Units fast acting i.e. NOVORAPID / TRURAPI
8.1-10	0.5
10.1-14	1
14.1-18	1.5
18.1-22	2
22.1-26	2.5
26.1-30	3
30.1 and above	3.5

Please use Paediatric insulin chart for insulin prescription

2.4 Flexible Insulin Dosing

Following Diabetes team review, the amount of insulin needed will be in accordance to what the patient chooses to eat and their blood glucose levels.

The dose will be determined using the patient's insulin to carbohydrate ratios and insulin sensitivity (correction) factor based on weight which should be prescribed on the PRN drug chart.

Rapid Acting Insulin Dosing for Mealtimes

Children weighing < 20kg	1 unit per 25 grams carbohydrate
Children weighing 20-30kg	1 unit per 20 grams carbohydrate
Children weighing 30 – 50kg	1 unit per 15 grams carbohydrate
Children weighing more than 50kg	1 unit per 10 grams carbohydrate

Total carbohydrate (grams) ÷ Carbohydrate ratio
= Units of rapid acting insulin required

Carbohydrate ratio → **Grams of carbohydrate ↓**	**1:10g** **CHILDREN WEIGHING > 50 KG**	**1:15g** **CHILDREN WEIGHING 30 - 50 KG**	**1:20g** **CHILDREN WEIGHING 20 - 30 KG**	**1: 25g** **CHILDREN WEIGHING < 20KG**
5	0.5	0	0	0
10	1.0	0.5	0.5	0.5
15	1.5	1.0	1.0	0.5
20	2.0	1.5	1.0	1.0
25	2.5	1.5	1.0	1.0
30	3.0	2.0	1.5	1.0
35	3.5	2.5	2.0	1.5
40	4.0	2.5	2.0	1.5
45	4.5	3.0	2.0	2.0
50	5.0	3.5	2.5	2.0
55	5.5	3.5	3.0	2.0
60	6.0	4.0	3.0	2.5
65	6.5	4.5	3.0	2.5
70	7.0	4.5	3.5	3.0
75	7.5	5.0	4.0	3.0
80	8.0	5.5	4.0	3.0
85	8.5	5.5	4.0	3.5
90	9.0	6.0	4.5	3.5
95	9.5	6.0	5.0	4.0
100	10.0	6.5	5.0	4.0

Example:
A child weighing 47 kg chooses a breakfast containing 48 grams of carbohydrate.
To calculate the insulin dose, divide the carbohydrate content by the ratio above;

47g / 15 = 3.1 units. Round to the nearest 0.5 units = 3.0 units

Correction ratio →	

For the carbohydrate content of hospital meals, refer to Ward 14's catering folder which will specify carbohydrate content of meals and snacks. A copy of 'Carbs and Cals' is also available to support this. For labeled foods, always use TOTAL CARBOHYDRATE CONTENT on the label, not '*of which sugars'*. For further support please contact the Diabetes Dietitians (15400).

2.5 Correction Ratios / Insulin Sensitivity Factor

Correction ratios (insulin sensitivity factor) to correct high glucose levels will also be prescribed PRN following Diabetes team review and applied to meal time doses as per the table below.
At main meal times, the insulin dose for the meal should be added to the insulin dose required for the correction dose (if required).

Blood Glucose Level ↓ (mmol/mol)	1:4 mmol CHILD WEIGHING > 50 KG	1:6 mmol CHILD WEIGHING 30 - 50 KG	1: 8 mmol CHILD WEIGHING 20 – 30 KG	1: 10 mmol CHILD WEIGHING < 20KG
8.1 – 9.0	0.5 units	0.5 units	0	0
9.1 – 10.0	0.5 units	0.5 units	0.5 units	0
10.1 – 11.0	1.0 units	0.5 units	0.5 units	0.5 units
11.1 – 12.0	1.0 units	0.5 units	0.5 units	0.5 units
12.1 – 13.0	1.5 units	1.0 units	0.5 units	0.5 units
13.1 – 14.0*	1.5 units	1.0 units	1.0 units	0.5 units
14.1 – 15.0*	2.0 units	1.0 units	1.0 units	1.0 units
15.1 – 16.0*	2.0 units	1.5 units	1.0 units	1.0 units
16.1 – 17.0*	2.5 units	1.5 units	1.0 units	1.0 units
17.1 – 18.0*	2.5 units	2.0 units	1.5 units	1.0 units
18.1 – 19.0*	3.0 units	2.0 units	1.5 units	1.0 units
19.1 – 20.0*	3.0 units	2.0 units	1.5 units	1.5 units
20.1 – 21.0*	3.5 units	2.0 units	1.5 units	1.5 units
21.1 – 22.0*	3.5 units	2.5 units	2.0 units	1.5 units
22.1 – 23.0*	4.0 units	2.5 units	2.0 units	1.5 units
23.1 – 24.0*	4.0 units	2.5 units	2.0 units	2.0 units
24.1 – 25.0*	4.5 units	3.0 units	2.0 units	2.0 units
25.1 – 26.0*	4.5 units	3.0 units	2.5 units	2.0 units
26.1 – 27.0*	5.0 units	3.0 units	2.5 units	2.0 units
27.1 – 28.0*	5.0 units	3.5 units	2.5 units	2.0 units
28.1 – 29.0*	5.5 units	3.5 units	2.5 units	2.5 units
29.1 – 30.0*	5.5 units	3.5 units	3.0 units	2.5 units
30.0*	6.0 units	4.0 units	3.0 units	2.5 units

Basal Bolus Insulin Regime	
Type of insulin	
Fast acting insulin e.g. Trurapi / Novorapid / Humalog / Apidra	Give for all meals and snacks containing carbohydrate Insulin dose dependent on carbohydrate intake / Insulin to Carbohydrate Ratio.
Long acting Insulin e.g. Glargine (Lantus) / Degludec / Levemir	Given once daily (Levemir/Degludec) Given twice daily (Glargine) 40% of the total daily dose

Example:

A patient weighing 27 Kg chooses to eat a meal containing 50g carbohydrates.

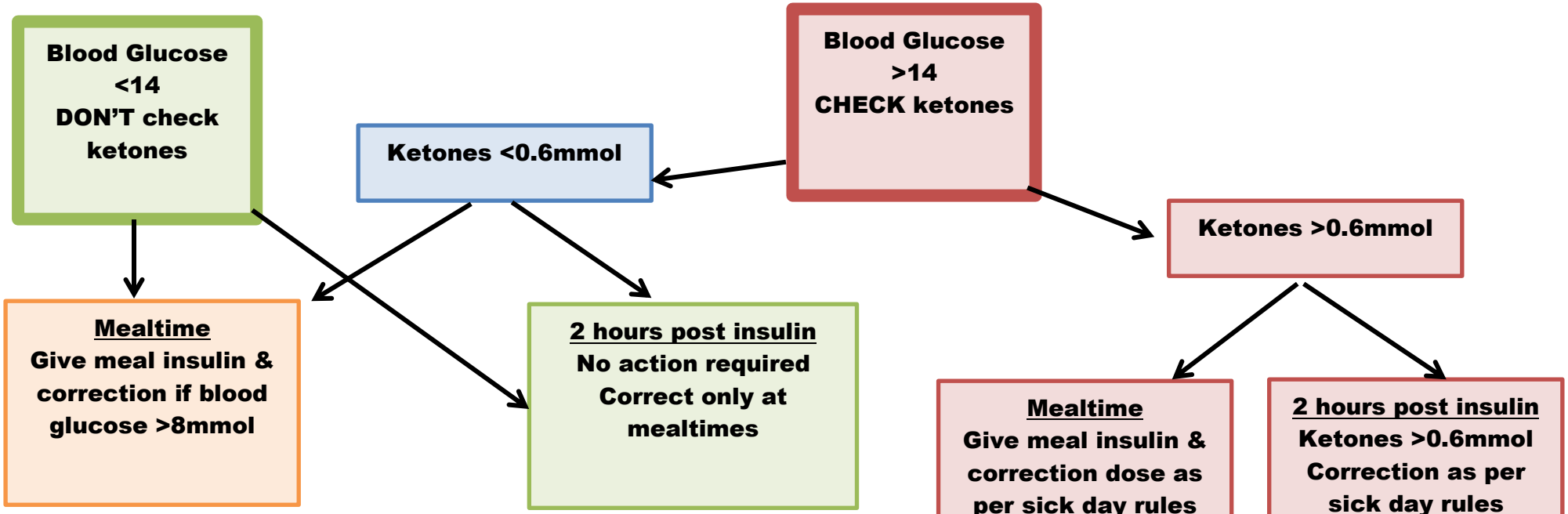
Before the meal, blood glucose level is 13.2 mmol / mol

Insulin required for food = 2.5 units rapid acting insulin

Insulin required for correction dose = 1.0 units

Total meal time insulin dose = 3.5 units

Management of High glucose levels



SICK DAY RULES – If Blood Glucose (BG) is 14 or above test for ketones		
Negative ketones <0.6mmol.l (Blood)	**Small to moderate ketones** 0.6 – 1.5mmol.l (Blood)	**Moderate to large ketones** >1.5mmol.l (Blood)
Take a correction dose (CD) to correct high blood glucose (BG) in addition to normal bolus for carbohydrates eaten (as per expert meter or pump)	Give 10% of your total daily dose (TDD) of insulin as additional fast acting insulin	Give 20% of your total daily dose (TDD) of insulin as additional fast acting insulin.
Then: Re -check BG and ketones in two hours	Then: Monitor fluid intake and drink enough fluids to keep well-hydrated Re-check BG and ketones in two hours. **Repeat dose if ketones and BG are still high**	Then: Monitor fluid intake and drink enough fluids to keep well-hydrated Re-check BG & ketones in two hours. **Repeat dose if ketones and BG are still high**

H.Dowers (2020)

2.6 TTO & Supplies:

IT IS IMPORTANT TO ORDER THE TTO SHORTLY AFTER ADMISSION TO ENABLE			
Drug	**Preparation**	**Dose**	**Route**
Glargine (Lantus)/ Levemir/ Degludec	3ml penfill cartridges	100 units /ml	SC
Novorapid / Trurapi / Apidra	3ml penfill cartridges	100 units /ml	SC
Glucagon	Injection	1mg	IM
Dextrogel	Gel	⅓ to 1 tube	Oral
In Starter Pack			
Consumables	**Supplier**	**Type**	
Novopen Echo	Novo Nordisk	368-7365 Red/368-7076 Blue	
BD autoshield needles	Becton Dickinson	BD microfine Ultra 4 mm Pen needles	
Glucose meter	Roche	Accuchek instant	
Blood glucose testing strips	Roche	Accuchek test strips	
Blood Ketone meter	Abbot	Free style Optium Neo	
Blood Ketone strips	Abbot	Abbot Optium Blood b-Ketone testing strips	
Finger pricker	Roche	Fastclix	
Blood lancets	Roche	Fastclix lancets	
Further equipment from GP			
Safe clip	Becton Dickinson		
Sharps Bin		1 litre	
Optional libre 2 sensor	Abbot	Libre 2	
Paediatric Diabetes Nurse Specialist to ensure GP Prescription letter (found in starter pack) is completed and faxed through to surgery ASAP enabling the family to initiate the repeat prescription process and receive supplies of blood glucose testing strips and lancets quickly.			

2.6 Blood glucose & ketone testing:

Intensive blood glucose control should start from the ward. This is important so that the family takes home the right message that high blood glucose is bad.

Blood Glucose should be tested via finger pricks or scanned for via a continuous glucose monitor

- Pre and 2 hours post meals
- Before bed
- Midnight
- 07:00 am

The family will have a home blood glucose monitor in the starter kit; it is important they become familiar with its use and that they start to use it as soon as is possible after diagnosis. Encourage the child and family to use this monitor at every opportunity. This meter should be used in conjunction with hospital glucose meter.

Blood ketones should be checked if the blood glucose is ≥ 14 mmol/l . Once blood ketones are less than 0.6mmol/L and the child is clinically well, there is no need to continue testing blood ketones.
Do not check blood ketones if blood glucose <14 mmol/l, unless the patient clinically unwell.

Subsequent Days

Review blood glucose readings and discuss with diabetes consultant.

If any concerns, discuss with the diabetes team.

2.7 Dietary advice:

The diet for diabetes is not a special/ restrictive diet. Children are encouraged to follow a balanced, healthy diet. It is important that foods containing carbohydrates are eaten at each meal and matched with the appropriate insulin dose based on the individual ratio.

Children can feel very hungry after diagnosis. Reassure parents that this will settle within a few weeks. In the meantime, encourage the child to fill up at mealtimes. Snacks are optional but most children will also want to eat between meals at this stage. This is acceptable, but food containing carbohydrates will require additional insulin. Use the carbohydrate ratios in section 2.3 to work out insulin doses for additional snacks.

The size of the snack will depend on appetite. There should ideally be only 1 snack time between any two meals.

Additional points to remember

- All food and drink should be recorded (including milk) on a food chart.
- Encourage the child to eat at least 3 meals per day.
- Try to encourage healthier choices (see snack guide below).
- The carbohydrate value for extra food between meals can be worked out using the Carbs and Cals book or food labels. Carb counted snacks list is available for patients and staff (see below).
- The carbohydrate value for meals served on the ward can be found in the Diabetes ward folder. Please note certain 'loose' foods e.g. jacket potatoes require weighing.
- Use the "total carbohydrate" value not the "of which sugars" value on the food label when working out the carbohydrate value.
- Water or sugar free squash should be given for thirst (not milk/milkshake as this is a food and contains carbohydrate).
- Pure fruit juice should be avoided unless treating hypoglycaemia.

Carbohydrate counted snacks

	Snack ♥ Healthy Choice	Carbohydrate g
♥	Apple	See 'Carbs&Cals'
♥	Orange	See 'Carbs&Cals'
♥	Banana	See 'Carbs&Cals'
♥	80g Sliced Apple and Grape Bag	10.4
♥	15g Sun-Maid Raisin box	10
♥	113g Fruit Pot	16.6
♥	Muller Light Yoghurt	14.1
	Thick & Creamy Vitality Yoghurt	15
♥	Medium Slice White Bread	16
♥	Medium Slice Brown Bread	15
	20g Single Serving Pot of Jam / Marmalade	12
♥	Weetabix x 1	13
♥	Bran Flakes	
	22g Serving Rice Krispies	19
♥	24g Serving Corn Flakes	20
	35g Serving Frosties	30
	35g Serving Coco Pops	30
♥	30g (5 heaped dessert spoons) Ready Brek powder + 150ml milk	17
♥	100 ml milk (any type)	5
♥	150 ml milk (any type)	7
♥	200 ml milk (any type)	10
	Chocolate Bourbon x 1 x2 x3	9.3 18.6 27.9
	Custard Cream x 1 x2 x3	8.8 17.6 26.4
	Jam Ring x 1 x2 x3	9.0 18.0 27.0
	Digestive x 1 x2 x3	8.3 16.6 24.9
	Highland Shortie x1 x2 x3	6.5 13.0 19.5
	Oat & Wholemeal x1 x2 x3	9.0 18.0 27.0
	MB Plain Sponge Cake Slice	17.0
	MB Strawberry Layered Sponge Cake	15.1
	MB Chocolate Layered Sponge Cake	14.3
	Blueberry Finger Muffin	22.2
	Carrot & Orange Finger Muffin	21.3
	KP Ready Salted Crisps	11
	KP Cheese & Onion Crisps	11
	KP Salt & Vinegar Crisps	11
	Quavers	13

2.8 Discharge from Hospital & Follow up:

Criteria for safe discharge when the child or the parent:

- safely administer an injection of insulin
- able to perform blood glucose testing
- understand how to treat a hypoglycaemic episode
- understand the basics of dietary advice.
- understand sick day rules

Once competent in these areas the family can be allowed home and further education and support will be provided by the Children's Diabetes team.

Follow up:

An Outpatient appointment should to be made within 1-2 weeks of discharge in the Thursday or Friday Diabetes Clinic (CHIMDT). Diabetes team will arrange this appointment.
The diabetes team will liaise with the school and arrange a visit to the school to train school staff involved in diabetes care. Most schools will not allow children to go back prior to this training

Contact details:

1. Consultants- Dr James Greening, Dr Prem Sundaram, Dr Sonal Kapoor, Dr Anbu Subbarayan: Extension 15027
2. Paediatric Diabetic Specialist Nurses (PDSNs) 8am-4pm: Extension 16796 (answer phone available)
3. Children's Specialist Diabetes Dietitians 8am-4pm: Extension 15400
4. Out of hours & Bank Holidays: Contact on call consultant for *East Midlands Network Paediatric Endocrine Consultant* via switchboard.

3. Hypoglycaemia (Hypo) in Children & Young People with Diabetes

The operational definition is blood glucose less than 4 mmol/l

3.1 Classification:

Hypoglycaemia has been traditionally classified mild, moderate and severe based on individual's ability to treat him/her. There are no clinically important reasons to differentiate mild and moderate hypoglycaemia so they are considered together for treatment.

Mild/moderate hypoglycaemia: Parent or child is aware of, responds to and treats the hypoglycaemia with oral treatment.

Severe Hypoglycaemia: Child has altered mental status with or without convulsions and needs parenteral treatment (IM Glucagon / IV glucose)

3.2 Principle:

This Hospital uses Multiple Daily Insulin Injection or Insulin Pump therapy and there are a very small number of patients on twice daily regimes. If the background insulin is dosed correctly then any hypoglycaemia that takes place is due to bolus insulin administration and will correct quickly using the "15 rule".

3.3 Risk Factors for Hypoglycamia:

- Insulin dose excessive or timed wrong or wrong type
- Reduced exogenous glucose e.g. missed meals or night fast
- Endogenous glucose production decreased e.g. alcohol
- Increased glucose uptake during and after exercise
- Increased insulin sensitivity (illness, weather)

3.4 Symptoms:

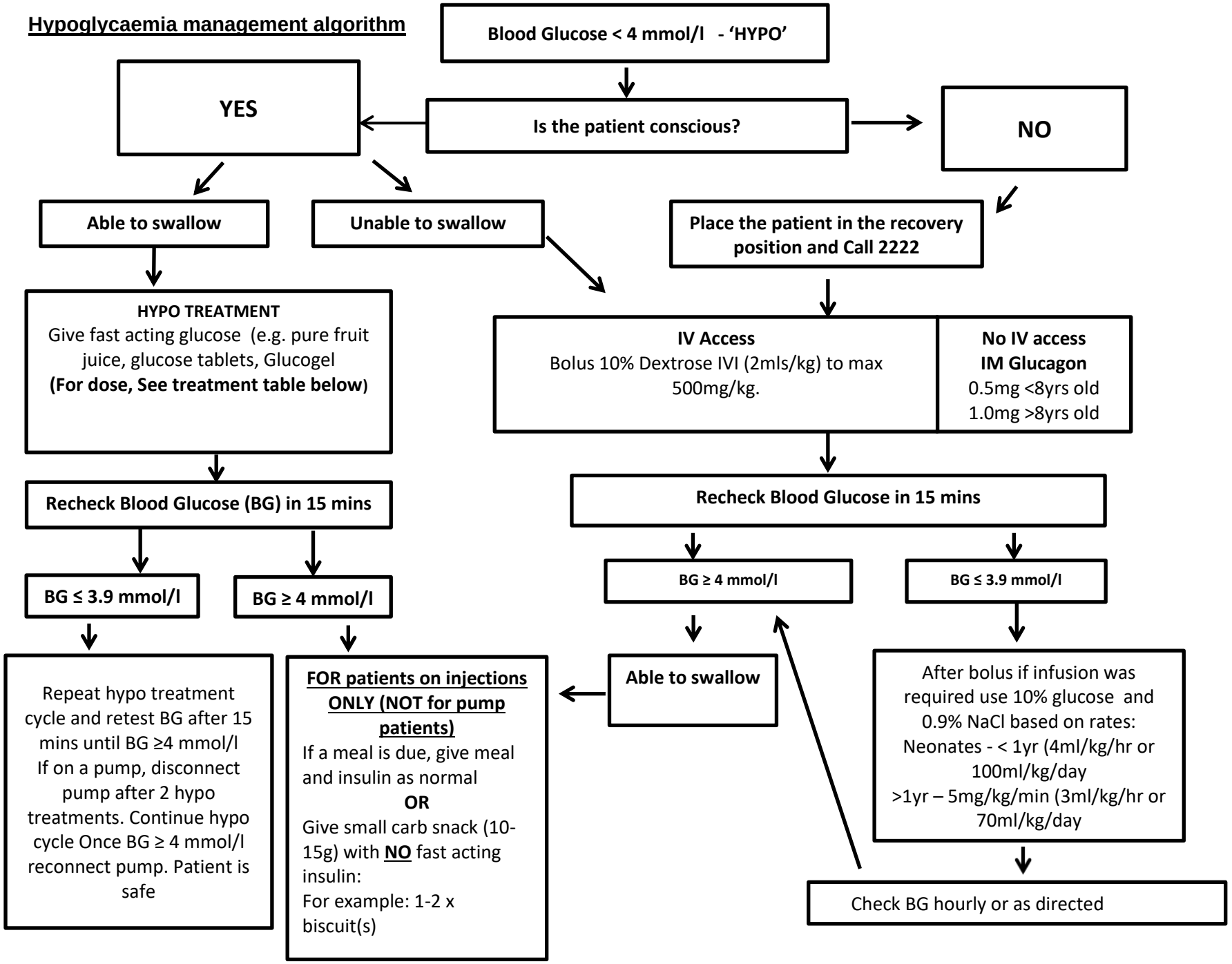
- Dizziness
- Sweating
- Hunger
- Confusion
- Headache
- Behavioral change
- Unresponsive
- Seizure

One or more of these factors may be involved, and a definite cause can usually be identified. It may be necessary to examine activities during the preceding 24 hours, as late onset hypos can occur several hours after physical activity.

3.5 Management of Hypoglycaemia:

(for management flow chart - see following page)

Hypoglycaemia management algorithm



Confirm blood glucose level is less than 4.0mmol/l

- Rapid Acting Carbohydrate will treat quickest and symptoms will go sooner.
- Quick Acting Carbohydrate can be used but treatment will be slower and symptoms last longer.

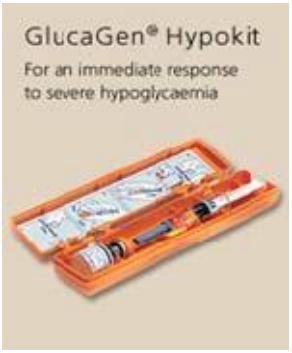
3.6 Rapid acting carbohydrate:

Weight	0- 10 Kg	10 – 20Kg	20-30Kg	30-40Kg	40-50Kg	50-60Kg	> 60 kg
Grams of carbs	3 grams	6 grams	9 grams	12 grams	15 grams	18 grams	21 grams
Glucotabs	1	2	2	3	4	4	5
Dextrose tablets	1	2	3	4	5	6	7
Glucogel	¼ tube	½ tube	1 tube	1 ½ tubes	1 ½ tubes	2 tubes	2 tubes

3.7 Quick acting carbohydrate:

Weight	0- 10 Kg	10 – 20Kg	20-30Kg	30-40Kg	40-50Kg	50-60Kg	> 60 kg
Grams of carbs	3 grams	6 grams	9 grams	12 grams	15 grams	18 grams	21 grams
Jelly babies	1	2	3	4	5	6	7
Starburst	1	2	3	4	5	6	7
Fruit juice	30mls	60mls	90mls	120 mls	180 mls	215 mls	250 mls

The brain needs glucose as its source of energy, and lowering of glucose levels quickly interferes with brain function, causing some of the above symptoms (pg. 26). The earlier the signs of hypo are recognized the easier it is to put it right. If in doubt check the blood sugar level.



Glucagon (GlucaGen hypo kit)

Fast acting drug and patient should respond in 5 minutes.
Administered intramuscularly in thigh

Side effect: Vomiting / nausea

Dose:
< 8 years – 0.5 mg IM, > 8 years – 1 mg IM

OGLUO (pre mixed preparation)

administered subcutaneously
2-5 years (upto 25 Kg) – 0.5mg SC
2-5 years (> 25 Kg) – 1 mg SC
6-17 years – 1 mg SC

Glucogel

Fast acting sugary gel
Comes in a tube with a twist top
Used in patient who refuses to eat and drink.

The contents of the tube are squirted into the side of each cheek and massaged gently from outside.

Do not use Glucogel in unconscious or fitting child as there is a risk of aspiration.

4. Blood Glucose Monitoring

Introduction:

Children and Young People with Diabetes requiring injections need their blood glucose levels taken regularly. This helps Clinical staff assess blood glucose levels to balance insulin, food intake and activity, which in turn will help prevent long-term complications as well as help keep them healthy and safe.

This guideline is intended for all staff caring for children and young people with Diabetes. Measuring the Blood glucose accurately will enable the person carrying out the check to interpret the results.

Normal blood glucose level ranges between 4-7 mmol/L. The information is used to advise and alter on the management of Hypoglycaemia and Hyperglycaemia for patients with Diabetes.

Initially, at least seven blood glucose tests per day in the early stages of diagnosis are required or if on a continuous glucose monitor check via the monitor.

- Blood Glucose requirements are carried out before meals, two hours after meals, before bed and during the night as advised by the diabetes team.
- These measurements will assess that the correct amount of insulin is being given.
- Normal blood glucose level ranges between 4-7mmol/L however can rise to around 9mmol/L after a meal.
- This information is used to alter insulin doses and therefore the need to accurately record the blood glucose levels is vital.

The procedural guideline applies to all registered professionals who will administer and /or adjust Insulin doses.

Staff authorised to prescribe and make insulin dose adjustments in babies, Children and Young People under 18 years old in UHL with Type 1 Diabetes, are any “practitioners legally authorised to prescribe under the Medicines Act 1968” in alliance with **LEICESTERSHIRE MEDICINES CODE**

This guideline should be used in conjunction with the UHL Consent Policy to ensure the individual and their families receive safe care and they understand the reasons for care to facilitate co-operation.

Involve the Play Specialist Team to help facilitate cooperation.

Staff using the Novo Biomedical STAT strips Blood Glucose meter, MUST have had appropriate training and be assessed as competent. Team Leader’s:- Ward Sisters/ Charge Nurses are responsible verifying ward staff’s competency.

For guidance on how to use the blood glucose monitor please refer to guideline - UHL - Procedure for Measuring Capillary blood glucose using a Novo Biomedical STAT strips blood glucose meter in Babies, Children and Young People under 18 years.

4.1 Normal Blood Glucose Values:

The normal fasting blood glucose range for a Child and young person without Diabetes is 4 mmol/litre to 7 mmol/litre on waking

For Children and Young Person's with Diabetes the normal blood glucose level ranges between 4-7mmol/L, however this can rise to around 9mmol/L after meals.

The information is used to alter insulin doses as advised by the Children's Diabetes team.

4.2 Hypoglycaemia:

Blood glucose ≤ 3.9 mmol/l (Refer to Hypoglycaemia guideline**)**

4.3 Hyperglycaemia:

A high blood glucose level is anything above 8mmol/L but action needs to be taken if it reaches 14mmol/L and if child or young person feels unwell/symptomatic

Hyperglycaemia is often caused by:

- Not enough insulin
- Too much food
- Not enough activity
- Illness
- Stress
- Insulin injected at the wrong time
- Lipohypertrophy

Signs and symptoms of hyperglycaemia can include:

- Headache
- Irritability/mood change
- Increased urine output (Polyuria)
- Increased thirst (Polydipsia)
- Abdominal pain
- Nausea/vomiting
- Blurred vision
- No symptoms

Correction doses using fast acting insulin is the best way to reduce blood glucose levels.

For management of HYPERglycaemia see page 48

5. Diabetes management for Patients on Insulin Pump Therapy

Introduction:

This guideline covers response for insulin pump, specifically covering the management of;

1. High Blood Glucose >14.0 mmol/l
2. Low Blood Glucose < 4.0 mmol/l (Hypoglycaemia)
3. Technical pump failure

5.1 When blood glucose above 14mmol/l:

- **Assess the child clinically**
- **Check Blood Ketones and blood gas as they are have increased risk of developing DKA**
- **If the patient unwell and if the blood results shows evidence of DKA, disconnect the pump and manage the patient as per DKA guideline**
- **If patient clinically well and tolerating oral fluids/feeds, they can be managed by giving rapid acting insulin** (NovoRapid / Trurapi or Humalog or Apidra) by pen using the traffic light system table below with close monitoring.
- **Children who are alert, not clinically dehydrated, with no nausea or vomiting, do not always require IV fluids even if their ketones are high. They can be managed with oral rehydration and subcutaneous insulin, but need regular monitoring to ensure they are improving and ketone levels are falling.**
- **The correction dose will depend on the total daily dose (TDD) and level of blood ketones.**
- Most parents will be able to tell you the child's total daily dose as this information is discussed in the diabetes clinic.
- Find out total daily dose (TDD) which can be found on the carelink or gloko reports or from the pump directly as below:

5.2 Medtronic pump 640G screen shots to find the TDD:

To get TDD on pump (medtonic / T-slim or omnipod: Go to Main menu → History → Summary →14 days see "TDD" (Total daily Insulin)

- Please see the table below for the management of high blood glucose and ketones

If ketones are more than or equal to 0.6 mmo/l give correction dose of rapid acting insulin via pen.

- Monitor the patient closely
- Check blood glucose and blood ketones every 2 hrs
- If blood ketones not improving or patient clinically worsens, change to DKA protocol

5.3 Traffic light system for high glucose and ketones for patients on insulin pump therapy (Sick-day rules):

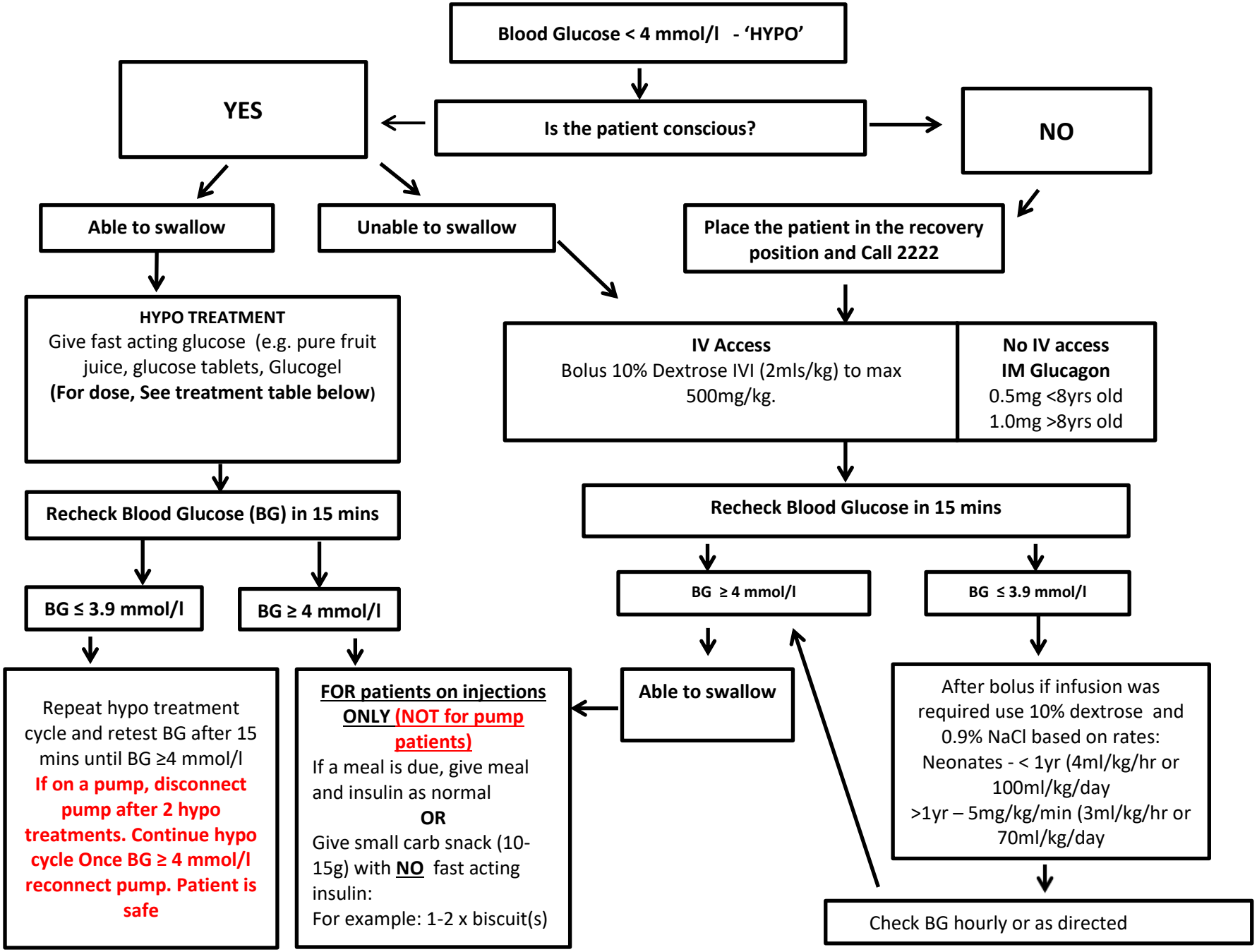
Negative ketones <0.6mmol/l	**Small to moderate ketones** 0.6 – 1.5mmol/l	**Moderate to large ketones** >1.5mmol/l
Trouble shoot the reservoir, infusion set & site, pump and insulin Take a correction dose to correct high BG by pump Give normal bolus's for carbohydrate eaten	Take a correction dose **by injection immediately (rapid acting insulin):** • 10% of your total daily dose (TTD) of insulin. • Your10% TTD = units • If eating work out bolus for carbohydrate add it on the bolus dose above and give insulin **by injection**	Take a correction dose **by injection immediately (rapid acting insulin):** • 20% of your total daily dose (TTD) of insulin. • Your 20% TTD = units • If eating work out bolus for carbohydrate add it on the bolus dose above and give insulin **by injection**
Then: • Re -check BG and ketones in two hours (see below)	Then: • Change reservoir, infusion set & site, trouble shoot the pump & insulin • Drink sugar free fluids. • Re-check BG and ketones in two hours (See below)	Then: • Change reservoir, infusion set & site, trouble shoot the pump & insulin • Drink sugar free fluids. • Re-check BG &ketones in two hours (see below)
If your BG is going down that is a good sign but monitor closely throughout the day. If BG increasing but negative ketones<0.6mmo/l: • Take another correction dose **by injection** • **C**hange reservoir, infusion set & site • Check BG and ketones in two hours If ketones 0.5 – 1.5mmol/l, follow orange column advice If ketones >1.5mmol/l, follow the red column advice	If ketones <0.6mmol/l follow green column advice If ketones still 0.6 – 1.5mmol/l: • Continue to give 10% of TTD as a correction with pen • Give bolus's for food via the pump • Re-check BG and ketones every 2 hours, even through the night! If ketones increase to >1.5mmol/l, follow the red column advice	If ketones <0.6mmol/l follow green column advice If ketones reduce to 0.6 – 1.5mmol/l, follow orange column advice If ketones are still >1.5mmolll: • Give another 20% TDD via injection Give bolus's for food via injection • Re-check BG and ketones in 2 hours **If after 2nd 20% TDD corrections ketones are still >1.5mmol/l or symptomatic then go to hospital immediately**

- **For 10% - multiply "TDD Insulin" by 0.1**
- **For 20% - multiply "TDD insulin" by 0.2**

E.g. TDD is 20 units: 10% 2 units and 20% 4 units

5.4 Low blood sugars <4 mmol/L (Hypoglycaemia):
<u>Confirm blood glucose level is less than 4.0mmol/l</u>

- Rapid Acting Carbohydrate will treat quickest and symptoms will go sooner.
- Quick Acting Carbohydrate can be used but treatment will be slower and symptoms last longer.


Blood Glucose < 4 mmol/l - 'HYPO'
Is the patient conscious?
YES
NO
Able to swallow
Unable to swallow
Place the patient in the recovery position and Call 2222
HYPO TREATMENT
Give fast acting glucose (e.g. pure fruit juice, glucose tablets, Glucogel
(For dose, See treatment table below)
IV Access
Bolus 10% Dextrose IVI (2mls/kg) to max 500mg/kg.
No IV access
IM Glucagon
0.5mg <8yrs old
1.0mg >8yrs old
Recheck Blood Glucose (BG) in 15 mins
Recheck Blood Glucose in 15 mins
BG ≤ 3.9 mmol/l
BG ≥ 4 mmol/l
BG ≥ 4 mmol/l
BG ≤ 3.9 mmol/l
Repeat hypo treatment cycle and retest BG after 15 mins until BG ≥4 mmol/l
If on a pump, disconnect pump after 2 hypo treatments. Continue hypo cycle Once BG ≥ 4 mmol/l reconnect pump. Patient is safe
FOR patients on injections ONLY (NOT for pump patients)
If a meal is due, give meal and insulin as normal
OR
Give small carb snack (10-15g) with NO fast acting insulin:
For example: 1-2 x biscuit(s)
Able to swallow
After bolus if infusion was required use 10% dextrose and 0.9% NaCl based on rates:
Neonates - < 1yr (4ml/kg/hr or 100ml/kg/day
>1yr – 5mg/kg/min (3ml/kg/hr or 70ml/kg/day
Check BG hourly or as directed

5.5 Rapid acting carbohydrate:

Weight	0- 10 Kg	10 – 20Kg	20-30Kg	30-40Kg	40-50Kg	50-60Kg	> 60 kg
Grams of carbs	3 grams	6 grams	9 grams	12 grams	15 grams	18 grams	21 grams
Glucotabs	1	2	2	3	4	4	5
Dextrose tablets	1	2	3	4	5	6	7
Glucogel	¼ tube	½ tube	1 tube	1 ½ tubes	1 ½ tubes	2 tubes	2 tubes

5.6 Quick acting carbohydrate:

Weight	0- 10 Kg	10 – 20Kg	20-30Kg	30-40Kg	40-50Kg	50-60Kg	> 60 kg
Grams of carbs	3 grams	6 grams	9 grams	12 grams	15 grams	18 grams	21 grams
Jelly babies	1	2	3	4	5	6	7
Starburst	1	2	3	4	5	6	7
Fruit juice	30mls	60mls	90mls	120 mls	180 mls	215 mls	250 mls

- Test after 15 minutes to check blood glucose is above 4mmol/l
- If not above 4mmol/l, repeat treatment
- **If still low disconnect the pump**
- Wait until blood glucose level has risen above 4mmol/l before reconnecting the pump.
- Pump patients DO NOT need additional long acting carbohydrate after rapid carbs have been given.
- If patient refuses to eat or drink they can be treated with Glucogel.
- **Please avoid using Glucogel in unconscious or fitting patients due to risk of aspiration or if they cannot swallow**.
- In the event of sever hypoglycaemia (loss of consciousness or fitting) use IM Glucagon or IV 10% Dextrose bolus. **(Please see section 3: Hypoglycaemia in diabetes guideline for more detailed information.)**
- If having something extra to eat e.g. biscuits, sandwich, MUST cover with bolus of insulin using normal carbohydrate ratio.

5.7 Technical pump failure:

This shows as ***warning*** on the pump screen.
Refer all enquiries to the Pump Manufacturer Technical Helpline immediately as they may be able to get pump back up and running. If not, they will try and arrange for replacement to be sent to family as soon as possible.

5.8 Pump technical support lines:

- Medtronic insulin pump: 01923205167
  Website: www.medtronic-diabetes.co.uk
- Omnipod insulin pump: 08000116132
- T-slim insulin pump: 0800 012 1560

If there is a delay, patient needs to be swapped to MDI regime with pens until a new pump is received.

Immediate management:

- Dose of insulin can still be calculated via the pump using the pump dose calculator if functioning.
- If not calculate the correction dose based on the insulin sensitivity (IS) (e.g. 1 unit of insulin corrects BG by x mmol/ to a target glucose, usually 7 mmol/l). The correction ratio should be the one used in the pump calculator.

5.9 Corrections formula:

(C urrent BG-7) /Insulin Sensitivity = units of RAPID ACTING INSULIN (NovoRapid / Trurapi Humalog or Apidra) for correction

Example:

- Insulin sensitivity 1 unit :3 mmols
- Current BG = 16mmol/l
- Target blood glucose = 7 mmol/l
- Calculation of glucose fall = 16 – 7mmol/l = 9 mmol/l
- Dose of correction = 9 / 3 = 3 units of fast acting insulin

- If pump failed completely then ask family to check insulin sensitivity on last pump download if available or the clinic sheet they were given which has all the pump settings
- Check that blood glucose has responded to insulin pen correction after 2 hours correcting toward the blood glucose target typically 7 mmol/l.
- Check blood glucose and give appropriate corrections every 2-4 hours until the new pump arrives. Discuss with the on call consultant about frequency of corrections
- If eating snacks or meal will need to have dose of rapid acting insulin as per carb counting. Please see below.

5.10 Longer term management (if delay in receiving pump):

- Carbohydrate ratios should be used for any food containing carbohydrates either meal or snacks.
- You can check the pump settings as below.
- Main Menu → Insulin settings → Bolus wizard or equivalent depending on the pump accessed set up → Note down the carb ratios, sensitivity and blood glucose target.

Food insulin dose = grams of Carbohydrate/ Carbohydrate ratio

Example:
Carbohydrate ratio 1: 6 grams
Child wants to eat 30 grams carbohydrates. Therefore, 30/ 6 = 5 units of rapid acting insulin

- Use insulin sensitivity ratio to correct any blood glucose over 7mmol/l aiming to reduce value to 7 mmol/l. (see Corrections formula).

- Add the two doses: FOOD DOSE + CORRECTION DOSE=TOTAL fast acting insulin dose prior to food. (When on injections we advise to correct only with main meals to avoid insulin stacking)

- Give LONG LASTING INSULIN (Levemir or Glargine (Lantus) or Degludec) as follows:

  Find out total daily dose (TDD) from the pump or ask parents as they will be given this information at each clinic visit

  50% of TDD will be the dose of long acting insulin

  Example: if TDD is 50 units, 50% 0f 50 units is 25 units will be the basal insulin dose. (Levemir, Degludec or Glargine) as once daily

- Continue until pump arrives.

- Pump will need to be set up by either family or diabetes team.

- Recheck blood glucose 2 hours after pump cannula is inserted.

Contact details of the Diabetes Team:

1. Consultants- Dr James Greening, Dr Prem Sundaram, Dr Sonal Kapoor, Dr Anbu Subbarayan: Extension 15027
2. Paediatric Diabetic Specialist Nurses (PDSNs) 8am-4pm: Extension 16796 (answer phone available)
3. Children's Specialist Diabetes Dietitians 8am-4pm: Extension 15400
4. Out of hours & Bank Holidays: Contact on call consultant for *East Midlands Network Paediatric Endocrine Consultant* via switchboard.

6. Diabetes Management: Guidance for Injectable Insulin

Introduction:

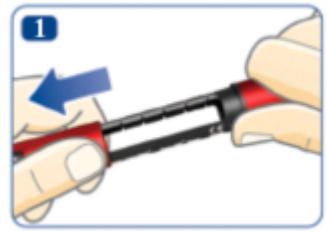
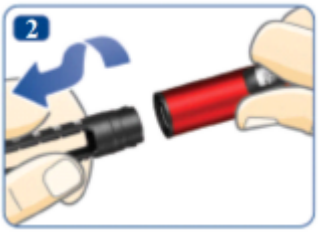
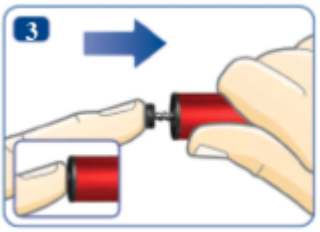
The aim of the guideline is to ensure a child or young person requiring sub-cutaneous insulin is given safely and effectively

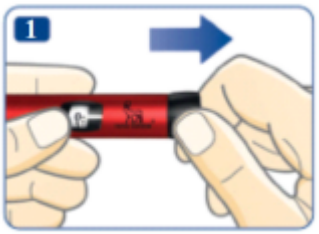
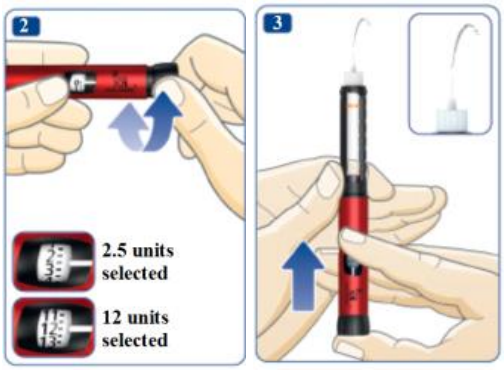
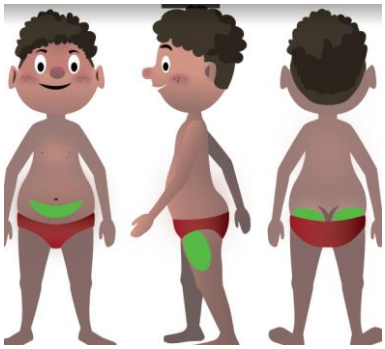
The guideline is intended for the safe administration of insulin to children and young person with Diabetes requiring sub-cutaneous injections.

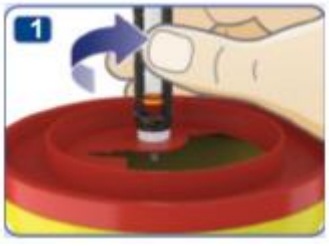
6.1 Resources:

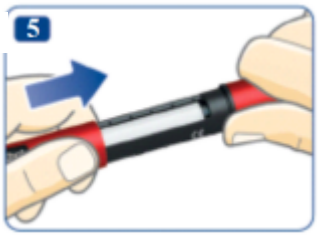
- Drug Chart
- Cartridge of insulin as prescribed
- Insulin pen
- BD Auto-shield safety needle
- Drug Tray
- Sharps bin
  Qualified competent Children's nurses experienced in the administration of sub-cutaneous insulin

6.2 Procedure/Process for Administration of Sub-Cutaneous Insulin Using an Insulin Syringe or Insulin Pen		
No.	**Action**	**Rationale**
1	Wash your hands	To prevent contamination and reduce Infection
2	Two nurses must independently check The prescription chart for using the 6 Rights of Medicine Administration (6R's): Right Patient, Right Drug, Right Dose, Right Route, Right Time, and Right Documentation.	To adhere to hospital policy and to maintain patient safety
3	Take unopened insulin cartridge from the fridge and ensure cartridge is to room temperature for approximately 15 minutes.	Cold insulin is painful when injected
4	Check for the expiry date on the insulin cartridge. Once opened keep at room temperature. The expiry date is 28 days after opening. Insulin cartridge must be changed every 28 days.	After 28 days bacteria begins to grow breaking down the protein in insulin leading to high Blood Glucose (BG) readings.
5	Inspect the insulin cartridge. **Do not use** if the cartridge is cracked/damaged, appears white/cloudy, or has any floating particles	Risk of contamination To ensure safe delivery of insulin Reduce the risk of infection
6	To insert an insulin cartridge into the insulin pen: 1. Pull off the pen cap	To prepare a safe delivery of insulin.

	2. Twist off the black cartridge holder 3. Ensure piston rod is pushed down 4. Take the insulin cartridge and insert in the black cartridge holder with the threaded end in first. 5. Twist the cartridge holder onto the base of the insulin pen	    
7	Use BD Auto shield safety needle (see picture below) 1. Tear off the paper tab. 2. Pull off insulin pen cap 3. Push the needle straight onto the insulin pen. 4. Turn the needle until it is on tight.	To ensure a clean needle is used at all times to prevent infection To avoid needle stick injury and to comply with E.U regulations (May 2013)

		
8	You must prime the needle first with insulin, to remove any air and to test for insulin flow. This is called an 'air shot'. 1. Pull out dose button found at the end of pen. 2. Turn the dose button clockwise, and select 2 units. 3. Press down on the dose button until dose counter appears '0'. See insulin squirt out. 4. Repeat process if no insulin 'squirts' out. 5. Select insulin dose to be administered as prescribed on prescription chart.	To Prime the needle Remove any air bubbles To ensure safe delivery of insulin  
9	Choose an injection site recommended by your Diabetes team	To ensure correct site for satisfactory absorption of insulin 

10	With the opposite hand form an 'L' shape with your index finger and thumb. Gently push down on the recommended skin area forming a small mound .	To ensure correct depth of needle penetration so allowing correct absorption of insulin
11	1. Hold the pen firmly ensuring dose counter can be seen. 2. Insert the needle into the skin at 90 degrees 3. Make sure you can see the dose counter 4. Push the needle into the bare skin until you can hear a 'click'. This is the needle coming into contact with the skin. Once you hear the click press the dose button until the dose counter shows '0'. 5. Wait and count to ten slowly 6. If dose button stops, the needle may be blocked. Look at the dose counter for the amount of insulin already given. Replace the needle and re-test flow. Inject remaining amount to Make up the full dose 7. If the needle has lost contact with the skin, replace the needle. 8. Re-test flow and inject the required dose of insulin	To inject insulin satisfactory and ensure complete dose is administered  
12	To complete the injection process, withdraw the needle from the skin in a direct and single motion, releasing the skin following withdrawal of the needle.	
13	Gently wipe the site if necessary with A clean tissue or cotton wool ball.	To maintain comfort
14	After injection, safely remove and dispose of needle in the Sharps bin as per UHL policy	To maintain safety To prevent needle stick injury 

15	Put pen lid back on. Store pen carefully in a locked cupboard With child's name and unit number Clearly identified As per UHL policy	To protect from light  To maintain safety
16	Do not store pen with a needle attached.	Minimise infection/contamination/blocked Needles and inaccurate dosing

6.3 Education and Training:

Children's Diabetes Specialist Nurse will demonstrate and apply the principles required for the safe administration of Sub-Cutaneous Insulin using an Insulin Pen to nursing staff.

Individuals will be assessed by an LCAT assessor/ Diabetes Specialist Nurse, and deemed as competent using a LCAT assessment framework.

Children's Diabetes Specialist Nurse will base their competency on completion of Learning Outcome (C) found in 'UHL Competency Assessment Booklet for Newly Appointed Children's Diabetes Nurses' UCHL version April 2014

It is incumbent on staff to ensure that they have;

Undergone any suitable training identified as necessary the terms of this policy or otherwise.

Been fully authorised by their line manager and their Clinical Business Unit (CBU) to undertake the activity., currently the online paediatric mandatory e-learning

Fully comply with the terms of the relevant Trust policies and/or procedures at all times and only depart from any relevant Trust guidelines providing it meets the needs of the individual circumstances and the judgement made to deviate from the trust guidelines is justifiable from a responsible clinician and such a decision is fully recorded in the patient's notes

7. Management of Type 1 Diabetes Mellitus during illness in children and young people under 18 years (Sick Day Rules for patients on MDI regime)

Introduction:

Illness generally raises the blood glucose levels and increases the risk of ketone body production due to a relative deficiency of insulin.

An increase in counter-regulatory hormone production causes gluconeogenesis and impaired peripheral glucose uptake which in turn leads to hyperglycaemia and hyper osmolality.

Insulin deficiency leads to lipolysis, hepatic fatty acid oxidation and formation of ketone bodies. This can result in Diabetic Ketoacidosis (DKA) if adequate insulin and hydration is not maintained.

Increased levels of stress hormones during illness contribute to high blood glucose levels

Diarrhoea and vomiting may reduce blood glucose levels with a possibility of hypoglycaemia rather than hyperglycaemia. Ketones may still be produced in significant quantities even with hypoglycaemia in gastroenteritis called as starvation ketones.

7.1 Importance of sick day rules:

NICE guidelines recommend that children and young people with T1DM should be offered clear guidance for the management of diabetes during periods of illness. Adequate sick day management at home may reduce the risk of progression to DKA and admission to hospital. The use of sick-day rules which include self-monitoring of blood glucose and ketones, and timely administration of supplemental insulin and fluids leads to reduced hospitalisation and potential cost savings. DKA admissions are associated more with increasing age, high HBA1c, high insulin doses and female sex.

7.2 Ketone testing:

Ketones are produced from the liver when there is a lack of glucose (starvation ketones) and as an alternative energy source when there is a relative insulin deficiency.

It is recommended that blood ketone testing instead of urine ketone testing is done during illness. All patients and their carers should be provided with equipment to measure blood ketone levels during illness.

7.3 Fluid management:

There is evidence that children and adolescents admitted to hospital with DKA are dehydrated, this is due to a combination of polyuria and vomiting. During intercurrent illness, the main reason for ensuring adequate hydration is to promote renal excretion of ketone bodies.

Fluid intake should be monitored to ensure they are drinking enough fluids to keep well hydrated. If the child is persistently vomiting with high ketones, have a low threshold for admission to hospital.

7.4 Diabetes self-management education: Recommendations

All CYP and their families and carers should be taught what to do when ill (sick day rules) at diagnosis, annually, at transition and opportunistically.

All CYP and their families and carers should have written information about

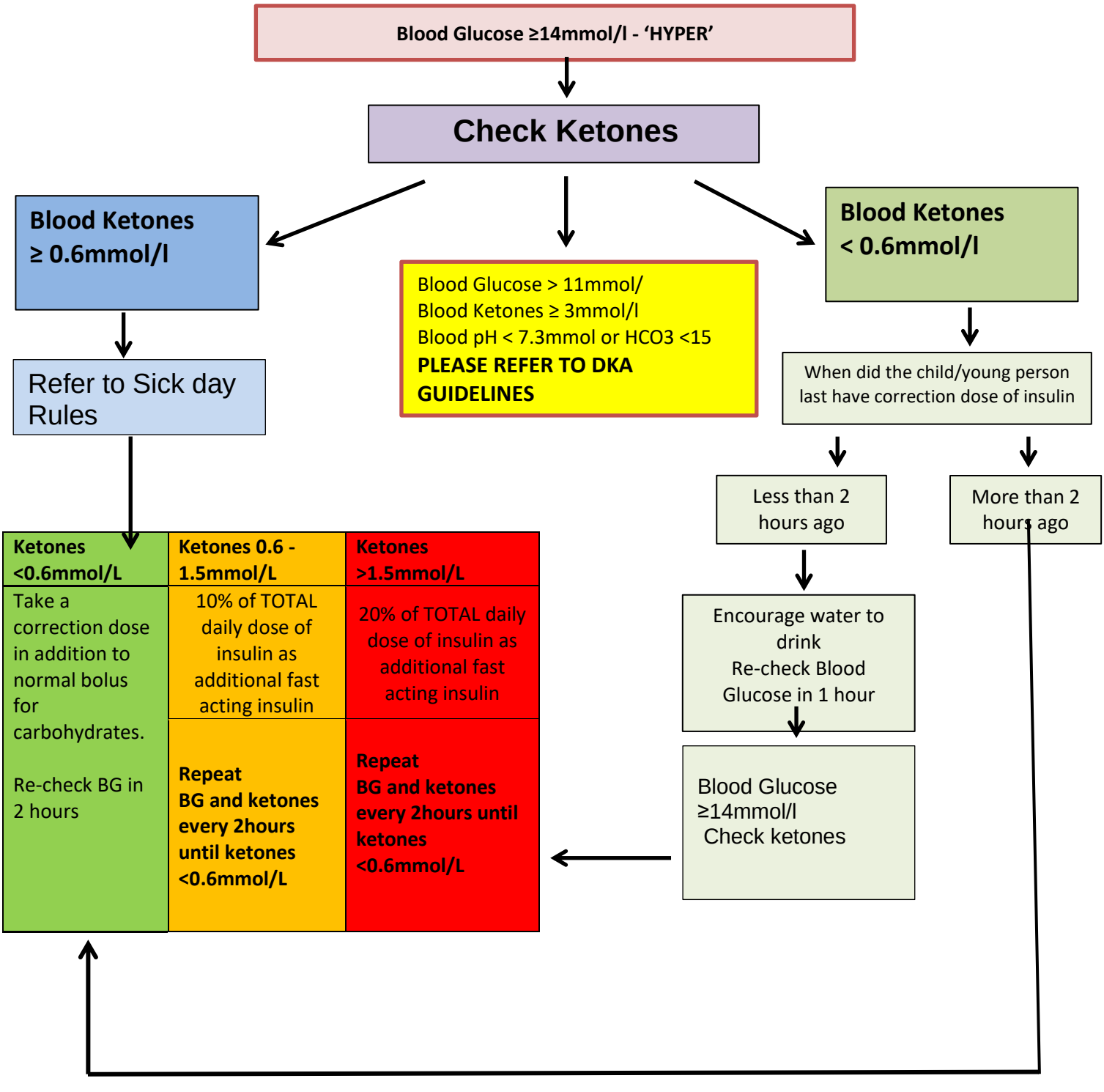
- what to do when ill
- how to test blood ketones and interpret results
- when to seek advice from their diabetes team and important contact numbers/addresses of health care team

7.5 General rules for managing diabetes during illness:

- Never stop or omit insulin (long-acting insulin).
    - However doses may need to be reduced or increased and this will depend on blood glucose and ketone levels.
- Check blood glucose more frequently e.g. every 2 hours including through the night.
    - This will help distinguish between conditions associated with hyperglycaemia and hypoglycaemia
- Check for blood ketone levels whenever a child is ill
    - If blood glucose ≥14 mmol/l, follow Managementt of Hyperglycemia flow chart below
    - Rarely, ketone levels may be elevated even if BG levels are normal, for example in gastroenteritis.
- Give additional fast acting insulin every 2 hours if blood glucose is above target. (See Table 1: Sick-day rules)
    - If ketones are less than 0.6mmol/l, then give the usual correction insulin dose
    - If ketones are between 0.6mmol/l and 1.5mmol/l then advise that patient has 10% of the total daily dose of insulin (TDD), or 0.1 units/kg body weight, as additional fast acting insulin.
    - If ketones are >1.5mmol/l then advise that patient has 20% of TDD, or 0.2 units/kg body weight as additional fast acting insulin.
- If ketones are present when blood glucose is low, they are called ‘starvation ketones’ and respond to drinking extra fluids containing sugar. Monitor blood glucose very closely and extra insulin may be required when blood glucose starts rising.
- Keep well hydrated by drinking plenty of fluids.

- Water or sugar-free fluids are probably most appropriate in the majority of cases where blood glucose levels are normal or high.
- If blood glucose levels are low, drinks containing glucose are required, or take carbohydrates if possible.
- Avoid carbonated drinks if possible.
- Inform the diabetes team early to seek advice
- Treat the underlying condition

7.6 Management of HYPERglycaemia



7.7 Table: Sick-day rules

Negative ketones <0.6mmol.l (Blood)	**Small to moderate ketones** 0.6 – 1.5mmol.l (Blood)	**Moderate to large ketones** >1.5mmol.l (Blood)
Take a correction dose (CD) to correct high blood glucose (BG) in addition to normal bolus for carbohydrates eaten	Give • 10% of your total daily dose (TDD) of insulin as additional fast acting insulin OR • 0.1 units/kg body weight as additional fast acting insulin	Give • 20% of your total daily dose (TDD) of insulin as additional fast acting insulin. OR • 0.2 units/kg body weight as additional fast acting insulin
Then: • Re -check BG and ketones in two hours	Then: • Monitor fluid intake and ensure you are drinking enough fluids to keep well-hydrated • Re-check BG and ketones in two hours (See below)	Then: • Monitor fluid intake and ensure you are drinking enough fluids to keep well-hydrated • Re-check BG & ketones in two hours (see below)
If your BG is going down that is a good sign but monitor closely throughout the day. If BG is increasing but ketones less than 0.6mmol/l: • Take another correction dose **using a pen** If ketones 0.5 – 1.5mmol/l, follow orange column advice If ketones >1.5mmol/l, follow the **red** column advice	If ketones negative follow green column advice If BG is increasing but ketones still 0.6 – 1.5mmol/l: • Continue to give 10% of TDD or 0.1 Units/kg as additional fast acting insulin every 2 hours using a pen • Give usual boluses for food • Re-check BG and ketones every 2 hours even through the night! If ketones increase to >1.5mmol.l, follow the **red** column advice	If ketones negative follow green column advice If BG is increasing but ketones have reduced to 0.6 – 1.5mmol/l, follow orange column advice If ketones are still >1.5mmol.l: • Give another 20% TDD or 0.2units/kg as additional fast acting insulin every 2 hours using a pen • Give usual boluses for food • Once vomiting with high ketones, have a low threshold for admission to hospital

Example:

If the TDD of insulin (Total daily dose) is 50 units

10% correction (Ketones 0.6-1.5): Give extra 5 units of fast acting insulin /Novorapid / Trurapi

20% correction (Ketones>1.5): Give extra 10 units of fast acting insulin /Novarapid

7.8 Management of infections usually associated with hypoglycaemia e.g. Gastroenteritis

- Encourage regular small sips of sugar-containing drinks (NOT diet drinks)
- Monitor blood glucose (BG) at least 2 hourly,
- If not taking much orally and BG are in normal/low range, DECREASE usual fast acting insulin whilst illness persists.
- If BG are >10 but <14, give correction doses of insulin as per guideline
- Once oral intake is tolerated again, give NORMAL dose of insulin
- If not tolerating anything orally and BG are <4 advise attend hospital. If drowsy or reduced conscious level, advise give IM glucagon as follows and dial 999:
  a. If age under 8 give 0.5 mg glucagon by IM injection
  b. If age 8 or over, give 1 mg glucagon by IM injection
- If then able to tolerate oral intake and BG >4, can go home. If not tolerating anything orally or BG still <4 admit for observation and intravenous dextrose if necessary.
- If child has been vomiting and not eating, they may have ketones with NORMAL BG ('starvation ketones'). Monitor BG frequently and encourage fluids containing sugar.
- If a child has HIGH (>14) BG, with ketones and is vomiting, this is DKA and they should be advised to attend hospital urgently.

8. Monitoring compliance:

What will be measured to monitor compliance	How will compliance be monitored	Monitoring Lead	Frequency	Reporting arrangements
Diabetes training offered all year round paediatric diabetes learning module	euhl	Clinical Education Lead	Annually	Paediatric Diabetes Specialist Nurse (PDSN)
Participation in External quality assurance scheme	WEQAS - External Quality assessment (EQA)	Point of care manager. (POCT)	Bi-monthly	
Glycaemic control	NPDA	PS	Annually	

9. Supporting References:

British Diabetic Association Balancing for Beginners. British Diabetic Association.

Becton Dickinson (1993) How to inject insulin. Becton Dickson and Company

Becton Dickinson (2001), Getting started with Diabetes. Becton Dickson and Company.

Clarke W, Jones T, Rewers A, Dunger D, Klingensmith GJ. Assessment and management of hypoglycaemia in children and adolescents with diabetes. Pediatric Diabetes 2009: 10 (Suppl. 12): 134–144.

Diabetes Children's Handbook: Information for Children, Parents and Carers. UHL NHS trust. September 2022

Department of Health (2003) The National Service Framework for Diabetes: Standards. London, DH.

Hunter, J. (2008) Subcutaneous injection technique. Nursing Standard. 22,21, 41-44

King L (2003), Sub-cutaneous Injection technique, Nursing Standard. 17,34, 45-52

Diabetes (type 1 and type 2) in children and young people: diagnosis and management:NICE guideline [NG18]Published: 01 August 2015 Last updated: 11 May 2023.

Sonkson, P. (1990) Diabetes at your fingertips. London.

Thompson.R, Peters.C, and Hindmarsh. P, DIABETES SELF MANAGEMENT IN THE HOSPITAL SETTING. Diabetes Services at Great Ormond Street Hospital for Children and University College London Hospitals. Date: February 19 2012

www.cc.nih.gov/ccc/patient_education/pepubs/subq.pdf [accessed 06/06/2024 no longer available]

www.gosh.nhs/health /health professionals/clinical guidelines/ insulin-safe-administration
www.novonordisk-us.com (2013)

10. Key Words:

Accu-Chek Performa, Blood glucose, Blood glucose meter, Capillary, Diabetes, Diabetic Ketoacidosis (DKA), Hyperglycaemia, Hypoglycaemia, Ketones, Insulin pen, Insulin pump, Sub-Cutaneous insulin, Sub-cutaneous Injection.

The Trust recognises the diversity of the local community it serves. Our aim therefore is to provide a safe environment free from discrimination and treat all individuals fairly with dignity and appropriately according to their needs.
As part of its development, this policy and its impact on equality have been reviewed and no detriment was identified.

CONTACT AND REVIEW DETAILS	
Guideline Lead (Name and Title) **James Greening – Consultant** **Prem Sundaram – Consultant** **Sonal Kapoor – Consultant** **Anbu Subbarayan- Consultant** **Katie Sparrow - Dietician**	**Executive Lead** Chief Medical Officer
Changes made during the review; May 2024 Added TRURAPI to newly diagnosed diabetes management. Added section 2.4 (pages 21-23) Flexible Insulin Dosing Dietary advice section 2.5 updated References and hyperlinks updated	

Appendix1: Initial management of Hyperosmolar Hyperglycaemic State (HHS)

For detailed guidelines please refer to ACDC guidelines (link in the reference)

HHS is very rare when compared to DKA in children and young people. Please contact paediatric diabetes consultant when you encounter this condition.

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

- Hypovolaemia
- Marked hyperglycaemia (Glucose >33.0 mmol/L or more)
- No significant hyperketonaemia (<3.0 mmol/L)
- No significant acidosis (Venous pH >7.25 or bicarbonate >15 mmol/L
- Osmolality usually 320 mosmol/kg or more
- Often altered consciousness

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. It can occur in type 1 diabetes. Where DKA and HHS co-exist treatment of DKA takes priority and treatment should be initiated as for DKA.

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 hypernatraemic 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.
- Starting insulin dose 0.025 – 0.05 unit/kg/hour can be used initially and dose titrated to reduce glucose levels by 3-4 mmol/l per hour.

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.

Reference

ISPAD Clinical Practice Consensus Guidelines 2018: Diabetic ketoacidosis (DKA) and the hyperglycaemic hyperosmolar state
(https://cdn.ymaws.com/www.ispad.org/resource/resmgr/consensus_guidelines_2018_/11.diabetic_ketoacidosis_and.pdf)

Association of Children's Diabetes Clinicians (ACDC) endorsed guidelines, Practical management of Hyperglycaemic Hyperosmolar Sate (HHS)in children

http://www.a-c-d-c.org/wp-content/uploads/2012/08/Practical-Management-of-Hyperglycaemic-Hyperosmolar-State-HHS-in-children-8.pdf

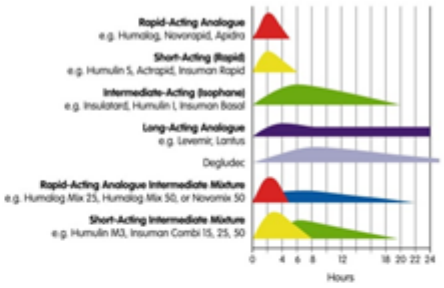
International Society of Paediatric and Adolescent Diabetes (ISPAD): Practice Consensus Guidelines 2022: Insulin treatment in children and adolescents with diabetes (2022). Guideline on Insulin dosage
Available:
https://cdn.ymaws.com/www.ispad.org/resource/resmgr/consensus_guidelines_2018_/guidelines2022/2nd/Ch._9_-_Insulin_ISPAD_2022.pdf

Appendix 2: UHL Children's Services Insulin Prescription Chart

UHL CHILDRENS SERVICES INSULIN PRESCRIPTION CHART

Ward		Weight	kg	Consultant	

Unit Number	
Name	
DOB	
Allergy NKDA ☐	If yes, nature of reaction: Signed: Date:
Device type: Please circle (Prefilled/Cartridge)	Device name:



Administration Time	Fixed Doses – See UHL Paediatric Diabetes Guideline for all dosing					
	Morning (Basal Insulin)	Evening (Basal Insulin)	Breakfast (Bolus Insulin)	Lunch (Bolus Insulin)	Evening meal (Bolus Insulin)	Snacks (Bolus Insulin)
	___:___	___:___	___:___	___:___	___:___	___:___
Name of Insulin						
Route	S/C	S/C	S/C	S/C	S/C	S/C
Insulin Dose 1	units	units	units	units	units	1 unit per ..... grams carbohydrate
Prescriber Print and Sign	Pharm	Pharm	Pharm	Pharm	Pharm	Pharm
Date started						
Insulin Dose 2	units	units	units	units	units	1 unit per ..... grams carbohydrate
Prescriber Print and Sign	Pharm	Pharm	Pharm	Pharm	Pharm	Pharm
Date started						
Insulin Dose 3	units	units	units	units	units	1 unit per ..... grams carbohydrate
Prescriber Print and Sign	Pharm	Pharm	Pharm	Pharm	Pharm	Pharm
Date started						

CORRECTION Doses	
Blood Glucose RANGE mmol/L	Units of fast acting insulin (Novorapid)
Prescribers Signature, Print and Date	Pharm

Administration Time	Fixed Doses – See UHL Paediatric Diabetes Guideline for all dosing					
	Morning (Basal Insulin)	Evening (Basal Insulin)	Breakfast (Bolus Insulin)	Lunch (Bolus Insulin)	Evening meal (Bolus Insulin)	Snacks (Bolus Insulin)
	___:___	___:___	___:___	___:___	___:___	___:___
Name of Insulin						
Route	S/C	S/C	S/C	S/C	S/C	S/C
Insulin Dose 1	units	units	units	units	units	1 unit per ..... grams carbohydrate
Prescriber Print and Sign	Pharm	Pharm	Pharm	Pharm	Pharm	Pharm
Date started						
Insulin Dose 2	units	units	units	units	units	1 unit per ..... grams carbohydrate
Prescriber Print and Sign	Pharm	Pharm	Pharm	Pharm	Pharm	Pharm
Date started						
Insulin Dose 3	units	units	units	units	units	1 unit per ..... grams carbohydrate
Prescriber Print and Sign	Pharm	Pharm	Pharm	Pharm	Pharm	Pharm
Date started						

Carbohydrate counting (Use values from clinic outcome form, glucometer, pump or patient)					
Date	Meal	Carbohydrate Ratio	Max Frequency	Prescriber Signature	Print and Date
Insulin Name	Breakfast ___:___	1 unit per.....g carbohydrate	2 hours		
	Lunch ___:___	1 unit per.....g carbohydrate	2 hours		
	Dinner ___:___	1 unit per.....g carbohydrate	2 hours	Pharm	

Carbohydrate counting (Use values from clinic outcome form, glucometer, pump or patient)					
Date	Meal	Carbohydrate Ratio	Max Frequency	Prescriber Signature	Print and Date
Insulin Name	Breakfast ___:___	1 unit per.....g carbohydrate	2 hours		
	Lunch ___:___	1 unit per.....g carbohydrate	2 hours		
	Dinner ___:___	1 unit per.....g carbohydrate	2 hours	Pharm	

Correction Dose *If not known, please use correction table on page 1*

Date	Meal	Insulin Sensitivity (Correction)	Max Frequency	Prescriber Signature	Print and Date
Insulin Name	Breakfast	1 unit to reduce BG by.....	2 hours		
	Lunch	1 unit to reduce BG by.....	2 hours		
	Dinner	1 unit to reduce BG by.....	2 hours	Pharm	

*BG = blood glucose

Date	Meal	Insulin Sensitivity (Correction)	Max Frequency	Prescriber Signature	Print and Date
Insulin Name	Breakfast	1 unit to reduce BG by.....	2 hours		
	Lunch	1 unit to reduce BG by.....	2 hours		
	Dinner	1 unit to reduce BG by.....	2 hours	Pharm	

Sick day rules - If blood glucose levels >14mmol/l, check ketones and follow as per below:

Sick Day Rules Correction Dose(s) – If required, use guide below				
Ketones <0.6mmol/L	Ketones 0.6-1.5mmol/L	Ketones >1.5mmol/L	Prescriber signature	Print and date
Take a correction dose in addition to normal bolus for carbohydrates. If the patient has an expert meter follow the advice on the meter	10% of TOTAL daily dose of insulin as additional fast acting insulin	20% of TOTAL daily dose of insulin as additional fast acting insulin		
	10% of insulin =	**20% of insulin =**	Pharm	

Hypoglycaemia treatment														
GLUCOSE GEL 40%	Route: Oral	Pharm	Date											
Signature	Dose		Time Given											
Date	Frequency		Checked											
GLUCAGON	Route: IM	Pharm	Date											
Signature	Dose		Time Given											
Date	Frequency		Checked											
0.5mg	<8yrs old													
1.0mg	>8yrs old													

Date / Time	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Hours
Blood Glucose (mmol/L)																									Blood Glucose (mmol/L)
Ketones																									Ketones
Carbohydrate content (g)																									Carbohydrate content (g)
Fixed bolus insulin dose (units)																									Fixed insulin dose (units)
Insulin dose for Carbohydrate (units)																									Insulin dose for Carbohydrate (units)
Basal insulin dose (units)																									Basal insulin dose (units)
Correction dose (unit)																									Correction dose (unit)
Total Units																									**Total Units**
Given by																									**Given by**
Checked by																									**Checked by**

Date / Time	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Hours
Blood Glucose (mmol/L)																									Blood Glucose (mmol/L)
Ketones																									Ketones
Carbohydrate content (g)																									Carbohydrate content (g)
Fixed bolus insulin dose (units)																									Fixed insulin dose (units)
Insulin dose for Carbohydrate (units)																									Insulin dose for Carbohydrate (units)
Basal insulin dose (units)																									Basal insulin dose (units)
Correction dose (unit)																									Correction dose (unit)
Total Units																									**Total Units**
Given by																									**Given by**
Checked by																									**Checked by**