Ashford and St. Peter's Hospitals NHS
NHS Foundation Trust

Integrated Care Pathway

PAEDIATRIC DIABETIC KETOACIDOSIS (DKA)

Patient Label

Details	
Ward:	
Consultant:	
Named Nurse:	
Date of Admission:	
Date of Discharge/Transfer:	

ALL STAFF TO WRITE IN BLACK INK WITHIN THE PATHWAY. DOCTORS WRITE AGAINST GREEN TEXT, NURSES AGAINST BLACK TEXT

Doctors /Diabetes Specialist Nurse Green **Nurses: Black** **Therapists: Red**

ALL STAFF WRITING IN THIS ICP SHOULD GIVE A SAMPLE SIGNATURE BELOW

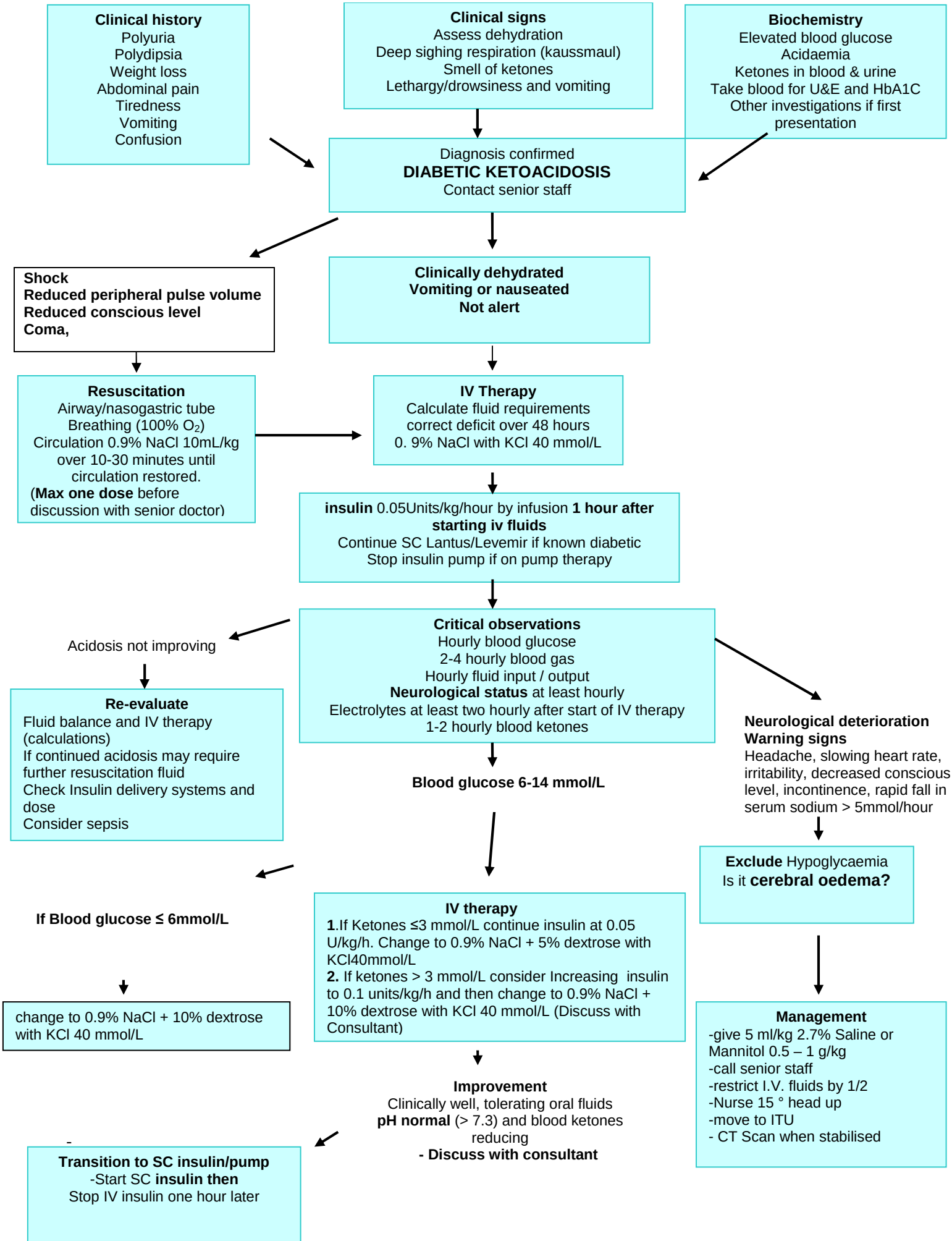
Name (print)	Position	Sample Signature	Initials

Definition Diabetic Ketoacidosis
Adapted ISPAD Consensus guidelines/BSPED guidelines for the management of type 1 diabetes mellitus in children and adolescents

1. Hyperglycaemia (Blood glucose (BG) >11 mmol/L)
2. pH <7.3
3. Bicarbonate <18 mmol/L
4. Blood ketones (near patient testing method)>3.0 mmol/l

MILD/MODERATE DKA – pH >7.1
SEVERE DKA – pH <7.1

ALGORITHM FOR THE MANAGEMENT OF DIABETIC KETOACIDOSIS IMMEDIATE ASSESSMENT



CEREBRAL OEDEMA

This is a medical emergency. Once suspected it should be treated immediately. Call for senior help.

Background

Cerebral oedema is a major cause of mortality and morbidity in children with diabetic ketoacidosis. It can occur any time up to 24 hours after the start of resuscitation. It can be present at the presentation of DKA.

One of the most important principles of management is the slow correction of biochemical abnormalities. This will help prevent the development of cerebral oedema.

Risk Factors

- Young age (< 5 years)
- Adolescents
- pCO2 < 2 kPa at presentation
- pH < 7.1 at presentation
- > 40mL/kg IV Fluid in first 4 hours
- Rapid falls in *corrected* Sodium (> 5 mmol/L/hour)
- $NaHCO_3$ therapy
- Raised serum urea
- Hyperventilation post-intubation

Symptoms

- Headache
- Impaired level of consciousness
- Confusion
- Convulsions
- Irritability
- Incontinence

Signs

- Hypertension
- Bradycardia
- Low saturations
- Change in neurological status
- Focal neurology
- Abnormal posturing
- Seizures

Management

- Increase frequency of neurological observations to every 15 minutes
- Exclude hypoglycaemia
- Give 5 mL/kg of 2.7% NaCl over 5 – 10 minutes (this is kept on Ash Ward and in A&E)
- Restrict fluids to 50% maintenance and replace the deficit over 72 hours
- Nurse at 15° head up and keep head in midline
- Call anaesthetists as may need intubation and ventilation
- Liaise with PICU
- Consider cranial imaging if patient stabilises
- Careful documentation in notes

USE ADDRESSOGRAPH LABEL IF AVAILABLE

NAME:	**Age & Sex:**
ADDRESS:	**Phone No:**
	GP & Surgery:
	GP phone no:
	Admitting Consultant:
Date of birth:	**Source & Type of Referral:**
Hospital Number:	**Information obtained from:**

DATE & TIME OF INTERVIEW:

PRESENTING COMPLAINT(S):

HISTORY OF PRESENTING COMPLAINT(S):

Continue on page 6 if necessary

PAST MEDICAL HISTORY:	**PERINATAL HISTORY**
	Delivery Type:
	Neonatal Problems:
FAMILY HISTORY:	**DRUG HISTORY/ALLERGIES**

IMMUNISATIONS:

Other

Any Problems:

DEVELOPMENTAL HISTORY

EDUCATION (School / Nursery)

PATIENT LABEL

DATE...../...../.....

PHYSICAL EXAMINATION:		
	Weight:	kg
	HR	
	BP	
	RR	
	O_2 sats	
	Temp	
	Capillary refill time	
	Capillary blood glucose	
	Blood ketones	
	Glasgow coma score:	
	% Dehydration	

Time	Assessment / Observations	Sign	Reason for variance & action taken	Sign
	Airway protected			
	Oxygen given 100% via face mask			
	Maintain NBM until assessed			
	Consider NG tube			
	IV access obtained x 2 IV cannulas in situ, and secured position			
	Cardiac monitor (consider T wave changes)			
	Consider urinary catheter			
	Commence ½ hourly recordings of B/P pulse and respiratory rate			
	1-2 hourly recordings of temperature			
	Hourly fluid balance of input &output			

PATIENT LABEL

	Record GCS ☐ ¼ hrly for 1st hour ☐ ½ hrly for next hour ☐ 1 hrly thereafter			

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION	SIGN

PATIENT LABEL

ADMISSION DAY IMMEDIATE MANAGEMENT DATE…….../……../…….

Time	Initial treatment	Sign	Reason for variance & action taken	Sign
	Calculate fluid requirements			
	Prescribe fluids as per requirements			

If shock is present 0.9% NaCl 10 mL/kg over 10-30 minutes.

No more than 1 bolus unless discussed with Consultant.

FLUID REQUIREMENT = DEFICIT + MAINTENANCE

The calculation of deficit is specific for the management of DKA only.

Assume 5% deficit in mild/moderate DKA (if pH >7.1)

Assume 10% deficit in severe DKA (if pH <7.1)

Subtract any resuscitation boluses above 20 ml/kg from the total fluid calculation over 48 hours

Initial fluid should be with 0.9% NaCl with potassium chloride 40 mmol/L if blood glucose > 14 mmol/L

FLUID REQUIREMENT CALCULATION

https://www.bsped.org.uk/media/1380/dka-calc-disclaimer.pdf

(see appendix I)

1. **If blood glucose level is > 14 mmol/L then use 0.9% NaCl with 40 mmol/L Potassium Chloride**

2. **If blood glucose level reduces to between 6 - 14mmol/L**
   - **And ketones ≤ 3 mmol/L change to 0.9% saline + 5% dextrose with KCl 40 mmol/L. Continue insulin at 0.05 Units/kg/h**
   - **If Ketones > 3 mmol/L consider Increasing insulin to 0.1 Units/kg/h and then change to 0.9% NaCl + 10% Dextrose with KCl 40 mmol/L (Discuss with Diabetes Consultant on call)**

3. **If blood glucose level reduces to ≤ 6mmol/L, change to 0.9% NaCl + 10% Dextrose with 40mmol/L Potassium Chloride**

DO NOT STOP INSULIN IF STILL IN DKA

It is useful to write all 3 different bags of fluids up at the start. Clearly document at what glucose levels each bag of fluid is to run at (as above).

PATIENT LABEL

ADMISSION DAY IMMEDIATE MANAGEMENT DATE…….../……../…….

Time	Initial treatment	Sign	Reason for variance & action taken	Sign
	Commence IVI soluble insulin 50 units made up to 50 mL with 0.9% NaCl @ 0.05 units/kg/hr			
	Hourly blood glucose analysis 2-4 hourly U&E and blood gas 1-2 hourly blood ketones			
	Discuss patient with Consultant			
	If patient on Lantus/Levemir do not stop whilst on IV insulin			
	If patient on Insulin pump therapy discontinue this until DKA resolved			

INSULIN

CONTINUOUS LOW DOSE INTRAVENOUS INFUSION OF INSULIN IS THE PREFERRED METHOD

Make up a solution of 1 unit per mL of human soluble insulin (e.g Actrapid) – 50 units made up to 50mL with 0.9% NaCl in a syringe pump.

Flush the giving set with 5 mL of insulin infusion as the insulin may be absorbed into the plastic.

The solution should run at 0.05 units/kg/hour (0.05 mL/kg/hour)

If the blood glucose falls to < 14 mmol/L, add dextrose to the IV fluids. Do not alter the insulin dose without consulting senior medical staff.

Time	Immediate Investigations	Sign	Reason for variance & action taken	Sign
	Blood glucose analysis			
	Lab blood glucose			
	Blood Ketones			
	HbA1c			
	Full blood count			
	Urea and electrolytes			
	Venous blood gas			
	Thyroid function			
	Coeliac screen			
	Islet cell and GAD antibodies (if new diabetic)			
	Consider Urine MC & S ☐ Throat swab ☐ CXR, ☐ Blood culture ☐ Other (please specify) ☐			

PATIENT LABEL

PATIENT LABEL

ADMISSION DAY CONTINUED **DATE……/……/…….**

Time	Communication	Sign	Reason for variance and action taken	Sign
	Explanations given to patient and family as appropriate			
	Specific communication needs identified.			
	Inform porter of impending patient transfer			
	Inform bleep holder of patient admission bleep 5119			
	Ensure patient name band and allergy band in situ as appropriate			

PLAN FOR PATIENT CARE AND INFORMATION GIVEN TO PARENTS: ***(CONTINUE OPPOSITE PAGE IF NECESSARY)***

Signature:

Dr's Name (printed): **Grade:** **Bleep No:**

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION	SIGN

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION	SIGN

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION	SIGN

PATIENT LABEL

ADMISSION TO WARD DATE…….../……../…….

Initials required for each shift

Clinical assessments	E	L	N	Reason for variance and action taken	Sign
Secure IVI's and check sites					
Complete hourly fluid balance chart					
Measure all urine and chart on fluid balance					
Monitor and record blood ketones 1-2 hourly					
Monitor and record blood glucose hourly. Inform medical staff if < 6 or > 14 mmol/L or if blood glucose decreasing more than 5mmol/L per hour.					
Record and chart hourly observations including O_2 saturation respiratory rate and neurological observations.					
Consider cardiac monitor					
Record waterlow score					

NB:
Consider cerebral oedema if deterioration in neurological observations, heart rate, blood pressure or O_2 saturations

If blood glucose level reduces to between 6 - 14mmol/L

1) **And ketones ≤ 3 mmol/L change to 0.9% saline + 5% dextrose with KCl 40 mmol/L. Continue insulin at 0.05 Units/kg/h**
2) **If Ketones > 3 mmol/L consider increasing insulin to 0.1 Units/kg/h and then change to 0.9% NaCl + 10% Dextrose with KCl 40 mmol/L (Discuss with Diabetes Consultant on call)**

If blood glucose level reduces to ≤ 6mmol/L, change to 0.9% NaCl + 10% Dextrose with 40mmol/L Potassium Chloride

DO NOT STOP INSULIN UNTIL DKA HAS RESOLVED

Initials required for each shift

Hygiene	E	L	N	Reason for variance and action taken	Sign
Continue nil by mouth (may have ice chips)					
Give / assist with regular mouth care including teeth cleaning					
Regular hygiene					

Initials required for each shift

Communication	E	L	N	Reason for variance and action taken	Sign
Explain treatment to patient and family as appropriate					
Inform diabetes nurse specialist of patients admission					
Inform diabetes team of patient admission					
Inform dietitian of patient admission					
Introduce and inform play specialist as appropriate					
Consider giving information pack (If new diabetic)					

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION TO WARD	SIGN

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION TO WARD	SIGN

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION TO WARD	SIGN

PATIENT LABEL

DAY TWO				DATE…….../……../…….	
Clinical assessments	E	L	N	Reason for variance and action taken	Sign
Ensure IVI's secure and check sites					
Complete hourly fluid balance chart					
Measure all urine and chart on fluid balance					
Record 1-2 hourly blood ketones whilst patient on IV insulin infusion					
Record hourly blood glucose whilst patient on IV insulin infusion					
Change insulin infusion set					
If started on SC insulin discontinue neurological observations and commence 4hourly observations of TPR					
Record weight					
Once DKA has resolved, tolerating oral fluids and ketosis resolving commence SC insulin regimen (new patient): *Calculate 0.66u/kg/per day* *⅓ to be given as Lantus/ Levemir daily.* *⅔ to be given as NovoRapid/ Humalog in 3 equal divided doses with meals*					
In existing patients commence Novorapid/ Humalog (or Insulin pump) as per previously prescribed doses					
Keep IV insulin running for 1 hour after first subcutaneous injection/pump reconnection					
Record food eaten (Do not restrict food because of high blood glucose levels).					
When IV insulin discontinued, record blood glucose pre-meal and 2 hours post meal, 22:00 and 02:00					
Communication	E	L	N	Reason for variance and action taken	Sign
Explain treatment to patient and carer as appropriate					
Choose insulin injection pen					
Education	E	L	N	Reason for variance and action taken	Sign
Commence education to parent & child					
Insulin injection					
Blood glucose reading and recording					
Ketone testing and recording					
Consultation with Dietitian					
Discharge	E	L	N	Reason for variance and action taken	Sign
Ensure diabetes information pack given					
Order TTO's					

Initials required for each shift

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR DAY TWO	SIGN

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION TO WARD	SIGN

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION TO WARD	SIGN

PATIENT LABEL

DAY THREE **DATE……./……./…….**

Initials required for each shift

Clinical assessments	E	L	N	Reason for variance and action taken	Sign
Review vital signs					
Record blood glucose pre-meal and 2 hours post meal, 22:00 and 02:00					
Continue checking blood ketones until negative for ketones					
Give NovoRapid / Humalog as prescribed immediately before main meals or immediately post meals.					
Do not restrict food because of high blood glucose levels.					
Snacks in between meals may be required. (Low sugar, high carbohydrate healthy eating plan)					

Hygiene	E	L	N	Reason for variance and action taken	Sign
Hygiene needs met by patient / carer					

Education	Sign	Reason for variance and action taken	Sign
Commence education to parent and child as appropriate:			
Insulin injection			
Blood glucose reading and recording			
Ketone testing and recording			
Consultation with Dietitian			

Communication	Sign	Reason for variance and action taken	Sign
Discuss with patient / carer relevant issues / concerns, giving time for parents / carer to ask questions.			

Discharge	Sign	Reason for variance and action taken	Sign
Ensure diabetes information pack given			
Order TTO's			
CONSIDER DISCHARGE IF DISCHARGE CRITERIA MET PAGE.29			

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR DAY THREE	SIGN

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION TO WARD	SIGN

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION TO WARD	SIGN

PATIENT LABEL

DAY FOUR	DATE…….../……../…….

Initials required for each shift

Clinical assessments	E	L	N	Reason for variance and action taken	Sign
Patient reviewed by medical staff					
Record blood glucose pre-meal and 2 hours post meal, 22:00 and 02:00					
Continue urinalysis until negative to ketones					
Give NovoRapid / Humalog as prescribed immediately before main meals or immediately post meals.					
Do not restrict food because of high blood glucose levels.					
Snacks in between meals may be required. (Low sugar, high carbohydrate healthy eating plan)					

Hygiene	Sign	Reason for variance and action taken	Sign
Hygiene needs met by patient / carer			

Education	Sign	Reason for variance and action taken	Sign
Continue education to parent and child as appropriate:			
Insulin injection			
Blood glucose reading and recording			
Ketone testing and recording			
Consultation with Dietitian			

Communication	Sign	Reason for variance and action taken	Sign
Continue discussions with patient / carer over relevant issues / concerns, giving time for parents / carer to ask questions.			

Discharge	Sign	Reason for variance and action taken	Sign
CONSIDER DISCHARGE IF DISCHARGE CRITERIA MET (PAGE 31)			

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR DAY FOUR	SIGN

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION TO WARD	SIGN

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION TO WARD	SIGN

PATIENT LABEL

DISCHARGE **DATE……/……/…….**

INSULIN REGIMEN ON DISCHARGE				
Insulin Time				
Dose				

Clinical assessments	Sign	Comments	Sign
Vital signs within normal parameters			
Blood glucose recordings stable			
Blood chemistry within normal limits			
Patient reviewed by paediatric consultant			
Patient reviewed by diabetic nurse specialist			
Patient reviewed by dietitian			
Discharge plan written			

Education	Sign	Comments	Sign
Diabetes information pack given			
Appropriate explanation given of condition			
Explanation given of diabetes management			
Written information of diet plan			
Demonstration of insulin pen given to parents/carer and child (if appropriate)			
Patient /carer and or child has demonstrated injections and blood glucose testing			
Demonstration of blood glucose technique given to parent / carer and child if appropriate			
Instruction given as how to document blood glucose			
Demonstration given as how to test blood for ketones and significance			
Carer / child verbalises understanding of diabetic care and demonstrates ability to provide care.			
Appropriate outpatient appointments made			
Contact numbers provided			
TTOs given to patient/carer and explanation given			
Discharge letter given to patient/carer			

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR DISCHARGE	SIGN

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION TO WARD	SIGN

PATIENT LABEL

DATE	MULTIDISCIPLINARY NOTES FOR ADMISSION TO WARD	SIGN

PATIENT LABEL

Results Flow Sheet

Date									
Time									
pH									
pCO_2									
HCO_3^-									
BE									
Glucose									
Lab Na									
Actual Na ***See Below****									
K									
Urea									
Creat									
CRP									
TSH									
fT_4									
Hb									
Plt									
WBC									
N									
L									
Blood Cultures									
Urine Culture									

***Actual Na = (Lab Na+ (Blood Glucose – 5)**
3

PATIENT LABEL

References & Bibliography

Isle of Wight Healthcare NHS Trust (March 2002) Paediatric Ketoacidosis ICP Version 3
Chelsea & Westminster Healthcare NHS Trust Integrated Care Pathway Paediatric Diabetes
Dunger,D. et al.(1999) Ketoacidosis; Practical Algorithms in Paediatric Endocrinology
Department of Health (April 2003) Getting the right start: National Service Framework for Children Standard for Hospital Services
International Society of Paediatric and Adolescent Diabetes (2000)ISPAD Concensus Guidelines for the management of type 1 Diabetes Mellitus in Children and Adolescents http://www.ispad.org/
BSPED Recommended DKA Guidelines. 2009 (Minor review 2013)

PATIENT LABEL

Appendix I

FLUID REQUIREMENT CALCULATION

Maintenance

Weight < 10kg give 2 ml/kg/h	mL/h
Weight 10 – 40 kg give 1 ml/kg/h	mL/h
Weight > 40 kg fixed volume 40ml/H	40 mL/h
Total for 24 hours	mL/h

Deficit

% Dehydrated × body weight × 10	mL
(Subtract any resuscitation fluid above 20 ml/kg)	ml
Replaced over 48 hours – divide by 48 for hourly rate	ml/h

Total Fluid Calculation

Hourly rate = (deficit/48 hr) + maintenance per hour	mL/hour