



Course: Key Competences

Background:

In 2007, the Royal College of Paediatrics and Child Health (RCPCH) published a new curriculum for postgraduate medical education, which has been approved by the Postgraduate Medical Education and Training Board¹. In addition, the RCPCH has devised an assessment strategy that uses multisource feedback tools to map specifically to assessment standards.

By the completion of Level One training, all trainees are expected to be able to initiate therapy in a child presenting with Diabetic Ketoacidosis. This scenario/workshop has been designed to assess competence in management of this key condition of childhood.

Curriculum Elements Addressed:

DKA occurs when a relative or absolute lack of insulin leads to the inability to metabolise glucose. This leads to hyperglycaemia, osmotic diuresis, and dehydration. Fat metabolism causes production of large amounts of ketones and metabolic acidosis. It is often the first presentation of diabetes. The management of Diabetic Ketoacidosis (DKA) can be separated into five distinct phases:

- **Assessment**
- **Recognition of the condition**
- **Formulation of differential diagnoses**
- **Investigation**
- **Definitive therapy**

Assessment (Expected)

Brief history should be obtained (key features – weight loss, polyuria, polydipsia, abdominal pain and vomiting (symptoms much less specific in under 5-year-olds).

The child should be examined thoroughly. Key features of examination: Tachypnoea 45 breaths.min⁻¹ deep and rapid (Kussmaul), smell of ketones on breath, Tachycardia 168 beats.min⁻¹, CRT 3-4 sec, NIBP 80/45; dry mucous membranes, reduced skin turgor, abdomen soft; irritable child.

Recognition of condition (Expected)

Signs are of shock, metabolic acidosis. Tachypnoea is out of proportion.

Formulation of differential diagnosis (Expected)

Diagnostic possibilities include hypovolaemia, sepsis, acute abdomen, urinary tract infection, salicylate poisoning, uraemia, other metabolic disorder.

¹ A Framework of Competences for Level 1 Training in Paediatrics.
<http://www.rcpch.ac.uk/Training/Competency-Frameworks>



Investigations (Expected)

Cardiovascular monitoring
Pulse oximetry
Blood gas
Glucose
Septic screen (partial) [LP should not be performed in this under-resuscitated child]
Laboratory investigations (to include U&Es, FBC, osmolality, blood and urine cultures)
Chest X-ray
Urine for Ketones and salicylate screen
Blood gas reveals metabolic acidosis with markedly low PaCO₂, hyperglycaemia, leukocytosis.

Definitive Therapy (Expected)

Apply oxygen
Gain intravenous / intraosseous access
Reverse shock (10ml/kg 0.9% saline)
Assess degree of dehydration (7.5% in this girl)
Provide rehydration over 48 hours (deduct resuscitation fluids)
Actual fluid volumes should rarely exceed 1.5x usual maintenance
Insulin infusion (0.1 Units/kg/hr- start 1 hour after resuscitation, then do not stop but can reduce to 0.05 units/kg if glucose falls >5 mmols/hour)
Add dextrose when glucose falls below 15 mmol/l
Potassium supplementation early
Empiric antibiotics until culture results
Appropriate monitoring, CVS, hourly level of consciousness, glucose, potassium
Discuss with PICU if severe acidosis, altered level of consciousness or < 2 years of age
Avoid bicarbonate replacement (associated with cerebral oedema and death)
Avoid overhydration never use >10% dehydration assessment (associated with cerebral oedema and death)
Appropriately manage cerebral oedema (mannitol 0.5g/kg over 20 minutes, CT scan to exclude cerebral venous thrombosis)
Avoid hypokalemia (increased risk of arrhythmia's)

Assessment Domains:

RCPCH Standards	Level of Achievement		
	Good	Adequate	Poor
Effective skills in paediatric assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Knowledge of common and serious paediatric conditions and their management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Effective initial management of ill-health and clinical conditions in paediatrics, seeking additional advice and opinion as appropriate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Safe practical skills in paediatrics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Advanced Neonatal and Paediatric Life Support Skills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Effective communication and interpersonal skills with colleagues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



Scenario: Diabetic Keto Acidosis

Learning Objectives: At the end of the session candidates should be able to:

- 1. Recognise symptoms and signs of DKA**
- 2. Accurately assess degree of dehydration**
- 3. Prescribe appropriate fluid and electrolyte replacement**
- 4. Appropriately manage insulin infusion**
- 5. Understand principles to minimise risk of cerebral oedema**
- 6. Appropriately manage cerebral oedema if occurs**

Faculty Script:

A two year-old girl is referred to the Paediatric Assessment Unit by her GP. She has a three-week history of weight loss and polyuria. She has now started vomiting and is noted to be pale and irritable. There is no fever, but the GP wishes to rule out an intercurrent infection.

Patient Demographics:

Name:

Gender: F **Age:** 2 years **Weight:** 15 kg

Candidate Brief:

Presenting History (Candidate Storyboard):

A two year-old girl is referred to the Paediatric Assessment Unit by her GP. She has a three-week history of weight loss and polyuria. She has now started vomiting and is noted to be pale and irritable. There is no fever, but the GP wishes to rule out an intercurrent infection.

Previous Medical History:

Nil of Note

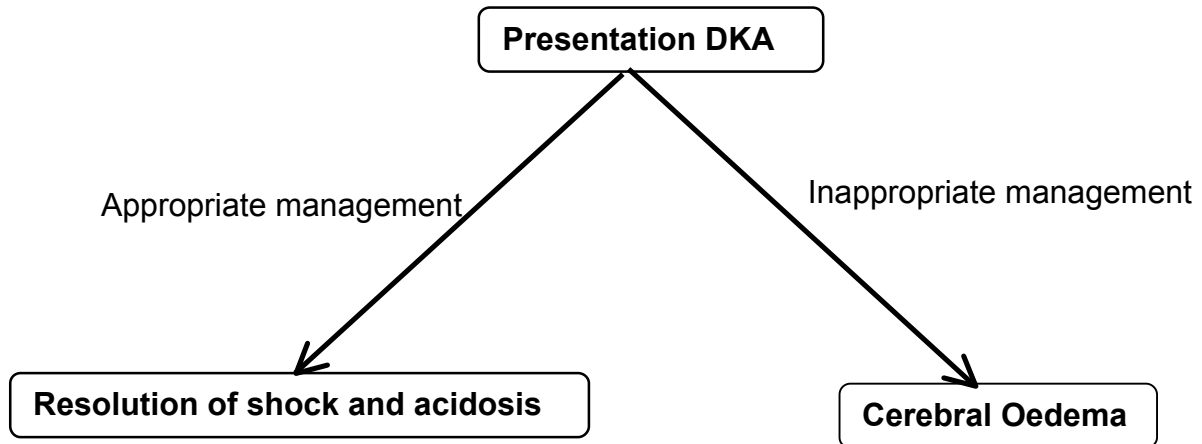
Family Medical History:

No history of Diabetes or any other illnesses





Flowchart of Scenario Progression:



Scenario setup and preparation:

Faculty Recommended: Director **Control**
 Actor/Confederate(s)
 Roles: Parent

If you have a multiprofessional group of candidate then you should have a multiprofessional faculty.

Participants:

Medical Roles

Paediatric SHO

Nursing Roles

AHP Roles

Location: Children's Assessment Unit

Simulator: Meti Paed ECS or alternative that has pupils that can change size

Monitor Setup: 3 wave format

Monitor Parameters Required:

ECG <input checked="" type="checkbox"/>	S _a O ₂ <input checked="" type="checkbox"/>	RR <input checked="" type="checkbox"/>	EtCO ₂ <input type="checkbox"/>	NIBP <input checked="" type="checkbox"/>	ABP <input type="checkbox"/>
CVP <input type="checkbox"/>	PAP <input type="checkbox"/>	ICP <input type="checkbox"/>	CPP <input type="checkbox"/>	Temp (P) <input type="checkbox"/>	Temp (C) <input type="checkbox"/>
Other:					

Equipment Checklist:

Respiratory:

Nasal Cannula	<input type="checkbox"/>	O ₂ Facemask	<input checked="" type="checkbox"/>	O ₂ Reservoir Facemask	<input type="checkbox"/>
Headbox	<input type="checkbox"/>	Wafting O ₂	<input type="checkbox"/>	Nebuliser	<input type="checkbox"/>
Suction	<input type="checkbox"/>	Yankuer	<input type="checkbox"/>	Suction Catheter <input type="checkbox"/> size	FG
Self inflating Bag	<input type="checkbox"/>	Ayers T piece	<input type="checkbox"/>	Nasopharyngeal airway	<input type="checkbox"/>
Oropharyngeal Airway	<input type="checkbox"/>	LMA	<input type="checkbox"/>		
Intubated?	<input type="checkbox"/>	ETT position		length 0.00cm at	
Respiratory Support		Non Invasive			
				➔ Settings:	
				Flow	l/min
				Insp O ₂	%
				PIP	
				PEEP	
		Invasive			
				➔ Settings:	
				iTime	sec
				Insp O ₂	%
				Rate	bpm
				PIP	
				PEEP	

Vascular Access:

Line Type	Site
Peripheral (1)	R Brachial
Peripheral (2)	R Foot
Central Venous	
Arterial	
Intraosseous	

Other Medical Equipment:

Drug Chart	<input checked="" type="checkbox"/>	Emergency Drug Sheet	<input checked="" type="checkbox"/>	Blood gas Venous
Blood Results Sheet	<input type="checkbox"/>	X Rays	CXR	Imaging CT Head
Other Props:				

IV Fluids:

Setup	Fluid Type
Fluids Running	
Fluids Available (1)	0.9% Saline
Fluids Available (2)	0.9% Saline + 40mmol KCl/L
Fluids Available (3)	0.45% Saline + 5% Dextrose / 10% Dextrose
Other Fluids	0.18% Saline + 4% Dextrose

Medications: (route, dose/rate)

Infusions (Running)	Dose	Running Rate (ml/hr)
Nil		

Infusions (Available)	Dose	Running Rate (ml/hr)
Insulin Infusion (Actrapid)	50U/50ml	0.1U/kg/h = 1.5ml/h

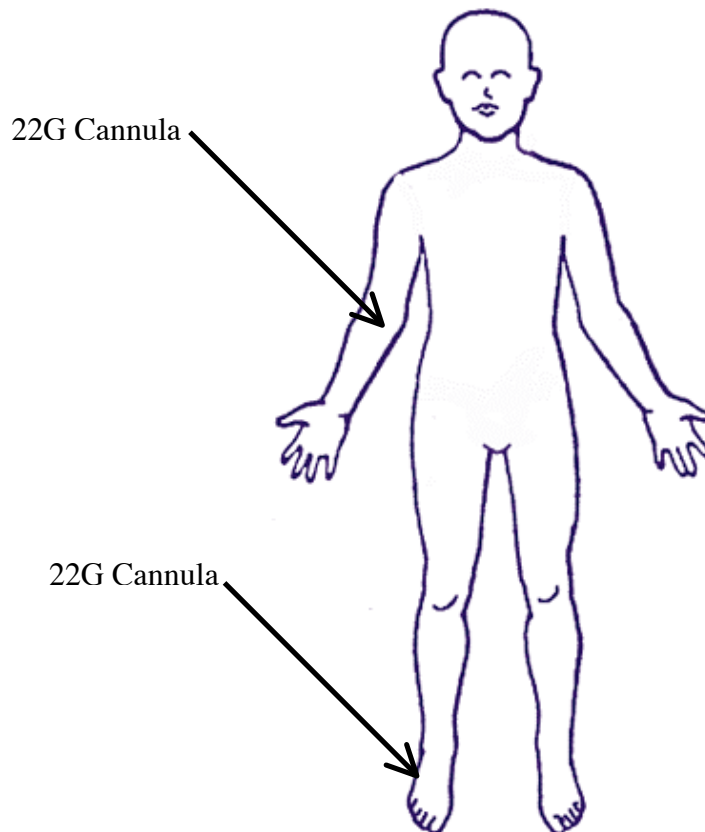
Bolus Drugs (Available)	Dose
Mannitol	0.5G/kg
Antibiotics	



Moulage:

Effect needed

Draw relevant equipment needed on diagram e.g. cannula, wounds etc.





Scenario States:

Name of State		DKA Presentation				Duration					
Vital Signs											
Rhythm	SR	HR	168	SBP	80	DBP	45	CVP			
Resp Rate	45	SaO₂	92	ETCO₂		Temp	37.5	Other			
AVPU	A	GCS	14	Pupils	4 ERL	ICP		NIRS			
Assessment											
Periph Pulses	thready	Cap refill	3 – 4sec	Skin	cool						
ECG/Heart	normal heart sounds										
Airway	unobstructed			Breathing	Kussmaul						
Air entry	Normal			Breath sounds	Normal						
WOB	Kussmaul			Recession							
Neuro	Alert			Renal			Hepatic				
Other											
Results											
Hb	10	WCC	7	PLT	185	HCT	0.3	CRP	5		
PH/ H+	7.01	PaCO₂	18 / 2.4	PaO₂	45 / 6	HCO₃	5	BE	- 25	Lactate	2.5
Na²⁺	128	K⁺	4.3	Cl⁻	89	Ur	12.5	Cr	75	Glucose	28
Ca²⁺	2.1	Mg²⁺	0.6	PO₄⁻	1.5						
Expected Outcomes:											
Participants should:	<p>Be aware of and use DKA pathway document Recognise poor perfusion in context of acidosis. Prescribe fluids:</p> <ul style="list-style-type: none"> • 10ml/kg 0.9% Saline • maintenance + deficit over 48h <p>Commence insulin infusion</p>										
Facilitators should:	<p>Provide feedback on CRT, perfusion and skin temp as appropriate Provide results, drug charts and pathway documents when requested</p> <p>If managed appropriately - progress to state resolution of shock and acidosis</p> <p>If management not appropriate - progress to State Cerebral Oedema (if give > 20ml/kg fluid bolus, failure to deduct resus fluid from deficit, if give bicarbonate)</p>										



Name of State		Resolution of shock and acidosis				Duration					
Vital Signs											
Rhythm	SR	HR	120	SBP	90	DBP	50	CVP			
Resp Rate	30	SaO₂	98	ETCO₂		Temp	37	Other			
AVPU	A	GCS	15	Pupils	4 ERL	ICP		NIRS			
Assessment											
Periph Pulses	Good		Cap refill	2		Skin	warm well perfused				
ECG/Heart	Normal heart sounds										
Airway	clear			Breathing	normal pattern						
Air entry	good			Breath sounds	normal						
WOB	normal			Recession	none						
Neuro	alert			Renal			Hepatic				
Other											
Results											
Hb		WCC		PLT		HCT		CRP			
PH/ H+	7.28	PaCO₂	32 /4.2	PaO₂	45 / 6	HCO₃	12	BE	- 18	Lactate	2
Na²⁺	135	K⁺	4.4	Cl⁻	92	Ur		Cr		Glucose	
Ca²⁺		Mg²⁺		PO₄⁻							
Expected Outcomes:											
Participants should:		Discuss management plan including investigations									
Facilitators should:											

Name of State		Cerebral Oedema				Duration			
Vital Signs									
Rhythm	SR	HR	80	SBP	138	DBP	60	CVP	
Resp Rate	15	SaO₂	85	ETCO₂		Temp	36	Other	
AVPU	U	GCS	6	Pupils	Fixed dilated	ICP		NIRS	
Assessment									
Periph Pulses	palpable		Cap refill	4		Skin	cool mottled		
ECG/Heart	normal heart sounds								
Airway	clear			Breathing	slow				
Air entry	good			Breath sounds	normal				
WOB	normal			Recession	nil				
Neuro	Unresponsive			Renal			Hepatic		
Other									
Results									
Hb		WCC		PLT		HCT		CRP	
PH/ H+		PaCO₂		PaO₂		HCO₃		BE	Lactate
Na²⁺		K⁺		Cl⁻		Ur		Cr	Glucose
Ca²⁺		Mg²⁺		PO₄⁻					
Expected Outcomes:									
Participants should:	Recognise deteriorated neurological state Call for Help Initiate management cerebral oedema prior to CT scan								
Facilitators should:									



Educational Material:



Rapidsystems™

VENOUS SAMPLE

SYSTEM NAME CHILDREN'S WARD
SYSTEM ID 2376-25327
PATIENT ID 1483564N
LST NAME
OPERATOR JONESR

ACID/BASE 37.0 °C
PH 7.01
PCO₂ 18.0 MMHG
PO₂ 45.0 MMHG
HCO₃ - ACT 6.0 MMOL / L
HCO₃ - STD 5.0 MMOL / L
BE (B) -25.0 MMOL / L
BE (ECF) -26.0 MMOL / L

CO-OXIMETRY
HCT 30.0 %
THB 9.8 G / DL
SO₂ 65.0 %
FO₂HB 0.0 %
FCOHB 0.0 %
FMETHB 0.0 %
FHBB 0.0 %

OXYGEN STATUS 37.0 °C
CTO2(A) 0.0 ML/DL

ELECTROLYTES
NA⁺ 128.0 MMOL / L
K⁺ 4.4 MMOL / L
CA⁺⁺ 0.9 MMOL / L
CL⁻ 89.0 MMOL / L

METABOLITES
GLU 28.0 MMOL / L
LAC 2.5 MMOL / L

PATM 754 MMHG

Rapidsystems™

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SYSTEM ID 2376-25327
PATIENT ID 1483564N
LST NAME
OPERATOR JONESR

ACID/BASE 37.0 °C
PH 7.28
PCO₂ 32.0 MMHG
PO₂ 45.0 MMHG
HCO₃ - ACT 12.0 MMOL / L
HCO₃ - STD 11.0 MMOL / L
BE (B) 18.0 MMOL / L
BE (ECF) 19.0 MMOL / L

CO-OXIMETRY
HCT 30.0 %
THB 9.8 G / DL
SO₂ 65.0 %
FO₂HB 0.0 %
FCOHB 0.0 %
FMETHB 0.0 %
FHBB 0.0 %

OXYGEN STATUS 37.0 °C
CTO2(A) 0.0 ML/DL

ELECTROLYTES
NA⁺ 135.0 MMOL / L
K⁺ 4.4 MMOL / L
CA⁺⁺ 0.9 MMOL / L
CL⁻ 92.0 MMOL / L

METABOLITES
GLU 18.0 MMOL / L
LAC 2.0 MMOL / L

PATM 754 MMHG

Rapidsystems™

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SYSTEM ID 2376-25327
PATIENT ID 1483564N
LST NAME
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ACID/BASE 37.0 °C
PH 7.28
PCO₂ 4.2 KPA
PO₂ 6.0 KPA
HCO₃ - ACT 12.0 MMOL / L
HCO₃ - STD 11.0 MMOL / L
BE (B) 18.0 MMOL / L
BE (ECF) 19.0 MMOL / L

CO-OXIMETRY
HCT 30.0 %
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SO₂ 65.0 %
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FCOHB 0.0 %
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METABOLITES
GLU 18.0 MMOL / L
LAC 2.0 MMOL / L

PATM 754 MMHG

Name: -
DOB: 22/08/2010 Collected: 23/09/2012 12:09

Serum/plasma

Magnesium	0.60	mmol/L	(0.70-1.00)
Calcium		mmol/L	(2.25-2.80)
Calcium (corrected)	2.10	mmol/L	(2.25-2.80)
Phosphate	1.50	mmol/L	(1.30-2.00)
Bilirubin	5	umol/L	(< 17)
Alkaline phosphatase	180	IU/L	(70-250)
Alanine aminotransferase	35	IU/L	(5-40)
Total protein	50	g/L	(62-80)
Albumin	29	g/L	(29-55)
Globulin	21	g/L	(22-36)

Serum/plasma

Creatinine	75	umol/L	(28-60)
Urea	12.50	mmol/L	(1.4-5.4)
Sodium	128	mmol/L	(133-143)
Potassium	4.30	mmol/L	(3.7-5.2)
Chloride	89	mmol/L	(95-105)
Bicarbonate	5	mmol/L	(21-34)
Anion gap	28	mmol/L	(6-14)
C-reactive protein	5	mg/L	(< 10)

COAGULATION SCREEN

Prothrombin time	13.00	s	(9.5-12.0)
INR	1.10		
Aptt time	38.00	s	(20.0-45.0)
Aptt ratio	1.20		

Hb:10.00g/dL(11.5-16.5) Plt:186 10*9/L(150-400) Wbc:7.00 10*9/L(5.00-19.00)

Rbc	10*12/L	:	4.00	(3.00-5.40)	Neut	10*9/L	:	3.00	(3.00-9.00)
Hct	l/l	:	0.30	(0.33-0.53)	Lymp	10*9/L	:	3.00	(3.00-16.00)
MCV	fL	:	98	(92.0-116.0)	Mono	10*9/L	:	0.2	(0.30-1.00)
MCH	pg	:	36	(30.0-36.0)	Eosi	10*9/L	:	0.40	(0.20-1.00)
MCHC	g/dL	:	37	(29.0-37.0)	Baso	10*9/L	:	0.10	(< 0.11)
Hypo	%	:	9						