ICP based approach to DKA management improves performance

Mohamed Madkour , P Rao Balakrishna.

Introduction:

An integrated care pathway (ICP) proforma was introduced in Manchester Royal Infirmary based on modified JBDS guidelines. The aim was to guide the frontline clinicians in managing Diabetic ketoacidosis safely.

Background

Several audits since 2008 have highlighted the inadequacies in the management of patients with DKA. Interventions since then by using written guidelines and education resulted in varying outcomes. An ICP was therefore introduced to standardise the management. Audits were done to check performance, and compared against previous similar audits (particularly, before the introduction of ICP Proforma)

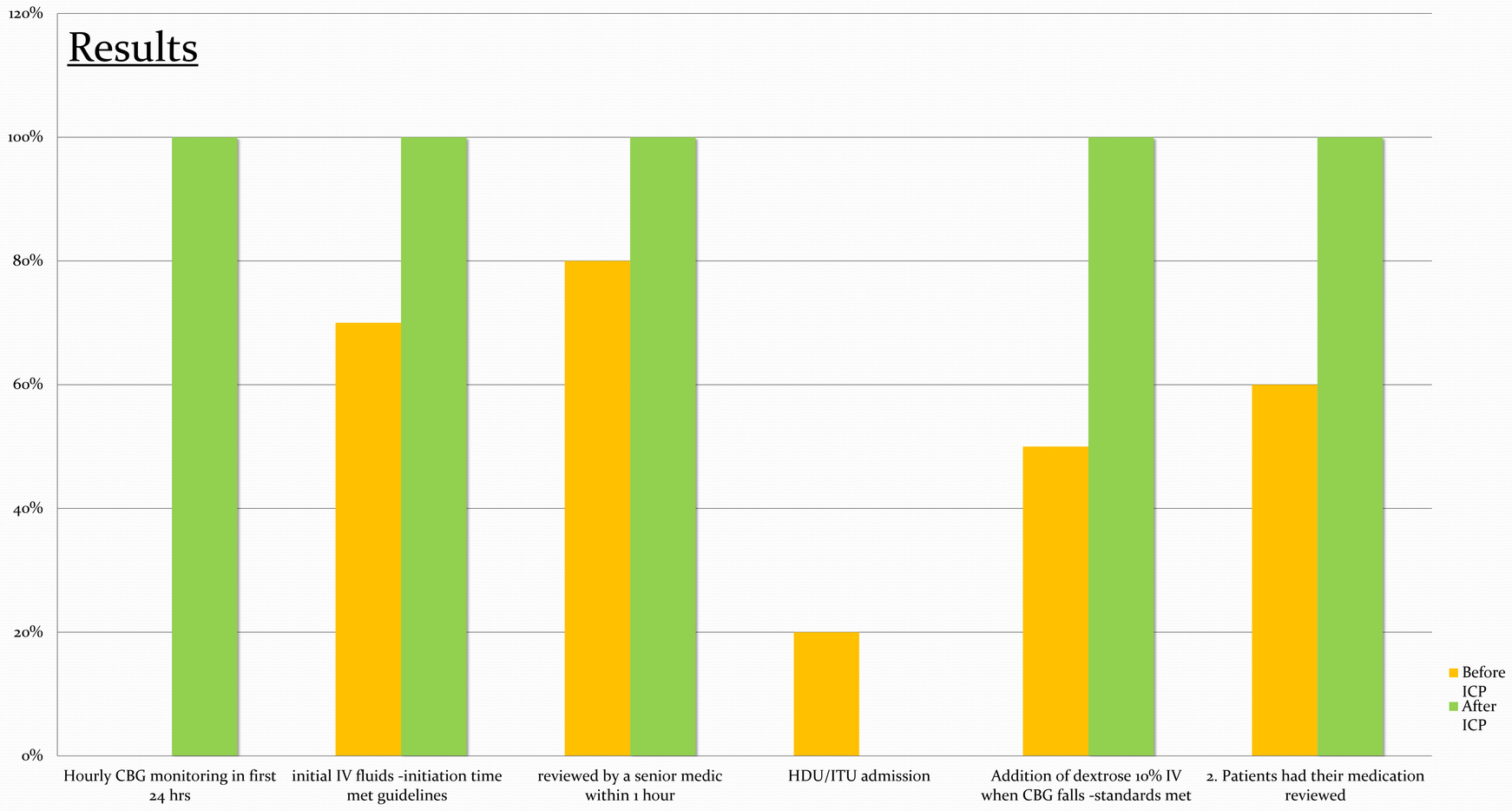
Method

A data collection tool was created against standards set by AQA, and then was collected from patients admitted with DKA/Hypoglycaemia in the period between Nov 17-Feb 18, *this was compared against similar Audits, prior to the introduction of the ICP approach*

Standards

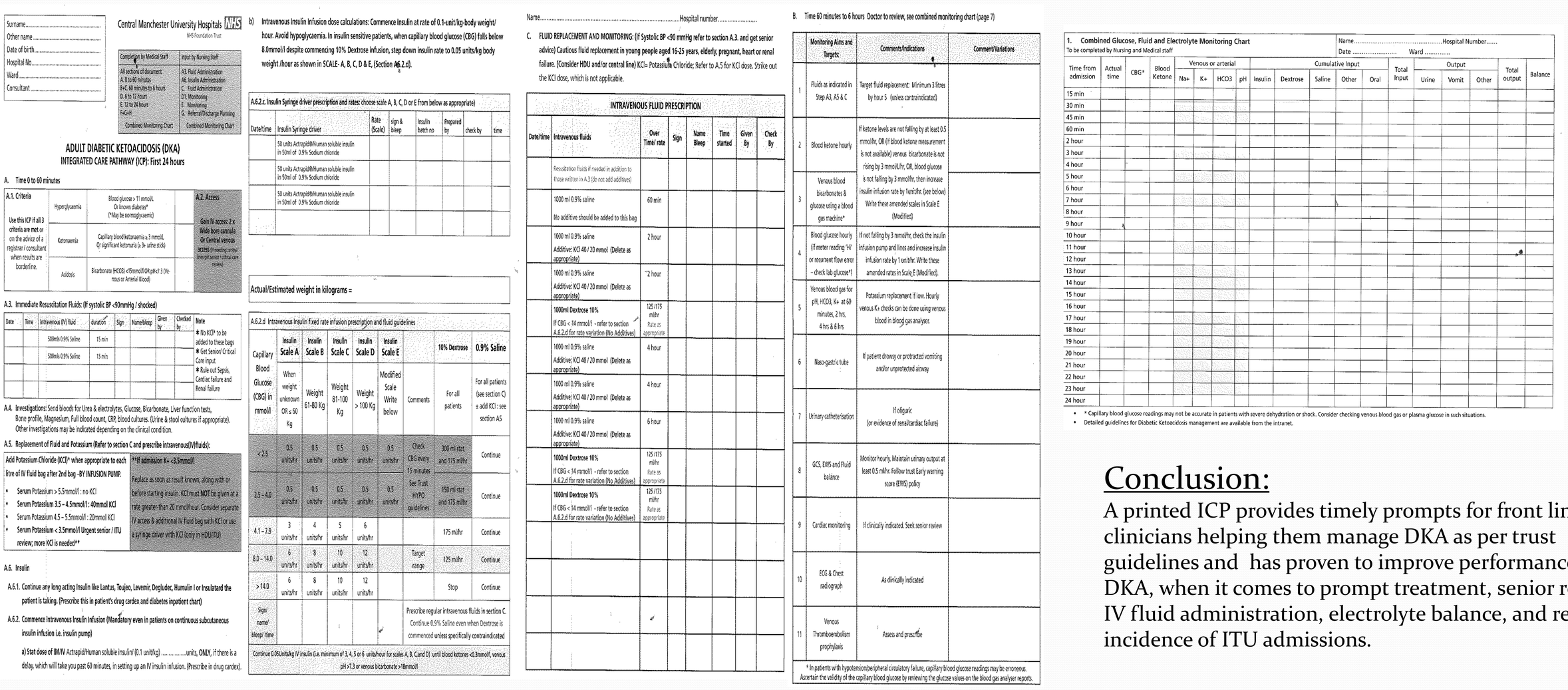
-Blood glucose monitoring within 30 minutes and hourly in first 24 hours
-IV insulin and fluids, within 60 minutes, and remaining, meeting guidelines
-Review within 1 hour by senior medic
-HDU or ITU admissions
-Prescribing and administering quick acting carbohydrates within 15 minutes of low blood glucose detection
-Escalation of care if blood glucose remains low after 1 hour
-Medication review

Results



Authors	N Long & M Rutter	N Movchan & P Rao Balakrishna	C Arunachalam, E Saunders, A Safran, P Rao Balakrishna	M Madkour, P Rao Balakrishna
	(2007)No Trust guidelines (n=10)	Written Trust Guidelines (Oct-2009-Jan2010) (n=15)	Written Trust guidelines (Oct2010 - Sept 2011) (n=30)	Trust ICP in place (Nov 2017- Feb 2018) (n=5)
Delay in assessment > 1 hr	20%			0%
HDU/ITU n		20%	20%	0
Hourly CBG monitoring in first 24 hrs	0%	31%	86%	100%
2 hourly CBG monitoring in first 24 hrs		69%	14%	100%
initial IV fluids -initiation time met guidelines	70%		83%	100%
all IV fluid administration met guidelines		0%	0%	100%
1st litre of iv fluids in 1st hr		100%	83%	100%
2nd litre of iv fluids in 2 hours		17%	93%	100%
3rd litre of fluid in 2 hours			65%	100%
Addition of dextrose 10% IV when CBG falls -standards met	50%	0%	90%	100%

Sample of DKA Integrated care pathway:



Surname.....
Other name.....
Date of birth.....
Hospital No.....
Ward.....
Consultant.....

Central Manchester University Hospitals NHS
NHS Foundation Trust

Completion by Medical Staff	Input by Nursing Staff
All sections of document A. 0 to 60 minutes B+C. 60 minutes to 6 hours D. 6 to 12 hours E. 12 to 24 hours F+G+H	A3. Fluid Administration A6. Insulin Administration C. Fluid Administration D1. Monitoring E. Monitoring G. Referral/Discharge Planning
Combined Monitoring Chart	Combined Monitoring Chart

ADULT DIABETIC KETOACIDOSIS (DKA)
INTEGRATED CARE PATHWAY (ICP): First 24 hours

A. Time 0 to 60 minutes

A.1. Criteria		A.2. Access
Use this ICP if all 3 criteria are met or on the advice of a registrar / consultant when results are borderline.	Hyperglycaemia: Blood glucose > 11 mmol/l. Or known diabetes* (*May be normoglycaemic) Ketonaemia: Capillary blood ketonaemia ≥ 3 mmol/l. Or significant ketonuria (≥ 3+ urine stick) Acidosis: Bicarbonate (HCO3) <15mmol/l OR pH<7.3 (Venous or Arterial Blood)	Gain IV access: 2 x Wide bore cannula Or Central venous access (if needing central lines get senior / critical care review)

A.3. Immediate Resuscitation Fluids: (If systolic BP <90mmHg / shocked)

Date	Time	Intravenous (IV) fluid	duration	Sign	Name/bleep	Given by	Checked by	Note
		500ml 0.9% Saline	15 min					* No KCl* to be added to these bags * Get Senior/ Critical Care input * Rule out Sepsis, Cardiac failure and Renal failure
		500ml 0.9% Saline	15 min					

A.4. **Investigations:** Send bloods for Urea & electrolytes, Glucose, Bicarbonate, Liver function tests, Bone profile, Magnesium, Full blood count, CRP, blood cultures. (Urine & stool cultures if appropriate). Other investigations may be indicated depending on the clinical condition.

A.5. Replacement of Fluid and Potassium (Refer to section C and prescribe intravenous(IV)fluids):

Add Potassium Chloride (KCl)* when appropriate to each litre of IV fluid bag after 2nd bag –BY INFUSION PUMP. • Serum Potassium > 5.5mmol/l : no KCl • Serum Potassium 3.5 – 4.5mmol/l : 40mmol KCl • Serum Potassium 4.5 – 5.5mmol/l : 20mmol KCl • Serum Potassium < 2.5mmol/l Urgent senior / ITU review; more KCl is needed**	**If admission K+ <3.5mmol/l Replace as soon as result known, along with or before starting insulin. KCl must NOT be given at a rate greater than 20 mmol/hour. Consider separate IV access & additional IV fluid bag with KCl or use a syringe driver with KCl (only in HDU/ITU)

A.6. Insulin

A.6.1. Continue any long acting Insulin like Lantus, Toujeo, Levemir, Degludec, Humulin I or Insulatard the patient is taking. (Prescribe this in patient's drug cardex and diabetes inpatient chart)

A.6.2. Commence Intravenous Insulin Infusion (Mandatory even in patients on continuous subcutaneous insulin infusion i.e. insulin pump)

a) Stat dose of IM/IV Actrapid/Human soluble insulin/ (0.1 unit/Kg) .....units, ONLY, if there is a delay, which will take you past 60 minutes, in setting up an IV insulin infusion. (Prescribe in drug cardex).

b) Intravenous Insulin Infusion dose calculations: Commence Insulin at rate of 0.1-unit/kg-body weight/ hour. Avoid hypoglycaemia. In insulin sensitive patients, when capillary blood glucose (CBG) falls below 8.0mmol/l despite commencing 10% Dextrose infusion, step down insulin rate to 0.05 units/kg body weight /hour as shown in SCALE- A, B, C, D & E, (Section A6.2.c).

A.6.2.c. Insulin Syringe driver prescription and rates: choose scale A, B, C, D or E from below as appropriate)

Date/time	Insulin Syringe driver	Rate (Scale)	sign & bleep	Insulin batch no	Prepared by	check by	time
	50 units Actrapid®/Human soluble insulin in 50ml of 0.9% Sodium chloride						
	50 units Actrapid®/Human soluble insulin in 50ml of 0.9% Sodium chloride						
	50 units Actrapid®/Human soluble insulin in 50ml of 0.9% Sodium chloride						

Actual/Estimated weight in kilograms =

A.6.2.d Intravenous Insulin fixed rate infusion prescription and fluid guidelines

Capillary Blood Glucose (CBG) in mmol/l	Insulin Scale A: When weight unknown OR ≤ 60 Kg	Insulin Scale B: Weight 61-80 Kg	Insulin Scale C: Weight 81-100 Kg	Insulin Scale D: Weight > 100 Kg	Insulin Scale E: Modified Scale Write below	Comments	10% Dextrose	0.9% Saline
< 2.5	0.5 units/hr	0.5 units/hr	0.5 units/hr	0.5 units/hr	0.5 units/hr	Check CBG every 15 minutes See Trust HYPO guidelines	300 ml stat and 175 ml/hr	Continue
2.5 – 4.0	0.5 units/hr	0.5 units/hr	0.5 units/hr	0.5 units/hr	0.5 units/hr		150 ml stat and 175 ml/hr	Continue
4.1 – 7.9	3 units/hr	4 units/hr	5 units/hr	6 units/hr			175 ml/hr	Continue
8.0 – 14.0	6 units/hr	8 units/hr	10 units/hr	12 units/hr		Target range	125 ml/hr	Continue
> 14.0	6 units/hr	8 units/hr	10 units/hr	12 units/hr			Stop	Continue
Sign/ name/ bleep/ time						Prescribe regular intravenous fluids in section C. Continue 0.9% Saline even when Dextrose is commenced unless specifically contraindicated		

Continue 0.05Units/kg IV insulin (i.e. minimum of 3, 4, 5 or 6 units/hour for scales A, B, C and D) until blood ketones <0.3mmol/l, venous pH >7.3 or venous bicarbonate >18mmol/l

Name.....Hospital number.....

C. FLUID REPLACEMENT AND MONITORING: (If Systolic BP <90 mmHg refer to section A.3. and get senior advice) Cautious fluid replacement in young people aged 16-25 years, elderly, pregnant, heart or renal failure. (Consider HDU and/or central line) KCl= Potassium Chloride; Refer to A.5 for KCl dose. Strike out the KCl dose, which is not applicable.

INTRAVENOUS FLUID PRESCRIPTION

Date/time	Intravenous fluids	Over Time/ rate	Sign	Name Bleep	Time started	Given By	Check By
	Resuscitation fluids if needed in addition to those written in A.3 (do not add additives)						
	1000 ml 0.9% saline No additive should be added to this bag	60 min					
	1000 ml 0.9% saline Additive: KCl 40 / 20 mmol (Delete as appropriate)	2 hour					
	1000 ml 0.9% saline Additive: KCl 40 / 20 mmol (Delete as appropriate)	2 hour					
	1000ml Dextrose 10% If CBG < 14 mmol/l - refer to section A.6.2.d for rate variation (No Additives)	125 /175 ml/hr Rate as appropriate					
	1000 ml 0.9% saline Additive: KCl 40 / 20 mmol (Delete as appropriate)	4 hour					
	1000 ml 0.9% saline Additive: KCl 40 / 20 mmol (Delete as appropriate)	4 hour					
	1000 ml 0.9% saline Additive: KCl 40 / 20 mmol (Delete as appropriate)	6 hour					
	1000ml Dextrose 10% If CBG < 14 mmol/l - refer to section A.6.2.d for rate variation (No Additives)	125 /175 ml/hr Rate as appropriate					
	1000ml Dextrose 10% If CBG < 14 mmol/l - refer to section A.6.2.d for rate variation (No Additives)	125 /175 ml/hr Rate as appropriate					

B. Time 60 minutes to 6 hours Doctor to review, see combined monitoring chart (page 7)

	Monitoring Aims and Targets:	Comments/Indications	Comment/Variations
1	Fluids as indicated in Step A3, A5 & C	Target fluid replacement: Minimum 3 litres by hour 5 (unless contraindicated)	
2	Blood ketone hourly	If ketone levels are not falling by at least 0.5 mmol/hr, OR if blood ketone measurement is not available) venous bicarbonate is not rising by 3 mmol/Lhr, OR, blood glucose is not falling by 3 mmol/hr, then increase insulin infusion rate by 1unit/hr. (see below) Write these amended scales in Scale E (Modified)	
3	Venous blood bicarbonates & glucose using a blood gas machine*		
4	Blood glucose hourly (If meter reading 'Hi' or recurrent flow error – check lab glucose*)	If not falling by 3 mmol/hr, check the insulin infusion pump and lines and increase insulin infusion rate by 1 unit/hr. Write these amended rates in Scale E (Modified).	
5	Venous blood gas for pH, HCO3, K+ at 60 minutes, 2 hrs, 4 hrs & 6 hrs	Potassium replacement if low. Hourly venous K+ checks can be done using venous blood in blood gas analyser.	
6	Naso-gastric tube	If patient drowsy or protracted vomiting and/or unprotected airway	
7	Urinary catheterisation	If oliguric (or evidence of renal/cardiac failure)	
8	GCS, EWS and Fluid balance	Monitor hourly. Maintain urinary output at least 0.5 ml/hr. Follow trust Early warning score (EWS) policy	
9	Cardiac monitoring	If clinically indicated. Seek senior review	
10	ECG & Chest radiograph	As clinically indicated	
11	Venous Thromboembolism prophylaxis	Assess and prescribe	

* In patients with hypotension/peripheral circulatory failure, capillary blood glucose readings may be erroneous. Ascertain the validity of the capillary blood glucose by reviewing the glucose values on the blood gas analyser reports.

1. **Combined Glucose, Fluid and Electrolyte Monitoring Chart**
To be completed by Nursing and Medical staff

Name.....Hospital Number.....
Date .....Ward .....

Time from admission	Actual time	CBG*	Blood Ketone	Venous or arterial Na+	K+	HCO3	pH	Cumulative Input: Insulin	Dextrose	Saline	Other	Oral	Total Input	Output: Urine	Vomit	Other	Total output	Balance
15 min																		
30 min																		
45 min																		
60 min																		
2 hour																		
3 hour																		
4 hour																		
5 hour																		
6 hour																		
7 hour																		
8 hour																		
9 hour																		
10 hour																		
11 hour																		
12 hour																		
13 hour																		
14 hour																		
15 hour																		
16 hour																		
17 hour																		
18 hour																		
19 hour																		
20 hour																		
21 hour																		
22 hour																		
23 hour																		
24 hour																		

- * Capillary blood glucose readings may not be accurate in patients with severe dehydration or shock. Consider checking venous blood gas or plasma glucose in such situations.
- Detailed guidelines for Diabetic Ketoacidosis management are available from the intranet.

Conclusion:

A printed ICP provides timely prompts for front line clinicians helping them manage DKA as per trust guidelines and has proven to improve performance in DKA, when it comes to prompt treatment, senior reviews, IV fluid administration, electrolyte balance, and reducing incidence of ITU admissions.

BES2018 82--P

Clinical practice, governance and case reports

Mohamed Madkour

Poster presented at: SfE BES 2018 19-21 November GLASGOW

PosterSessionOnline.com