

NAVIGATING DKA TREATMENT

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DISCLOSURE

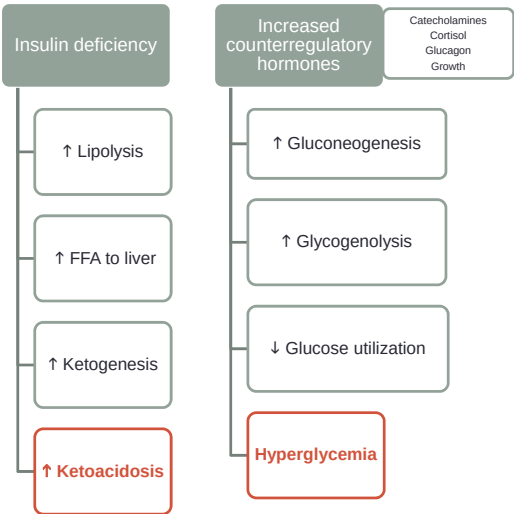
- No disclosures

OBJECTIVES

- State the 4 goals of DKA treatment



What is DKA?



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DKA Diagnostic Criteria

Lab	Mild DKA	Moderate DKA	Severe DKA
Arterial pH	<7.25—7.3	<7.0 to <7.24	<7.0
Serum Bicarb (mEq/L)	15—18	10 to <15	<10
Beta Hydroxybutyrate	Positive	Positive	Positive
Anion Gap	>10	>12	>12

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- ### DKA Causes

 - Precipitating factors leading to insulin deficiency
 - Infection
 - Omission of insulin
 - New diagnosis
 - MI, stroke, pancreatitis

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DKA Symptoms

- Patient history
 - Polyuria
 - Polydipsia
 - Weight loss
 - Vomiting
 - Blurry vision
 - Weakness
 - Abdominal pain
- Physical findings
 - Poor skin turgor
 - Kussmaul respirations
 - Fruity breath
 - Tachycardia
 - Hypotension
 - Mental status changes

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DKA treatment requires...

Urgency

Treatment needs to start immediately

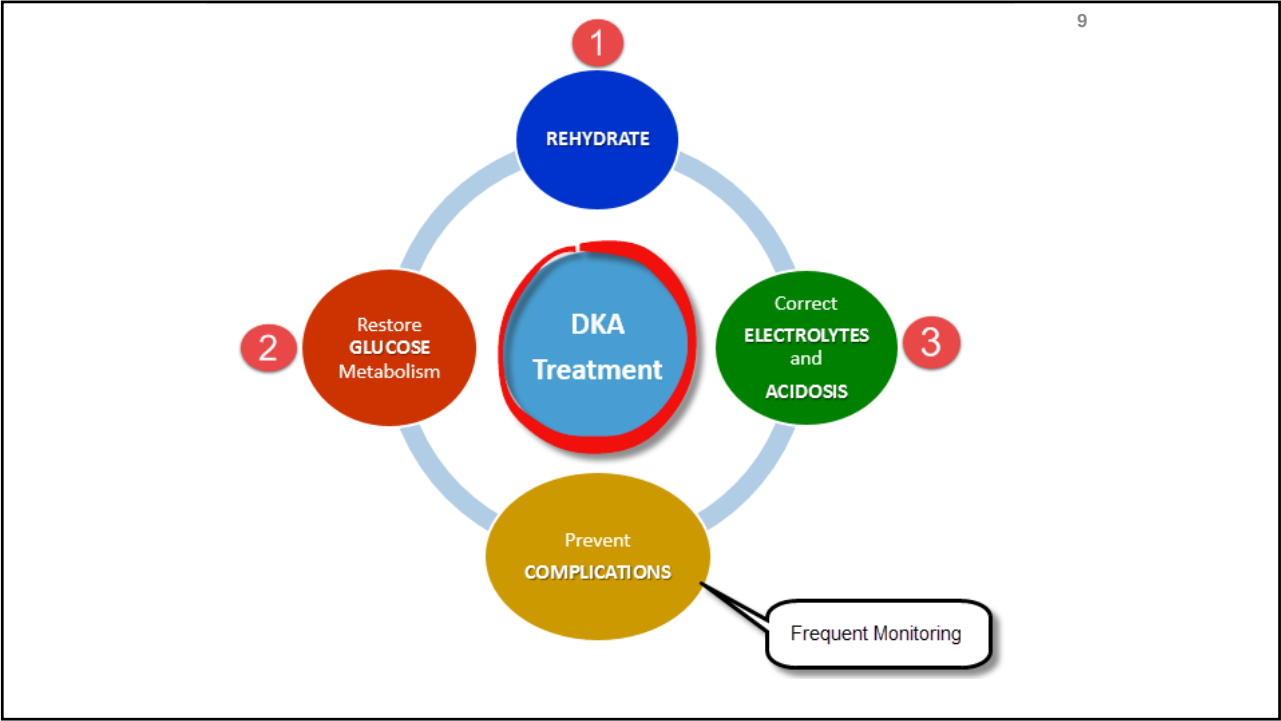


Vigilance

Frequent monitoring of labs, glucose and fluids

Follow complex set of orders





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REHYDRATE

- IV fluids to **REHYDRATE**
 - Start with 1 liter bolus NaCl 0.9% over 1 hour...
 - then 250-500 ml/hr
- Fluids variance
 - 0.45% NaCl for high Na
 - Verify rate for renal disease/dysfunction and heart failure
- When glucose 200 mg/dL (or 250 mg/dL)
 - change to D5 NaCl 0.45% 150-250 ml/hr

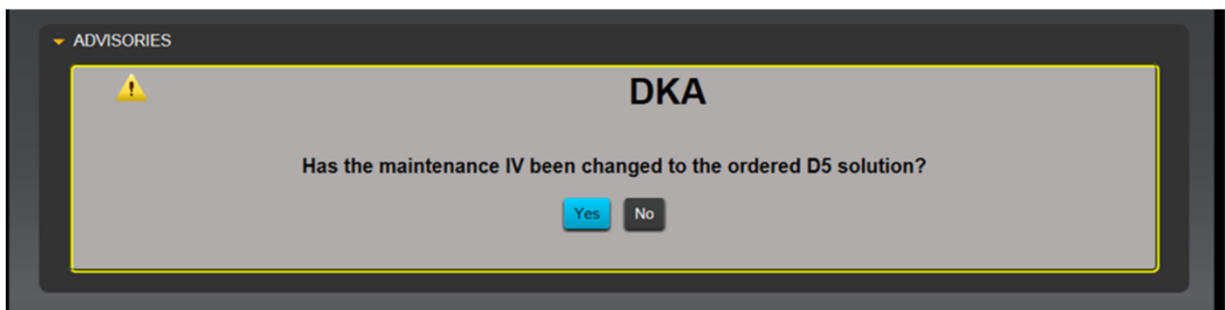
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Why dextrose containing fluids?

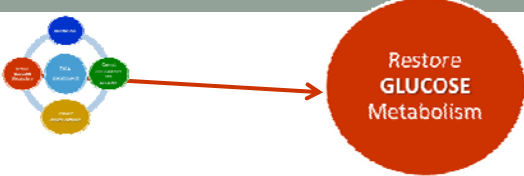
- Hyperglycemia is corrected faster than the acidosis.
- Addition of dextrose to the fluids allows continued insulin administration until the ketonemia is cleared, while preventing hypoglycemia.

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EndoTool IV Alert



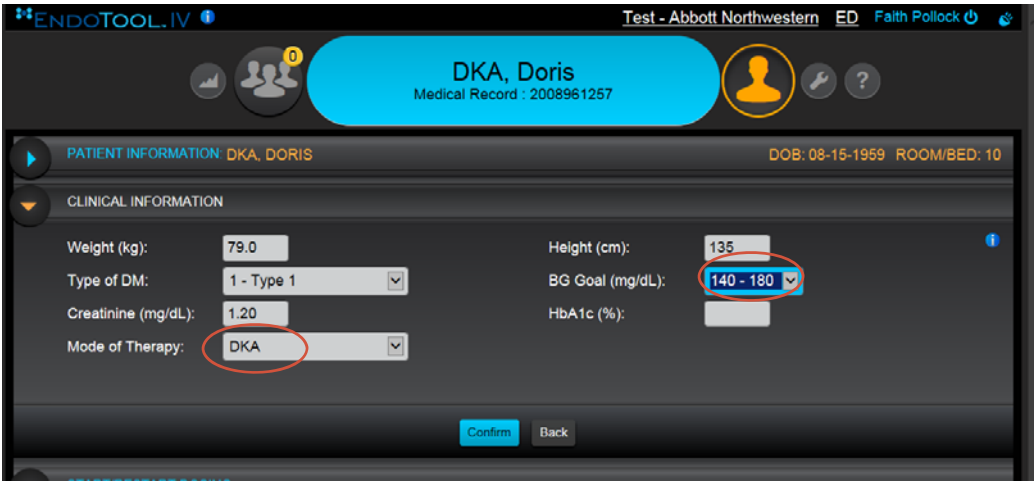
13



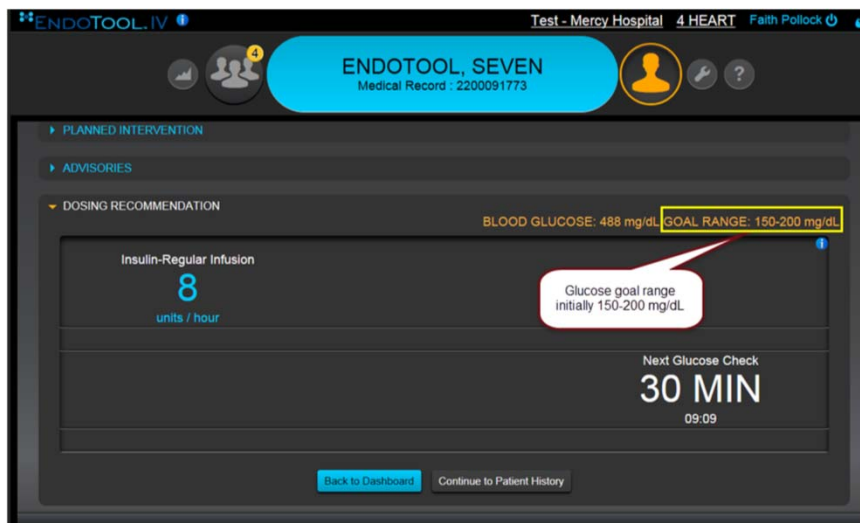
- Insulin Infusion to **restore and maintain GLUCOSE metabolism**
 - Initial glucose goal is 150-200 mg/dL until DKA resolved
 - Convert to a standard glucose goal
- Initial insulin dosing
 - IV insulin bolus: 0.1 unit/kg (no bolus for pediatrics)
 - Insulin infusion rate: 0.1 unit/kg/hr
- DO NOT START insulin infusion until confirmed that K level is greater than 3.3 mEq/L
 - To prevent life-threatening arrhythmias and respiratory weakness

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EndoTool Initiation

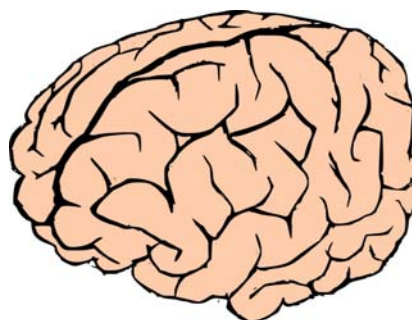


EndoTool IV-initial glucose goal



Cerebral Edema

- Rare complication in adults
 - 20-40% mortality rate
- PREVENTION
 - Avoid excessive hydration
 - Avoid rapid reduction of glucose
 - Insulin infusion adjusted by "rate of change"



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EndoTool IV-conversion to standard mode of therapy

ADVISORIES

⚠

DKA

When the anion gap <12 mEq/L, call provider for approval to transition to standard mode. Provider approved transition to standard mode?

Yes

No

ADVISORIES

⚠

The Patient's Mode of Therapy has been changed.

The patient will now be treated with the Standard goal range.

Confirm

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EndoTool IV-next glucose goal

ENDOTOOL IV

Test - Mercy Hospital 4 HEART Faith Pollock

ENDOTOOL, SEVEN

Medical Record : 2200091773

PLANNED INTERVENTION

ADVISORIES

DOSING RECOMMENDATION

BLOOD GLUCOSE: 162 mg/dL

GOAL RANGE: 140-180 mg/dL

Insulin-Regular Infusion

2.2

units / hour

Glucose goal range is now at "Standard" mode of therapy of 140-180 mg/dL

Next Glucose Check

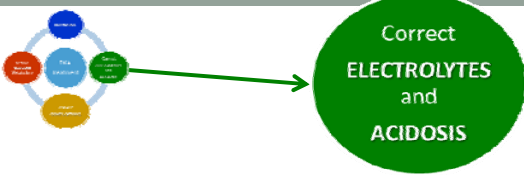
1 HOUR

09:34

Back to Dashboard

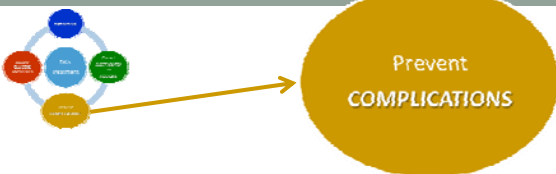
Continue to Patient History

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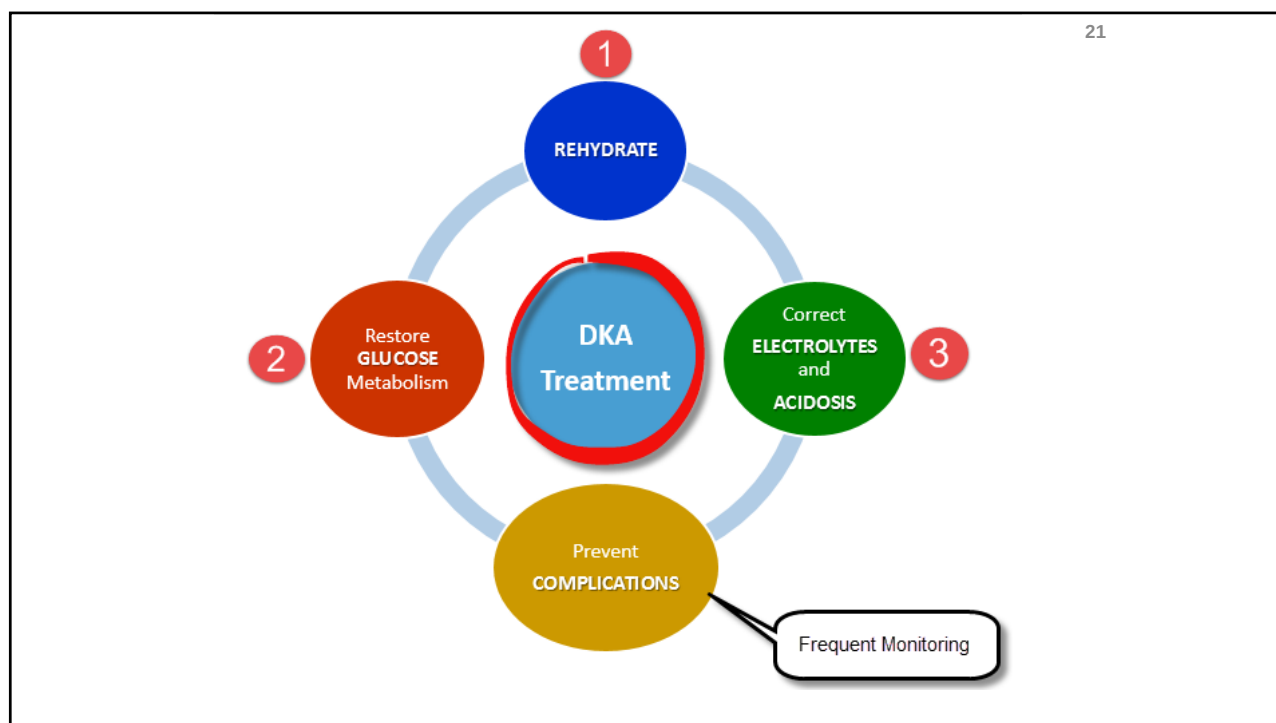


- **Potassium** replacement to **correct ELECTROLYTES**
 - K replacement is to be initiated when serum levels fall below 5.2 mEq/L to prevent hypokalemia
 - Goal K is between 4.0 and 5.0 mEq/L
 - Best to add to current IV fluids (not bolus doses)
- **Bicarbonate** replacement to **correct ACIDOSIS**
 - When pH is less than 6.9
 - to prevent impaired myocardial contractility, cerebral vasodilation and coma, and gastrointestinal complications

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- **Prevent the COMPLICATIONS** of—
 1. **hypokalemia**
 - K monitoring
 - K replacement
 2. **hypoglycemia**
 - Glucose monitoring



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Case Study-starting from ED

- **Physical Assessment**
 - Alert
 - Looking ill
 - Dry mucous membranes
- **VS**
 - Temp 98.5
 - Pulse 114 (tachy)
 - R 21
 - BP 159/79
- CXR clear
- EKG with peaked T waves, QRS intact. Elevated K.
- No clear signs of illness or infection

ISTATEC8

Status: Final result

Visible to patient: Not Released

	Ref Range	1/12/16 10:23 AM
GLUCOSE,ISTAT	65-100 mg/dL	>700 (HH)
BUN,ISTAT	8-25 mg/dL	33 (H)
SODIUM,ISTAT	135-145 mmol/L	129 (L)
POTASSIUM,ISTAT	3.5-5.0 mmol/L	8.0 (HH)
CHLORIDE,ISTAT	98-107 mmol/L	104
CO2,TOTAL,ISTAT	21-31 mmol/L	7 (LL)
ANION GAP,ISTAT	10-20 mEq/L	26 (H)
PH,VENOUS,ISTAT	7.32-7.42	7.17 (LL)
PCO2,VENOUS,ISTAT	41-51 mmHg	19 (LL)
HCO3,VENOUS,ISTAT	22-30 mmol/L	7 (LL)
BASE EXCESS	-2.5-2.5	-22.0 (LL)

1020

	Ref Range	1/12/16 10:19 AM
SODIUM	135-145 mmol/L	130 (L)
POTASSIUM	3.5-5.0 mmol/L	7.6 (HH)
CHLORIDE	98-110 mmol/L	94 (L)
CO2,TOTAL	21-31 mmol/L	6 (LL)
ANION GAP	5-18	30 (H)
GLUCOSE	65-100 mg/dL	809 (HH)
CALCIUM	8.5-10.5 mg/dL	9.7
BUN	8-25 mg/dL	28 (H)
CREATININE	0.72-1.25 mg/dL	2.13 (H)
BUN/CREAT RATIO	10-20	13
GFR if African American	>60 mL/min/1.73m2	40 (L)
GFR if not African American	>60 mL/min/1.73m2	33 (L)
BETA HYDROXYBUTYRATE	<0.6 mmol/L	5.7 (HH)

Lab	Mild DKA	Moderate DKA	Severe DKA
Arterial pH	<7.25—7.3	<7.0 to <7.24	<7.0
Serum Bicarb (mEq/L)	15—18	10 to <15	<10
Beta Hydroxybutyrate	Positive	Positive	Positive
Anion Gap	>10	>12	>12

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1. Rehydrate- time 1020

☐ NaCl 0.9% IV - Bolus	1	ONE TIME, Intravenous, Dose: 1000 mL bolus over 1 hour.
☐ NaCl 0.9% IV infusion	2	CONTINUOUS, Intravenous, Rate: 500 mL/hour for 2 hours
☐ NaCl 0.9% IV infusion	3	CONTINUOUS, Intravenous, Rate: 150 mL/hr. Begin after initial bolus and 500 mL/hr x 2 hours infusion are completed.

NaCl 0.9% 1,000 mL

Dose: 1,000 mL Freq: ONE TIME Route: IV

Start: 01/12/16 1030 End: 01/12/16 1330

Admin. Amount: 1,000 mL

Volume: 1,000 mL

Administrations Remaining: 0

Dispense Loc: ANW MATERIALS

Last Admin: 01/12/16 1130

NaCl 0.9% 1,000 mL

Dose: 1,000 mL Freq: ONE TIME - BOLUS Route: IV

Start: 01/12/16 1000 End: 01/12/16 1020

Admin. Amount: 1,000 mL

Volume: 1,000 mL

Administrations Remaining: 0

NaCl 0.9%

Rate: 150 mL/hr Freq: CONTINUOUS Route: IV

Start: 01/12/16 1500 End: 01/12/16 1412

Admin Instructions:

*Begin after initial bolus and 500 mL/hr x 2 hours infusion are completed.

*Notify provider.

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1130 (1,000 mL): Given

1230 (1,000 mL): Infusion Complete

1

1020 (1,000 mL): Given

1120 (1,000 mL): Infusion Complete

3

1247 (150 mL/hr): New Bag

1500 Canceled Entry

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2. Glucose- time 1109

Sample Time Time Entered	Flags	Glucose mg/dL	Calculated / Confirmed					Unconf / Conf Meal	EREI	Goal Range mg/dL	Next Check Due Frequency	Mins Late Sample Mins Late Entered
			Drip	Bolus	Dextrose	Carbs	SubQ					
01-12-2016 11:09	¥	500	10.5	9						150 - 200	01-12-2016 11:39	0
01-12-2016 11:09			10.5	9							30	0
01-12-2016 11:37	¥	457	10							150 - 200	01-12-2016 12:08	-2
01-12-2016 11:38			10								30	-1
01-12-2016 12:15	¥	500	16	21						150 - 200	01-12-2016 12:46	7
01-12-2016 12:16			16	21							30	8
01-12-2016 13:01	¥	500	22	18						150 - 200	01-12-2016 13:32	15
01-12-2016 13:02			22	18							30	16
01-12-2016 13:37	¥	388	11.5						1.81	150 - 200	01-12-2016 14:38	5
01-12-2016 13:38			11.5								60	6
01-12-2016 14:41	¥	347	13							150 - 200	01-12-2016 15:44	3
01-12-2016 14:44			13								60	6

No delay in glucose check

Transferred to ICU

Transfer 1330

Was the K level ok to start the insulin infusion?

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3. Electrolytes and Acidosis

This replacement is recommended until this order set is discontinued.

1) Serum K > /= 5.3: No replacement. Make sure no potassium is in IV Fluids and no supplemental potassium is being given. Recheck potassium in 2 hours.

2) Serum K 4.5 - 5.2: 20 mEq of KCl/Liter should be in IV Fluids.

3) Serum K 3.5 - 4.4: 40 mEq of KCl/Liter should be in IV Fluids.

4) Serum K <3.5: Continue with 40 of KCl/Liter and initiate site specific potassium replacement protocol (if applicable) via 2nd line.

Goal K is between 4.0 and 5.0 mEq/L

Initial labs at 1020

PH, VENOUS, ISTAT	7.32-7.42	7.17 (LL)
SODIUM	135-145 mmol/L	130 (L)
POTASSIUM	3.5-5.0 mmol/L	7.6 (HH)
CHLORIDE	98-110 mmol/L	94 (L)
CO2, TOTAL	21-31 mmol/L	6 (LL)
ANION GAP	5-18	30 (H)

Then at 1236

No K needed

SODIUM	Ref Range 135-145 mmol/L	1/12/16 12:36 PM 135
POTASSIUM	3.5-5.0 mmol/L	5.3 (H)
CHLORIDE	98-110 mmol/L	102
CO2, TOTAL	21-31 mmol/L	7 (LL)
ANION GAP	5-18	26 (H)

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3. Electrolytes and Acidosis

Initial labs at 1020

PH, VENOUS, ISTAT	7.32-7.42	7.47 (LL)
SODIUM	135-145 mmol/L	130 (L)
POTASSIUM	3.5-5.0 mmol/L	7.6 (HH)
CHLORIDE	98-110 mmol/L	94 (L)
CO2, TOTAL	21-31 mmol/L	6 (LL)
ANION GAP	5-18	30 (H)

Bicarb given due to high K per notes, not because of pH

sodium bicarbonate injection 50 mEq
Dose: 50 mEq Freq: EACH TIME PRN Route: IV
PRN Reason: pH < (Specify)
PRN Comment: 6.9
Start: 01/12/16 1028 End: 01/15/16 2229
[Admin Instructions](#)
Recheck arterial blood gas in 15 minutes. Call physician if pH remains less than 6.9.
For treatment of DKA.

1123 (50 mEq): Given [C]

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Handoff from ED

1. Fluids

- What fluid
- What rate

2. Glucose

- Last glucose
- Current rate/bolus per EndoTool
- Next glucose due time

3. Labs

- Last results
- Next set due time

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Sample Time Time Entered	Flags	Glucose mg/dL	Drip	Calcu Bolus
01-12-2016 11:09	¥	500	10.5	9
01-12-2016 11:09			10.5	9
01-12-2016 11:37	¥	457	10	
01-12-2016 11:38			10	
01-12-2016 12:15	¥	500	16	21
01-12-2016 12:16			16	21
01-12-2016 13:01	¥	500	22	18
01-12-2016 13:02			22	18
01-12-2016 13:37	¥	388	11.5	
01-12-2016 13:38			11.5	
01-12-2016 14:41	¥	347	13	
01-12-2016 14:44			13	
01-12-2016 15:46	¥	258	9.5	
01-12-2016 15:46			9.5	
01-12-2016 17:01	¥	187	4.6	
01-12-2016 17:03			4.6	
01-12-2016 17:57	¥	128	1.3	
01-12-2016 17:58			1.3	

Change to
dextrose IV

ICU DKA

Labs at 1640

	Ref Range	1/12/16 4:20 PM
SODIUM	135-145 mmol/L	142
POTASSIUM	3.5-5.0 mmol/L	4.4
CHLORIDE	98-110 mmol/L	111 (H)
CO2,TOTAL	21-31 mmol/L	14 (L)
ANION GAP	5-18	17

3) Serum K 3.5 - 4.4: 40 mEq of ~~KCl~~ Liter should be in IV Fluids.

D5 in NaCl 0.45% infusion
Dose: 125 mL/hr Freq: CONDITIONAL Route: IV
Start: 01/12/16 1157 End: 01/13/16 0751
Admin Instructions:
Start after first BG is less than 250 mg/dL.
Nurse to modify this order to indicate frequency of CONTINUOUS when order is started.
Volume: 1,000 mL
Dispense Loc: ANW MATERIALS
Last Admin: 01/13/16 0137

1707 (125 mL/hr):
Given

No K in IV

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Sample Time Time Entered	Flags	Glucose mg/dL	Drip
01-12-2016 18:59	¥	117	1.2
01-12-2016 18:59			1.2
01-12-2016 20:01	¥	141	1.8
01-12-2016 20:01			1.8
01-12-2016 21:13		153	2.2
01-12-2016 21:16			2.2
01-12-2016 23:26		121	0.8
01-12-2016 23:26			0.8
01-13-2016 01:15		151	1.8
01-13-2016 01:17	stable		1.8
01-13-2016 03:15		191	3.2
01-13-2016 03:15	stable		3.2
01-13-2016 04:10		154	1.7
01-13-2016 04:10	stable		1.7
01-13-2016 05:08		174	2.6
01-13-2016 05:08	stable		2.6
01-13-2016 06:16		182	3
01-13-2016 06:17	stable		3

Off DKA
Mode

ICU DKA

Labs at 2010

	Ref Range	1/12/16 8:10 PM
SODIUM	135-145 mmol/L	143
POTASSIUM	3.5-5.0 mmol/L	4.6
CHLORIDE	98-110 mmol/L	113 (H)
CO2,TOTAL	21-31 mmol/L	17 (L)
ANION GAP	5-18	13

Post DKA Treatment

- Transition to SQ insulin
 - When tolerating nutritional insulin
 - Give SQ BASAL insulin 2 hours before insulin infusion discontinued!
- Diabetes Education
 - If newly diagnosed
 - Review what may have caused DKA
 - Omission of insulin doses
 - fear of hypoglycemia
 - limited finances
 - when ill
 - stress of chronic illness
 - rebellion
 - Insulin pump troubleshooting

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REFERENCES

- Kitabchi, A. E. et. al. (2009). Hyperglycemic crises in adult patients with diabetes. *Diabetes Care*, July 2009, vol. 32, no. 7: 1335-1343.
- Pollock, F. P., Funk, D. C. (2013). Acute diabetes management: Adult patients with hyperglycemic crises and hypoglycemia. *AACN*, vol. 24, no. 3: 314-324.

TO CONTACT ME

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