



DKA Definition

Glucose > 200 mg/dL **AND**

Moderate to Large Ketonuria (or B-OHB > 3 mmol/L) **AND**
Venous pH < 7.3, Arterial pH < 7.35 or serum tCO₂ or venous HCO₃ < 15 mEq/L

Therapy:

1. NS BOLUS PRN upon arrival to ED

NS 10 mL/kg IV x 1, may repeat with caution.

Goal is to ensure adequate perfusion, not euolemia.

2. FLUID MANAGEMENT 2-BAG METHOD

*Defer initiating 2-bag method if serum K ≥ 5 mmol/L, consider NS or D5NS if glucose ≤ 300 mg/dL

Rate:

1.5 - 2x maintenance (MAX rate usually 2x)

Initial IVF for at least 4 - 6 hours.

Corrected Na⁺ should remain normal or move towards normal. If decreases by > 1 mEq/L/hr or corrected serum sodium is <135 mEq/L, evaluate for evolving cerebral edema & follow neuro exam closely.

IV Fluid Therapy with the 2-bag method:

Bag #1: NS with Potassium Acetate 20 mEq/L and Potassium Phosphate 20 mEq/L

Bag #2: D12.5W 1/2NS with Potassium Acetate 20 mEq/L and Potassium Phosphate 20 mEq/L

Determining the Infusion Rate:

Infusion rates of both bags are determined using the [DKA 2-Bag Infusion Rate Calculator]

*may be found in the hyperlink in all DKA Powerplans, BCH formulary, on eLibrary or Powerchart link

Prescriber should order the fluids once, then modify infusion rates throughout the course; *do not cancel/reorder for each rate change.*

Goal Dextrose Content (used in the calculator)

Goal Dextrose Concentration	
Blood Glucose (mg/dL)	Goal Dextrose
>300	0%
276 – 300	5%
251 – 275	7.5%
201 – 250	10%
≤ 200	12.5%

Potassium Content: (after voiding)

Goal K⁺ = 3.5 – 4.5 mmol/L

Serum K ⁺ (mmol/L)	K ⁺ in IVF (mEq/L)
< 5	40
≥ 5	0
* May add K up to 80 mEq/L if needed for significant hypokalemia but patient cannot remain on the 2-bag method	

3. INSULIN

Do Not give insulin bolus

Insulin infusion: After 1 hr of NS administration, initiate regular insulin infusion (1 unit/mL in NS) at 0.1 unit/kg/hr*

* **For mild DKA** (venous pH 7.2 - 7.29; serum tCO₂ or venous HCO₃ 10 - 15 mEq/L) may use 0.05 unit/kg/hr

Target Blood Glucose: 150 – 250 mg/dL

Most patients require increasing dextrose & potassium concentrations as the anion gap normalizes.

If BG remains < 200 mg/dL, K⁺ remains < 3 mEq/L (despite goal dextrose concentration of 12.5% and infusion rate at 2x maintenance), and anion gap is near to normal, reduce insulin infusion to 0.075 unit/kg/hr, then to 0.05 unit/kg/hr. Discuss with endocrine prior to adjusting.

Subcutaneous Insulin: start when:

- Patient can eat & drink
- At mealtime
- vpH > 7.3, tCO₂/vHCO₃ > 15 mEq/L and/or anion gap 14
- Give first subcutaneous rapid and long-acting insulin 15 min pre-meal, stop IVF & insulin drip 30 min after subQ dose (May need to continue IVF if patient refuses to eat)

Subcutaneous Insulin Regimen:

Total Daily Dose (TDD) (unit/kg/day):

	No DKA	DKA
Age < 6y or A1c < 7%	0.15 - 0.25	0.5 - 0.75
Prepubertal	0.25 - 0.5	0.75 - 1
Pubertal	0.5 - 0.75	1 - 1.2
Postpubertal	0.25 - 0.5	0.75 - 1

A. Basal - bolus regimen (recommended initial regimen):

~50% of TDD as long acting insulin (Lantus) once daily
~50% of TDD as rapid acting insulin (Humalog) divided in meals

B. Split - mixed insulin regimen:

2/3 TDD QAM (1/3 Humalog + 2/3 NPH)

1/3 TDD QPM (1/3 Humalog Qdinner & 2/3 NPH bedtime)

Sliding Scale:

Humalog	BG 250 - 400	BG > 400
None – Small Ketones	5-10% TDD	10-15% TDD
Mod – Large Ketones	10-15% TDD	15-20% TDD

IV FLUID LIMITS

Fluid	PIV Max	CVL Max
Potassium	80 mEq/L	200 mEq/L
Dextrose	12.5%	50%

Maximum Phosphorous infusion rate: 0.12 mEq/kg/hr

Maximum Potassium infusion rate: (see administration of supplemental potassium policy)

All patients: ≤0.25 mEq/kg/hr (max 7.5 mEq/hr)

>0.25mEq/kg/hr (must have continuous ECG monitoring)
ICU/ICP/ED/HemeOnc/HSCT: >0.5 mEq/kg/hr (max 15mEq/hr)

COMPLICATIONS

All patients are dehydrated & depleted of Na^+ , K^+ , Cl^- , PO_4^- , Mg^{2+}

1. Cerebral Edema:

Peak Incidence during first 8-12 hours after initiation of therapy, but can occur as late as 24 hours

Treat Empirically:

- Decrease IV rate, raise HOB @ 30°
- Mannitol 1 g/kg IV over 15 min, follow UOP and VS (BP, HR) for subsequent diuresis. *If no response within 20 – 30 min, repeat mannitol, or consider 3% Hypertonic Saline 5 mL/kg over 15 min*
- Consider ETT placement for airway control & hyperventilate to pCO_2 pt had prior to intubation – slowly normalize over 12-24 hrs
- Consider STAT head CT once airway is stabilized

Symptoms (in increasing order of importance & severity):

Headache, emesis, increased BP (dBP > 90mmHg), change in level of consciousness/responsiveness, delirium or confusion, unequal or dilated pupils, cranial nerve palsy, papilledema, age-inappropriate incontinence, bradycardia (sustained drop of 20bpm from baseline), respiratory irregularity or arrest, sudden onset of polyuria (from DI secondary to pituitary necrosis)

2. Hypophosphatemia:

Symptoms usually occur when Phos < 1 mg/dL

- $\downarrow \text{ATP} \rightarrow \downarrow$ cardiac output (CHF) or possible cardiac arrest (< 0.5 mg/dL)
- Decreased Hgb affinity for O_2
- Metabolic encephalopathy (irritability, paresthesias, then confusion, seizure, coma)
- Ileus & dysphagia
- Proximal myopathy
- Hemolysis (if Phos < 0.5 mg/dL)

3. Hyponatremia:

Always use measured sodium. The brain is exposed to the measured sodium (not corrected sodium).

Na^+ 115 - 120 mEq/L: seizure, coma, respiratory arrest

Na^+ 120 - 125 mEq/L: HA, lethargy, obtundation

Na^+ 125 - 130 mEq/L: nausea & malaise

Symptomatic Hyponatremia: infuse 3% Hypertonic Saline 5 mL/kg IV over 15 min. Stop infusion when symptoms resolve.

4. Hypoglycemia

Most patients will eventually require $\text{D}_{12.5}\text{W}$ with sodium and potassium @ 2x maintenance. If BG's still < 200 and anion gap is near to normal, reduce insulin infusion to 0.075 unit/kg/hr, then to 0.05 unit/kg/hr. Discuss with endocrine prior to decreasing.

5. Hypokalemia:

Hypokalemia always occurs even with normal serum potassium due to extracellular shift.

Symptomatic Hypokalemia: 0.5 – 1 mEq/kg IV K^+ intermittent dose over 2 hr

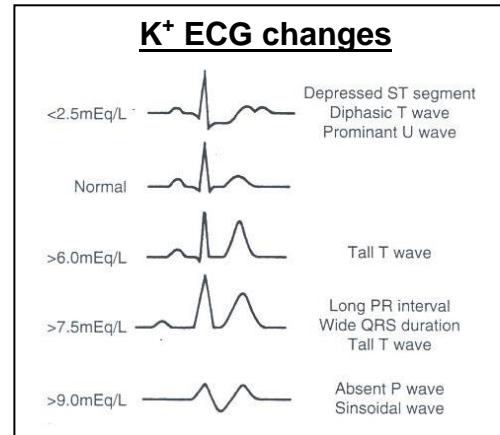
Goal K^+ = 3.5 - 4.5 mEq/L

ECG Changes: usually when K^+ < 3 mEq/L

U Waves (best seen in V4 - V6)

Flat T Waves (best seen in II & V2)

Long QTc (< 6mo: >0.44sec; Child: >0.43sec; Adult: >0.424sec)



6. Hypocalcemia:

May result with excess phosphate administration.

Clinical Presentation: \downarrow BP, tetany, laryngospasm

Important Values

K^+ :

K^+ < 2 mEq/L: significant weakness

K^+ < 3 mEq/L: see "Hypokalemic ECG changes" above.

K^+ 3.5 - 4.5 mEq/L: goal values

K^+ 5.5 - 6.5 mEq/L: peaked T waves

K^+ > 7 mEq/L: wide P waves

K^+ > 8 mEq/L: absent P waves

K^+ > 9 mEq/L: A-V Block, VT, V-Fib

Na^+ :

Always use the measured Na^+ since the brain is exposed to the measured Na^+

Na^+ < 130 mEq/L: Nausea & malaise may begin

Na^+ < 120 mEq/L: Seizure, coma, resp arrest

Phos:

Phos < 1 mg/dL: symptoms possible

Phos < 0.5 mg/dL: risk of metabolic collapse

CALCULATIONS

Corrected Na^+ = Na^+ + $[(\text{Glu} - 100)/100] \times 2$

Anion Gap = Na^+ - (Cl^- + HCO_3^-) [Normal 8-12]

Osmolality = $2(\text{Na}^+ + \text{K}^+) + (\text{Glu}/18) + (\text{BUN}/2.8)$

* Effective Osmolality = $2(\text{Na}^+ + \text{K}^+) + (\text{Glu}/18)$
(more relevant in DKA as BUN crosses BB barrier)

GOALS

1. Target blood glucose 150-250 mg/dL
2. Blood glucose should fall 70-100 mg/dL/hr after the first hour
3. Corrected Na^+ should remain normal or trend towards normal
4. Anion gap closes to 14, venous pH rises > 7.3, serum tCO_2 or venous HCO_3^- rises > 15

LABS

Glucometer Q1h while on insulin infusion; then before meals, before bed, Q2am while on subcutaneous insulin

Chem 10, beta-hydroxybutyrate & VBG Q2h while on insulin infusion, then prn while on subcutaneous insulin

Consider continuous etCO_2 or transcutaneous CO_2 while on insulin infusion – it should start low and rise towards 35-45. If drops, check patency of insulin infusion.

Urine ketones initially, no need to follow repeatedly

Other: HgbA1c, consider pancreatic autoantibody panel (refer to CPG for recommendations), TFT's, c-peptide, insulin

ECG