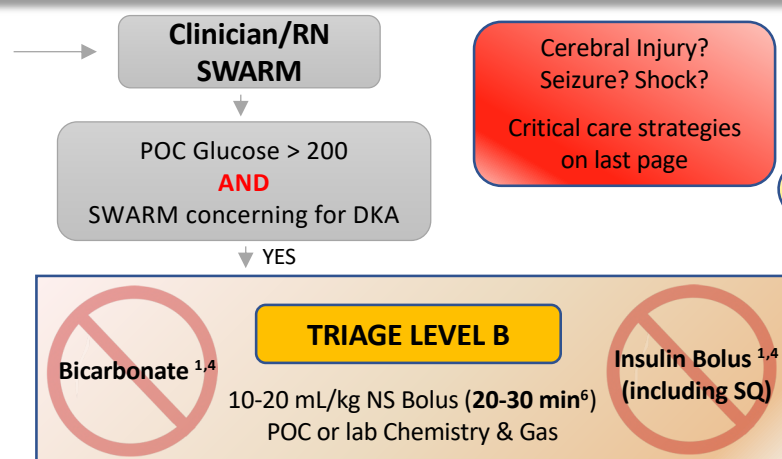


UNMH Pediatric Diabetic Ketoacidosis Pathway – Starting an Insulin Drip

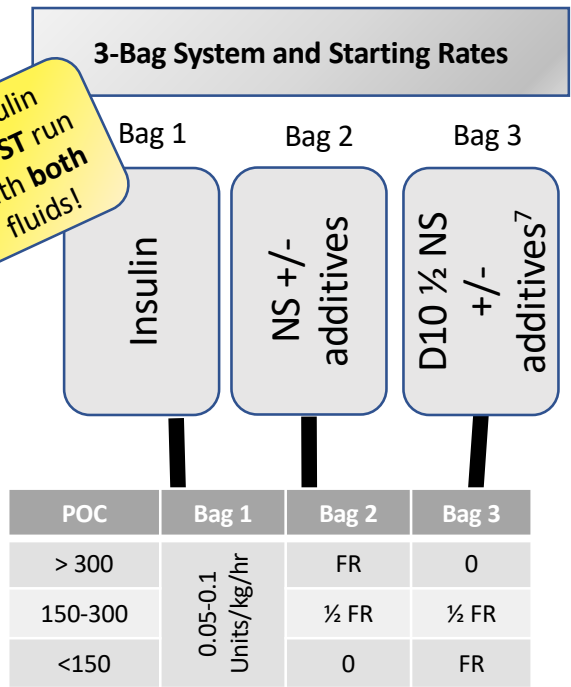
DKA Triage Screening Tool	
History	Known or SUSPECTED Type I Diabetes Mellitus
PLUS ONE OF	<ul style="list-style-type: none"> Abdominal Pain Altered Mental Status Extreme Thirst Fatigue Frequent Urination Kussmaul Breathing Respiratory Distress Vomiting¹ Weight Loss



Cerebral Injury?
Seizure? Shock?

Critical care strategies
on last page

Insulin **MUST** run with **both** fluids!



HHS Dx Criteria:
Blood Glucose > 600
pH > 7.25
Serum Osms > 320
Serum Bicarb > 15
Absent/Mild ketonemia/ketonuria

Exit Guideline
Consider Hyperglycemic Hyperosmolar State (HHS) or alternate diagnosis

NO → pH < 7.3 or CO₂ < 18
AND
Ketones in urine

Mixed DKA HHS Dx Criteria:
Blood Glucose > 600
Serum Osms > 320

Repeat POC glucose after first bolus

PICU Criteria
*based on first gas

pH < 7.1 K ⁺ < 2.5 Age < 2 years Profound shock	Altered Mental Status Dysrhythmia Intubation Cerebral Edema (See Page 5)
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Floor patients must have a bed on PSCU/6-East!

PHYSICIANS
USE DKA POWERPLAN for insulin drip, labs, and TWO bags of IV fluids!

- If initial K⁺ < 2.5, replete K⁺ before starting insulin drip
- If initial POC glucose is > 500, consider mixed HHS and DKA, and hold insulin drip until drop in glucose is < 50 x 2 hours on IV fluids alone
- If glucose drops > 100 in one hour, start IV fluids with dextrose!^{1,6}
- If on insulin pump, stop insulin pump

NURSES
Use 3-bag system (on right)

- If initial POC glucose > 500, notify MD and hold insulin drip until serum glucose is resulted
- If initial K⁺ < 2.5, notify MD and hold insulin drip
- Start insulin drip 1 hour after initiation of IV fluids
- Q15 Neuro checks for first hour on drip
- Notify MD if glucose drops > 100/hr

Fluid Rate (FR) = 1.5 x maintenance¹

If glucose drops > 100 in one hour, ↑ proportion of fluids running with dextrose!^{1,6}

ELECTROLYTE DISTURBANCES

Hyponatremia	<ul style="list-style-type: none"> If corrected sodium > 155, consider treatment for hyponatremic dehydration
Potassium abnormalities <i>Total body K⁺ and Phos deficit, initial K⁺ often falsely elevated secondary to acidosis</i>	<ul style="list-style-type: none"> If K⁺ ≥ 5.5 and/or no UOP → NO K⁺ in initial IVF until K⁺ < 5.5, <i>consider EKG</i> If K⁺ < 5.5 and +UOP → IVF with 40 meq K⁺ If K⁺ ≤ 2.5 → replete K⁺ and hold insulin drip until K⁺ > 3 prior to starting insulin drip, <i>consider EKG, admit to PICU</i>
*Low bicarbonate ⁶	Replacement is <u>not recommended</u> except for treatment of life-threatening hyperkalemia or unusually severe acidosis, <i>often refractory</i> , with evidence of compromised cardiac contractility (cardiogenic shock and/or arrhythmia)

Labs on Insulin Drip

Q1 hour POC glucose
Q4 hour Chem 10
VBG PRN after first gas

Urine Ketones Qvoid or Q2hours

UNMH Pediatric Diabetic Ketoacidosis Pathway – Maintaining and Stopping an Insulin Drip

DKA Patient on Insulin Drip

Cerebral Edema?
Seizure? Enuresis?
Critical care strategies on last page

Expected Management

- Monitor q1 hr POC glucose and adjust dextrose IVF to prevent dropping glucose > 100/hr
- Avoid and treat hypoglycemia (<70)
- Monitor q4 hr labs for electrolyte disturbances
- Monitor neurologic status for cerebral edema
- Administer basal insulin (Glargine) **0.2 Units/kg** on admission for all new onsets. For known insulin dependent diabetics, give home dose of basal insulin at home dosing time. For < 6 years old, call endocrine for dosing recommendations.
- Do NOT stop insulin drip until acidosis has resolved**
- Avoid bicarbonate

GOALS ON INSULIN DRIP:

- Normalization of electrolytes
- Maintain or regain normal neurologic status
- Timely dose of basal insulin (Glargine) ⁷
- Timely transition to Sub-Q insulin
- Reduce the risk of cerebral edema by:
 - Avoiding glucose drop > 100/hr on insulin drip
 - Avoid bicarbonate treatment*

ELECTROLYTE DISTURBANCES

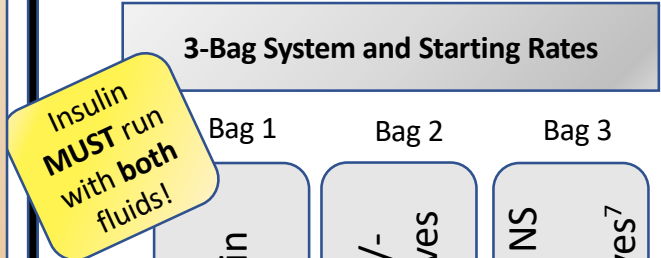
Hypoglycemia (BG <70)	<p>DO NOT STOP INSULIN DRIP UNLESS IT IS AN EMERGENCY</p> <ul style="list-style-type: none"> If NPO → bolus with dextrose (D10W 5cc/kg) and adjust IVF therapy If <u>not</u> NPO → give 15 grams of carbs (4 ounces of juice) and recheck POC blood glucose in 15 mins
Potassium abnormalities (K <2.5 or > 5.5)	<ul style="list-style-type: none"> If K+ ≥5.5 and/or no UOP → REMOVE K+ in IVF, consider EKG If K+ ≤2.5 → Notify attending, replete K+, consider EKG & decreasing insulin drip rate
*Low bicarbonate ⁶	Replacement is <u>not recommended</u> except for treatment of life-threatening hyperkalemia or unusually severe acidosis, often refractory, with evidence of compromised cardiac contractility (cardiogenic shock and/or arrhythmia)

TRANSITION TO SUBCUTANEOUS INSULIN

Contact Endocrine Prior to Transition

DKA is resolved when serum anion gap ≤ 12 **AND** serum CO2 ≥15

- Transition to SubQ insulin when acidosis resolves, *regardless* of time of day:
 - If basal insulin has been administered in the hospital in the last 24 hours, turn off the insulin drip and discontinue dextrose containing IV fluids.
 - If basal insulin has NOT been administered in the hospital in the last 24 hours, give basal insulin 1 hour before turning off the insulin drip and discontinuing dextrose containing IV fluids.
 - If on insulin pump at home, have family replace pump site or POD and resume insulin pump 1 hour prior to discontinuing insulin drip
- Once insulin drip is off, allow the patient to eat, dose meal-time insulin, and continue IVFs without dextrose until taking adequate PO



POC	Bag 1	Bag 2	Bag 3
> 300	0.05-0.1 Units/kg/hr	FR	0
150-300		½ FR	½ FR
<150		0	FR

Fluid Rate (FR) = 1.5 maintenance¹
Glucose Goals:
 Glucose ↓ 50-100/hr until 130-200
 Maintain glucose between 130-200
 Prevent hypoglycemia (<70)

Labs on Insulin Drip

- Q1 hour POC glucose
- Q4 hour Chem 10
- VBG PRN after first gas
- Urine Ketones Qvoid or Q2hours

UNMH Pediatric Diabetic Ketoacidosis Pathway – Documentation, Labs, & IVF Orders

HISTORY AND PHYSICAL

Review of Systems	Polyphagia, Polydipsia, Polyuria, Weight Loss, Anorexia, Vomiting, Fatigue, Malaise
Known Diabetic	Insulin Use, most recent dose, insulin pump Home glucose/ketone measurements
Other Teenage females	Age at dx, prior hospitalizations, previous DKA Infectious sx, Ingestions, Trauma Risk of Pregnancy, STI
Physical Exam	Airway Breathing: Tachypnea, Kussmaul breathing Circulation: Capillary refill, pulses Neuro: Pupils, CN exam, motor, GCS, Mental Status Vital Signs (including temperature)

Diabetic Ketoacidosis Severity⁶

Mild	Moderate	Severe
pH 7.21 – 7.3 OR CO ₂ 11-15	pH 7.11 – 7.2 OR CO ₂ 6-10	pH < 7.1 OR CO ₂ < 5 OR Altered Mental Status

ADDITIONAL TREATMENT

Assure good IV access but avoid central lines due to risk of thrombus
Neurologic assessments every 15 minutes for first hour or until stable

Reeval for need for 2nd bolus
Start 1.5 MIVF NS until 3-bag system ready

Start insulin infusion at least 1 hour AFTER 1st bolus started^{1,4,6}

Add glucose to fluids when blood sugar drops below 300 mg/dL or if dropping > 100/hr

0.2 U/kg Lantus now if new diabetic. Otherwise order their regular home dose at home dosing time.

Do NOT give bicarbonate OR insulin boluses^{1,4}

Add antibiotic coverage if febrile

INITIAL LAB ORDERS

All	If New Onset Diabetes
VBG (if not already done) Chem 7, Mg, Phos CBC with diff Hemoglobin-A1c Ionized Calcium (iCa) Urinalysis (UA) Q1 hour POC Glucose	Gad Ab Islet Antigen-2 Antibody Insulin Ab ZnT8 <u>When acidosis resolves</u> TSH Celiac Disease Reflex Panel Fasting Lipids
If Severe DKA add a Lactate If Febrile consider cultures + antibiotics	

IV FLUID ORDERS¹

ALWAYS ORDER a bag with AND a bag without dextrose!

K > 5.5	K < 5.5
Normal Saline AND D10 ½ NS	NS + 20 mEq/L KCl + 20 mEq/L KPhos AND D10 + ½ NS + 20 mEq/L KCl + 20 mEq/L KPhos

IF K < 2.5 or > 5.5, consider ordering an EKG

May use K Acetate instead of KCl in the setting hyperchloremia

USE THE FOLLOWING INITIAL RATE

POC Glucose	NS +/- additives	D10 ½ NS +/- additives ⁷
> 300	1.5 maintenance	Bag at bedside
150 - 300	0.75 maintenance	0.75 maintenance
< 150	Bag at bedside	1.5 maintenance

Nurses need BOTH IV fluid bags to start insulin drip
Specialized fluids take time, may start with NS at 1.5 maintenance while waiting for insulin and supplemental fluids

UNMH Pediatric Diabetic Ketoacidosis Pathway – Basal Bolus Insulin Therapy

Estimate Total Daily Dose of Insulin (TDD)

Infant (0-2 years)	0.2 units/kg/day
Early pre-puberty (3-6 years)	0.3-0.4 units/kg/day
Late pre-puberty (7-13 years)	0.5-0.7 units/kg/day
Pubertal	0.8-1.0 units/kg/day

STEP 1: Calculate total daily dose (TDD) of insulin

- TDD = weight (kg) x age factor

STEP 2: Determine basal insulin dose based on TDD

- Typical basal insulin dose is 50% of TDD every 24 hours

STEP 3: Determine meal time regimen based on TDD

- Carb Ratio
 - 500/TDD OR
 - If age \leq 5 or a severely obese adolescent, use Daily g of CHO/($\frac{1}{2}$ TDD)
 - Daily g of CHO = $[1000 + (100 \times \text{year of age})] \div 8$
- BG Correction Factor
 - 1800/TDD

Basal Bolus Calculation Example: 10 yo, 40 kg child

1. Calculate TDD = 0.7 units/kg/day x 40 kg = 28 units/day
2. Calculate basal insulin dose = TDD/2 = 14 units Lantus once a day
3. Calculate carb ratio
 - 500/TDD = 500/28 = 18
 - Or Daily g CHO/($\frac{1}{2}$ TDD) = 250/14 = 18
 - Administer 1 unit of Humalog per 18 grams of carbs with meals (ie 1 unit : 18g CHO)
4. Calculate BG correction factor
 - Correction Factor: 1800/TDD = 1800/28 = 64
 - Administer 1 unit of Humalog to decrease BG by 64 mg/dL above target (ie 1 unit : 64 mg/dL > 120 mg/dL) OR if using a sliding scale 1 unit of Humalog to decrease BG by 64 mg/dL starting at a specified threshold (ie 1 unit : 64 mg/dL starting at a BG of 150 mg/dL)

Basal Bolus Insulin Orders

Use Peds Insulin (subQ) order set

Rapid acting (bolus) Insulin: Lispro/Humalog

- If TDD is \leq 20 = order $\frac{1}{2}$ unit dosing increments

Bolus insulin for BG Correction: Insulin Lispro/Humalog (custom sliding scale)

- For sliding scale orders *thresholds may be adjusted by endocrine depending on age and TDD
 - Daytime: Start sliding scale at a BG of 150 (threshold)
 - Bedtime and 2AM: Start sliding scale at a BG of 200 (threshold)

Bolus insulin for Carb Coverage: Insulin Lispro/Humalog (nutritional dose)

- X unit: X grams carbohydrates

Long acting (basal) insulin: Lantus (Glargine)

- X units at bedtime

Blood Glucose Monitoring POC: Before meals, bedtime, 0200, and as needed for symptoms of hypoglycemia

For glucose < 80 during the day, give 4 ounces of juice (15 grams of simple carbs) and recheck BG in 15 min, repeat as needed.

For glucose < 100 at bedtime or overnight, give 4 ounces of juice (15 grams of simple carbs) and recheck BG in 15 min, repeat as needed.

Urine Ketones:

- If admitted in DKA, continue urine ketones q void until negative two consecutive times then check urine ketones as needed when BG is > 300
- If admitted not in DKA, urine ketones as needed when BG is > 300

ROUNDING RULE for $\frac{1}{2}$ Unit:

0.1-0.3 = Round down to whole unit

0.4-0.7 = Round to $\frac{1}{2}$ unit

0.8-0.9 = Round up to Whole Unit

ROUNDING RULE for Whole Unit:

0.1-0.4 = Round down to whole unit

0.5-0.9 = Round up to whole unit

Insulin Type	Brand Name	Onset
Rapid Acting	Admelog Humalog Novolog	15-30 min
Short Acting	Regular	30-60 min
Intermediate	NPH	1-4 hrs
Long Acting	Levemir Lantus Semglee Tresiba	1-2 hrs

UNMH Pediatric Diabetic Ketoacidosis Pathway – Critical Care & References

CRITICAL CARE STRATEGIES		
CEREBRAL EDEMA RISK FACTORS ³		
Risk Factors	Age < 3 years Prior Hx of DKA pH < 7.0 Na fails to correct as sugar ↓ Initial glucose > 1000 mg/dL	Bolus Insulin administration Insulin infusion within 1 hour of 1 st fluid bolus Bicarbonate administration
CEREBRAL EDEMA DIAGNOSIS ³ = 1 Major + 2 Minor or 1 Diagnostic + 2 Major		
Diagnostic	Abnl verbal/motor to pain Posturing (e.g. decorticate)	CN Palsy (usually III, IV, or VI) Cheyne-Stokes respirations
Major	Altered/fluctuating consciousness (GCS ≤ 13)	Sustained bradycardia Age-inappropriate incontinence
Minor	Vomiting Headache Age < 5 years	Does not easily wake Diastolic bp > 90 mmHg

Cerebral Edema Treatment:	
Elevate head of bed 3% NS over 30 minutes Mannitol Consider a slower initial insulin drip rate ⁴ Consider head CT AFTER initial treatment	5 mL/kg 0.5g/kg 0.05 units/kg/hr
Call PICU attending if intubation or treatment for cerebral edema is required	
Shock Treatment:	
NS or LR boluses until perfusion restored	20 mL/kg (up to 3)
Dopamine (Cold shock) Epinephrine (Cold shock) Norepinephrine (Warm shock)	3 mcg/kg/min (Max 20) 0.03 mcg/kg/min (Max 1) 0.03 mc/kg/min (Max 1)
Fever	See UNMH PED Sepsis Pathway
Possible alternate diagnoses:	
Stress response due to bacteremia, pneumonia, sepsis, metabolic disorder, or trauma	

Diabetic Ketoacidosis Criteria ⁶		
Mild	Moderate	Severe
pH 7.21 – 7.3 OR CO ₂ 11-15	pH 7.11 – 7.2 OR CO ₂ 6-10	pH < 7.1 OR CO ₂ < 5 OR Altered Mental Status

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