RUSH UNIVERSITY MEDICAL CENTER

NEW ONSET PEDIATRIC DIABETES AND KETOACIDOSIS GUIDELINES

This is not a formula or protocol; rather it is a tool for thoughtful management and re-evaluation.

- Not all children who present with new onset diabetes require all of the interventions detailed below.
- For patients who are fully hydrated and well-appearing, the initial work-up only needs to include:
  - Glucose and Bicarbonate or a glucose and pH from a Venous Blood Gas (VBG) or an Arterial Blood Gas (ABG).
  - Urine ketones
  - C-peptide (new diagnosis only)

Definition: Diabetic ketoacidosis (DKA) consists of:

- Significant acidosis (arterial and venous pH < 7.30)
- Hyperglycemia (serum glucose > 200)
- Bicarbonate ≤ 15 mEq/L and significant ketosis (moderate to large urinary ketones).

Most children with this constellation of findings will require an insulin drip and frequent monitoring as described below. Although most patients with DKA do very well, a number of children die every year from complications related to treatment. The most dreaded of these complications is cerebral edema. We believe that most complications are avoidable with meticulous attention to detail.

THE ENDOCRINOLOGIST ON CALL IS TO BE CALLED WITH ALL INITIAL LAB TEST RESULTS IN ED.

I. INITIAL EVALUATION (in the emergency department)

A. Clinical

1. Make patient NPO.
2. Mental status.
3. Degree of dehydration; check capillary refill.
4. Vital signs: pulse, temperature, respiration, blood pressure.
5. Details of prodromal symptoms.
6. Height and weight, calculate BSA –

$$\text{BSA } (m^2) = \sqrt{\frac{\text{Weight (kg) x Height (cm)}}{3600}}$$

B. Laboratory Tests

1. Initial bedside glucose by reagent strip (i.e. Accucheck, Glucometer)
2. Urine dipstick for ketones, urinalysis.
3. BMP, CBC, iCa, PO_4, pH (VBG or ABG), and serum ß-hydroxybutyrate
4. If newly diagnosed, C-peptide and insulin level.
5. Lead II EKG only if K ≤ 2.5 or ≥ 7 or complaints of chest pain.

C. Procedures

1. Two large bore IV lines (1 for infusions, 1 for blood draws)
2. Record accurate intake and output.
3. Complete history and physical.
4. Rarely: Foley if oliguric, obtunded, or unable to cooperate. (Only after ICP stabilized)
5. Rarely: Nasogastric tube for persistent vomiting or gastric dilatation.

D. Notify Endocrinologist On Call With Lab Values And Fluid Calculations (see below)

II. EMERGENCY DEPARTMENT FLUID THERAPY

A. Initial fluid bolus (Phase 1):

1. Initially give IV fluids as necessary to reverse shock.
   - A reasonable starting bolus is 10 ml/kg of normal saline over one hour
   - It is uncommon for a second bolus to be needed.
   - Consider a 20 ml/kg bolus of normal saline only if patient is in shock.

B. After initial fluid bolus (Phase 2):

1. Quantity of fluid: $\frac{3500 \times \text{body surface area } (m^2) - \text{initial fluid bolus (mL)}}{24 \text{ hours}}$ = fluid rate in mL/hr

Do not exceed 3900 mL/ m^2/day (including initial fluid bolus[es]) or 2x Maintenance IVF

2. Type of fluid: Two-bag system.

Each patient will have 2 Intravenous Bags: One will contain 10% dextrose/0.9% NaCl and the other will be 0.9 % NaCl without dextrose.

Both must have identical electrolytes: **20 mEq/L KAcetate +20 mEq/L KPhosphate.**

a. ***Sodium:*** After the initial bolus (see IIA above), continue normal saline at the rate calculated in IIB1 (see above).

b. ***Potassium:***

1. Adjust after obtaining the STAT lab results
2. When K < 5.5 **AND** patient has voided, add 40 mEq/L of K to the IV solution
3. K should be added as KAcetate 20 mEq/L + K Phosphate 20 mEq/L unless hypophosphatemic or other concern

c. ***Glucose:*** Glucose containing solutions should be added using the two-bag technique as follows(see example below):

	BAG 1	**BAG 2**	
	Given as parts of hourly fluid rate		
Plasma Glucose	**0.9%NaCl (with/without K per guidelines above)**	**D_{10} 0.9%NaCl (with/without K per guidelines above)**	**Final Dextrose Concentration**
> 250	100 %	0 %	No dextrose
200-249	50 %	50 %	Dextrose 5%
150-199	25 %	75 %	Dextrose 7.5%
100-149	0 %	100 %	Dextrose 10%
< 100 Call the Endocrinologist On Call			

Example: if the patient's accucheck is 175 and the total fluid rate is 100 mL/hr, please adjust D10 0.9 NaCl to 75 mL/hr (75% of the total fluid rate) and 0.9 NaCl to 25 mL/hr (25% of the total fluid rate) to achieve a final dextrose concentration of Dextrose 7.5 %.

3. Sodium Bicarbonate IV:

a. Only to be considered in severe acidosis with hemodynamic instability requiring pressors ***MUST HAVE APPROVAL OF ACCEPTING PICU ATTENDING PRIOR TO USE.***

4. **Mannitol 20% IV:**

a. Mannitol (0.5 - 1 gm/kg) will be available in the ED and PICU Pyxis floorstock if needed for concern for life-threatening cerebral edema. ***Call PICU attending if using mannitol. CT Head MUST be completed prior to transfer to the PICU.***

III. INSULIN THERAPY

(Order standard insulin infusion: 100 units regular insulin/100ml 0.9%NS)(conc 1 unit/ml)

A. Infusion dose: 0.1 units/kg/hour (regular insulin only). Prepared by pharmacy. Order STAT.

NO Insulin should be given by IV push or subcutaneously.

B. Insulin infusion should be begun immediately upon completion of initial fluid bolus.

C. Infuse at 0.1 units/kg/hour. Ideally, the rate of glucose decline should not exceed 100-150 mg/dl/hr. The rate may need to be adjusted downward if rate of fall exceeds 100-150 mg/dl/hr or upward if rate of fall slower than 150 mg/dl/hr. **Discuss with Endocrinologist/PICU On Call.**

D. See Table in II.B.2.c. for titration of dextrose solution. If the patient is no longer acidotic and the blood glucose drops below 150 mg/dl, may decrease insulin drip to 0.05 units/kg/hr and then titrate as needed to keep blood glucose 150-250 (consult with endocrine prior to decreasing the drip).

IV. MONITORING

A. To start in the ER and continue in the PICU.

B. Vital signs with neurological checks every two hours unless otherwise clinically indicated.

- Any deterioration in mental status or neurological exam must be considered evidence of cerebral edema.
- Consider mannitol (0.5 - 1 gm/kg) and CT scan.
- If mannitol is given, must place Foley catheter only after intracranial pressure (ICP) has been stabilized.

C. Cardio-Respiratory monitoring of all patients is MANDATORY, especially if patient is lethargic or if K $\leq$ 2.5 or $\geq$ 7.

a. Strict hourly I/Os

b. Labs

1. **Every hour:** bedside glucose by reagent (i.e. Accuchecks).
   Send serum glucose if bedside glucose ≥ 500 (HI on meter) until < 500 mg/dl.

2. **Every two hours:** VBG with VBG electrolytes

3. **Every four hours:** serum BMP, iCa, and Phos

4. **Each void:** urine dipstick for ketones or urinalysis

V. TRENDS

These guidelines are not meant to be followed without thinking. They are not a recipe and the management of DKA must be individualized to each patient. The electrolytes, mental status, and physical exam need to be followed closely so that adverse trends can be recognized early and dealt with in a prompt and timely fashion.