DOWNSTATE HEALTH SCIENCES UNIVERSITY/UNIVERSITY HOSPITAL AT DOWNSTATE
POLICY AND PROCEDURE

	No. PHARM-96A
Subject: Pediatric Diabetic Ketoacidosis (DKA) Guideline	**Page: 1 of 7**
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Reviewed by: Ramon Gist, MD	**Supersedes: (NEW)**
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Committee Approval: Pediatric Critical Care Committee Pharmacy and Therapeutics (P&T) Executive Performance Improvement Council (EPIC) Medical Executive Committee (MEC)	**TJC Standards:** **MM.01.01.01:** The hospital plans its medication management processes.
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I. PURPOSE

This guideline outlines the management of diabetic ketoacidosis (DKA) in pediatric patients based on updated recommendations from the ISPAD Clinical Practice Consensus Guidelines (2022).

The aim is to ensure effective, safe, and timely treatment of DKA and minimize complications, including miscommunication regarding fluid management.

II. POLICY

This guideline provides standardized care for pediatric patients with DKA admitted to the Pediatric Intensive Care Unit on NS 43. It addresses fluid resuscitation, insulin therapy, electrolyte management, and criteria for transitioning to subcutaneous insulin and discontinuing intravenous (IV) therapy.

Resident physicians and nurses should use this guideline to facilitate communication regarding medication orders, labs, and adjustments to IV fluid rates. Pediatric Endocrinology should be consulted prior to IV insulin discontinuation.

This document is to serve as a guideline, recognizing it may not be applicable to all patients; any changes should be discussed with the Attending Physician.

III. DEFINITION(s)

1. **Diabetic Ketoacidosis (DKA):** A life-threatening complication of diabetes characterized by hyperglycemia (> 200 mg/dL), ketonemia, metabolic acidosis (venous pH < 7.3 or bicarbonate < 18 mmol/L), and dehydration.
    a. **Note** that DKA can (rarely) present with euglycemia, e.g., in the setting of sodium-glucose co-transporter-2 (SGLT-2) exposure, e.g., dapagliflozin.

2. **Two-bag system:** A method of managing fluids by alternating between a dextrose-containing and a non-dextrose-containing solution based on glucose levels.

IV. RESPONSIBILITIES

1. Nurses:
    a. Initiate monitoring and fluid management.

    b. Perform hourly assessments of blood glucose, neurological status, and fluid input/output.

    c. Adjust fluid rates according to orders and communicate with the resident physician.

    d. Document all fluid rate changes in I/Os.

2. Prescribers:
    a. Confirm the diagnosis of DKA and assess severity.

    b. Prescribe fluids and insulin therapy.

    c. Collaborate with nursing staff on the interpretation of the two-bag system and adjust as necessary.

3. Pharmacist:
    a. Check all orders for appropriateness and safety prior to verification and dispensing.

    b. Contact the prescriber if orders require clarification or correction.

    c. Serve as a drug information resource as needed.

V. PROCEDURES/GUIDELINES

A. Admission

1. Confirm DKA diagnosis based on biochemical criteria:
    a. Plasma glucose > 200 mg/dL
    b. Venous pH < 7.3 or bicarbonate < 18 mmol/L
    c. Ketonemia
2. Admit to the Pediatric Intensive Care Unit (PICU) for continuous monitoring and management.
3. **Initial** nursing orders:
    a. Nothing by mouth (NPO)
    b. Hourly vital signs
    c. Hourly blood glucose
    d. Hourly neurological assessment for cerebral edema (symptoms may include headache, bradycardia, vomiting, restlessness, increased drowsiness, increased blood pressure, and decreased oxygen saturation)
    e. Continuous cardiopulmonary monitoring and oximetry
    f. Strict I/Os

B. Initial Volume Resuscitation

1. Shock: Administer 20 mL/kg of 0.9% sodium chloride (NS) as quickly as possible through a large bore cannula; repeat as needed for adequate perfusion.
2. No Shock: Administer 20 mL/kg NS over **20-30 minutes** and reassess perfusion and glucose levels post-infusion.
3. Begin fluid replacement before insulin therapy; start insulin **1 hour** after fluid resuscitation.

C. Fluid Management (Two-Bag System)

1. Evaluate blood gas and urine output:
    a. If no urine output or potassium > 5.5 mmol/L after initial volume resuscitation, hold potassium; administer NS and D10NS using the two-bag method described below.
    b. If potassium ≤ 5.5 mmol/L and urine output is established, initiate potassium-containing fluids as described below.

2. Use **a two-bag system** for fluid management:
    a. **Bag A:** NS with 20 mEq/L potassium acetate and 14 mmol/L potassium phosphate.

    b. **Bag B:** D10NS with 20 mEq/L potassium acetate and 14 mmol/L potassium phosphate.

3. Initiate the ***TOTAL rate*** (to be split between Bag A and Bag B) at 1.5-2x maintenance.
    a. TOTAL rate must be written in both orders in Nurse Instructions: "TOTAL rate to be SPLIT between 2 bags =_____ mL/hour"

4. The *proportion* of the *TOTAL rate* to be given via Bag A vs Bag B is based on plasma glucose:
    a. Blood glucose **< 200** mg/dL: **100%** from **Bag B**.

    b. Blood glucose **200-250** mg/dL: **75%** Bag B, **25%** Bag A.

    c. Blood glucose **250-300** mg/dL: **50%** from each bag.

    d. Blood glucose **> 300** mg/dL: **100%** from **Bag A**.

5. The RN will document all fluid rate changes in the I/Os.

D. Insulin Therapy
1. Start insulin infusion at 0.1 U/kg/hour (or 0.05 U/kg/h if pH > 7.15) 1 hour after fluid resuscitation

2. Do not decrease insulin dose while the patient remains acidotic, except:
    a. If blood glucose consistently < 100 mg/dL and already receiving 100% fluid from Bag B.
        i. Reevaluate insulin infusion rate and dextrose concentration in IV fluid with attending.

    b. In severe or very symptomatic hypoglycemia (blood glucose < 40 mg/dL), give D10% 5 mL/kg IV bolus; or, if awake and able to tolerate PO, give 120 mL of apple juice.
        i. Stop insulin drip, contact attending, and repeat blood glucose checks **every 15 minutes** until blood glucose is > 70 mg/dL.

E. Criteria and Workflow for Discontinuation of IV Insulin Infusion and Fluids
   1. Discontinue IV insulin when the patient can tolerate oral intake and acidosis has resolved (pH > 7.3, bicarbonate > 18 mmol/L).

   2. Time for the discontinuation of IV insulin to be at/near meal time. Order a diabetic tray; make sure the tray is physically present before proceeding.

   3. Consult endocrinology for insulin regimen recommendations (and also to facilitate eventual transfer to the floor).

   4. Administer subcutaneous **rapid-acting** insulin **15-30 minutes** before stopping IV insulin; administer subcutaneous **intermediate** or **long-acting** insulin **2 hours** before stopping IV insulin.

   5. Ensure the patient begins eating after subcutaneous insulin is administered.

   6. **Stop Bag B** when IV insulin is stopped; **continue Bag A** at maintenance rate for a few hours to ensure hydration.

   7. Deficit fluid correction should be continued based on individual patient requirements.

F. Monitoring
   1. Hourly capillary blood glucose. (Note: unreliable when > 500 or < 50 mg/dL, so in these cases, must obtain serum glucose level)

   2. Serum glucose every **2 hours** until < 300 mg/dL.

   3. Urine dipstick test for ketones with each urinary void.

   4. Venous blood gas every **2 hours** until pH > 7.2, then every **4 ho**urs.

   5. Electrolytes, calcium, magnesium, and phosphate every **4 hours**.

   6. Neurological assessments hourly, with attention to cerebral edema symptoms.

   7. Review all orders and revise as appropriate as a patient transitions out of DKA status.

G. Communication Between Nurses and Physicians
    1. Fluid Management: Ensure clear communication between nursing staff and resident physicians about ALL glucose levels and fluid adjustments. **Instruct nurses to verify glucose readings and fluid rates with resident physicians when changing proportions in the two-bag system.**
        a. ALL rate changes should be documented in I/Os by the RN after discussion with the resident physicians.

    2. Electronic medical record (EMR) Documentation: The EMR order rate will represent only the INITIAL rate for each bag.
        a. **All changes** in fluid management should be **verbally confirmed** between the nurse and resident to prevent misinterpretation from the EMR display.

VI. ATTACHMENTS

None

VII. REFERENCES

1. Glaser N, Fritsch M, Priyambada L, et al. ISPAD Clinical Practice Consensus Guidelines 2022: Diabetic ketoacidosis and hyperglycemic hyperosmolar state. *Pediatr Diabetes.* 2022;23(7):835-856.

2. Wolfsdorf J, Glaser N, Sperling MA. Diabetic ketoacidosis in infants, children, and adolescents: A consensus statement from the American Diabetes Association. *Diabetes Care*. 2006;29(5):1150-1159.

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DATE REVIEWED	REVISION REQUIRED (CLICK BOX)		RESPONSIBLE STAFF NAME AND TITLE
	YES	NO	
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