Clinical Practice Guideline for Management of Diabetic Ketoacidosis (DKA) in the ED/Inpatient/PICU

**NURSING PROTOCOL CIP 5-04**

IF PATIENT ARRIVES ON FLUIDS FROM OUTSIDE FACILITY OR EMS:
- DO NOT DISCONTINUE INSULIN DRIPS UNTIL PHARMACY DELIVERS INSULIN
- DOCUMENT AMOUNT OF FLUID RECEIVED

TRIAGE HISTORY CONSISTENT WITH INCLUSION CRITERIA

CONTINUE TREATMENT AS APPROPRIATE

Yes

No

RN ASSESSMENT

PATIENT AT RISK FOR CEREBRAL EDEMA, IF SIGNS EXIST OR DEVELOP, NOTIFY PHYSICIAN IMMEDIATELY

FULL SET OF VITAL SIGNS:
- HR
- RR
- BP
- PULSE OX
- TEMPERATURE

DEHYDRATION:
- MUCOUS MEMBRANES
- CAPILLARY REFILL > 3 SECOND
- SKIN TURGOR

OBTAIN

LABS:
- CG8
- BMP
- URINALYSIS
- ISTAT GLUCOSE EVERY HOUR

OTHER ORDERS:
- CARDIAC MONITORING
- IV ACCESS X 1-2
- STRICT NPO DIET
- REASSESS PATIENT Q 30-60 MINUTES

IF FEBRILE, OR SIGNS OF INFECTIOUS ILLNESS:
- CBC WITH DIFF
- BLOOD CULTURES
- URINE CULTURE

METHODOLOGY

- Notify ED Attending

SUSPECT DKA?

SUSPECT DIABETES?

Yes

No

IF EXTREME HYPERGLYCEMIA WITHOUT EXPECTED ACIDOSIS, CONSIDER HYPEROSMOLAR HYPERGLYCEMIC SYNDROME

INITIATE TREATMENT FOR DKA:
- IVF
- INSULIN
- CONTINUE MONITORING

CONSULT ENDOCRINOLOGY AND ADMITTING SERVICE FOR DISPOSITION

ADMIT TO PICU WITH ENDOCRINOLOGY CONSULT

GENERAL CARE AREA ADMIT TO ENDOCRINE SERVICE

DISCHARGE HOME ONLY WITH ENDOCRINOLOGY APPROVAL

SEE DETAILS FOR IVF AND INSULIN TREATMENT ON PAGE 2

**1 INCLUSION CRITERIA**

Suspected new onset diabetic with symptoms such as below OR known diabetic with signs/labs suggestive of DKA:

**Symptoms:**
- Polyuria
- Thirst
- Weight loss
- Vomiting
- Enuresis

**Signs/Labs:**
- Hyperglycemia (>200)
- pH < 7.3
- Dehydration
- Ketonuria
- Rapid &/or deep respirations

**2 WARNING SIGNS OF CEREBRAL EDEMA**

- Headache
- Inappropriate slowing of heart rate (>20 beats below baseline) &/or rising blood pressure
- Recurrence of vomiting
- Change in neurologic status: restlessness, irritability, increased drowsiness, or incontinence
- Change in neurologic signs: Cranial nerve palsies, or slower pupillary response
- Altered/abnormal respiratory rate

**3 ED RN REASSESSMENT**

- DO NOT discontinue outside insulin drips until pharmacy delivers insulin
- Reassess Q 30-60 minutes:
  - Risk of cerebral edema
  - Mental status
  - Vital signs
- Obtain repeat glucose every 1 hour
- Notify ED Attending of change or decreasing level of consciousness
- Do not use sedating medications (e.g. narcotics and antiemetics) without consulting ED Attending or Endocrinologist

**4 DKA CRITERIA**

<table>
<thead>
<tr>
<th>pH</th>
<th>OR</th>
<th>HCO₃/Total CO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>7.2-7.29</td>
<td>10-14</td>
</tr>
<tr>
<td>Moderate</td>
<td>7.1-7.19</td>
<td>5-9</td>
</tr>
<tr>
<td>Severe</td>
<td>&lt; 7.1</td>
<td>&lt; 5</td>
</tr>
</tbody>
</table>

**5 PICU ADMISSION CRITERIA**

**ANY OF THE FOLLOWING:**
- pH < 7.1
- K⁺ < 3.0
- Altered mental status
- Shock persisting after fluid resuscitation

**CONSIDER PICU ADMISSION**

- pH 7.1-7.19 AND ANY OF THE FOLLOWING:
  - K⁺ < 3.9
  - Age < 5 years
  - MD/Nursing supervisor judgment

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PHASE I: FLUID RESUSCITATION**

**MONITORING DURING ALL PHASES**

Glucose using ISTAT
- Every 1 hour
- Target BG Range: 100-200mg/dl

Vital Signs and Neurovitals (Cerebral Edema)
- Every 1 hour

Venous Blood Gas and BMP or CG8
- Every 2-4 hours

POOR PERFUSION?¹

IF GIVING THIRD BOLUS, NOTIFY ENDOCRINOLOGIST

No

REPEAT BOLUS:
10ML/KG NS OVER 30 MINUTES

Yes

POOR PERFUSION?¹

Yes

No

PHASE II²³

REHYDRATION WITH ELECTROLYTES, NO DEXTROSE, BEGIN INSULIN

IV Fluid²
No Dextrose
NS + K⁺
1½-2 times maintenance

Insulin³
Same line or Different IV line
Insulin Solution:
Strength: 1 unit/mL NS
Rate: 0.1unit/kg/hr

Nursing: If BG<80mg/dl, hold insulin and notify physician

PHASE III²⁴

CONTINUE INSULIN, BEGIN DEXTROSE WHEN BG<250MG/DL
CONTINUE DEXTROSE-FREE IV FLUID AND ADD DEXTROSE-CONTAINING IV FLUID

IV Fluid²
Continue NS + K⁺

IV Fluid with Dextrose
D₁₀ + NS + K⁺

Insulin³
Continue Insulin:
Strength: 1 unit/mL NS
Rate: 0.1unit/kg/hr

Total fluids at1½ -2 times maintenance rate.
Dextrose-free and dextrose-containing fluids begin at the same rate.
Titrates rates to desired serum glucose level.
Split maintenance between the 2 bags.

¹POOR PERFUSION SIGNS
- Cool extremities
- Capillary refill > 3 seconds
- Hypotension (policy 23.00)

The following symptoms may persist, but not indicative of poor perfusion:
- Elevated heart rate
- Dry mouth
- Sunken eyes

IVF FOR PATIENTS TRANSFERRED IN

If patient has received over 30cc/kg IVF, consider starting replacement fluids at 1-1½ times maintenance

REPLACEMENT FLUID THERAPY
- Goal is to re-hydrate patient, correct acidosis, and avoid major fluid shifts
- Provides ability to alter replacement therapy fluids with minimal bag changes without changing the rate of the Insulin therapy

²ADDITIONAL POTASSIUM (K⁺)

Add potassium based on serum K⁺ level:

K⁺>5.5
No K⁺

K⁺ 3.5-5.5
20mEq/L K⁺ phosphate AND 20mEq/L K⁺ chloride

K⁺<3.5
30mEq/L K⁺ phosphate AND 30mEq/L K⁺ chloride

³INITIATING INSULIN
- Initiate Insulin after bolus(es) have infused
- If K⁺<3.5, start K⁺ prior to initiating insulin
- Prime IV tubing with insulin; let additional 20mL run out of tubing before connecting to patient/pump (this allows saturation of plastic binding sites)

³PHASE III
- Start when BG<250mg/dL
- The K⁺ and Na⁺ content in each bag should be identical to each other

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**Clinical Practice Guideline for Ongoing Management of Diabetic Ketoacidosis (DKA) in PICU/Inpatient**

**Patient has completed Phase I-II of treatment and BG<250mg/dL:**
- Phase I: Fluid Resuscitation with NS
- Phase II: Rehydration without dextrose, replace K⁺, begin insulin
- Phase III: Rehydration adding dextrose, continue insulin and K⁺

**Assess Need for Labs³**

**PHASE IV**: REDUCE SODIUM CONTENT OF IV FLUID
- IF patient is sufficiently stable, consider change to ½ NS after 4-6 hours of Phase III therapy
- **DO NOT TRANSITION TO THIS STAGE, OR USE CAUTION, IF PATIENT HAS BEEN TREATED FOR SUSPECTED CEREBRAL EDEMA DURING THIS ADMISSION OR IS AT UNUSUALLY HIGH RISK FOR DEVELOPING CEREBRAL EDEMA**

**IV Fluid⁴**
- Replace NS + K⁺ with
  - ½ NS + K⁺

**IV Fluid with Dextrose**
- Replace D₁₀ + NS + K⁺ with
  - D₁₀ + ½ NS + K⁺

**Total fluids at 1½ - 2 times maintenance rate.**
**Dextrose-free and dextrose-containing fluids begin at the same rate.**
Titrated rates to desired serum glucose level.
**Split maintenance between the 2 bags.**

**Insulin**
- Continue Insulin:
  - Strength: 1 unit/mL NS Rate: 0.1unit/kg/hr

**PHASE V**: TREATMENT OF PERSISTENT BLOOD GLUCOSE <100MG/DL
- If blood glucose is decreasing despite
  - D₁₀ fluids at 75%,
    - Increasing D₁₀ to 100%
    - Decreasing insulin to 0.05 units/kg/hr; AND/OR
    - Insulin and dextrose titration per physician order

**Nursing:** If BG<80mg/dl, hold insulin and notify physician

**PHASE VI**: TRANSITION TO SUBCUTANEOUS INSULIN AND ORAL FEEDS
- TRANSFER OF CARE TO ENDOCRINOLOGY

**1️⃣ INCLUSION CRITERIA**
- Suspected new onset diabetic with symptoms such as below
- OR known diabetic with signs/labs suggestive of DKA:
  - Signs/Labs:
    - Hyperglycemia (>200)
    - pH <7.3
    - Dehydration
    - Ketonuria
    - Rapid &/or deep respirations

**2️⃣ DKA CRITERIA**
- If labs not previously drawn, obtain the following:
  - Upon arrival at PICU:
    - Hemoglobin A1c
    - β-hydroxybutyrate
- Antibodies for New Onset Diabetes ONLY:
  - Tissue Transglutaminase, IgA [TTGAB]
  - Immunoglobulin A Total [IgA]
  - Thyroid Peroxidase AB
  - Thyroglobulin AB [ATHY]

**3️⃣ LABS**
- If labs not previously drawn, obtain the following:
  - Upon arrival at PICU:
    - Hemoglobin A1c
    - β-hydroxybutyrate

**4️⃣ ADDING POTASSIUM (K⁺)**
- Add potassium based on serum K⁺ level:
  - K⁺>5.5
    - No K⁺
  - K⁺ 3.5-5.5
    - 20mEq/L K⁺ phosphate AND
    - 20mEq/L K⁺ chloride
  - K⁺<3.5
    - 30mEq/L K⁺ phosphate AND
    - 30mEq/L K⁺ chloride

**CRITERIA TO TRANSITION TO GENERAL CARE**
- When appropriate care team identified
- Patient meets Mild DKA criteria²

**DISCHARGE CRITERIA**
- Consider when social and educational needs are met
- When patient is on subcutaneous insulin regimen and tolerating solid food