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

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

NURSING PROTOCOL CIP 5-04

TRIAGE HISTORY CONSISTENT WITH INCLUSION CRITERIA[1]

No → CONTINUE TREATMENT AS APPROPRIATE

Yes

RN ASSESSMENT
PATIENT AT RISK FOR CEREBRAL EDEMA, IF SIGNS EXIST OR DEVELOP, NOTIFY PHYSICIAN IMMEDIATELY[2]

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[3]

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

NOTIFY ED ATTENDING

SUSPECT DKA?[4] → No → SUSPECT DIABETES? → No → MANAGE HYPERGLYCEMIA AS APPROPRIATE FOR CLINICAL SITUATION

Yes (DKA?) → NOTIFY ENDOCRINOLOGY: IF EXTREME HYPERGLYCEMIA WITHOUT EXPECTED ACIDOSIS, CONSIDER HYPEROSMOLAR HYPERGLYCEMIC SYNDROME

Yes (DIABETES?) → NOTIFY ENDOCRINOLOGY: MANAGEMENT OF DIABETES WITHOUT DKA PER ENDOCRINOLOGIST

INITIATE TREATMENT FOR DKA:
- IVF
- INSULIN
- CONTINUE MONITORING[3]

SEE DETAILS FOR IVF AND INSULIN TREATMENT ON PAGE 2

CONSULT ENDOCRINOLOGY AND ADMITTING SERVICE FOR DISPOSITION

- ADMIT TO PICU[5] WITH ENDOCRINOLOGY CONSULT
- GENERAL CARE AREA ADMIT TO ENDOCRINE SERVICE
- DISCHARGE HOME ONLY WITH ENDOCRINOLOGY APPROVAL

[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

	pH	*OR*	HCO_3/Total CO_2
Mild	7.2-7.29		10-14
Moderate	7.1-7.19		5-9
Severe	<7.1		<5

[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

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

PHASE I: FLUID RESUSCITATION**
10ML/KG NS
OVER 30 MINUTES

POOR PERFUSION?[1]

YES

REPEAT BOLUS:
10ML/KG NS
OVER 30 MINUTES

IF GIVING THIRD BOLUS, NOTIFY ENDOCRINOLOGIST

POOR PERFUSION?[1]

YES

No

No

PHASE II[2,3]
REHYDRATION WITH ELECTROLYTES, NO DEXTROSE, BEGIN INSULIN

IV Fluid[2]
No Dextrose
NS + K^+
1½-2 times maintenance

Insulin[3]
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 III[2,4]
CONTINUE INSULIN, BEGIN DEXTROSE WHEN BG<250MG/DL
CONTINUE DEXTROSE-FREE IV FLUID AND ADD DEXTROSE-CONTAINING IV FLUID

IV Fluid[2]
Continue NS + K^+

IV Fluid with Dextrose
D_{10} + NS + K^+

Insulin[3]
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.
Titrate rates to desired serum glucose level.
Split maintenance between the 2 bags.

**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

[1]POOR 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

[2]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

[3]INITIATING 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)

[4]PHASE III

- Start when BG<250MG/dL
- The K^+ and Na^+ content in each bag should be identical to each other

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

Patient has completed Phase I-III 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^+

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Assess Need for Labs[3]

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PHASE IV[4]: 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 Fluid[4]	IV Fluid with Dextrose	Insulin
Replace NS + K^+ with **½ NS + K^+**	Replace D_{10} + NS + K^+ with **D_{10} + ½ NS + K^+**	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.
Titrate rates to desired serum glucose level.
Split maintenance between the 2 bags.

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PHASE V: TREATMENT OF PERSISTENT BLOOD GLUCOSE <100MG/DL

If blood glucose is decreasing despite D_{10} fluids at 75%, consider:
- Increasing D_{10} 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

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

When:			
• Patient ready by clinical assessment; **AND** • HCO3 >14; **OR** • pH >7.29	• Provide ice chips, sips of clear liquids • Advance sugar-free, clear liquid diet as tolerated	Insulin management to be discussed with Endocrinology	Long-acting insulin must be administered prior to discontinuing insulin drip

[1]INCLUSION CRITERIA

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Signs/Labs:
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- Dehydration
- Ketonuria
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[2]DKA CRITERIA

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Severe	<7.1		<5

[3]LABS

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]

[4]ADDING POTASSIUM (K^+)

Add potassium based on serum K^+ level:

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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 criteria[2]

DISCHARGE CRITERIA

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