

COVID 19: Treatment of Adult Patients with Diabetic Ketoacidosis Outside of the Intensive Care Unit Protocol and Management

SCOPE:

Indicators of appropriateness for floor admission (should be placed into context by ED and HM):

1. Mild/Moderate DKA as defined by:
 - a. Serum glucose > 250
 - b. Arterial pH: ≥ 7.1
 - c. Serum HCO₃: ≥ 10.1
 - d. Serum ketones or ketonuria
 - e. Not meeting any of the severe DKA criteria

Indicators of appropriateness for ICU admission (should be placed into context by ED, HM and ICU):

1. Severe DKA as defined by:
 - a. Arterial pH: < 7
 - b. Serum HCO₃: < 10
 - c. K < 2.8 and unable to tolerate PO
 - d. Altered mental status
 - e. Hypotension
 - f. Hypothermia
 - g. Another diagnosis that requires MICU admission (severe sepsis, respiratory failure, etc.)
 - h. ESRD and severe or decompensated CHF

Treatment Goals and Algorithm ED management:

1. Assess volume status
2. Insert 2 peripheral IV's
3. Obtain diagnostics (if not done in initial workup)
 - a. BMP
 - b. Phos
 - c. Venous blood gas
 - d. CBC
 - e. Beta Hydroxybutyrate
 - f. Urinalysis
 - g. ECG 12 Lead
4. Volume repletion
 - a. 2L of Normal Saline (NS) or Lactated Ringers (LR) should be given (reduce volume in heart failure, cirrhosis, nephrosis or those with hypoxia.)

2. Potassium repletion
 - a. Appendix 1. Action based on serum potassium level
2. Insulin - **Potassium must be > 3.5 before starting insulin.**
 - a. If **severe** DKA, start insulin drip and use MICU DKA protocol
 - b. If **mild or moderate** DKA initiate insulin subq and use floor DKA protocol as written below

Floor Protocol:

Note:

1. This is an active management protocol. Weight based dosing for insulin is a good starting point but dosing will likely need to be adjusted based on the patient's response to a previous insulin doses. Further context can be obtained by reviewing a patient's history of prior DKA treatment and home insulin dosing (if available). Type I diabetics and those with diabetes from pancreatic insufficiency are going to be much more insulin sensitive and may require lower doses.

1. Insulin and D5W
 - a. Time 0 - Administer lispro subcutaneous **0.3 units/kg**
 - b. Time 1 hour - Administer lispro subcutaneous **0.2 units/kg** and continue q2 hours until glucose less than 250
 - c. When glucose less than 250 - transition to lispro subcutaneous **0.1 unit/kg** q2 hours and start D5 at 150 ml/hr (when patient volume replete, can discontinue supplemental NS or LR, buff cap IV, and change D5 to D5 1/2NS). Adjust rate based on table
 - i. For patient with fluid restrictions (CHF or cirrhosis) start D10 at 75 ml/hr and adjust based on table below
 - d. If glucose is less than 71 mg/dl, adjust D5 or D10 drip as needed, administer 125 ml D10, check POC glucose q15 min until >100 and then resume q2 hour lispro. Dose will likely need to be adjusted.
 - e. If glucose 71-100 mg/dl, adjust D5 or D10 drip as needed, repeat glucose q15min until >100 and then resume q2 hour lispro. Dose will likely need to be adjusted.
 - f. If glucoses, insulin and D5 rates are stable for six hours, consider changing to q4 hour subcutaneous injections of regular insulin at double the last dose of lispro given (for example, if patient has received 5 units of lispro 2 hours and 4 hours ago, give 10 units of subcutaneous regular now and every four hours until patient ready to transition to basal bolus insulin). Glucose monitoring can be changed to q4 hours

Glucose (mg/dl)	Fluid infusion rate D5W	Fluid infusion rate D10W
< 100	D5 @ 250 ml/hr	D10 @ 125 ml/hr
101-180	D5 @ 200 ml/hr	D10 @ 100 ml/hr
181-230	D5 @ 150 ml/hr	D10 @ 75 ml/hr

231-280	D5 @ 100 ml/hr	D10 @ 50 ml/hr
<u>281-330</u>	D5 @ 50 ml/hr	D10 @ 25 ml/hr
<u>331-380</u>	Hold D5 until glucose < 331	Hold D10 until glucose < 331
<u>381-430</u>	Hold D5 until glucose < 331	Hold D10 until glucose < 331

2. Potassium
 - a. See insulin restrictions above.
 - b. Replete potassium q4 hours per instructions in supplemental potassium repletion table (do not use if Cr > 2, Cr up >50% from recent baseline or GFR < 30)
3. Phosphorous
 - a. Replete phosphorus q4 hours per instructions in the supplemental phosphorus repletion table.
4. Continued fluid resuscitation (Exercise caution in heart failure, cirrhosis, nephrosis or those with hypoxia. Assess volume status)
 - a. Severe Volume Depletion: 500 ml/hr IV NS x 2 hours, then 250 ml/hr x 8 hrs
 - b. Moderate Volume Depletion: 250 ml/hr IV NS x 2 hours, then 125 ml/hr x 8 hrs
5. Ongoing fluid maintenance
 - a. When blood glucose < 250 mg/dl and volume replete, can stop LR or NS, buff cap IV and transition D5 to D5 ½ NS
6. Monitoring parameters
 - a. Q2H blood glucose monitoring
 - b. Q4H serum chemistry monitoring
 - i. Can discontinue frequency of monitoring when 1) anion gap (<15) is closed, AND 2) electrolytes have normalized (k stable between 4-5) for two lab checks
 - c. Q4H Phos x 2
 - d. Q4H beta hydroxybutyrate x 3
 - e. HgbA1C at next lab draw
 - f. Fasting lipids in AM
7. Transition to basal/bolus insulin
 - a. Markers for resolution of DKA and appropriateness for transition to basal bolus insulin
 - i. Serum anion gap < 15 mmol/L for two consecutive checks, 4 hours apart
 - ii. All blood glucose levels < 180 mg/dl for 4 hours
 - iii. Patient has reached steady state of insulin dosing
 - iv. Patient is tolerating oral intake
 - b. Timing of transition - Give long acting insulin at the same time as the last dose of short acting insulin from the above protocol
 - i. Attempt to transition at standard times (0900 or 2100).

1. If transitioning off the DKA protocol at non-standard times (e.g. middle of the night, mid-day, or afternoon) give a dose of NPH or Regular insulin to bridge the patient to a standard administration time (0900 or 2100).
 - a. If it is **less than 6 hours** until the patient's scheduled glargine dose, give ¼ of the glargine dose as Regular insulin to bridge the patient until the scheduled dose.
 - b. If it is **6-18 hours** until the patient's scheduled glargine dose, give ½ of the glargine dose as NPH insulin to bridge the patient until the scheduled dose.
 - c. If it is **18-24 hours** until the patient's scheduled glargine dose, give the full glargine dose now.
- c. Transition options
 - i. Resume home regimen
 - ii. Initiate new regimen by calculating insulin needs
 1. Use a 4-h period of **stable** insulin dosing (i.e. giving correction factor only with BG values in range 100-180 mg/dl) to calculate the 24-hour **total** insulin requirement.
 2. Determine the average hourly dose and multiply by 24 to obtain a 24-hour total insulin dose. Ex: 3 units/hr (avg) x 24 = 72 units (total daily dose or TDD)
 3. Divide total daily dose in ½
 - a. Basal insulin dose is 50% (ex: 50 units TDD, 25 units for basal).
 - b. Prandial insulin dose is 50%, divided as TID with meals (ex: 50 units TDD. 25 units for prandial insulin divided by three meals is 8 units with meals).
 4. Ordering prandial (meal-time) insulin
 - a. Select one of the lispro orders in the diabetes management and medication order set to provide both meal and correction insulin.
 - b. "Sensitive to insulin" lispro order provides a base dose of 3 units for meals and a correction factor of 1 unit for every 50 mg/dL above target (150 mg/dL).
 - c. "Moderate-resistance to insulin" lispro order provides a base dose of 6 units for meals and a correction factor of 2 units for every 50 mg/dL above target (150 mg/dL)
 - d. "High-resistance to insulin" lispro order provides a base dose of 10 units for meals and a correction factor of 3 units for every 50 mg/dL above target (150 mg/dL)
 - e. All three orders can be customized to provide different base (meal) doses and correction factors to meet individual patient needs.
 - f. For patients who count carbohydrates and use carb ratios to dose meal-time insulin consider selecting "insulin-to-carb ratio(s)/correction factor(s)" to order lispro under alternative insulin management in the diabetes order set.
 - iii. Change blood glucose and chemistry checks to standard monitoring under the Diabetes Management and Medication Order Set
 - iv. Proceed with standard correction factor coverage per the Diabetes Management and Medication Order Set.

Potassium Repletion Guideline for the Inpatient Floor

(Reference Range: 3.6 – 5.1 mmol/L)

Level \leq 2.9 mmol/L	Level 3 – 3.9 mmol/L	Level 4-4.9 mmol/L
NOTE: Add-on magnesium and replete magnesium as needed.		
Tolerating PO:	Tolerating PO:	Tolerating PO
KCl 60 mEq PO x 1 dose (KDur tablets) <i>PLUS</i> KCl 10 mEq IV x 3 doses	KCl 20 mEq PO x 2 doses (KDur tablets)	KCL 20 mEq PO x 1 doses
Not Tolerating PO:	Not Tolerating PO:	Not Tolerating PO:
KCl 10 mEq IV x 6 doses	KCl 10 mEq IV x 3 doses	KCL 10 mEq IV x 2 doses

1. Oral potassium replacement will be in the form of potassium chloride (KCl) tablets or solution. Tablets (KDur) are the preferred route. If the patient is unable to tolerate large pills, the nurse will notify the provider to change the order to 20mEq/15mL solution.
2. IV potassium replacement will be in the form of potassium chloride 10 mEq/100ml premixed IV bags. Each bag will be infused over 1 hour.
3. If the patient is reporting burning or pain with the IV potassium infusion, after first assessing the patient to ensure no extravasation or infiltration, then:
 - a. The RN can provide the patient with a non-pharmacologic pain relief intervention such as a cool compress.
 - b. The RN can reduce the rate of the infusion.
 - c. The RN can administer the KCl concurrently with normal saline.
 - d. If the above interventions provide insufficient relief for the patient, the RN will notify the provider. The provider may consider ordering the addition of lidocaine to the KCl.

Phosphorus Repletion Guidelines for the Inpatient Floor

(Reference Range: 2.7 – 4.9 mg/dL):

Level \leq 1.9 mg/dl	Level 2-2.6 mg/dl
NaPO ₄ 30mmol IV infused over 6 hours x 1 dose	Tolerating PO (and K < 5 mmol/L):
	PhosNaK 1 packet q4h x 4 doses
	Not tolerating PO:
	NaPO ₄ 20mmol IV infused over 4 hours x 1 dose

1. The patient's nurse will notify the provider if the patient's phosphorus level is \leq 1.9 mg/dL.
2. Oral phosphate replacement will be in the form of PhosNaK powder for solution (must be diluted in liquid). This product contains 8 mmol phosphorus, 13 mEq sodium, and 7.1 mEq potassium per each packet. **If a patient's potassium level is > 5 mmol/L do NOT use oral potassium phosphate replacement.**
3. IV phosphate replacement will be in the form of sodium phosphate. All doses of sodium phosphate will be mixed in 100 ml of D5W and **infused at a standard rate of 5 mmol/hr**. While Pharmacy is responsible for any adjustments to the protocol due to drug shortages, sodium phosphate is the preferred IV phosphorus replacement per this guideline. Potassium phosphate is not included in this protocol and will require a separate order from the provider.
4. **Do not infuse IV calcium with IV phosphorus products concomitantly regardless of IV line access as precipitation may occur.** It is recommended to give IV calcium products prior to administering IV phosphorus products.