This guideline serves as a guide and does not replace clinical judgment.

**Who should be assessed for Hyperglycemic hyperosmolar syndrome (HHS)/Hyperosmolar DKA?**
Known or suspected diabetes with blood glucose > 600 mg/dL

- ABCs, GCS
- 20 mL/kg 0.9% NaCl (NS) bolus IV. May give repeat boluses as needed for shock and engage ED, PICU and endocrine attending/fellow
- Assess hydration status, review recent prior weight

**VBG with lytes, BMP, Mg, Phos, serum Osm, serum lipase, urine dip and Ua reflex if patient has voided**
If initial K > 6 mmol/L, get an EKG
DO NOT DELAY TREATMENT WHILE OBTAINING LABS

**Is serum glucose > 600 mg/dL and effective serum Osm > 320 mOsm/kg?**
Consult Endocrine if ONLY blood glucose OR osm are elevated.

- Is HCO₃ ≥ 15 and pH ≥ 7.25?
- Is HCO₃ < 15 or pH < 7.25?

**Hyperglycemic hyperosmolar syndrome (HHS)**

- Initially run NS infusion at 2x maintenance rate.
- For hyperosmolar DKA, switch to 2 bag system, once available – see page 3.
- Once in PICU, calculate deficit and adjust maintenance fluids – see page 4.
- Discuss maximal IV fluid (IVF) rate for high BMI patients with attending

**Hyperosmolar DKA**

- Ongoing poor circulation?
  - Administer another 10 mL/kg NS bolus, consider vasopressors

For questions concerning this guideline, contact:
chorclinicalguidelines@vcuhealth.org

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Hyperglycemic hyperosmolar syndrome

- Continue NS infusion WITHOUT insulin; if there is still a concern for circulation, consider an additional NS bolus
- POCT BG every 1h; BMP, Mg, Phos, Osmol every 4-6hr, trend CK daily; Strict I/O (consider foley placement).
- If initial K >6 mmol/L, get an EKG
- Replace electrolytes as needed (see page 4)

Hyperosmolar DKA

- Start IV insulin at 0.05 units/kg/hr with 2 bag system (see page 3)
- If BG decreasing ~75-100 mg/dL/hr?
  - Continue IVF at same infusion rate
  - Add D5% to IVF (see page 3)

- BG decreasing by >100 mg/dL/hr?
  - May titrate IV insulin to a lower rate OR add bag 2, see page 3

- BG decreasing by >100 mg/dL/hr?
  - Continue IV insulin at current infusion rate

- BG decreasing 75-100 mg/dL/hr?
  - May titrate IV insulin to a lower rate OR add bag 2, see page 3

**Consider urine replacement 0.5-1:1 if urine out > 5ml/kg/hr **

- BG decreasing 75-100 mg/dL/hr?
  - Continue with treatment until hyper-osmolality (< 315), AG < 12, and bicarb >17 and subcutaneous insulin is started
  - Monitor circulatory status and manage complications as outlined in page 3

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Complications

**Shock/Arrhythmias**
- Discuss need with PICU attending for vasopressors. Continue to monitor for signs and symptoms of SHOCK
- Check EKG for electrolyte dysregulation. Replete electrolytes as needed

**High risk for venous thrombosis**
- SCDs for all patients; consider prophylaxis SubQ lovenox / heparin; AVOID Central Lines access if possible
- Consider CBC daily while in intensive care

**Malignant hyperthermia-like syndrome and/or rhabdomyolysis**
- Monitor for increasing body temperature and CK, and consider treatment with Dantrolene sodium as needed
  - Loading dose 2.5 mg/kg and 1mg/kg every 4-6h IV until s/s resolve (MAX 10mg/kg) per episode
- Monitor for rhabdomyolysis with CK and urine myoglobin

**Altered mental status**: Immediately discuss with PICU attending. Consider IV mannitol 20% or 3% NS bolus.

IV mannitol 20% dose: 0.25-1 gram/kg over 2 minutes
IV 3% NS dose: 2-3 mL/kg over 2 minutes

<table>
<thead>
<tr>
<th>2 Bag system Total</th>
<th>IVF rate = Bag 1 _____mL/kg + Bag 2 _____mL/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>If K+ &lt;5:</td>
<td>If K+ &gt; 5:</td>
</tr>
<tr>
<td>Bag 1: NS + KPhos 15 mmol/L + KCl 20 meEq/L</td>
<td>Bag 1: NS</td>
</tr>
<tr>
<td>Bag 2: D5 NS + KPhos 15 mmol/L + KCl20 meEq/L</td>
<td>Bag 2: D5 NS</td>
</tr>
<tr>
<td></td>
<td>Add KPhos and KCl once K+ falls &lt;5 + patient is voiding</td>
</tr>
</tbody>
</table>

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Fluid replacement

In order to more accurately capture rate of rehydration, the following calculation tool can be used.

Fluid Rate Calculation
A. Deficit = ________ % dehydrated x 10 x preadmission weight in kg __________ mL
B. Hourly maintenance rate (4-2-1 rule) x total hours to replace __________ mL
C. Add “A” and “B” __________ mL
D. Total fluids given by outside hospital, EMS, and VCU ED __________ mL
E. Subtract “D” from “C”. Will give you total remaining fluid to replace =__________ mL
F. Total hours remaining to infuse replacement fluids __________ hours
G. Divide answer in “F” from “E” to obtain hourly replacement fluid rate =__________ mL/hr

(Rate will be ~ 2 x maintenance fluid rate. Do not start rate above 2 x maintenance without first discussing with Attending)

Effective serum Osmolality calculation: 2* Na (uncorrected) + Glucose/18 +BUN/2.8

Electrolyte replacement

1. Magnesium sulfate: if serum Mg value is less < 1 mg/dL; administer IV 25-50 mg/kg/dose every 4 -6 hours; max dose of 2 gram/hr. Monitor levels every 4-6 hours

2. Potassium:
   - With acidosis, K+ will shift from the intracellular to extracellular compartment. Once acidosis is corrected, it will shift back out into extracellular fluid.
   - If K+ is < 5mmol/L and patient is voiding, ensure sufficient K+ is added to IV fluids.
   - If K+ is > 5mmol/L, DO NOT add K+ to IV fluids until patient is voiding and K+ is < 5mmol/L. Subsequent potassium replacement therapy can be based on serum potassium

3. Phosphate: Monitor levels every 4-6 hours due to risk of hypophosphatemia leading to rhabdomyolysis, hemolytic anemia, and paralysis.

4. Bicarbonate therapy is generally contraindicated due to the risk of hypokalemia – Trials have shown no clinical benefit of Na Bicarb, but well recognized adverse effects noted.

5. Calcium: Replace as needed with CaCl 10-20 mg/kg (max 1000 mg) over 15-60 minutes.
   - via CVL only; if PIV access, give IV Ca Gluconate 60 mg/kg/dose (max 3 grams/dose) infuse over 50-60 minutes
Hyperglycemic Hyperosmolar Syndrome and Hyperosmolar DKA Guideline

Executive Summary

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Approved (November 2021)

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References


Citation

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Example:

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