DKA Diagnostic Criteria (See page 3 for more details):
- Blood glucose >250 mg/dl,
- Arterial pH <7.3,
- Bicarbonate ≤18 mEq/l,
- Anion Gap Acidosis
- Moderate ketonuria or ketonemia.

1. Start IV fluids (1 L of 0.9% NaCl per hr initially)
2. If serum K+ is <3.3 mEq/L hold insulin
   - Give 40 mEq/h until K ≥ 3.3 mEq/L
3. Initiate DKA Order Set Phase I
4. Start insulin 0.14 units/kg/hr IV infusion (calculate dose)
   - RN will titrate per DKA protocol

**Look for the Cause**
- Insulin deficiency
- Infection/Inflammation
  (PNA, UTI, pancreatitis, cholecystitis)
- Ischemia/Infarction
  (myocardial, cerebral, gut)
- Intoxication (EtOH, drugs)
- Iatrogenic (drugs, lack of insulin)
- Pregnancy

### IVF
- Determine hydration status
- Hypovolemic shock
- Mild hypotension
- Cardiogenic shock
  - Administer 0.9% NaCl (1.0 L/h) and/or plasma expander
  - Hemo-dynamic monitoring
  - Evaluate corrected serum Na+
  - Serum Na high
  - Serum Na normal
  - Serum Na low
  - 0.45% NaCl (4-14 ml·kg⁻¹·h⁻¹) depending on hydration state
  - 0.9% NaCl (4-14 ml·kg⁻¹·h⁻¹) depending on hydration state

### Insulin
- Initiate and continue insulin gtt until serum glucose reaches 250 mg/dl.
  - RN will titrate per protocol to achieve target.
  - When sugar < 250 mg/dl proceed to DKA Phase II (reverse side)

### Potassium
- If initial serum K⁺ is <3.3 mEq/L, hold insulin and give 40 mEq K⁺ per h (2/3 KCL and 1/3 KP0₄) until K ≥ 3.3 mEq/L
- If initial serum K⁺ ≥ 5.0 mEq/L, do not give K⁺ but check K⁺ every 2 h
- If initial serum K⁺ ≥ 3.3 but < 5.0 mEq/L, give 20-30 mEq K⁺ in each liter of IV fluid (2/3 as KCL and 1/3 as KP0₄) to keep serum K⁺ at 4-5 mEq/L

### Bicarbonate
- Assess need for bicarbonate
  - pH <6.9
  - pH >7.0
- Dilute NaHCO₃ (100 mmol) in 400 mL H₂O with 20 mEq KCL. Infuse for two hrs.
  - No HCO₃
- Repeat NaHCO₃ administration every two hrs until pH >7.0. Monitor serum K⁺.

Approved by Diabetes Steering Committee, MMC, 2015
DKA/HHS Pathway Phase 2 (Adult)

Phase 2: Blood sugar now less than 250mgd/dl.

If Anion Gap Elevated*

- Transition to DKA Order Set Phase 2
- Discontinue Phase 1 insulin infusion order and DKA nursing titration protocol from phase 1.
- Change to fixed dose insulin infusion at suggested rate of 2.5 units/hr (Adjust as needed for individual patient with typical dose range of 0.02 to 0.05 units/kg/hr based on drip rate and response in phase 1). Do not discontinue insulin therapy.
- Start dextrose containing IV fluid such as D5 ½ NS and adjust dextrose to goal blood sugar 150-200.
- Continue to check labs regularly.
- Reevaluate for underlying causes and consider undetected stressors/illness.

Follow guidelines to the right when gap has normalized.*

If Anion Gap Normalized*

Non-ICU Patients

Desire to continue IV insulin?

- Yes
  - Insulin Naïve?
    - Yes
      - Consider total daily dose of 0.5 u/kg with 50% given as basal.
    - No
      - Previously Under Good Control?
        - Yes
          - Consider resuming home basal/prandial regimen.
        - No
          - Use past 6 hours of drip rate in phase 1 to estimate daily basal requirement. Reduce by 20% for safety. Order prandial insulin.

Critical Illness (ICU)

- Change to Inpatient IV Insulin Protocol
  - RN will titrate Insulin using IIP calculator.
  - Discontinue D5 infusion if/when appropriate.
  - Advance diet when able/appropriate, and if eating add prandial insulin.
  - Overlap IV infusion for 2 hours with basal dose.
  - Order correctional insulin in addition on all patients.
  - Advance diet as tolerated.

Refer to Clinical Support Tools: IV Insulin or IV to SC Insulin Transition for further guidance.

*Normal Anion Gap at MMC is 5-16 meq/L for the typical patient.

Approved by Glycemic Steering Committee, MMC, 2015
## Diagnostic Criteria for DKA/HHS*

<table>
<thead>
<tr>
<th></th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>HHS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plasma Glucose (mg/dl)</strong></td>
<td>&gt; 250</td>
<td>&gt; 250</td>
<td>&gt; 250</td>
<td>&gt;600</td>
</tr>
<tr>
<td><strong>Arterial pH</strong></td>
<td>7.25 – 7.30</td>
<td>7.00 – 7.24</td>
<td>&lt; 7.00</td>
<td>&gt;7.30</td>
</tr>
<tr>
<td><strong>Serum Bicarbonate (meq/l)</strong></td>
<td>15 to 18</td>
<td>10 to &lt; 15</td>
<td>&lt; 10</td>
<td>&gt; 18</td>
</tr>
<tr>
<td><strong>Urine Ketones</strong></td>
<td>Positive</td>
<td>Positive</td>
<td>Positive</td>
<td>Small</td>
</tr>
<tr>
<td><strong>Serum Ketones</strong></td>
<td>Positive</td>
<td>Positive</td>
<td>Positive</td>
<td>Small</td>
</tr>
<tr>
<td><strong>Serum Osmolarity</strong></td>
<td>Variable</td>
<td>Variable</td>
<td>Variable</td>
<td>&gt;320</td>
</tr>
<tr>
<td><strong>Anion Gap</strong>*</td>
<td>High Normal to Elevated</td>
<td>Elevated</td>
<td>Elevated</td>
<td>Variable</td>
</tr>
<tr>
<td><strong>Change in Mental Status</strong></td>
<td>Alert</td>
<td>Alert/Drowsy</td>
<td>Stupor/Coma</td>
<td>Variable to Stupor/Coma</td>
</tr>
</tbody>
</table>

*HHS = Hyperosmolar Hyperglycemic State  
*DKA = Diabetic Ketoacidosis  
*Normal Anion Gap at MMC is 5-16 meq/L for the typical patient.

Approved by Glycemic Steering Committee, MMC, 2015
Additional Considerations for DKA/HHS

**Diet:** Patients should be kept NPO until their blood sugar is < 250mg/dl, their anion gap has normalized, and they are feeling well enough to eat. Once through the acute phase above, patients may be offered a diet and should have prandial insulin ordered as well.

**Hyperglycemia:** In phase 1, the desired rate of decrease is approximately 50-75 mg/dl per hour. Adjust insulin infusion based on guidelines in DKA phase 1 protocol. Additional doses of subcutaneous insulin are discouraged.

**Hypernatremia:** Most patients presenting with DKA will be mildly hyponatremic, but occasionally patients may present with significant hypernatremia. Additionally, those with HHS may frequently present with significant hypernatremia. Treatment in these patients should begin with reconstituting intravascular volume depletion with isotonic fluid such as NS or LR. Once adequately resuscitated in the acute phase, ½ NS or other hypotonic fluid should be used to address free water depletion (see phase 1 algorithm). Patients with significant hyperglycemia at presentation may experience a rise in serum sodium during treatment. That is expected and due to osmotic shifts that occur with reduction in hyperglycemia. In cases of patients presenting with significant hypernatremia initially, where serum sodium falls early on during treatment, there is increased concern for cerebral edema, and patients should be monitored more closely.

**Hypokalemia:** Insulin should be held while potassium is administered for patients with significant hypokalemia (K< 3.3 meq/l) until potassium has normalized. Patients with hypokalemia should have q1h potassium levels in early phase.

**Hypophosphatemia:** Body stores of phosphate are significantly depleted in DKA. Most patients with DKA, however, will not require phosphate repletion. Severe hypophosphatemia (≤1 mmol/dl) though can be a medical emergency. Patients whose phosphate falls to this level should be treated with IV phosphate repletion. Periodic measurement of phosphate levels during the initial treatment of DKA is reasonable.
**Glucometers**: Concern about use of glucometers in DKA exists though they remain the standard of care for measurement of glucose during Phase 1 at this time in the inpatient setting. MMC is building a new workflow to support hourly monitoring of blood glucose using venous specimens on the inpatient units. Please continue to use glucometers until that new work flow is in place. In the ED, hourly venous blood glucose via DKA panel should be used as principal method of glucose measurement, and glucometers utilized only as a fail safe for concern of hyoglycemia or when venous specimen cannot be obtained. As a reminder, all patients should have hourly blood glucose monitoring while on an insulin infusion in DKA/HHS.

**Phase 2**: Once a patient’s glucose has dropped to less than 250mg/dl, a patient is considered to have passed through the initial phase of treatment (Phase 1). However, patients who continue to have an elevated anion gap (>16 meq/l) due to ongoing ketoacidosis (and not another etiology) should be continued on IV insulin therapy until the anion gap has normalized. During this phase, considered Phase 2, patients should continue to have hourly blood glucose monitoring. In order to keep their sugars stable, patients should be given a dextrose infusion for a target blood sugar range of 150-200 mg/dl. The rate of dextrose and concentration of dextrose should be adjusted as needed, but most importantly is that IV insulin should not be discontinued. The exact rate of insulin infusion may be a patient specific decision based on the rates in phase 1. However, the typical dose range in Phase 2 is 0.02 to 0.05 U/kg per hour, and 2.5 units per hour is a reasonable suggested infusion rate. Once their anion gap has closed, they may be transitioned to subcutaneous insulin (with 1-2 hour overlap with the IV infusion) or continued on IV insulin titrated using the standard inpatient insulin protocol if desired.

**Special Populations**: Certain patients who are undernourished, or pregnant may have only mild hyperglycemia in the context of DKA, but have marked anion gap elevation from significant ketoacidosis. In these patients treatment should continue as it would normally with the focus of normalizing glucose, and continuing IV insulin until the anion gap has normalized (see phase 2 above). Subsequent glucose control will differ for pregnant patients as well.

This guideline was ratified by the emergency department faculty at Maine Medical Center in 2015. It reflects our expert opinion and is not necessarily applicable to all institutions. It is intended to be a reference for clinicians caring for patients and is not intended to replace providers’ clinical judgment.

Approved by Glycemic Steering Committee, MMC, 2015