**History and physical**
- Basic metabolic panel, phosphorous, magnesium, and ionized calcium
  - Notify provider if bicarbonate < 15 mEq/L
- Point of care (POC) fingerstick glucose
- Urine ketones
  - If urine ketones are positive, send beta-hydroxybutyrate, and start treatment pending results
- Diagnostic imaging, as clinically indicated
- Strict input and output hourly
  - Notify provider if urine output < 0.5 mL/kg/hour

**Workup/Assessment**

**Is bicarbonate < 15 mEq/L or respiratory rate > 16 breaths per minute?**
- Yes
  - Obtain arterial blood gas and notify provider if pH ≤ 7.14 (see Page 2 for management recommendations)
- No
  - Assess the following:
    - Hydration status
    - Electrolyte status
    - Blood glucose
    - Acidosis
    - Anion gap

**Diagnosis/Treatment**
- Admit to ICU
- Initiate Step 1 of 2: DKA or HHS
- Hyperglycemia INITIATION order set
- Consult Endocrinology-General Service
- POC fingerstick glucose every hour
- Sodium, potassium, chloride, and bicarbonate every 4 hours for 24 hours then every 8 hours as indicated
- Calcium, BUN, creatinine, phosphorus, glucose, and magnesium every 8 hours as indicated
- See Page 2 for DKA/HHS Management
- Continue work up for further treatment or alternative diagnosis
- Refer to Inpatient Hyperglycemia-Adult algorithm as indicated

**Note:** Blood glucose may be lower than expected in patients on SGLT-2 inhibitors (e.g., canagliflozin, dapagliflozin, empagliflozin, ertugliflozin)

---

1 Diabetic ketoacidosis (DKA), hyperosmolar hyperglycemic state (HHS), and euglycemic diabetic ketoacidosis (EDKA)

2 Continue to look for the underlying cause of events

3 Diagnostic criteria:
- DKA: blood glucose > 250 mg/dL, arterial pH < 7.3, bicarbonate < 15 mEq/L, and moderate ketonuria or ketonemia
- HHS: blood glucose > 600 mg/dL, arterial pH > 7.3, bicarbonate > 15 mEq/L, and minimal ketonuria and ketonemia
- EDKA: blood glucose ≤ 250 mg/dL, arterial pH < 7.3, bicarbonate < 15 mEq/L, and moderate ketonuria or ketonemia

[Note: Blood glucose may be lower than expected in patients on SGLT-2 inhibitors (e.g., canagliflozin, dapagliflozin, empagliflozin, ertugliflozin)]
Hyperglycemic Emergency Management
(DKA/HHS/EDKA) - Adult

TREATMENT

Hydration

1 liter\(^1\) of crystalloid fluids\(^2\) IV over 1 hour, then initiate continuous infusion to replete volume status

Potassium and initiation of insulin\(^4\)

Potassium < 3.3 mmol/L

Potassium 3.3-5.5 mmol/L

Potassium > 5.5 mmol/L

pH

< 6.9

6.9 - 7.14

> 7.14

ACCC = Acute Cancer Care Center

\(^1\) Consider reduction for patients with heart failure, end-stage liver or renal disease, or age > 65 years; consider additional fluids as indicated for continued volume repletion
\(^2\) Crystalloid IV fluids include 0.9% sodium chloride or plasmalyte
\(^3\) Calculation for corrected sodium = 0.016 x (measured glucose – 100) + measured sodium
\(^4\) Prime all insulin tubing with 25 units of insulin from bag

INTERVENTION

Calculate corrected sodium\(^3\)

Corrected sodium < 147 mmol/L

Corrected sodium ≥ 147 mmol/L

Additional crystalloid fluids\(^2\)

Additional fluids of 0.45% sodium chloride

When blood glucose ≤ 250 mg/dL, see Page 3 for continued management

Recheck potassium level every 2 hours until < 5.5 mmol/L

Replete and recheck potassium per electrolyte replacement\(^7\) orders

Notify ICU/ACCC team if electrolyte replacement orders are contraindicated or not ordered

Give regular insulin 0.15 units/kg IV bolus\(^6,7\) and start regular insulin 0.1 units/kg/hour IV infusion\(^4,7\)

Once potassium ≥ 3.3 mmol/L, give regular insulin 0.15 units/kg IV bolus\(^6,7\) and start regular insulin 0.1 units/kg/hour IV infusion\(^4,7\)

Notify ICU/ACCC team

Stop all sources of potassium administration and treat hyperkalemia as clinically indicated

Give regular insulin 0.15 units/kg IV bolus\(^6,7\) and start regular insulin 0.1 units/kg/hour IV infusion\(^4,7\)

Repeat potassium level every 2 hours until < 5.5 mmol/L

Recheck blood gas hourly for pH and bicarbonate until pH ≥ 7.2

If initiated, consider discontinuing sodium bicarbonate IV when pH ≥ 7.14

Consider sodium bicarbonate IV\(^8\) (as per ICU/ACCC team management)

Treat with sodium bicarbonate IV\(^8\) (as per ICU/ACCC team management)

\(^5\) Refer to the Critical Care Adult PRN Electrolyte Replacement Orders via CVC, PIV
\(^6\) For insulin management with regular insulin bolus: Usual dose 10-15 units for patients 70-100 kg
\(^7\) Consider reducing insulin dose for patients with liver dysfunction/failure or renal disease
\(^8\) Sodium bicarbonate should NOT be initiated until potassium ≥ 3.3 mmol/L

\(^1\) Consider reduction for patients with heart failure, end-stage liver or renal disease, or age > 65 years; consider additional fluids as indicated for continued volume repletion
\(^2\) Crystalloid IV fluids include 0.9% sodium chloride or plasmalyte
\(^3\) Calculation for corrected sodium = 0.016 x (measured glucose – 100) + measured sodium
\(^4\) Prime all insulin tubing with 25 units of insulin from bag

Disclaimer: This algorithm has been developed for MD Anderson using a multidisciplinary approach considering circumstances particular to MD Anderson’s specific patient population, services and structure, and clinical information. This is not intended to replace the independent medical or professional judgment of physicians or other health care providers in the context of individual clinical circumstances to determine a patient’s care.
**Hyperglycemic Emergency Management (DKA/HHS/EDKA) - Adult**

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**DIAGNOSIS**

- **DKA/HHS**
  - **Is blood glucose ≤ 250 mg/dL?**
    - Yes: Continue to monitor capillary blood glucose every hour **and** titrate insulin infusion per Appendix A
    - No: Decrease insulin infusion rate by half
      - ICU/ACCC Team to:
        - Discontinue Step 1 of 2
        - Initiate Step 2 of 2: DKA/HHS/EDKA (glucose ≤ 250 mg/dL) order set
        - Change IV to D5/0.45% sodium chloride to infuse at current rate
        - Initiate long-acting insulin: glargine 0.125 unit/kg subcutaneous every 12 hours
      - Notify Endocrinology-Diabetes if insulin is stopped
      - Consider reducing insulin dose for patients with liver dysfunction/failure
      - If estimated glomerular filtration rate (eGFR) < 60 mL/minute/1.73 m² or age > 70 years, reduce glargine dose to 0.1 units/kg subcutaneous every 12 hours
      - See Appendix C

**TREATMENT**

- Titrate insulin infusion per Appendix B
- Notify Endocrinology-Diabetes if insulin is stopped
- Decrease insulin infusion rate by half
- ICU/ACCC Team to:
  - Discontinue Step 1 of 2
  - Initiate Step 2 of 2: DKA/HHS/EDKA (glucose ≤ 250 mg/dL) order set
  - Change IV to D5/0.45% sodium chloride to infuse at current rate
  - Initiate long-acting insulin: glargine 0.125 unit/kg subcutaneous every 12 hours

**EVALUATION**

- **Is anion gap ≤ 12 and bicarbonate ≥ 18 mEq/L?**
  - Yes: Notify Endocrinology-Diabetes
  - Discontinue insulin IV infusion no sooner than 2 hours after administration of long-acting insulin
EDKA management is currently under revision.
Please refer to the ACCC/ICU EDKA (Glucose Less Than or Equal to 250 mg/dL) order set for current management orders.
## APPENDIX A: Blood Glucose Monitoring and Insulin Infusion Management for Blood Glucose > 250 mg/dL

<table>
<thead>
<tr>
<th>Glucose Level</th>
<th>Intervention</th>
<th>Recheck Glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased by &lt; 50 mg/dL or increased by any amount</td>
<td>Double infusion rate</td>
<td>1 hour post change</td>
</tr>
<tr>
<td>And remains &gt; 250 mg/dL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decreased by 50-100 mg/dL and remains &gt; 250 mg/dL</td>
<td>Continue current rate</td>
<td>1 hour</td>
</tr>
</tbody>
</table>
| Decreased by > 100 mg/dL and remains > 250 mg/dL  | Decrease rate by half  
Notify Endocrinology-Diabetes, if infusion stopped | 1 hour post change |

Once blood glucose is ≤ 250 mg/dL:
- Decrease insulin infusion rate by half and
- Notify ICU/ACCC Team:
  - Discontinue Step 1 of 2
  - Initiate Step 2 of 2: DKA/HHS/EDKA (glucose ≤ 250 mg/dL) order set
  - Change IVF to D5/0.45% sodium chloride to infuse at current rate\(^1\)
  - Initiate long-acting insulin: glargine 0.125 unit/kg subcutaneous every 12 hours\(^2,3\)
- See Appendix B

\(^1\) See Appendix C
\(^2\) Consider reducing insulin dose for patients with liver dysfunction/failure
\(^3\) If estimated glomerular filtration rate (eGFR) < 60 mL/minute/1.73 m\(^2\) or age > 70 years, reduce glargine dose to 0.1 units/kg subcutaneous every 12 hours

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## APPENDIX B: Blood Glucose Monitoring and Insulin Infusion Titration for Blood Glucose ≤ 250 mg/dL

**Note:** Check capillary glucose 1 hour after initiating Step 2 insulin infusion and titrate per parameters below.

<table>
<thead>
<tr>
<th>Glucose Level</th>
<th>Intervention</th>
<th>Recheck Glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease &gt; 100 mg/dL at one time</td>
<td></td>
<td>1 hour</td>
</tr>
<tr>
<td>&lt; 70 mg/dL</td>
<td>Stop infusion, give D&lt;sub&gt;5&lt;/sub&gt;W 25 mL IV push, and notify Endocrinology-Diabetes</td>
<td>1 hour</td>
</tr>
<tr>
<td>70-90 mg/dL</td>
<td>Stop infusion, notify Endocrinology-Diabetes</td>
<td>1 hour</td>
</tr>
<tr>
<td>91-120 mg/dL</td>
<td>Decrease infusion rate by half of the current rate and recheck capillary glucose in 1 hour</td>
<td>1 hour</td>
</tr>
<tr>
<td>121-140 mg/dL</td>
<td>Decrease infusion rate by 1 unit/hour and recheck capillary glucose in 1 hour</td>
<td>1 hour</td>
</tr>
<tr>
<td>141-180 mg/dL</td>
<td>Decrease infusion rate by half of the current rate and recheck capillary glucose in 1 hour</td>
<td>1 hour</td>
</tr>
<tr>
<td>181-200 mg/dL</td>
<td>Decrease infusion rate by 1 unit/hour and recheck capillary glucose in 1 hour</td>
<td>1 hour</td>
</tr>
<tr>
<td>201-250 mg/dL</td>
<td>Decrease infusion rate by 1.5 units/hour and recheck capillary glucose in 1 hour</td>
<td>1 hour</td>
</tr>
<tr>
<td>251-300 mg/dL</td>
<td>Decrease infusion rate by 2 units/hour and recheck capillary glucose in 1 hour</td>
<td>1 hour</td>
</tr>
<tr>
<td>301-350 mg/dL</td>
<td>Decrease infusion rate by 2 units/hour and recheck capillary glucose in 1 hour</td>
<td>1 hour</td>
</tr>
<tr>
<td>&gt; 350 mg/dL</td>
<td></td>
<td>1 hour</td>
</tr>
</tbody>
</table>
## Hyperglycemic Emergency Management (DKA/HHS/EDKA) - Adult

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### APPENDIX C: Crystalloid And Dextrose Containing Fluids

<table>
<thead>
<tr>
<th>Fluids</th>
<th>Sodium (mEq/L)</th>
<th>Chloride (mEq/L)</th>
<th>Potassium (mEq/L)</th>
<th>Magnesium (mEq/L)</th>
<th>Dextrose (grams/L)</th>
<th>Buffer (mEq/L)</th>
<th>Osmolarity (mOsm/L)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma</td>
<td>140</td>
<td>103</td>
<td>4</td>
<td>2</td>
<td>N/A</td>
<td>Bicarbonate (25)</td>
<td>275-290</td>
<td></td>
</tr>
<tr>
<td>0.9% sodium chloride</td>
<td>154</td>
<td>154</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>308</td>
<td>Not preferred in patients with/or at risk for hyperchloremia and/or acute kidney injury</td>
</tr>
<tr>
<td>Plasma-Lyte A</td>
<td>140</td>
<td>98</td>
<td>5</td>
<td>3</td>
<td>N/A</td>
<td>Acetate (27)</td>
<td>294</td>
<td>Preferred for patients with low sodium bicarbonate and hyperchloremia. Monitor electrolytes, especially potassium and magnesium</td>
</tr>
<tr>
<td>D5/0.45% with potassium chloride (KCl) 20 mEq</td>
<td>77</td>
<td>77</td>
<td>20</td>
<td>N/A</td>
<td>50</td>
<td>N/A</td>
<td>447</td>
<td>Consider in Step 2 of the DKA/HHS/EDKA for patients with potassium ≤ 5 mmol/L</td>
</tr>
<tr>
<td>D5/0.45% sodium chloride</td>
<td>77</td>
<td>77</td>
<td>N/A</td>
<td>N/A</td>
<td>50</td>
<td>N/A</td>
<td>406</td>
<td></td>
</tr>
<tr>
<td>D10/0.45% sodium chloride</td>
<td>77</td>
<td>77</td>
<td>N/A</td>
<td>N/A</td>
<td>100</td>
<td>N/A</td>
<td>660</td>
<td>Consider increasing dextrose to 10% if patient is experiencing hypoglycemia and persistent anion gap metabolic acidosis</td>
</tr>
</tbody>
</table>
SUGGESTED READINGS


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DEVELOPMENT CREDITS

This practice consensus statement is based on majority opinion of the Hyperglycemic Emergency Management workgroup at the University of Texas MD Anderson Cancer Center for the patient population. These experts included:

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