DKA and HHS

2024 consensus criteria, treatment order, potassium, euglycemic DKA and monitoring

DIAGNOSIS (2024 CONSENSUS)

DKA needs all three: D (diabetes or high glucose), K (ketonemia), A (acidosis). HHS needs all four of its criteria; altered mental status is no longer one. Over a third of crises are mixed.

BOHB = beta-hydroxybutyrate. Effective osmolality (mOsm/kg) = 2 × Na^+ + glucose ÷ 18.

MARKER	DKA	HHS
Glucose	≥200 mg/dL or known diabetes	≥600 mg/dL
Ketones	BOHB ≥3.0 mmol/L or urine ≥2+	BOHB <3.0 or urine <2+
Acid–base	pH <7.30 and/or HCO_3^- <18	pH ≥7.30 and HCO_3^- ≥15
Osmolality	Variable	Effective >300 or total >320
Onset	Hours to days	Days to weeks
Picture	Kussmaul, fruity breath, abdominal pain	Older, T2D, severe dehydration, confusion

EXAM TIP 2024 changes: DKA glucose 250 → 200 or known diabetes; blood BOHB preferred; HHS effective osmolality 320 → 300; hold insulin if K^+ <3.5 (was 3.3); dextrose at 250 (was 200). Older books use 2009 numbers.

DKA SEVERITY AND RESOLUTION

Severe DKA and HHS go to the ICU.

GRADE	PH	HCO_3^-	MENTAL STATUS
Mild	>7.25 to <7.30	15–18	Alert
Moderate	7.00–7.25	10 to <15	Alert or drowsy
Severe	<7.00	<10	Stupor or coma

- DKA resolved: BOHB <0.6 mmol/L plus venous pH ≥7.3 or HCO_3^- ≥18
- HHS resolved: osmolality <300, glucose <250, urine >0.5 mL/kg/h, mentation improving
- Do not use the anion gap or urine ketones to call resolution

TREATMENT ORDER

Typical adult doses for exam study. Follow your institution's protocols.

1. Fluids: 0.9% saline or balanced crystalloid 500–1,000 mL/h for 2–4 h (smaller boluses, e.g. 250 mL, if older, heart failure or dialysis)
2. Potassium: check before insulin (table below)
3. Insulin: regular IV 0.1 unit/kg/h; 0.1 unit/kg bolus (IM or IV) only if IV access is delayed. Uncomplicated mild to moderate DKA may use SC rapid-acting insulin every 1–2 h
4. Glucose <250 mg/dL: add D5–D10, lower insulin to 0.05 unit/kg/h, aim for about 200
5. Bridge: SC basal insulin 1–2 h before the drip stops
6. Treat the trigger: infection, missed insulin, new diabetes, MI, stroke, pancreatitis

Goal K^+ 4–5 mEq/L.

K^+ (MEQ/L)	ACTION
<3.5	Hold insulin; give K^+ about 10 mEq/h until >3.5
3.5–5.0	Start insulin; add 20–30 mEq K^+ per liter
>5.0	Start insulin; no K^+ yet, recheck

SAFETY Never start insulin with K^+ below 3.5: it drives K^+ into cells and can cause fatal arrhythmias and respiratory weakness.



Severe hyperkalemia (tall T, flat P, wide QRS). K^+ may be high on arrival from a shift out of cells; total body K^+ is still low.

EXAM TIP Priority: fluids, potassium, then insulin. Glucose falls below 250 long before ketoacidosis clears: add dextrose and keep insulin running.

BICARBONATE, PHOSPHATE AND HHS PACING

- Bicarbonate: not routine; consider only if pH <7.0 (2009: <6.9)
- Phosphate: replace only if severely low with weakness or respiratory or cardiac compromise
- HHS insulin: 0.05 unit/kg/h; 0.1 if mixed DKA–HHS (BOHB ≥3.0, pH <7.30 or HCO_3^- <18)
- HHS limits: glucose fall ≤90–120 mg/dL per h, osmolality fall 3–8 mOsm/kg per h, Na^+ fall ≤10 mEq/L in 24 h
- Na^+ rises about 1.6 mEq/L per 100 mg/dL glucose fall; that alone is no reason for 0.45% saline

EUGLYCEMIC DKA AND SGLT2 INHIBITORS

- Glucose <200 mg/dL with DKA ketones and acidosis; about 10% of DKA
- Most cases now: SGLT2 inhibitors (-gliflozins). Also pregnancy, fasting, alcohol, liver failure
- Check ketones and pH in any ill SGLT2 inhibitor user, whatever the glucose
- Treat as DKA, but start D5–D10 with the first fluids
- Stop SGLT2 inhibitors on admission; hold at least 3 days before elective surgery (ertugliflozin 4)
- After DKA: no routine restart in T2D; not recommended in T1D

EXAM TIP Classic trap: vomiting, Kussmaul breathing and a high anion gap with glucose 160 on empagliflozin. Glucose under 200 does not rule out DKA.

COMPLICATIONS AND NURSING MONITORING

SAFETY Cerebral edema: rare in adults (<0.1%), about 30% fatal; more common in children. Report new headache or vomiting after treatment starts, falling LOC, slowing heart rate or incontinence at once. Mannitol or hypertonic saline treats it.

- Glucose every 1–2 h; hypoglycemia is common during treatment
- K^+ 2 h after insulin starts, then every 4 h; about half drop below 3.5; cardiac monitoring
- Electrolytes, phosphate, BOHB, venous pH (and osmolality in HHS) every 4 h
- Strict I&O; watch for fluid overload in older, cardiac or renal patients
- Serial neuro checks; VTE prophylaxis unless contraindicated
- Discharge teaching: sick-day rules, never skip basal insulin, ketone checks

Sources (9) are listed with links at icubasics.com/sheets/dka-hhs.html. For education and exam preparation only. Not medical advice; follow current guidelines and your institution's protocols. ICU Basics is an independent study aid not affiliated with any certifying body.