DKA/HHS Pathway Phase 1 (Adult)

DKA Diagnostic Criteria (See page 4 for more details):

- Blood glucose >250 mg/dl (unless SGLT2 inhibitor, liver disease, pregnancy…)
- 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** (insulin will drop the potassium further--> risk for cardiac arrhythmia)
   - Give 40 mEq/h until K ≥ 3.3 mEq/L
3. **Initiate DKA Order Set Phase I** (***In** PREGNANCY utilize OB DKA order set**)**
4. **Start insulin** 0.14 units/kg/hr IV infusion (calculate dose)
   RN will titrate per DKA protocol

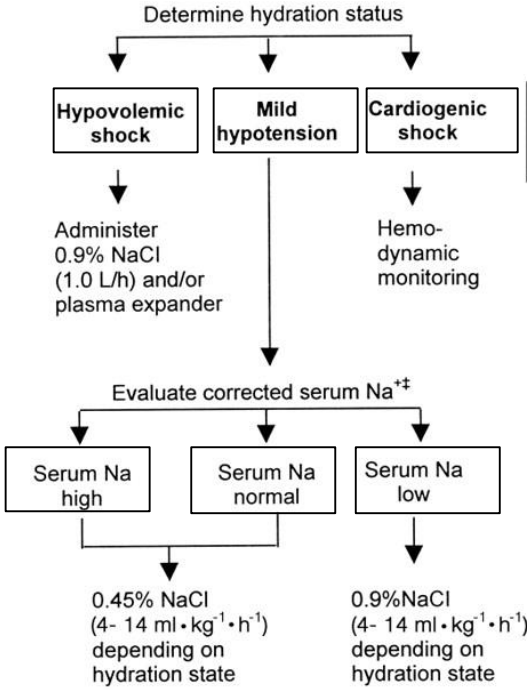
Look for the Cause:

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

PREGNANCY

- Utilize OB DKA order set Phase 1
- When glucose reaches 200mg/dL, Initiate OB DKA Phase 2
- Glucose goals 100-150mg/dL OB DKA Phase 2

IVF



Insulin

Initiate and continue insulin gtt until serum glucose reaches 250 mg/dl.

RN will titrate per protocol to achieve this target.

When sugar < 250 mg/dl proceed to DKA Phase II

*In PREGNANCY when sugar <200 proceed to OB DKA Phase II

Potassium

K <3.3 mEq/L:

HOLD insulin and give 40mEq K per hour until 3.3 or greater

K 3.3-5.3 mEq/L:

Give 20-30 mEq K in each liter of IV fluid for a **goal serum K 4-5** mEq/L

K > 5.3 mEq/L:

Do not replete K, monitor the level q2h

Bicarbonate

Assess need for bicarb

- pH 6.9 or less → Give 100mEq bicarb in 1L 0.45% NaCl → Repeat q2h until pH is > 6.9
  Consider adding K to these fluids as bicarb drives K into cells
- pH > 6.9 → No bicarb

Approved by the DKA & Glycemic Control Committee, MMC, updated 6_2021
Owners: Dr. Laura Anderson and Stacey Starbird-Richmond

DKA/HHS Pathway Phase 2 (Adult)

Phase 2: Glucose now less than 250mg/dL

(*BS <200mg/dL in pregnancy)

Patients with euglycemic DKA, glucose less than 250, will start at phase 2

If Anion Gap has not resolved

- 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. (***100-150mg/dL IN PREGNANCY**)
- Continue to check labs regularly.
- Reevaluate for underlying causes and consider undetected stressor/ illness.

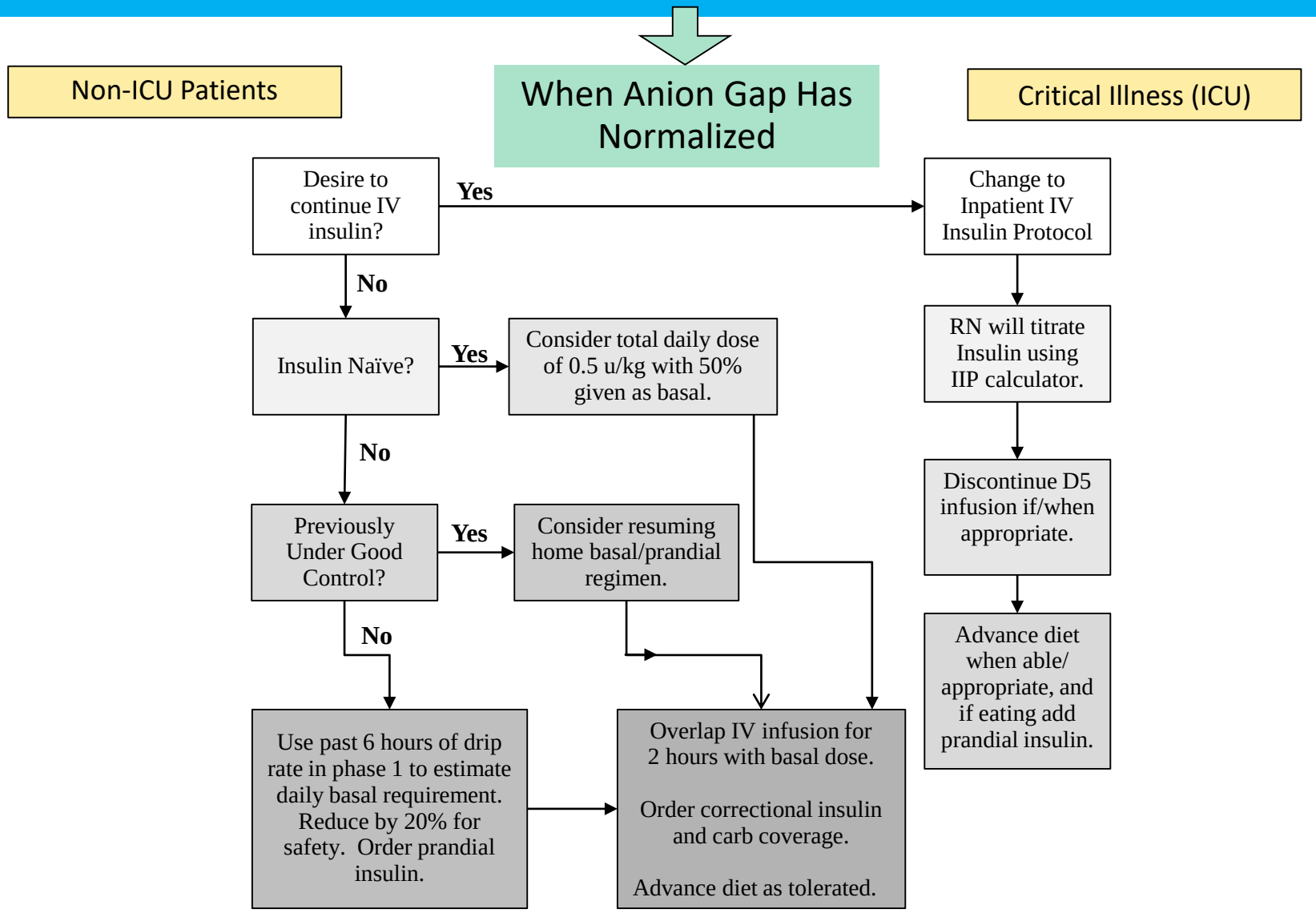
Refer Intranet> Search Glycemic> Select Diabetes (Glycemic Control) Program: IV Insulin or IV to SC Insulin Transition for further guidance.

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

Approved by the DKA & Glycemic Control Committee, MMC, updated 6_2021
Owners: Dr. Laura Anderson and Stacey Starbird-Richmond

DKA/HHS Pathway Phase 3 (Adult)

Phase 3: If starting subcutaneous (SC) insulin, the insulin drip must overlap with the SC basal insulin for two hours



Refer Intranet> Search Glycemic> Select Diabetes (Glycemic Control) Program: 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 the DKA & Glycemic Control Committee, MMC, updated 6_2021
Owners: Dr. Laura Anderson and Stacey Starbird-Richmond

DKA vs HHS

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

HHS = Hyperosmolar Hyperglycemic State
DKA = Diabetic Ketoacidosis

Severe DKA with pH less than 7 and bicarbonate less than 10 may warrant treatment with bicarbonate

*With the exception of euglycemic DKA
**Normal Anion Gap at MMC is 5-16 meq/L for the typical patient

Approved by the DKA & Glycemic Control Committee, MMC, updated 6_2021
Owners: Dr. Laura Anderson and Stacey Starbird-Richmond

Considerations in DKA: Diet and Electrolytes

Diet: Patients should be NPO until their blood glucose is < 250mg/dl, their anion gap has normalized, and they are feeling well enough to eat. At that point, add prandial insulin to cover carbohydrate intake.

Hypokalemia: For patients with significant hypokalemia (K< 3.3 meq/l), INSULIN MUST BE HELD until the K is 3.3 or greater. Patients must have q1h potassium checks throughout phase 1.

Hypernatremia: Most patients presenting with DKA are mildly hyponatremic because hyperglycemia leads to a dilutional effect. Occasionally patients may present with significant *hyper*natremia, particularly those with HHS. This reflects significant volume depletion and must be repleted with isotonic fluids (NS or LR). LR is preferred with large volumes as NS can drop the bicarb. 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 with treatment. This is expected and due to osmotic shifts that occur with reduction in hyperglycemia. For a patient with significant hypernatremia on presentation, serum sodium *falls* early on during treatment, and carries risk for cerebral edema. These patients must be monitored closely.

Hypophosphatemia: Body stores of phosphate are significantly depleted in DKA. Nonetheless, most patients with DKA, will not require phosphate repletion. Severe hypophosphatemia (≤1 mmol/dl) however, can be a medical emergency. These should be treated with IV phosphate repletion and monitored on telemetry. Periodic measurement of phosphate levels during the initial treatment of DKA is reasonable.

Approved by the DKA & Glycemic Control Committee, MMC, updated 6_2021
Owners: Dr. Laura Anderson and Stacey Starbird-Richmond

Considerations in DKA

BG Monitoring/Insulin Infusion Titration: All patients in DKA/HHS must have hourly blood glucose monitoring while on an insulin infusion. The Nova Meter bedside glucometer has been approved for use in DKA with a BG range of 10-600mg/dL and is preferable due to more rapid results**.** If the BG is > 600mg/dL, an hourly venous lab BG must be obtained. Do not follow both venous and glucometer readings simultaneously.

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

Phase 2: Once the glucose has dropped to less than 250mg/dl, phase 1 is complete. Patients who continue to have an elevated anion gap (>16 meq/l) due to ongoing ketoacidosis (and not another etiology), should continue on IV insulin therapy until the gap has closed (phase 2). Continue hourly BG monitoring and keep NPO. In order to avoid hypoglycemia, add a dextrose infusion for a target range of 150-200 mg/dl. The rate and concentration of dextrose should be adjusted as needed, but most importantly, the IV insulin should not be discontinued. The typical insulin dose range in Phase 2 is 0.02 to 0.05 U/kg per hour, and 2.5 units per hour is a suggested infusion rate for most patients.

Approved by the DKA & Glycemic Control Committee, MMC, updated 6_2021
Owners: Dr. Laura Anderson and Stacey Starbird-Richmond

Considerations in DKA

Phase 3: Once DKA is resolved with a normal anion gap, add a diet and transition the patient to SC basal, prandial & correctional insulin. *Long-acting SC insulin should overlap with the insulin infusion overlap for two hours.*

Certain patients who are critically ill and will remain NPO (pre-op, bowel obstruction, etc), may benefit from continuing on an insulin drip after DKA has resolved. In this case, transition to the Insulin Infusion order set.

Euglycemic DKA: Patients with hepatic dysfunction, malnutrition, pregnancy, or on SGLT2 inhibitors may on occasion present with only mild hyperglycemia (BG < 250 mg/dl), but a marked anion gap elevation from significant ketoacidosis. These patients should be started in phase 2 of the DKA protocol.

Pregnancy: Pregnancy warrants tighter control. Initiate the OB DKA Phase 1 until BG 200mg/dL, then maintain BG 100-150mg/dL on IV insulin utilizing OB DKA Phase 2 until anion gap normalized.

Approved by the DKA & Glycemic Control Committee, MMC, updated 6_2021
Owners: Dr. Laura Anderson and Stacey Starbird-Richmond