

Diabetic Ketoacidosis (DKA) Emergency Department 2 Bag System Care Guideline

Inclusion Criteria (Definition of DKA):

- Blood glucose (BG) > 200 mg/dl
 - Acidosis (bicarbonate < 15 or blood gas pH < 7.3)
 - Associated glycosuria, ketonuria & ketonemia
- Requires Critical Care level of care**

If patient is wearing an insulin pump – remove pump, cannula and tubing

Initial Evaluation

Assessment: VS, weight, severity of dehydration, level of consciousness, acute trigger for DKA (e.g. infection, trauma, failure to take insulin, pump failure)

Laboratory: Stat bedside BG, BMP, phosphorous, magnesium, venous pH, pCO₂, pO₂, CBC, UA, appropriate cultures if infection suspected. (HbA1c only if new onset DM/DKA)

Give 10-20 mL/kg of 0.9% normal saline (NS), administer over one hour
For overt shock – consider giving up to 40mL/kg

Insulin Drip

Ensure K level WNL prior to starting insulin drip

Starting dose 0.05 to 0.1 units/kg/hr
Titrate insulin by 0.01 units/kg/hr to keep
Blood Glucose between 150-300

Progress to 2 Bag System
Starting with Phase 1
On page 2

❖ Neuro checks for S/S of cerebral edema every hour

Cerebral Edema Signs and Symptoms

- Headache
- Altered or fluctuating level of consciousness
- Sustained heart rate deceleration
- Abnormal and deteriorating neurological exam
- Abnormal respiratory pattern
- Recurrent vomiting
- Rising blood pressure
- Decreased oxygen saturation
- Change in neuro status
- Restlessness

Cerebral Edema Treatment

- Give mannitol 0.5 gm/kg may be repeated X 1 for a total max of 50 gm
- Ensure adequate circulation but if possible reduce fluid rate by one third
- Avoid maneuvers and drugs likely to increase intracranial pressure
- If intubation is necessary consider neurosurgery consult for intracranial pressure monitoring
- Treat suspected cerebral edema based on clinical criteria immediately. Do not delay treatment to obtain confirmatory CT scan.

Ongoing Monitoring

- BP, HR, RR
- Neuro checks every hour
- Bedside BG every hour
- BMP every 2 hours X 3 then every 4 hours if improving

Patient to be Admitted to PICU

Recommendations/Considerations

- **The severity of DKA** is defined by the degree of acidosis: **mild** – pH 7.2 – 7.3; **moderate** – pH 7.1 – 7.2; **severe** pH < 7.1
- Goal decrease in glucose no more than 100 mg/dl per hour
- If glucose decreases rapidly this may increase the risk of cerebral edema
- Monitor Na level correction to ensure Na rises as glucose decreases using calculation of corrected Na level

Severity of dehydration:

- **5%** - reduced skin turgor, dry mucous membranes, tachycardia
- **10%** - capillary refill ≥ 3 seconds, sunken eyes
- **>10%** - weak or impalpable peripheral pulses, hypotension, shock, oliguria

Calculations:

- Anion gap = Na – (Cl+HCO₃); normal is 12 ± 2 mmol/l
- Corrected sodium = measured Na + 1.6 X [(glucose mg/dl – 100) / 100]
- DKA at diagnosis is more common in children < 5 yrs of age
- Omission of insulin is the leading cause of recurrent DKA in adolescents

Causes of Morbidity and Mortality:

- **Cerebral edema**, which occurs in 0.5 – 1 % of all episodes of DKA, is the most common cause of mortality in children with DKA, Cerebral edema usually develops 4 – 12 hours into treatment, but it can occur at any time
- **Hypokalemia**
- **Na Bicarb should not be given without discussion with two attending physicians as this increases the risk of cerebral edema.**
- **For insulin drip, tubing must be manually primed.**

Correction of Dehydration

- Estimate fluid deficit
- Subtract initial bolus received
- Divide remaining deficit over 48 hours
- Add deficit replacement/hour to normal maintenance/hr = Total fluid rate per hour
- Re-evaluate I/O for excessive ongoing urine loss
- **Do not bolus > 40 mL/kg in 4 hours unless hypotensive or has significantly compromised perfusion**

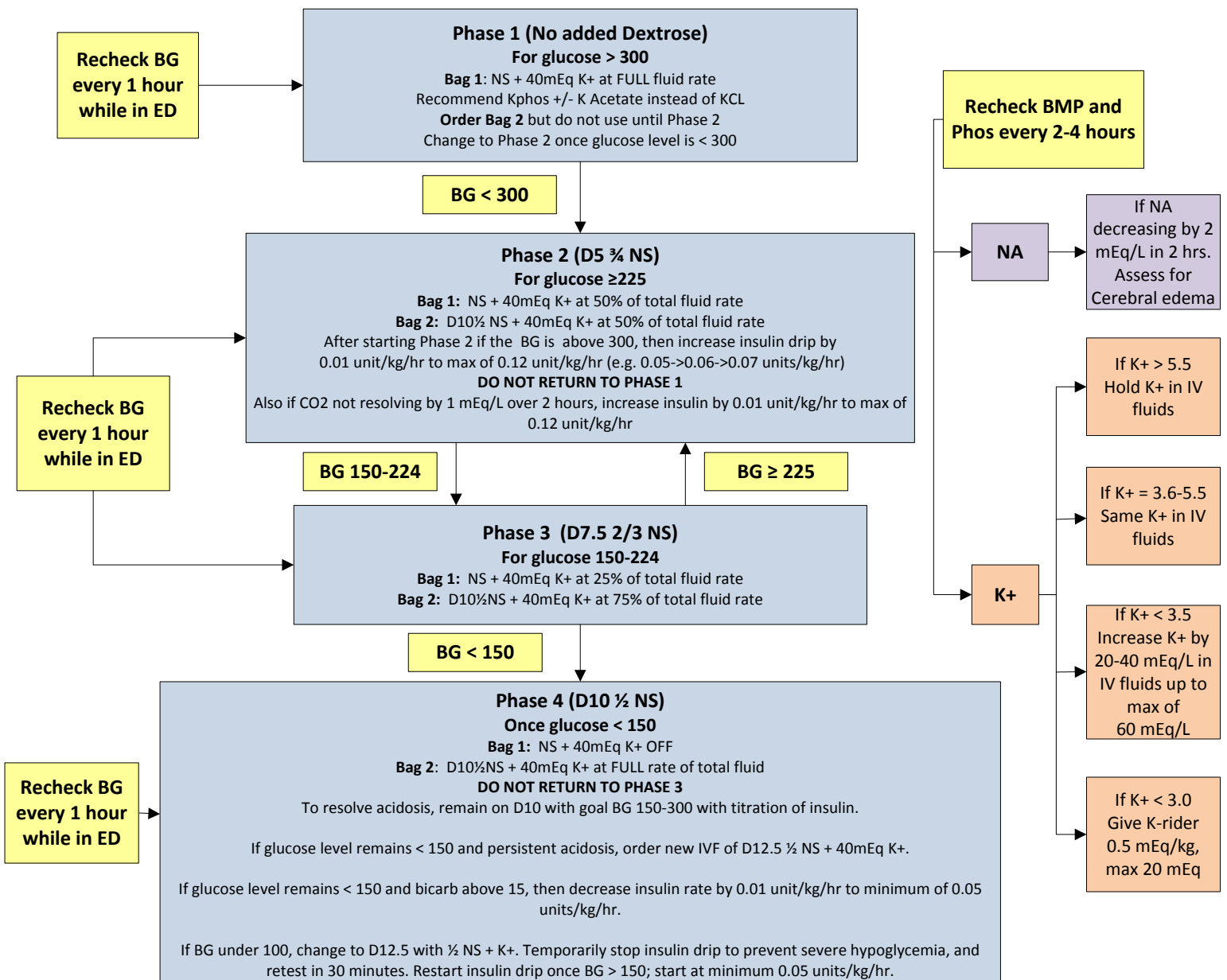
Principals of 2 Bag System

- Total fluid rate is dependent on amount needed for treatment of dehydration as above (usually around 1.5 X maintenance)
- Using 2 bags allows for change in glucose infusion rate without ordering multiple IV bags
- Insulin drip rate is adjusted to ensure resolution of acidosis – 0.05-0.12 unit/kg/hr
- Do not decrease insulin rate below 0.05 unit/kg/hr without discussion with Endocrinologist on-call

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Individual rates of Bag 1 and Bag 2 are dependent on glucose level with goal of maintaining glucose of 150-300.
Total rate depends on fluid needs.

	Plasma Glucose	Bag 1 NS	Bag 2 D10 ½ NS	Final Dextrose Concentration %	Final NaCL Concentration
Start Phase 1	>300	100%	0%	0	NS
Once BG <300 Phase 2	225-300	50%	50%	5	¾ NS
Phase 3	150 – 224	25%	75%	7.5	2/3 NS
Phase 4	100 – 149	0%	100%	10	½ NS
	<100	Change to D12.5% with ½ NS + K and hold insulin drip for 30 minutes until BG > 150			



References
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Dunger DB, Sperling MA, Acerini CL, *et al* ESPE/LWPES consensus statement on diabetic ketoacidosis in children and adolescents. Archives of Disease in Childhood 2004;89(2):188-194. doi: <http://dx.doi.org/10.1136/adc.2003.044875> **(Level V)**

Fagan MJ, Avner J, Khine H. Initial fluid resuscitation for patients with diabetic ketoacidosis: How dry are they? Clinical Pediatrics 2008; 47(9): 851-855. doi: <http://dx.doi.org/10.1177/0009922808319960> **(Level V)**

Felner EI, White PC. Improving management of diabetic ketoacidosis in children. Pediatrics 2001; 108(3): 735-740. doi: <http://dx.doi.org/10.1542/peds.108.3.735> **(Level V)**

Glaser N. Pediatric diabetic ketoacidosis and hyperglycemic hyperosmolar state. Pediatric Clinics of North America 2005; 52(6): 1611-1635. doi: <http://dx.doi.org/10.1016/j.pcl.2005.09.001> **(Level V)**

Koul PB. Diabetic ketoacidosis: A current appraisal of pathophysiology and management. Clinical Pediatrics 2009; 48(2): 135-144. doi: <http://dx.doi.org/10.1177/0009922808323907> **(Level V)**

Wolfsdorf J, Glaser N, Sperling MA. Diabetic ketoacidosis in infants, children, and adolescents. A consensus statement from the American Diabetes Association. Diabetes Care, May 2006; 29(5): 1150-1159. doi: <https://doi.org/10.2337/dc06-9909> **(Level V)**