GUIDELINES FOR MANAGEMENT OF PEDIATRIC DKA

IMMEDIATE ASSESSMENT

PLEASE NOTE: the DKA protocol and supplementary material are designed as a guideline/algorithm for treating the majority of cases of DKA in infants, children and adolescents. **It cannot replace careful clinical observation and judgment in treating this potentially very serious condition.** If you have questions or problems related to the management of DKA or diabetes, please feel free to contact the Janeway Pediatric Intensive Care Specialist or Pediatric Diabetes Doctor on call 709 777 6300.

BC CHILDREN'S HOSPITAL DKA TOOLKIT:
www.bcchildrens.ca/Services/SpecializedPediatrics/EndocrinologyDiabetesUnit/forprofessionals/dkaprotocol.htm

ISPAD PEDIATRIC DKA GUIDELINES:
www.ispad.org/FileCenter/ISPAD_Guidelines_2009_DKA.pdf

Mild hyperglycemia: even with ketones and mild acidosis, mild DKA can often be managed without IV fluids or IV insulin, particularly in the older child or known diabetes patient who is not vomiting or seriously dehydrated.

Since most patients develop DKA over days, slow metabolic repair is safest. Over-hydration may contribute to cerebral edema.

DKA RISK FACTORS

- New onset T1DM or T2DM
- Age < 5 years
- Adolescent (F>M)
- Psychosocial difficulties
- Children with poor metabolic control
- Recurrent DKA
- Insulin omission
- Stress: Infection/Trauma
- Insulin delivery issues with insulin pump therapy (only delivers rapid-acting insulin)

CLASSIFICATION OF DKA

	pH	bicarbonate
mild	<7.3	<15mmol/L
moderate	< 7.2	<10mmol/L
severe	< 7.1	<5mmol/L

MOST PATIENTS WITH DKA REQUIRE ICU ADMISSION PARTICULARLY:

- Moderate (pH<7.2) or Severe DKA (pH< 7.1)
- Presence of shock
- IV insulin infusion
- Altered level of consciousness
- Age < 5 years
- Other risk factors for cerebral edema

INFECTION COULD BE A TRIGGER FOR DKA:

- Examine for signs of infection
- Do appropriate septic workup and treat with IV antibiotics if indicated

Caution with giving medications that may alter mental status: ie. dimenhydinate (Gravol®), benzodiazepines.

Large fluid boluses are potentially dangerous: IV fluids should be administered slowly and with caution, unless the patient is in hypotensive shock. Only very rarely will a 20 cc/kg fluid bolus be required to maintain perfusion.

Rapid, deep mouth-breathing (Kussmaul respiration): often dries out the oral mucosa, making the child appear more dehydrated than s/he really is. The hematocrit and other clinical signs noted are more accurate.

Calculations:

Anion gap = Na − (Cl + HCO3) Normal = 12 ± 2 mmol/L

Corrected Na = measured Na + (2 x ([plasma glucose − 5.6]/5.6))

Serum Osmolality (mOsm/L) = 2(Na + K) + glucose + Urea

DKA TREATMENT

Hydration:

- Most patients do not need intravenous fluid (IVF) bolus
- Give normal saline (NS) resuscitation bolus only if patient has signs or symptoms of shock; recommended amount:
  hypotensive shock...10-20 cc/kg 0.9% NS bolus.
  normotensive shock…. 7ml/kg over 30 minutes
- Do not use hypotonic fluids in the first 4-6 hours
- Goal is to correct dehydration, acidosis and hyperglycemia over 48 hours
- Continually re-evaluate status (glycemia, acidosis, vital signs, mental status)
- Aim to decrease blood glucose by 3-5 mmol/L every hour
- Add dextrose as D5WNS when BG <14-17 mmol/L OR when decrease in glucose is too rapid (> 5mmol/hr)
- Estimate extent of dehydration (↓ BP, tears, skin turgor, capillary refill; ↑ hematocrit) in ml/kg

INSULIN TREATMENT:

- Do not give bolus of insulin
- Start IV insulin 1-2 hours after IV fluid initiation
- IV insulin infusion at 0.1 U/kg/hr
- Maintain IV insulin infusion until anion gap and pH normalize
- Monitor blood glucose at least every 1 hour on insulin infusion
- **IV insulin boluses are always contra-indicated**
- **Insulin given in the first 1–2 h of DKA repair is thought to increase mortality**

COMPLICATIONS OF DKA:

- Neurologic: Cerebral edema, CNS infarction
- Electrolyte abnormalities: Hyper/hypokalemia, hyper/hyponatremia, hypophosphatemia, hypomagnesemia,
- Hypoglycemia
- Cardiopulmonary: Hypovolemic shock, pulmonary edema, arrhythmia
- Other Systems: Bowel ischemia, acute renal failure, pancreatitis, rhabdomyolysis
- Death

The leading causes of mortality are: 1) not recognizing severity of shock; 2) too much fluids leading to cerebral edema; and 3) arrhythmia from hypokalemia.

Cerebral Edema:

Subclinical brain swelling is common in children with DKA. Cerebral edema (CE) accounts for more than half of the 1–5% mortality rate of DKA in children. The etiology of CE remains unclear, but aggressive hydration has been implicated in several studies.

Cerebral Edema associated risk factors:

- New onset diabetes
- Age < 5 years old
- Initial pH <7.1 or pCO2 <18
- High initial urea
- Failure of Na to rise
- Rapid rehydration with hypotonic fluids (> 50cc/ kg in first 4 hrs)
- Insulin given as bolus or in the first hour of fluid administration
- Bicarbonate administration

DOCTORS' ORDERS ON ADMISSION STAT:

- Vital signs and neurovital signs on admission and then hourly
- Weigh patient (kg)
- Strictly monitor input and output
- Nothing by mouth
- Pulse oximetry and cardiac monitor
- Insert large-bore intravenous cannula X 2
- Capillary blood glucose by fingerpoke
- Urine for ketones
- Capillary blood gas; serum sodium, potassium, chloride; anion gap, ionized calcium, glucose, serum osmolality, urea, creatinine, phosphorus; complete blood-cell count/ differential, HbA1C
- Other investigations such as septic workup if required

Fluid Resuscitation Bolus (ONLY AS NECESSARY FOR CARDIOVASCULAR INSTABILITY) 0.9% sodium chloride _____ mL IV over _____ minutes
Fluid Repair (initial 1–2 hours): 0.9% sodium chloride, run at _____ mL/hour IV until _____ o'clock
Fluid Repair (after first 1–2 hours) add potassium: begin at _____ o'clock
Insulin Infusion (after first 1–2 hours): begin at _____ o'clock

Ongoing Monitoring:

- capillary glucose every _____ minutes (suggested 30–60 minutes)
- capillary blood gas; serum sodium, potassium, chloride; anion gap, ionized calcium, glucose, urea, creatinine, phosphorus every _____ hours (suggested 2–4 hours)

If patient develops severe headache or alteration in vital signs or Glasgow Coma Scale Score <15: notify physician STAT, raise head of bed 30°, decrease all IV fluids to 5 mL/hour, and have mannitol ready at bedside for infusion.