BOTTOM LINE RECOMMENDATIONS

Diabetic Ketoacidosis (DKA)

Diabetic ketoacidosis (DKA) is a serious complication of new-onset or existing Type 1 or Type 2 diabetes. Dehydration and metabolic derangements associated with DKA are treated with liberal fluid resuscitation, insulin infusion, and close monitoring of neurological, metabolic, and fluid status. Episodes of pediatric DKA **must** be treated according to a pediatric-specific protocol (refer to TREKK's Pediatric DKA Algorithm) in close communication with a pediatric diabetes specialist.

Make the diagnosis and determine severity

» Diabetes (either new-onset or existing): random blood glucose of >11 mmol/L **AND**
» Acidosis: pH <7.3 or HCO_3 <18 mmol/L on venous or capillary blood gas **AND**
» Ketonuria/ketonemia: moderate/large urine ketones or serum beta-hydroxybutyrate ≥3 mmol/L

DKA Severity			
	Mild	Moderate	Severe
pH	7.2-7.29	7.1-7.19	<7.1
HCO_3 (mmol/L)	10-17	5-9	<5

Assess the patient

» Evaluate airway, breathing, circulation, level of consciousness, and signs of dehydration.
» Reassess ABCDs and vital signs frequently, as clinical condition can rapidly change.
» Obtain history of oral intake, urine output, weight loss, headache, nausea, vomiting, abdominal pain, weakness, and additional health conditions and medications.
» Ask about precipitating factors: intercurrent illness, adherence to insulin regimen in patients with known diabetes, new medications, pregnancy.
» Urgent laboratory investigations should include:
  - Blood glucose, venous blood gas, Na, K, Cl, (Ca, PO_4, if available), urea, creatinine, osmolality, serum or urine ketones

CEREBRAL INJURY MAY COMPLICATE ANY EPISODE OF PEDIATRIC DKA

» Up to 1% of episodes of pediatric DKA may be complicated by significant cerebral injury (CI) associated with high morbidity and mortality.[1] Additionally, evidence suggests that pediatric patients may experience both subclinical CI as well as long-term cognitive sequelae.[2,3]
» There is NO difference in the incidence of CI between pediatric DKA patients treated with a standard or rapid fluid resuscitation protocol using isotonic or hypotonic IV fluid.[4]

IDENTIFY PATIENTS AT RISK FOR CEREBRAL INJURY:

- Greater acidosis (↓pH), hypocapnia (pCO_2<18)
- Longer duration of symptoms
- More severe evidence of dehydration (↑hematocrit, ↑urea)
- Younger age (<5 years)
- New-onset diabetes
- Sick appearance

RECOGNIZE CEREBRAL INJURY:

» GCS ≤13, severe/progressive headache, vomiting, focal neurological signs, incontinence
» Irritability/inconsolability in pre-verbal children
» Cushing's triad (↑BP, ↓HR, abnormal breathing)

Contact Pediatric Referral Centre

Please visit our website at trekk.ca for more information.

BOTTOM LINE RECOMMENDATIONS

Diabetic Ketoacidosis (DKA)

Initiate management

Minimize treatment-associated risks for cerebral injury.
NEVER start insulin infusion before 1 hour of IV fluid. **NEVER** give bolus IV insulin.
Sodium bicarbonate is **ONLY** used for hyperkalemia with ECG changes or if indicated during CPR.

- **ALL** pediatric DKA patients should receive NS or RL 20 mL/kg (MAX 1 L) IV bolus over 20 minutes.[5] In the rare circumstance that the patient is hypotensive, give as rapid push over 5-10 minutes. Reassess perfusion.
- Repeat IV bolus in patients with ongoing hypoperfusion (capillary refill time ≥3 sec centrally, cool extremities) or hypotension. Reassess perfusion after each bolus. Discuss further fluid management with Pediatric Referral Centre.
- Delay start of IV infusion of insulin (0.1 units/kg/hour) until **1 hour** after IV fluid is started.
- **Calculate** ongoing IV fluid rates using Rehydration Table below, which replaces a 10% fluid deficit and maintenance requirements over 36 hours. Use NS or RL with added KCl as per TREKK's Pediatric DKA Algorithm.

Rehydration Table: Ongoing IV Fluids				
Weight (kg)	5 - <10 kg	10 - <20 kg	20 - <40 kg	≥40 kg
Rate (mL/kg/hr)	6.5	6	5	4 (max 500 mL/hr)

- Add 5% dextrose to IV fluid once blood glucose is less than 17 mmol/L or if blood glucose is decreasing by more than 5 mmol/L/hr after insulin infusion is started. Increase to 10% dextrose as needed to keep blood glucose >10 mmol/L.
- Monitor blood glucose and fluid balance Q1H. Monitor venous blood gas, electrolytes, urea, and creatinine Q2H.

TREAT SUSPECTED CEREBRAL INJURY:

- Manage ABCs. Monitor BP and perfusion closely to avoid hypotension and prevent further cerebral injury.
- Elevate the head of the bed to 30 degrees; keep head in midline.
- After initial fluid resuscitation, run ongoing IV fluids at 75% of rate outlined in Rehydration Table above.[6]
- Administer 3% NaCl 5 mL/kg (MAX 250 mL) IV over 10 min OR mannitol 0.5-1 g/kg (MAX 100 g) IV over 15 min.
- May repeat hyperosmolar agent dose x 1 after 30 min if no improvement or use alternate agent.
- Head CT is not required prior to treatment or transport.

CAUTION: Intubation and ventilation are **HIGH RISK** procedures in DKA. Unless there is acute respiratory failure, consult Pediatric Referral Centre or Transport Team prior to intubation. The patient's $ETCO_2$ must not be allowed to rise prior to/during intubation.

Patient disposition

- Discuss the need for admission, transfer, or intensive care with Pediatric Diabetes Specialist and/or Pediatric Referral Centre.
- A diagnosis of Type 1 or 2 diabetes is life-changing and must be communicated sensitively and with appropriate supports in place. Key messaging should emphasize that recent advancements in diabetes care have led to much improved health and quality of life; this diagnosis should not limit the future goals and dreams of the child/youth. Receiving a diagnosis of diabetes may be devastating for young people, especially since they may know of a friend or relative with severe complications from this disease. Approach the conversation with care.

For a full list of references and development team members, please see the following page.

BOTTOM LINE RECOMMENDATIONS

Diabetic Ketoacidosis (DKA)

Bottom Line Recommendations

Bottom Line Recommendations are short summaries for healthcare providers of the latest knowledge related to the diagnosis and management of pediatric emergency conditions. This resource is not intended to be used as a step-by-step guide. It is ideal for educational purposes and to summarize existing evidence on diabetic ketoacidosis in pediatric emergency care. Development of this resource involved a rigorous and iterative process, bringing together experts from a variety of specialties (nursing, emergency medicine, intensive care, and pharmacy). To learn more about the development, see the References & Development Team section below.

References

1. Edge JA, Hawkins MM, Winter DL, Dunger DB. The risk and outcome of cerebral oedema developing during diabetic ketoacidosis. Arch Dis Child 2001;85:16-22.
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Thank you to the TREKK Editorial Committee and Editor Sarah Reid, who provided editorial support and expertise in the development of this resource.

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To see our resource development process please visit our website here.

Funded by: