

Diabetic Ketoacidosis (DKA) Treatment ALGORITHM

Algorithm for the Management of Diabetic Ketoacidosis (DKA)

Inclusion:
Suspicion of DKA
Exclusion:
Symptoms clearly attributed to other causes

Immediate Assessment:
Place patient on full cardio/respiratory (CR) monitor and obtain Vital Signs
Refer to ED/UC RN standing orders

Clinical History
Polyuria
Polydipsia
Weight loss
Abdominal pain
Fatigue
Vomiting
Confusion

Clinical Signs
Assess dehydration
Deep sighing respiration (Kussmaul)
Smell of ketones
Lethargy/drowsiness + vomiting

Obtain Initial Labs
RFP or BMP with phos, ketones (urine or blood), blood glucose, VBG, A1C
DKA diagnosis confirmed by initial labs:
Hyperglycemia with glucose greater than (>)200 mg/dL
pH less than (<)7.3 or HCO3 less than (<)15, and
Ketonemia or ketonuria
Contact diabetes physician
* If patient is wearing an insulin pump, remove it after confirmation of DKA

If blood glucose is ≥ 600 mg/dL, calculate Serum Osmolality to evaluate for possible hyperosmolality. Contact diabetes physician if calculated Serum Osmolality is ≥ 320 mOsm/kg for further guidance on management.
$$\text{Serum osmolality} = (\text{Na} \times 2) + (\text{Glucose}/18) + (\text{BUN}/2.8)$$

If not DKA, but the patient has diabetes or hyperglycemia, contact diabetes physician

! If considering intubation, contact PICU physician and suspect cerebral edema

! Intravenous insulin boluses and sodium bicarbonate are contraindicated in DKA patients

Does the patient have concern for shock: hypovolemic instability, decreased end organ perfusion, altered mental status, and/or hypotension?

Resuscitation
• Maintain SpO2 at 100%
• 0.9% NaCl 10-20 ml/kg over 30 minutes and repeat until circulation is restored. Do not exceed 40mL/Kg
• Consider early pressors
• Avoid sedating drugs

If acidosis not improving or if deterioration, contact PICU physician

Re-evaluate
• IV fluid calculations
• Insulin delivery system and dose
• Need for additional resuscitation
• Consider sepsis

Initial Interventions
NaCl 0.9% 10-20 ml/kg bolus over 1 hour
Consider ECG if K is over 6 or under 3 mEq/L

- Obtain blood glucose (BG) after bolus complete and prior to starting insulin drip. Begin Q1 hour BG checks at this time
- Start regular insulin IV at 0.1 units/kg/hour after IV fluid bolus complete
Consider insulin drip rate as low as 0.05 units/kg/hour for the following situations: cerebral edema, altered mental status, difficulty in the past with higher rates, risk for hypoglycemia, hypokalemia, small body weight
- IV fluids at 1.5X maintenance
- Document strict I/O
- **Check neurological status at least hourly**

neurological WARNING SIGNS
Severe or worsening headaches, slowing heart rate more than expected from fluid resuscitation, irritability, irregular breathing, decreased level of consciousness, incontinence, or focal neurological abnormalities are present

Then, exclude hypoglycemia
Is it cerebral edema?

Management
Elevate head of bed
Give hypertonic saline 5ml/kg or Mannitol 1 g/kg, max dose 50g
Restrict to maintenance fluid rate
Contact ICU and diabetes physician
Consider cranial imaging only after patient stabilized

Labs
BG Q1 hour
RFP (or BMP with phos) q2 hours
VBG initially, Q2 until pH at or above 7.15
Beta Hydroxybutyrate initially and as needed before transition to SC
Obtain ECG if K is over 6 or under 3

***Initial Potassium Supplementation Table**

Initial Serum Potassium	Potassium Supplementation
Greater than 5.5	None
4.5-5.5	20 mEq/L K-Acetate + 20 mEq/L Kphos*
Less than 4.5	30 mEq/L K-Acetate + 30 mEq/L Kphos* Hold Insulin drip until K above 3.

K supplementation is based on initial lab level. If K changes in management, patient may require repletion with potassium bolus
*40 mEq/L KCL may be used if K-Acetate and Kphos unavailable

Blood Glucose (mg/dL)	% Rate NS ± Electrolytes	% Rate D10NS ± Electrolytes	Final Dextrose Concentration
>300	100%	0%	0
251-299	50%	50%	5
200-250	25%	75%	7.5
151-199	0	100%	10
< 150	Either decrease insulin drip as low as 0.05unit/kg/hour and/or increase GIR by increasing D10NS fluid rate (up to 2X maintenance) or change to D12.5 NS at 100% total rate		

* See potassium supplementation table.

DKA Resolution
Serum bicarbonate greater than or equal to (\geq)18 mEq/L OR Beta Hydroxybutyrate less than 1 mmol/mL
AND
Clinically well, tolerates PO challenge with non-carbohydrate containing liquid

Transition to Subcutaneous (SC) insulin
Contact diabetes physician for doses and timing
*See page 7 for transition algorithm

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TARGET POPULATION

Inclusion Criteria

Patients with suspected DKA

- Patients up to 21 years of age
- Patients referred for admission for diabetic ketoacidosis
- Patients admitted for evaluation and treatment of diabetic ketoacidosis
- Patients identified with diabetic ketoacidosis during their hospital stay

Exclusion Criteria

Patients with symptoms attributed to other causes

BACKGROUND | DEFINITIONS

Diabetic ketoacidosis (DKA) is a life-threatening medical emergency requiring immediate evaluation and treatment. Please notify the diabetes physician on call through One Call for all patients with known or suspected DKA.

Diabetic ketoacidosis (DKA) is a life-threatening condition. Almost 1 in 100 children with DKA will develop clinically significant cerebral edema, which has a mortality rate of 21-24%. Those with severe DKA have a much higher mortality and risk of complications. Meticulous attention to the details of therapy and the child's clinical course can decrease this risk. A patient who is unresponsive to vocal commands or presents with hypotension is rare and requires immediate critical care in a hospital. Urgent critical care and diabetes consultation should be obtained.

DKA is defined by:

- Hyperglycemia with glucose greater than 200 mg/dL, and
- pH less than 7.3 or HCO₃⁻ less than 15 and
- Ketonemia or ketonuria

INITIAL EVALUATION

- ED/UC Triage ESI level 1 or 2
- Immediate clinical assessment and history regarding presentation
- Patients need full cardio respiratory (CR) monitoring
- Obtain weight, vital signs, Glasgow Coma Scale, and pupil assessment
- Check bedside glucose (point-of-care blood glucose or POC BG)
- Assess signs/symptoms of DKA, which may include (but may not necessarily be present): polyuria/polydipsia, weight loss, breath with “fruity” odor (smell of ketones), Kussmaul breathing, altered mental status, abdominal pain, vomiting, fatigue, or candidiasis.
- Initial labs: RFP (Renal Function Panel) or BMP (Basic Metabolic Panel) and Phosphorous, ketones (urine or blood), blood glucose, VBG, A1C. See [Laboratory Study](#) section for details
- Do a full exam to look for concurrent infection, including GU to assess for candidiasis/abscesses.
- **Suspect cerebral edema if** the patient has severe or worsening headaches, slowing heart rate, irritability, irregular breathing, decreased level of consciousness, incontinence, focal neurological abnormalities, persistent vomiting, mental status changes, GCS less than 13. Rapid changes in serum Na, in either direction, also increase risk and should prompt increased vigilance for other signs of edema.

Clinical Criteria for Cerebral edema include: 1 Diagnostic Criterion, 2 Major criteria, or 1 Major and 2 Minor criteria (92% sensitivity, 96% specificity).

Diagnostic Criterion for Cerebral Edema:

- Abnormal motor or verbal response to pain
- Decorticate or decerebrate posture
- Cranial nerve palsy (esp. III, IV, and VI)
- Abnormal neurogenic respiratory pattern (grunting, tachypnea, Cheyne-Stokes, apneusis)

Major Criteria

- Altered mentation, confusion, fluctuating level of consciousness
- Sustained HR deceleration (decrease 20 bpm or greater) not attributable to fluid resuscitation or sleep state
- Age-inappropriate incontinence

Minor Criteria:

- Vomiting
- Headache
- Lethargy or not easily arousable
- Diastolic blood pressure greater than 90mmHg
- Age less than 5yrs

If cerebral edema is suspected, consider the following:

- Notify attending physician
- If outside the ED/ICU, activate code team and simultaneously call the pharmacy alerting them of the need for STAT medications. Initiate transfer to higher level of care
- Elevate the head of the bed.
- Decrease fluid rate to 1x maintenance and ensure patient is running isotonic fluids.
- Hypertonic saline (3%) 5 mL/kg IV over 15 minutes or mannitol 1 g/kg IV (max 50g) over 15 minutes
- Consider endotracheal intubation for GCS less than 8. For intubation, use ICP precautions and target ETCO₂ matching the patient’s pre-intubation pCO₂ or no higher than 30-35 mmHg – **CALL PICU FOR ASSISTANCE** with ETCO₂ targets and ventilator settings.
- Do NOT give dexamethasone or sodium bicarbonate.
- Do NOT delay treatment of cerebral edema to obtain imaging.

CLINICAL MANAGEMENT

Order set and initial clinical management

- If you suspect DKA, place orders using the DKA order set
 - **NOTE:** If the patient is on a study protocol, you will need to order medications per study protocol
- Obtain IV access
 - 2 PIV optimal
- Diet: NPO
- Monitors: place on cardio-respiratory monitors
- Neurological checks at least Q1 hour
 - For patients admitted to the floor, Q2 hour neuro checks

Initial Fluids

- Administer sodium chloride 0.9% 10-20 ml/kg bolus over 1 hour. Repeat as necessary to maintain adequate circulation. Unless patient is in shock, do not give more than 40 mL/kg in bolus fluids in the first 4 hours.
- If patient is in shock (hypovolemic instability, decreased end organ perfusion, altered mental status, and/or hypotension), follow PALS guidelines and contact PICU physician

Following IV NS Bolus(es)

- Vitals and neurological assessment (nursing)
- Place a second PIV for frequent laboratory sampling

Insulin

- Disconnect insulin pump and infusion site if patient is currently on their home insulin pump.
- Start IV regular insulin at 0.1 units/kg/hr – do NOT give an IV bolus of insulin. Insulin therapy and DKA IV fluids should be started after the initial rehydration bolus is complete. Do NOT start while bolus is still running.
 - Consider insulin drip rate as low as 0.05 units/kg/hour for the following situations: cerebral edema, altered mental status, difficulty in the past with higher rates, risk for hypoglycemia, hypokalemia, small body weight
 - Insulin is compatible with DKA fluids

Refer to [Insulin administration, subcutaneous and intravenous policy](#) for additional information

Fluids

- For patients whose initial potassium is 4.5-5.5: NS + 20 mEq/L potassium acetate + 20 mEq/L potassium phosphate, run at 1.5X maintenance. Also, order a bag of D10 NS + 20 mEq/L potassium acetate + 20 mEq/L potassium phosphate, to have at the bedside.
- For patients whose initial potassium is less than 4.5, standard IV fluids are: NS + 30 mEq/L potassium acetate + 30 mEq/L potassium phosphate, run at 1.5X maintenance. Also, order a bag of D10 NS + 30 mEq/L potassium acetate + 30 mEq/L potassium phosphate. Hold insulin drip until potassium is above 3.
- 40mEq/L KCL may be used if K-Acetate and Kphos unavailable
 - Order fluids per rate in orderset (refer to table below)
 - This may vary based on medication shortages or physician judgment.
 - Consider lower fluid rates if cerebral edema is suspected
 - Fluids may need to be adjusted based on serum potassium.
- Potassium supplementation

If hyperkalemia (K greater than 6) or hypokalemia (K less than 3), consider an ECG to assess T-waves.

Serum potassium	Potassium in the fluids
Greater than 5.5	None
4.5– 5.5	20 mEq/L K-Acetate + 20 mEq/L Kphos*
Less than 4.5	30 mEq/L K-Acetate + 30 mEq/L Kphos*
Less than 3.0	Hold insulin drip until K above 3. Utilize site specific resources, Pharmacy and Endocrine consultant for potassium repletion guidance, and insulin drip recommendations.
	*40mEq/L KCl if K-Acetate and Kphos unavailable

K supplementation is based on initial lab level. If K changes during management, patient may require addition of potassium to the fluids or repletion with potassium bolus.

The goal is to keep total fluids at 1.5x maintenance

- Goal blood glucose range is 150-250 mg/dL.
- When the blood glucose is approaching or is less than 300 mg/dL, the dextrose containing bag will need to be Y-ed into NS fluid bag.
 - Goal for fall in blood glucose: should not exceed 100 mg/dL/hour (after initial normal saline bolus is given).
 - Titrate the two bags based on current blood glucose and rate of blood glucose fall to maintain the blood glucose within the goal.
 - If the blood glucose falls below 150 mg/dL, either decrease insulin drip as low as 0.05 units/kg/hour and/or increase Glucose Infusion Rate (GIR) by increasing D10 fluid rate not to exceed 2x maintenance, or change to D12.5 NS at 100% total rate.
 - If the blood glucose continues to drop, please contact attending. For persistent hypoglycemia consider contacting the on-call Diabetes team.

The chart below is a suggestion for rates: Anschutz, COS, North and South Campus

Blood glucose (mg/dL)	% of rate from NS ± electrolytes	% of rate from D10NS ± electrolytes	Final dextrose concentration
Greater than or = 300	100	0	0
251-299	50	50	5
200-250	25	75	7.5
151-199	0	100	10
Less than 150	Either decrease insulin drip as low as 0.05 units/kg/hour and/or increase GIR by increasing D10 fluid rate (up to 2X maintenance) or change to D12.5 NS at 100% total rate		

Alternative chart for PARKER or when the above fluids are not available:

The following chart is for reference only, consult the on-call diabetes provider for specific fluid recommendations and insulin drip rates:

Blood glucose (mg/dL)	% of rate from NS+40KCl	% of rate from D5NS+20KCl	% of rate from D10 1/2NS	Final dextrose concentration
Greater than or = 300	100	0	0	0
251-299	0	100	0	5
200-250	0	50	50	7.5
151-199	0	0	100	10
Less than 150	Consult the on-call diabetes provider for dextrose concentration and insulin drip rate prior to transfer.			

Please consider early transfer. Immediate transfer if BG below 200 mg/dL due to limited treatment options. D10W is contraindicated as maintenance fluid.

Admission Criteria:

All patients with suspected **Cerebral Edema** should be admitted to the PICU. See page 3 for diagnostic criteria and signs and symptoms of cerebral edema.

Anschutz, NOC and COS:

- PICU admission for patients with initial pH less than (<) 7.15 and/or the initial HCO₃⁻ less than 5 mEq/L. The admit decision should be based on clinical judgement of the ED, PICU and diabetes providers.
- Inpatient floor admission for patients who have no evidence of cerebral edema AND have initial pH greater than 7.15 AND have an initial HCO₃⁻ greater than 5 mEq/L. The admit decision should be based on the clinical judgement of the ED, Hospitalist and diabetes providers. The ability of the medical unit to provide safe care through adequate staffing should also be considered and discussed with the medical unit Charge RN before patient transfer.
 - Please note: initial pH and HCO₃⁻ may drop after normal saline bolus and thus admission criteria is based on initial lab values.
 - Patients who initially meet PICU criteria, but improve throughout ED course and subsequently meet floor criteria, may be admitted to the inpatient floor unit.
- **Patients initially admitted to the PICU may be transferred to the inpatient floor when the following criteria have been met: pH is above 7.15, HCO₃⁻ is above 5 mEq/L AND there is no concern for cerebral edema.**
- Mental status changes may be difficult to assess in young children. Consider admission to the PICU for children under 5 years of age and any patients with impaired communication or developmental delay based on the clinical judgment of the ED, PICU, hospitalist and diabetes providers.

PICU-specific Hospital Management:

Given risk for cerebral edema perform Q1 hour Neuro checks and notify provider with any changes in mental status.

- Notify provider if BG drops greater than 50 mg/dL in 1 hour.
- Notify provider with change in fluid rates on two-bag system
- Notify provider when BG is less than 150 mg/dL
- Obtain RFP Q2 hour. Obtain VBG Q2 hour until pH >7.15 and with improving trend
- DKA pathway to determine all other management unless clinically indicated or requested by provider

LABORATORY STUDIES

Initial Labs:

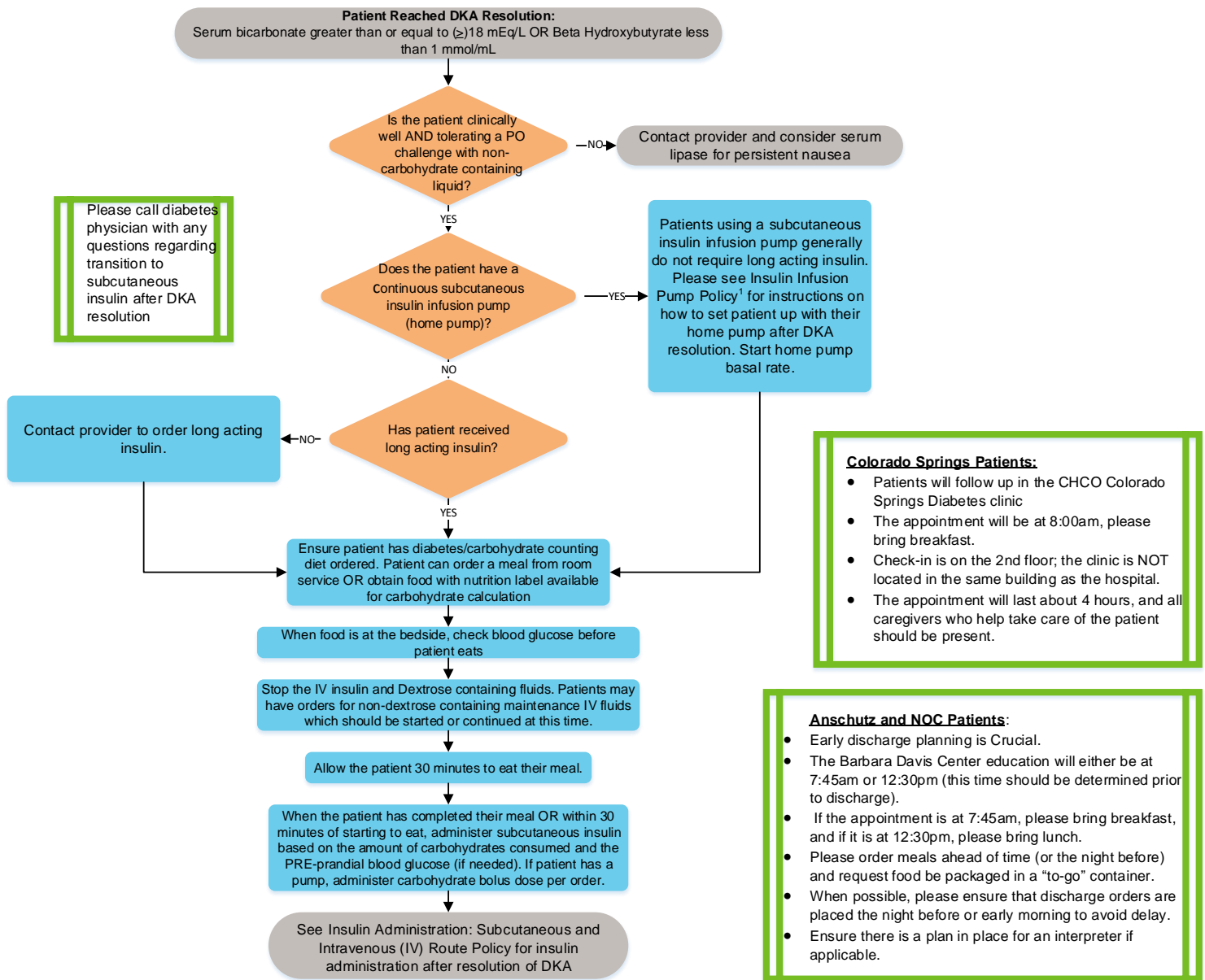
- Renal Function Panel (RFP) or Basic Metabolic Panel (BMP) with phos, ketones (urine or blood), blood glucose, VBG, A1C
- Any additional labs as warranted by clinical presentation
- Osmolality can be estimated by: $2(Na + K) + \frac{glucose}{18}$
- Na correction for elevated glucose = serum Na + $(1.6) \frac{serum\ glucose - 100}{100}$
- Obtain a serum lipase if patient has persistent nausea, vomiting or abdominal pain
- **NOTE:** Contact the on-call diabetes physician once the initial labs have returned

Labs following IV bolus(es)

- BG Q1 hour while on insulin drip
 - POC BG every hour (POC BG must also be obtained after NS bolus(es) and prior to starting insulin drip)
 - If POC BG greater than 600 mg/dL, send sample to lab for serum glucose
 - If patient has 2 PIVs, use 1 for venous blood draws as they are more accurate than capillary samples in DKA patients.
- RFP or BMP with phos Q2 hours
- VBG initially, Q2 hours until pH greater than 7.15, and as needed
- Beta Hydroxybutyrate as needed before transition to subcutaneous (SC) insulin

TRANSITION TO SUBCUTANEOUS INSULIN

INSULIN INFUSION PUMP POLICY | INSULIN ADMINISTRATION: SUBCUTANEOUS AND INTRAVENOUS (IV) ROUTE



For patients on subcutaneous insulin injections

- Order their subcutaneous insulin using the “INSULIN SUBQ *INJECTION* + HYPOGLYCEMIA” order set, which includes orders for HYPOGLYCEMIA.
- **Timing of transition:**
 - DKA resolution is considered a serum bicarbonate greater than or equal to 18 mEq/L OR Beta Hydroxybutyrate less than 1 mmol/mL AND patient is clinically well and tolerates a PO challenge with non-carbohydrate containing liquid
 - Obtain a serum lipase if patient has persistent nausea, vomiting or abdominal pain.

Key points about long-acting subcutaneous insulin:

- The formulary in the hospital includes only Lantus (glargine) for the long-acting insulin. Some patients with known type 1 diabetes may use a different long-acting insulin at home, such as Levemir or Tresiba. If the family has these medications in the hospital and wishes to use them instead of Lantus, transition to subcutaneous insulin would follow the same recommendations as the ones below for Lantus.
- Lantus is generally given once every 24 hours but may be given either every 12 or 24 hours. Total daily dose of Lantus is generally around 0.2-0.6 units/kg/day in a regimen that includes a basal insulin (such as Lantus) and a bolus insulin (such as Humalog).
- There may be times when the endocrine/diabetes team will advise for administration of Lantus prior to resolution of DKA (such as the evening before).
 - This is often in patients with known type 1 diabetes who have a previously determined home insulin schedule (i.e. altering the time of their Lantus administration by giving it in the morning or during the day in the hospital when they normally do it at night may make it hard or confusing for some to transition back to their home schedule when they are discharged).
 - If Lantus is given early, then it should not be given again at the time of transition unless it has been 24 hours or more since the last dose of Lantus.
 - The early Lantus dose should be ordered to be administered every 24 hours to avoid missing a dose.
- If Lantus is given at the time of transitioning off the insulin drip to the subcutaneous regimen, the insulin drip should remain running for 45-60 minutes after the Lantus dose is given. This gives Lantus the appropriate amount of time to be absorbed and begin to take effect.
 - This Lantus dose should be ordered to be administered every 24 hours unless directed otherwise by the endocrine/diabetes team.
- Because of variability between patients, please ask the diabetes physician about the timing of the first dose of long-acting SC insulin during the day when possible.
- Recommendations will be documented in chart notes for reference.
- Types of insulin (NOTE: insulin in BOLD is available on the formulary)

Type	Insulin Name	Onset	Peak	Duration
Long-acting (provides basal coverage)	Lantus® (insulin glargine)	1-2 hours	No peak	22-24 hours
Long-acting (provides basal coverage)	Levemir® (insulin detemir)	1-2 hours	No peak	Less than 24 hours
Long-acting (provides basal coverage)	Tresiba® (insulin degludec)	1 hour	No peak	Up to 42 hours
Intermediate-acting	NPH	1 hour	4-6 hours	8-16 hours
Rapid-acting	Humalog® (insulin lispro)	15-30 minutes	1-1.5 hours	3-4 hours
Rapid-acting	Novolog® (insulin aspart) & Apidra® (insulin glulisine)	15-30 minutes	1-1.5 hours	3-4 hours

NOTE: the concentration of all the types of insulin listed above is 100 units/mL

General principles regarding subcutaneous (SC) insulin regimens

- Carbohydrate counting + blood glucose correction
 - Give rapid-acting (Humalog/lispro) insulin to cover the amount of carbohydrates the child is about to eat + additional rapid-acting insulin to bring the blood glucose down.
 - Example
 1. Carbohydrate counting: If a child is on a 1:15 gram carbohydrate coverage (i.e. 1 unit of rapid-acting insulin for every 15g of carbohydrates consumed) and eats a 60g pancake breakfast, s/he needs 4 units of rapid-acting insulin before breakfast (60g/15g = 4 units).
 2. Correction factor: If the child has a correction factor of “1 for every 100 mg/dL starting at 150 mg/dL,” that means if the child’s blood glucose is 130 mg/dL before a meal, s/he does not need any additional rapid-acting insulin on top of the insulin given to cover carbohydrates. However, if the blood glucose is 151-250 mg/dL prior to their meal, s/he needs 1 unit of rapid-acting insulin in addition to the insulin given to cover the carbohydrates. If her/his blood glucose is 251-350 mg/dL, s/he needs 2 units of rapid-acting insulin in addition to the insulin to cover carbohydrates, etc.
 - Ideally, rapid-acting insulin should be given 20-30 minutes before eating (to match onset of action), but for young children (especially younger than 3 years of age), children with newly diagnosed diabetes, or children who may not finish their meal or vomit, it is acceptable to give insulin immediately after the meal and within 20-30 minutes of STARTING to eat.
 - Do NOT give rapid-acting insulin injections for blood sugar correction more often than every 4 hours unless specified by endocrinology as this can cause “insulin stacking” and puts the child at risk for hypoglycemia (given the duration of rapid-acting insulins).
- Sliding scale
 - This is essentially carbohydrate counting + correction factor but written together to simplify calculations.
 - This is rarely used in the inpatient setting.
 - This works best for children who eat a fixed amount of carbohydrates at every meal (a “consistent carb” diet) and is often used for families who have a child with new onset diabetes or otherwise have not learned carbohydrate counting yet.

For patients on an insulin pump

- Order insulin pump orders using the “INSULIN SC *PUMP* + HYPOGLYCEMIA” order set, which includes orders for HYPOGLYCEMIA.
- Pumps use only rapid-acting insulin that is delivered continuously (basal rate) and as boluses that cover elevated glucose and carbohydrates.
- The CHCO [Insulin Infusion Pump Policy Here](#)

THERAPEUTICS

Cerebral Edema:

- Hypertonic Saline (HTS) 3% NaCl
 - Dose: 5 mL/kg
 - Route: IV - infuse over 15 minutes
- Mannitol
 - Dose: 1 g/kg, max dose 50g
 - Route: IV - infuse over 15 minutes
 - Administration requires 0.2 micron filter

- Fluids:
 - Initial 10-20 mL/kg 0.9% NaCl bolus over 1 hour
 - If shock, may give initial bolus over 30 minutes
 - May repeat bolus up to 40 mL/kg
 - For patients whose initial K is 4.5-5.5: NS + 20 mEq/L potassium acetate + 20 mEq/L potassium phosphate, run at 1.5X maintenance. Also, order a bag of D10 NS + 20 mEq/L potassium acetate + 20 mEq/L potassium phosphate
 - For patients whose initial potassium is less than 4.5, standard IV fluids are: NS + 30 mEq/L potassium acetate + 30 mEq/L potassium phosphate, run at 1.5X maintenance. Also, order a bag of D10 NS + 30 mEq/L potassium acetate + 30 mEq/L potassium phosphate. Hold insulin drip until potassium is above 3.
 - 40mEq/L KCl if K-Acetate and Kphos unavailable
- IV Insulin boluses and sodium bicarbonate are **CONTRAINDICATED** for DKA

Insulin:

- Drip: start regular insulin IV at 0.1 units/kg/hour after the initial rehydration bolus is complete.
 - Consider insulin drip rate as low as 0.05 units/kg/hour for the following situations: cerebral edema, altered mental status, difficulty in the past with higher rates, risk for hypoglycemia, hypokalemia, small body weight
- Subcutaneous (SC): See [General Principles SC Insulin](#) above

PARENT | CAREGIVER EDUCATION

The Barbara Davis Center (BDC) for Diabetes - <http://www.barbaradaviscenter.org/>
 The Juvenile Diabetes Research Foundation (JDRF) – <http://jdrf.org/>

Patients with previously known Type 1 Diabetes:

Refer to individualized sick day protocol from your outpatient primary endocrinologist / diabetes health care provider.

- It is extremely important for patients to continue to hydrate, based on instructions from the sick day protocol. In general, if blood sugar is < 150 mg/dL, your child should be hydrating with sugar containing fluids such as diluted juice / Pedialyte. If blood sugar is > 150 mg/dL, hydrate with non-sugar liquids.
- Blood sugar and ketones should continue to be checked every 2-3 hours, while acute illness symptoms continue and/or ketones remain present.
- In general, blood sugar corrections based on regular dosing to be given if ketones remain small or less (urine) or < 1.0 mmol/mL (blood). If ketones moderate or greater (urine) or 1.0 mmol/mL or greater (blood), patients will require additional insulin; please refer to individualized sick day protocol plan for dosing. Give blood sugar corrections every 2-3 hours while ketones remain present.
- If patient is managed on insulin pump, please change insulin pump site/set immediately. Consider blood sugar corrections with injections if blood sugars are not decreasing or if ketones are not clearing.
- Call your primary diabetes care provider with questions or concerns about sick day management.
 - If your primary provider is at the Barbara Davis Center: 303-724-2323
 - If your primary provider is at CHCO Colorado Springs Diabetes: 719-305-9000

Depending on the underlying illness, the patient will possibly continue to have symptoms of acute illness for the next few days. It will be important to follow up with your primary care physician as instructed.

Seek medical care if patient has vomiting or refusing to hydrate with liquid, changes in mental status or behavior, has trouble breathing, or any other emergency symptoms.

Patients with newly diagnosed Type 1 Diabetes:

Patients will either be seen at the Barbara Davis Center (1775 Aurora Court, Aurora, CO, 80045) or at CHCO Colorado Springs Diabetes clinic (4125 Briargate Parkway, Colorado Springs, CO, 80920) for new onset diabetes education. Timing of this first appointment will be determined prior to the child discharging from the outpatient clinic office, emergency department or hospital admission.

- If the appointment is at the Barbara Davis Center: this appointment will either be at 7:45am or 12pm (this time should be determined for you prior to discharge). If the appointment is at 7:45am, please bring breakfast, and if it is at 12pm, please bring lunch. The appointment will last about 4 hours, and all caregivers who help take care of the patient should be present.

To print detailed information for BDC, with map:

If not within Children's Hospital Network Site: Go to Barbaradaviscenter.org --> Patient and Provider Resources --> Welcome to the BDC PDF: [direct link here](#)

If within Children's Hospital Network Site: (My Children's Colorado → Patient Handouts → Endocrinology → Welcome to BDC: English and Spanish – direct [link here](#)

- If the appointment is at CHCO Colorado Springs Diabetes clinic: the appointment will be at 8:00am, please bring breakfast. Check-in is on the 2nd floor; the clinic is NOT located in the same building as the hospital. The appointment will last about 4 hours, and all caregivers who help take care of the patient should be present.
- The next steps in caring for the patient are:
 - Continue to encourage plenty of water and sugar free liquids. Avoid juice, soda, Gatorade.
 - The patient can have their regular meals between now and the diabetes education appointment, but we do ask that you avoid high sugar items and liquid sugar (i.e. cake frosting, honey, syrup).
- Seek medical care if the patient has vomiting, changes in mental status, or any other emergency symptoms.

REFERENCES

Consensus Guidelines

- Wolfsdorf et al. Diabetic Ketoacidosis in Infants, Children and Adolescents. A Consensus Statement from the American Diabetes Association. *Diabetes Care*. 2006. 29(5):1150-1159.
- Wolfsdorf et al. ISPAD Clinical Practice Consensus Guidelines 2018. Diabetic Ketoacidosis and Hyperglycemic and Hyperosmolar State. *Pediatric Diabetes*. 2018. 19 (suppl. 27):155-177.

DKA

- Zeitler P, Haqq A, Rosenbloom A, Glaser N; Drugs and Therapeutics Committee of the Lawson Wilkins Pediatric Endocrine Society. Hyperglycemic hyperosmolar syndrome in children: pathophysiological considerations and suggested guidelines for treatment. *J Pediatr*. 2011 Jan;158(1):9-14, 14.e1-2.
- Edge JA et al. Conscious level in children with diabetic ketoacidosis is related to severity of acidosis and not to blood glucose concentration. *Ped Diab* 2006; 7:11-15.
- Rewers A, Chase HP, Mackenzie T, Walravens P, Roback M, Rewers M, Hamman RF, Klingensmith G. Predictors of acute complications in children with type 1 diabetes. *JAMA*. 2002 May 15;287(19):2511-8.
- Dabelea D, Rewers A, Stafford JM, Standiford DA, Lawrence JM, Saydah S, Imperatore G, D'Agostino RB Jr, Mayer-Davis EJ, Pihoker C; SEARCH for Diabetes in Youth Study Group. Trends in the prevalence of ketoacidosis at diabetes diagnosis: the SEARCH for diabetes in youth study. *Pediatrics*. 2014 Apr;133(4):e938-45. PubMed PMID: 24685959.
- Cengiz E, Xing D, Wong JC, Wolfsdorf JI, Haymond MW, Rewers A, Shanmugham S, Tamborlane WV, Willi SM, Seiple DL, Miller KM, DuBose SN, Beck RW; T1D Exchange Clinic Network. Severe hypoglycemia and diabetic ketoacidosis among youth with type 1 diabetes in the T1D Exchange clinic registry. *Pediatr Diabetes*. 2013 Sep;14(6):447-54. PubMed PMID: 23469984

Cerebral Edema

- Muir AB, Quisling RG, Yang MC, Rosenbloom AL. Cerebral edema in childhood diabetic ketoacidosis: natural history, radiographic findings, and early identification. *Diabetes Care*. 2004 Jul;27(7):1541-1546.
- Glaser N et al. Risk Factors for Cerebral Edema in children with diabetic ketoacidosis. The Pediatric Emergency Medicine Collaborative Research Committee of the American Academy of Pediatrics. *N Engl J Med*, 344:264-9, 2001.

Insulin Treatment


- Danne et al. ISPAD Clinical Practice Consensus Guidelines 2018. Insulin Treatment in Children and Adolescents with Diabetes. *Pediatric Diabetes*. 2018. 19 (suppl. 27):15-135.


CLINICAL IMPROVEMENT TEAM MEMBERS

- Irina Topoz, MD | Emergency Medicine
- Courtney Braund, MD | Emergency Medicine
- Arleta Rewers, MD | Emergency Medicine
- David Listman, MD | Emergency Medicine, COS
- Joan MacKenzie, NP | Clinical Practice Specialist, ED
- Guy Alonso, MD | Barbara Davis Center for Diabetes/ Endocrinology
- Paul Wadwa, MD | Barbara Davis Center for Diabetes/ Endocrinology
- Erin Cobry, MD | Barbara Davis Center for Diabetes/ Endocrinology
- Sarah Bartz, MD | Endocrine, COS
- Richard Roberts, MD MPH | Endocrine and Diabetes Fellow
- Kalie Tommerdahl, MD | Endocrine and Diabetes Fellow
- Shoshana Tell, MD | Endocrine and Diabetes Fellow
- Amy Rydin, MD | Endocrine and Diabetes Fellow
- Justin Beverly, MD | Hospitalist
- Kristin Kalita, MD | Hospitalist
- Patrick Cripe, MD | Hospitalist, COS
- Michelle Fennell, RN | Clinical Practice Specialist Inpatient Medical Unit/Level 8
- Jessica Perdue, RN | Clinical Education Specialist, Inpatient Medical Unit/Level 8
- Christina Bruce, RN | Endocrine Liaison, Inpatient Medical Unit/Level 8
- Karen Thomason, RN | Clinical Practice Specialist, COS
- Gina DeMasellis, MD | Critical Care
- Adam Yazbeck, CPNP-AC | Critical Care
- Allison Duchman, RN | PICU
- Kevin Poel, PharmD | Clinical Pharmacist, ED
- Aimee English, PharmD | Clinical Pharmacist, NOC
- Stephanie Soles, PharmD | Clinical Pharmacist, NOC
- David Nash, PharmD | CSH Pharmacy Director
- Kaleigh Ogawa, RN | PI Clinical Effectiveness

APPROVED BY

- Clinical Pathways and Measures Review Committee – 5/19/2020
- Pharmacy & Therapeutics Committee – 05/07/2020 & 07/01/2021
- Medication Safety Committee – September 2020
- Antimicrobial Stewardship Committee – not applicable

MANUAL/DEPARTMENT	Clinical Pathways/Quality
ORIGINATION DATE	01/05/2021
LAST DATE OF REVIEW OR REVISION	07/01/2021
COLORADO SPRINGS REVIEW BY	

<p>APPROVED BY</p>	 Lalit Bajaj, MD, MPH Medical Director, Clinical Effectiveness
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REVIEW | REVISION SCHEDULE

Scheduled for full review on date here (January 2025).

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