CCPO Pre-operative Optimization for Children with **Insulin Pumps***

*For patients with Hybrid Closed Loop systems, please proceed to page 5

Patients with insulin pumps should be seen at the CCPO for pre-operative assessment and optimization

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Is there an **absolute contraindication** to intraoperative maintenance of insulin pump?
- MRI

Yes → Is the **entire** anticipated anesthetic duration less than 90 min (induction to emergence)?

No → Consult patient's primary endocrinologist to initiate transition to long-acting insulin (basaglar, levemir, lantus) and to provide perioperative correction factors

No ↓

Patient's primary endocrinologist should be consulted to provide perioperative insulin pump recommendations, including basal/NPO adjustments and correction factors

Yes ↓

Pt may temporarily remove pump for procedure; consult patient's primary endocrinologist for any basal/NPO adjustments to pump and correction factors

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Patient should be scheduled for FIRST case of the day. Patient should be reminded to:
- refill the pump reservoir and change the infusion set 8-24 hours before surgery
- make sure the infusion set is not near the surgical field; move if necessary
- replace the battery
- bring EXTRA set of pump supplies (infusion set, reservoir and insulin)
- take blood sugar upon awakening in AM; if low, apple juice okay. Omit breakfast.

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Current insulin pumps in use:
-Omnipod
-Tandem T-Slim
-Medtronic 630G/670G

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Pre-operative Management for **Insulin Pump**

Is there a contraindication to intraoperative maintenance of insulin pump?
- MRI

No → Continue subQ insulin delivery via pump at usual basal rate or adjusted NPO basal rate as per endocrinologist

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On the Day of the Procedure:
- Child should take blood sugar upon awakening in AM; if low, apple juice okay. Omit breakfast.
- Child should arrive in the early morning for FIRST case of the day
- Parent should bring EXTRA set of pump supplies
- Pre-op RN to obtain POCT glucose (if > 300 mg/dL, send serum electrolytes and ketones)
- The patient's continuous glucose monitor (CGM) is not to be used perioperatively.

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Is patient's blood glucose 140-250 mg/dL?
- **Yes →** Proceed to Page 3
- **No →** If > 250: Have parent or child administer insulin via pump using child's correction factor → Proceed to Page 3

Yes → **Is the entire anticipated anesthetic duration less than 90 min (induction to emergence)?**

Yes → Temporarily remove pump (and continuous glucose monitor, if applicable) for procedure.

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On the Day of the Procedure:
- Child should take blood sugar upon awakening in AM; if low, apple juice okay. Omit breakfast.
- Child should arrive in the early morning for FIRST case of the day
- Parent should bring EXTRA set of pump supplies (for PACU)
- Pre-op RN to obtain POCT glucose (if > 300 mg/dL, send serum electrolytes and ketones)

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If patient's pre-op blood glucose is > 250 mg/dL, have parent or child administer insulin via pump using child's correction factor PRIOR to removing pump for procedure.

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No → Endocrinologist to write order for long-acting insulin (e.g., basaglar, levemir) to be given the night before; parent or child to remove pump once given.

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On the Day of the Procedure:
- Child should take blood sugar upon awakening in AM; if low, apple juice okay. Omit breakfast.
- Child should arrive in the early morning for FIRST case of the day.
- Parent should bring EXTRA set of pump supplies (for PACU)
- Pre-op RN to obtain POCT glucose (if > 300 mg/dL, send serum electrolytes and ketones)

↓

Is patient's blood glucose 140-250 mg/dL?
- **Yes →** Proceed to Page 3
- **No →** If > 250: Administer subQ aspart) using child's correction factor → Proceed to Page 3

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Intraoperative Management

Patients on subQ insulin PUMP

- Continue pump settings; make sure infusion set is padded and accessible during procedure; shielded with lead if radiation is used
- If electrocautery is required for case:
  - Recommend bipolar electrocautery whenever possible
  - If monopolar cautery is needed, place the ground plate so that current pathway does not pass through or near pump
- Fluid management: no dextrose necessary
- Consider carefully whether to administer perioperative steroids given risk of hyperglycemia

Patients transitioned to LONG-ACTING insulin

- Fluid management: no dextrose necessary
- Consider carefully whether to administer perioperative steroids given risk of hyperglycemia

Call Pre-op or PACU RN to measure POCT blood glucose concentration every hour during procedure

Is patient's intraoperative blood glucose 140-200 mg/dL at the hourly check?

No

Is patient's blood glucose >200 mg/dL at the hourly check?

No

Blood glucose < 100 mg/dL:
- Hypoglycemia best treated with boluses of dextrose (2-3 cc/kg D10)
- Re-check blood glucose 20-30 minutes later

Yes

Administer subQ aspart using child's "correction factor" to keep glucose 140-200 mg/dL

Yes

Continue monitoring blood glucose every hour until end of procedure; correct using subQ aspart **no more often than every 3 hours**.

Proceed to Page 4

Post-operative Management

Is patient able to resume oral nutrition?

Yes

If patient was on insulin pump intraoperatively:
- Ask parent to verify pump is functioning
- PACU RN to perform HOURLY blood glucose checks

If patient had been transitioned to long-acting insulin (i.e., basaglar):
- Re-attach insulin pump
- Basal rate MUST be temporarily set to zero for 24 hours after basaglar administration.
- PACU RN to perform HOURLY blood glucose checks

If pump had been temporarily removed for procedure (i.e., MRI):
- Re-attach insulin pump
- PACU RN to perform HOURLY blood glucose checks

No

Primary team to consult pediatric endocrinology for formal recommendations and insulin regimen

Is blood glucose 140-200 mg/dL?

Yes

Is patient going home?

Yes

D/c home

No

<u>If blood glucose > 200 mg/dL:</u>
Have parent administer insulin via pump using child's correction factor

<u>If blood glucose < 140 mg/dL:</u>
Treat with oral agents (juice or glucose tablets)

No

Have endocrine orders been placed by **primary team**?

Yes

Transfer to floor

Addendum 1: Pre-procedure planning for Hybrid Closed-Loop (HCL) Systems:
-Tandem t:slim X2 with Control-IQ
-Omnipod 5

Is the patient a candidate for perioperative continuation of their hybrid closed-loop insulin pump?

Contraindications:

1. MRI
2. Anticipated perioperative decreased perfusion/hemodynamic instability
3. No available parent/caregiver to use pump post-operatively
4. Planned post-op PICU disposition and/or intubation (requires further discussion with PICU team)

No → Proceed to traditional perioperative insulin pump algorithm, page 1

Yes ↓

Arrange pre-operative visit with child's endocrinologist and/or CCPO for pre-operative optimization

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Child should be scheduled for the FIRST CASE OF THE DAY

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Addendum 1: Pre- and Intra-Operative Management for Hybrid Closed-Loop (HCL) Systems

Day before surgery:
- Ensure insulin pump and CGM have been moved out of surgical field and arc of Bovie, if applicable.

On the Day of the Procedure:
- Child should arrive for FIRST case of the day
- Parent should bring EXTRA set of pump supplies
- **Upon arrival to pre-op area, change pump settings:**
  - **-Tandem t:slim X2:** switch to exercise activity mode
  - **-Omnipod 5:** switch to activity feature
- Parent should sign Insulin Pump Agreement & Waiver
- Obtain passcode for pump from family.
- CGM will be used perioperatively (this is how HCL systems titrate insulin)
- Pre-op RN to obtain POCT glucose (if > 300 mg/dL, send serum electrolytes and ketones); verify value is concordant ±20% with patient's CGM (if not, consult attending anesthesiologist)

Is patient's blood glucose <100 or >200 mg/dL?

No

BG < 100 → Have child take 2 oz apple juice in pre-op

Yes

BG > 200 → Have parent administer insulin via pump using child's correction factor; **do NOT override pump.**

Proceed to OR

- Continue pump settings; make sure infusion set, transmitter and CGM are padded and accessible during procedure; shielded with lead if radiation is used
- If electrocautery is required for case:
  - Recommend bipolar electrocautery whenever possible
  - If monopolar cautery is needed, place the ground plate so that current pathway does not pass through or near pump
- Fluid management: no dextrose supplement necessary, unless evidence of ketonuria*
- Judiciously administer perioperative steroids given risk of hyperglycemia
- Chart BG values into Epic Anesthesia Record (as a Quick Note) once every 30 minutes.

Goal BG intraoperatively 100-200 mg/dL. The CGM may be used to monitor BG intraoperatively assuming no extreme fluid shifts or hemodynamic lability that may result in decreased peripheral perfusion.

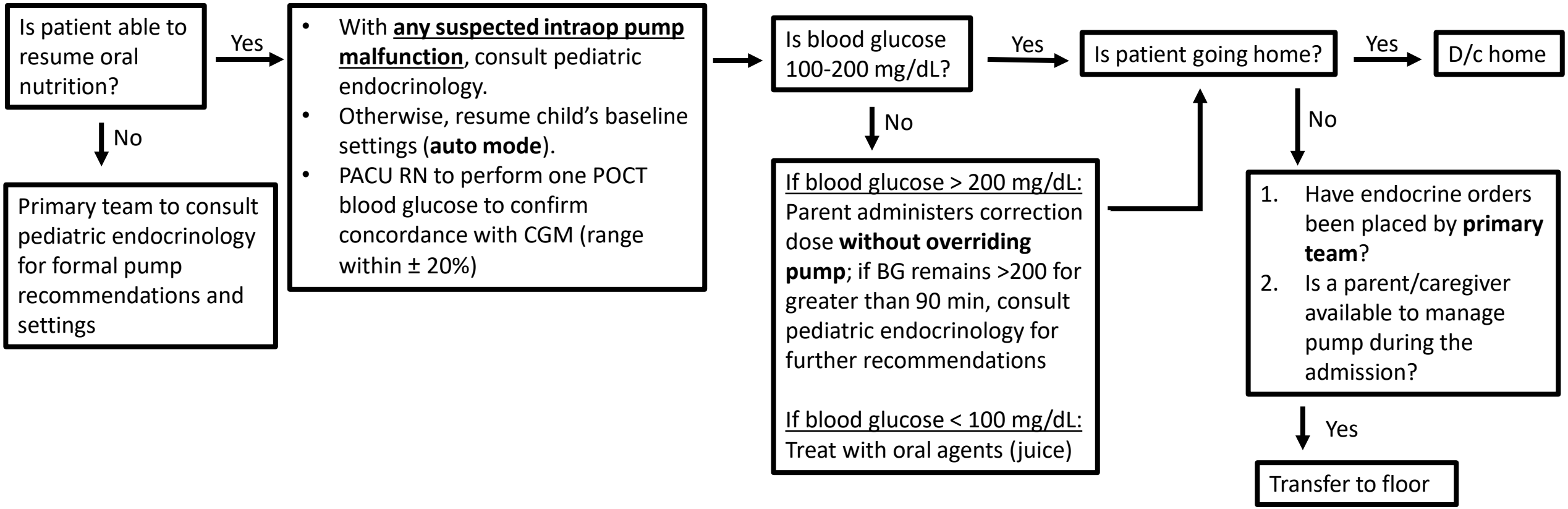
BG less than 100 mg/dL → Initiate dextrose source (D5LR or D5 ½ NS at 1/2 maintenance)

BG greater than 200 mg/dL **FOR > 90 min** → Concern for pump malfunction/inadequate ability to titrate insulin:
1. Switch pump to manual mode (see instructions on page 8)
2. Check POC BG with glucometer to ensure concordance with CGM
3. Administer subQ aspart correction dose using child's correction factor (see page 8)
4. Send urine or blood ketones
5. Monitor BG every 30 min; do not re-dose aspart more often than once every 3 hours

*For cases exceeding 4 hours, check urine or blood ketones to rule out ketosis. If ketones are present, consult pediatric endocrinology for further treatment recommendations.

Proceed to Page 7 (PACU/post-op)

PACU/Post-Operative Management for Hybrid Closed-Loop (HCL) Systems



How to calculate a child's correction dose using most recent pump settings:

1. Go to the notes section of the patient's Epic chart; using the magnifying glass at the upper right hand corner of the screen, search for "updated pump settings"
2. In the most recent endocrine note, scroll to the bottom where updated pump settings are listed.
3. To calculate the correction dose, go the appropriate time of day and apply the following formula:

$$\frac{\text{CURRENT BG} - \text{GOAL BG (typically 150)}}{\text{Correction factor (unique for each child)}}$$

Example: $\frac{227 \text{ (current)} - 150 \text{ (goal)}}{185 \text{ (unique factor)}} = 0.42$ units aspart

4. **DO NOT correct hyperglycemia (BG >200 mg/dL) more than once every 3 hours** to avoid insulin stacking.

How to convert a pump from hybrid closed-loop to manual mode:

Omnipod 5

From main screen, click Hamburger Button (3 lines at the top left of the screen)
Click "Switch Mode" (first option from the top)
Click "Switch" (bottom right hand corner of the screen)

Tandem t:slim

From main screen, click "1, 2, 3" in sequential order
Click "Options"
Click "My Pump"
Click "Control IQ"
Toggle button to left next to Control-IQ row
Click the blue "Check" box to confirm that you would like to deliver regular basal rates and Personal Profile Settings
Click green "Check" box at top right