New Onset Diabetes Mellitus: Inpatient Unit Management Clinical Guideline

This guideline was developed to ensure the proper management of **pediatric patients with new onset diabetes mellitus**. Please direct questions and patient referrals to the on-call Pediatric Endocrinologists at The Barbara Bush Children's Hospital and Maine Medical Partners, 207.662.5522.

IPU Admission Criteria
- **Bicarbonate ≥ 15 mEq/L**
- **Normal mental status**
- **Able to take oral fluid and food**

Often does not require venous access

PICU Admission Criteria
- **Diabetic Ketoacidosis**
  - **Requires insulin drip**
  - **Requires fluid restriction (to decrease the likelihood of cerebral edema)**
  - **Requires frequent glucose and electrolyte monitoring**

Refer to the "Critical Care Guideline for the Management of Diabetic Ketoacidosis (DKA) in the Pediatric Patient"

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1. **Weigh patient, obtain vital signs, examine patient (looking for signs of Addison or thyroid disease).**

2. **Utilize EPIC order set "PEDI DIABETES NEW ONSET"**

3. **At admission, check finger stick blood glucose and check urine ketones.**

4. **If blood draws can be delayed 30-60 minutes, place EMLA on bilateral anticubital fossas.**

5. **Laboratory Testing**
   KEY: **The only essential test at the time of admission for a *non-obese* patient is a "STAT CMP". If the patient is *obese*, all tests must be collected prior to administering insulin. In order to expedite laboratory testing, physicians should consider drawing samples, instead of waiting for an available phlebotomist.**

   For non-obese patients (need a total of 5.5 ml of blood, and a urine sample)
   - **STAT CMP (mint green microtainer, 0.5 ml)**
   - **CBC (lavender microtainer, 0.5 ml)**
   - **Hemoglobin A1c (adult lavender, 1.5 ml)**
   - **TSH, free T4, thyroid antibodies (adult red top, 3 ml)**
     - *KEY*: **Thyroid studies must be ordered as ADULT studies, so the sample goes to Nordex. If ordered as PEDI studies, the sample goes California.**
   - **Urinalysis**

   For obese patients, order above laboratory studies, as indicated, in addition to the following (need total of 7 ml blood = 2 ml and 5 ml in each of 2 adult red tops)
   - **C-peptide and Insulin Level (adult red top, 2 ml)**
   - **IA-2, GAD-65, Insulin Antibodies (adult red top, 5 ml)**
   Place all laboratory orders STAT for obese patients with new onset diabetes mellitus.

   For patients with signs and/or symptoms of celiac disease (need an additional 1 - 2 ml of blood)
   - **Tissue Transglutaminase IgG and IgA (adult red top, 1 - 2 ml)**

6. **Determine the amount of insulin per day the patient requires, based on age and weight:**

< 5 years	0.3 - 0.8 units/kg/day
5 - 11 years	0.5 - 1.0 units/kg/day
12 - 18 years	0.8 - 1.5 units/kg/day

   KEY: **Patients with moderate to large urine ketones need more insulin than those without ketonuria.**
   KEY: **Teens often require more than 1.0 unit/kg/day (insulin resistance secondary to increased growth hormone).**
   KEY: **When a patient with new onset IDDM is transferred to the IPU from the PICU, after DKA has resolved, they will usually need at least 30% more insulin/day than the typical ranges.**

7. Determine the amount of **long-acting insulin** the patient requires.
   - **40% of the total daily insulin dose is given as long-acting insulin, usually at dinner (or bedtime)**
     - *KEY*: Most patients receive **Lantus (glargine)** as their long-acting insulin. Lantus is injected daily
     - *KEY*: Patients receive the **first dose of long-acting insulin** at the time of admission. While either long-acting insulin may be injected any time of day, most patients transition to dinnertime dosing of either Lantus or Levemir.
     - *KEY*: Neither Lantus nor Levemir may be injected from a syringe containing other insulins.

8. Determine the amount of **short-acting insulin** the patient requires, using **insulin:carbohydrate ratios**.
   - *KEY*: This calculation involves determining **insulin:carbohydrate ratios** based on:
     - a. 60% of the total daily insulin dose
     - b. ADA diet calories
     - c. Estimation of the number of carbohydrates consumed in one day
     - Finally, the **insulin:carbohydrate ratios** determine the **carbohydrate coverage scale**.

   a. 60% of the daily insulin dose during the day (excluding snacks) is used to determine the **insulin:carbohydrate ratios**. This is injected as **short-acting insulin**.
      - 40% units at breakfast
      - 30% units at lunch
      - 30% units at dinner

   b. **ADA diet calories** by the formula: **1000 kcal + (100 kcal x age in years)**.
      - *KEY*: The patient may eat as many or as few calories as desired. This formula is used to calculate the **insulin:carbohydrate ratios**.
      - *KEY*: Attempt to minimize carbohydrates at the morning snack. (Ideally, 15 g, but no more than 30 g. This alleviates the need for a 6th daily injection.)
      - *KEY*: Snacks are optional.
      - Order 3 meals with afternoon and bedtime snacks.
        - *SCM Diet, Diabetic (D)*. Do not specify number of calories. Then, select, *"This is a Pediatric (ADA) diet"*, under Diet Instructions #1.
        - For older patients, *SCM Diet, type-in: "Snacks BID"*
        - For younger patients who want a morning snack, *SCM Diet, type-in: "Snacks TID"*

   c. Estimate the **carbohydrates consumed in one day** by the formula: (ADA diet calories)/32. The calculations to derive this formula are outlined below.
      - Approximately half of calories in an ADA diet are carbohydrates. Divide the number of calories (**1000 kcal + (100 kcal x age in years)**) in half to determine the **carbohydrate calories per day**.
      - Approximately 25% of carbohydrates are consumed at each of 3 meals (and 25% for snacks). Divide the carbohydrate calories per day by 4 (25%) to determine the **carbohydrate calories per meal**.
      - Convert the carbohydrate calories per meal to **grams of carbohydrates per meal** by dividing carbohydrate calories per meal by 4 calories/gram.

   d. Calculate the **insulin:carbohydrate ratios** (**carbohydrate coverage scale**), using the **short-acting insulin** percentages (See "a") and the **grams of carbohydrates per meal** (See "c").
      - Breakfast: Divide the grams of carbohydrates per meal (See "c") by the units of short acting insulin (See "a - breakfast") to calculate the **grams of carbohydrates covered by one unit of short-acting insulin** *at breakfast*.
      - Lunch, dinner, and snacks: Divide the grams of carbohydrates per meal (See "c") by the units of short acting insulin (See "a – lunch /dinner") to calculate the **grams of carbohydrates covered by one unit of short-acting insulin** *at lunch, dinner, snacks.*
      - *KEY*: Patients get 15 grams of carbohydrates free at morning and bedtime snacks (except for toddlers who have all of their snacks covered).

9. Calculate the **blood glucose correction scale**.
   - 1500/total daily dose insulin = mg/dL of glucose lowered by one unit of **short-acting insulin**.
     - *e.g.*: If a patient requires 50 units of total insulin per day, 1 unit of short-acting insulin would lower blood glucose 1500/50 = 30 mg/dL.
     - *KEY*: 1 unit per 25 mg/dL is the lower limit.

10. Begin a **glucose record** with complete insulin schedule, carbohydrate coverage scale, target glucose levels, and blood glucose correction scale. Blood **glucose target ranges**:

Age	Daytime glucose range	Nighttime (bedtime/0300) glucose range
< 3 years	100 - 200 mg/dL	100 - 250 mg/dL
3 - 7 years	80 - 180 mg/dL	80 - 230 mg/dL
> 7 years	80 - 150 mg/dL	80 - 200 mg/dL

   KEY: **To avoid nocturnal hypoglycemia, permit higher glucose values at bedtime and at 0300.**

11. Order **bedside glucose checks** before all meals, before afternoon and bedtime snacks, and at 0300; call resident with results.
   - *SCM Beside glucose: AC + HS + 0300. Call residents with results.*
     KEY: **Usually, a glucose check is not performed with the morning snack since it is close to lunch. No glucose correction is given with the morning snack.**

12. Order nurse to check all initial **urine samples for ketones** and to call residents with results.
     KEY: **Once the urine is free of ketones, check urine ketones only if blood glucose is > 240.**

13. **For each meal, calculate the total insulin dose** to be given (the **sum of the carbohydrate coverage for the meal and the blood glucose correction**).
     KEY: **For patients greater than 5 years of age, inject insulin and wait 0-30 minutes prior to eating (Refer to "roadmap"). For patients 5 years of age and younger, allow patients to eat, followed by insulin injection, based on actual carbohydrate consumption.**

14. **Discuss management plan with the patient's nurse.**

15. Teach the patient about the **signs and symptoms of hypoglycemia**: diaphoresis, feeling faint or dizzy, tachycardia, clamminess, tiredness, and shakiness.

16. Order **glucagon** on call for hypoglycemia (0.5 mg IM if pt is < 20 kg; 1.0 mg IM if pt ≥ 20 kg).
     KEY: **This should be used ONLY if the patient is unarousable or seizing. Other symptoms of hypoglycemia (listed above) should be treated with carbohydrate consumption.**

17. Order **consults**
   - *SCM: Nutrition Consult: "New diabetic"*
   - *SCM: Social Work Consult: "New diabetic"*
     KEY: **Diabetic teaching will be arranged by the endocrinologist.**

18. **Evaluate for infectious disease signs or symptoms and begin antimicrobials if warranted.**

Example with sample calculations: The patient is a 10 year-old, 30 kg boy presenting with new onset diabetes mellitus.

After a brief examination to verify he is an appropriate patient for the IPU, you ask the nurse to put a large cup of water at his bedside, check a finger stick blood sugar (FSBS), and dip his urine for ketones. FSBS is 486, and urine is positive for moderate ketones. You draw labs for the non-obese patient (5.5 ml total) and send the CMP STAT. You complete the H&P.

After the H&P, you note the results of the CMP (bicarb 24). You estimate that he requires about 0.7 units insulin/kg/day, or 20 units of insulin. This equates to 8 units (40%) of long-acting insulin (Lantus/Levemir) daily, and about 12 units (60%) of short-acting insulin (Aspart) over the course of a day. 4.8 units (40%) will be at breakfast, 3.6 units (30%) at other meals.

He should consume about 2000 calories per day, with 62.5 g carbohydrates per meal.

Dividing 62.5 g by his insulin doses, you calculate that he is should receive 1 unit short-acting insulin per 13 g carbohydrates at breakfast, and 1 unit per 17.4 g at other meals/snacks. You round to 1 unit/13 g and 1 unit/18 g, respectively (rounding up to nearest whole number). He can have 2 snacks if he wishes. He will get 15 g of carbohydrates free at morning and bedtime snacks, but his afternoon snacks will be entirely covered.

You determine that his target glucose range is 80-150 mg/dL. Therefore, you decide to correct over 150mg/dL during the day, and over 200 mg/dL at night. You calculate that his correction scale should be 1500/20 or 1 unit/75 mg/dL. Because 75 mg/dL is a wide range, you decide on 0.5 units per 40 mg/dL (again, rounding up).

For his first meal (lunch), he plans to eat about 75 g of carbohydrates. You verify your calculations with the endocrinologist who agrees with your insulin regimen. So, you give him two shots: one with 8 units Lantus, one with 6.5 units Aspart (2 units for carbs, 4.5 units for blood sugar). He eats 30 minutes later, while you complete the other admission orders.

The Barbara Bush
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At Maine Medical Center