LEGACY
Health System

MANAGING HYPERGLYCEMIA IN THE HOSPITAL

This is a guide for treating non-critically ill inpatients with hyperglycemia. (Last revised: February 2010 E.Valcarlos)

Step 1: Know the goal. Fasting and pre-meal: 100 to 140 mg/dL for most patients (80 to 140 mg/dL is appropriate too). Post-meal or random glucose always <180 mg/dL. On continuous tube feeds or TPN: 100 to 180 mg/dL.

Step 2: Check the A1c. Order if not documented in the last 3 months. It helps you adjust the inpatient regimen and choose the home regimen for discharge. Note: Difficult to interpret after blood transfusions.

Step 3: Hold oral agents. Most patients should have oral agents held until the hospital course is clear. Metformin carries a risk of lactic acidosis in patients with compromised renal function, e.g. secondary to nephrotoxicity from contrast media, poor perfusion with decompensated heart failure, etc. Glitazones can cause fluid retention, which may lead to or exacerbate heart failure. Sulfonylureas may cause hypoglycemia, especially in patients who miss meals or have declining renal function.

Step 4: Order an insulin regimen. Insulin is the most effective therapy for managing glucose in the hospital, regardless of the patient's needs outside of the hospital. All patients with Type 1 diabetes, any patient with Type 2 diabetes already on insulin at home or poorly controlled on oral agents, and any patient with consistently elevated glucose measurements will need insulin therapy in the hospital.

The best insulin regimens have 3 components to be used all together.

1) Basal insulin: glargine (Lantus) or NPH (Novolin N). Most patients need basal coverage. Glargine is preferred for its more predictable kinetics. Basal insulin does not need to be held if the patient is made NPO, but if using NPH, the NPH dose should be reduced 50%.
2) Scheduled nutritional insulin: aspart (Novolog) or regular (Novolin R). Patients who are being fed, whether by meals or tube feeds, need scheduled short acting insulin even if they are at goal glucose. Aspart is preferred for the patient eating meals or receiving bolus tube feeds. Regular is preferred for the patient on continuous tube feeds. The scheduled nutritional insulin should be held if the patient will miss a meal or if tube feeds will be stopped or held. If the patient's eating is unpredictable, aspart (NOT regular) may be administered during or after the meal.
3) Supplemental insulin: aspart (Novolog) or regular (Novolin R). The term supplemental replaces the old terminology of "sliding scale" in order to emphasize the best use of a scale. Supplemental insulin is added to nutritional insulin to correct for pre-meal hyperglycemia. See Step 6 below for more information about supplemental scales.

Step 5: Choose an insulin dose. If the patient is already on insulin at home, then use the home dose. Consider adjusting it up or down though based on the overall glucose control on that regimen (per A1c or glucometer readings).

If you don't know where to start, calculate a weight-based total daily dose (TDD), then divide it up into basal and nutritional components. Note: the following dose recommendations are conservative and dose titration will likely be necessary.

	Total Daily Dose (TDD)	Basal Dose	Nutritional Dose
Sensitive (e.g. very lean, renal or liver failure)	0.3 units/kg	Pt eating meals: 50% TDD	Pt eating meals: 50% TDD, divided into 3 doses before meals
Average	Normal body habitus (BMI 18.5-24.9) → 0.4 units/kg Overweight (BMI 25-29.9) → 0.5 units/kg	Bolus tube feeds: 50% TDD	Bolus tube feeds: 50% TDD, divided into equal doses before tube feeds
Resistant (e.g. steroids or obese)	0.6-1 units/kg	Continuous tube feeds: 40% TDD	Continuous tube feeds: 60% TDD, divided into equal around the clock doses

Step 6: Choose or build a supplemental scale: based on the patient's known or estimated insulin sensitivity.

1) Low requirement: e.g. BMI <25 or TDD <40 units/day. Also for patients with higher risk of hypoglycemia due to renal, hepatic, or cardiac dysfunction or elderly age.

2) Medium requirement: e.g. BMI 25-29.9 or TDD 40-80 units/day. For those between low and high, or who don't reach goal using the low requirement option.

3) High requirement: e.g. BMI ≥30 or TDD >80 units/day. Also for obesity, infections, post-CABG, open wounds, or receiving steroids.

If the default preprinted scales don't seem to work (and they won't every time!), build an individualized scale.

- First, calculate the correction factor. You may generally use the "rule of 1800." The correction factor, 1800 ÷ TDD, = the number of glucose units (mg/dL) that 1 unit of insulin will correct. For example, if a patient's TDD = 40 units/day then 1800 ÷ 40 = 45. So 1 unit of insulin is expected to drop the blood glucose by 45 points. The correction factor may be rounded to 40 or 50 to make building the scale easier.
- Second, build the scale increments based on the correction factor. You must first decide though at what glucose level the supplemental scale should be initiated. So as not to drop the glucose too low, you might decide to set 100 as the minimum CBG you would want to see, which means supplemental insulin would not be administered until the CBG was >140. The scale would thus be: for CBG 141-180, give 1 unit of insulin; for CBG 181-220, give 2 units of insulin; and so on. On the other hand, if you wanted to be more aggressive, you might tolerate dropping the CBG to 80, so your scale would be initiated for CBG >120.
- Remember to adjust the scale up or down based on the results it gets. One scale does not fit all!

Step 7: Titrate insulin (up or down) 1 to 2 times daily. There are various ways to adjust the insulin regimen, depending on which glucose values are out of range.

- Glargine (Lantus): titrate every other day by 20%. Increase if fasting BG >140, decrease if <100. Exception: if fasting BG is >200 after the first dose, then increase the next dose by 20-30%.
- NPH: titrate daily. For evening dose: if fasting BG is <70, decrease by 50%. If fasting BG 140-200, increase by 20%. If fasting BG is >200, increase by 30%. For morning dose: adjust by 20% if pre-lunch BG is not at goal.
- Nutritional insulin: Increase the pre-meal dose if supplemental insulin is being given consistently. If pre-meal glucose is above goal, increase previous meal insulin by 1-2 units. If pre-meal glucose is below goal, lower previous meal insulin by 1-2 units.
  -OR-
- If fasting glucose is consistently >140 but <180 with no threat of hypoglycemia, increase the TDD by 10-20%.
- If fasting glucose consistently >180, increase the TDD by 30%.
- If 2 or more episodes of hypoglycemia (BG <70), start D5-1/2NS at 75 mL/hr and decrease the TDD by 20%.

A note on treatment of hypoglycemia: Hypoglycemia is commonly over-treated. IV dextrose should only be used if mental status is altered or patient is NPO. Standard treatment = 15 gm glucose = 1 tube Glutose gel or 4 oz juice/non-diet soda drink. For NPO patient: 25 mL dextrose 50% IV. Repeat BG in 15 minutes. Protocol allows RN to initiate treatment as a verbal order of the licensed independent practitioner (LIP) prior to actually notifying the LIP.

Step 8: Plan for discharge. Most patients with diabetes on oral agents at home can be discharged on oral agents. Some, however, may need to stay on insulin. To decide:

- All inpatients with hyperglycemia should have an A1c done in the last 3 months: if <7%, home Rx is working well; if 7-8%, consider changing the home Rx; if >8%, it's time for a change.
- If a patient requires >40 units/day of insulin on the day prior to discharge, they may require insulin at home (sometimes temporarily). Communicate the need for teaching at least one day prior to discharge. Contact the patient's PCP to communicate the need for insulin therapy and arrange for close outpatient follow up.
- New diagnosis Type 2 diabetes and patient on <40 units/day of insulin probably do not require insulin at home. Consider starting an insulin sensitizer, e.g. metformin, early during the stay. For those requiring >2 units pre-meal insulin, consider a sulfonylurea. One day prior to anticipated discharge discontinue the pre-meal insulin and add a sulfonylurea to test the patient's response to the drug. If good response, discharge patient on both sulfonylurea and an insulin sensitizer.
- **For any patient new to insulin therapy, please notify the patient's PCP prior to discharge. Arrange for close outpatient follow-up.**

CHOOSING AN INSULIN REGIMEN

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EATING MEALS

Rx#1: Basal glargine Q24H + pre-meal aspart + supplemental aspart
(If cost an issue at discharge: Basal NPH Q12H + regular pre-breakfast and dinner + supplemental regular)

24 HOUR CONTINUOUS TUBE FEEDING

Rx#1: Basal glargine Q24H + nutritional regular Q6H + supplemental regular
Rx#2: Basal NPH Q12H + nutritional regular Q6H + supplemental regular

INTERMITTENT TUBE FEEDING

- Bolus tube feeds: Same as Rx#1 for patient eating meals.
- Nocturnal tube feeds: This might take a little work . . .
  - Nutritional: Order aspart supplemental scale and check glucose Q4H for the first night or two to determine the estimated nightly insulin dose. Convert the total nightly supplemental aspart dose to NPH in a 1:1 ratio. OR, order 1 unit NPH for every 10-15 grams of carbohydrates to be provided by the feeds. Administer the NPH with the initiation of tube feeds each evening.
  - Basal: Glargine Q24H or NPH Q12H (split 2/3 PM and 1/3 AM if patient not eating during day) with the evening NPH dose administered with the initiation of tube feeds.

INTRAVENOUS NUTRITION

Add regular insulin to TPN once insulin dose is determined from insulin infusion or supplemental scale doses. Order Q6H glucose checks and supplemental scale with regular insulin.

CRITICALLY ILL PATIENT WITH HYPERGLYCEMIA

Rx#1: Insulin infusion. See “Adult Critical Care Intensive Insulin” orders.

HYPERGLYCEMIC CRISIS

Rx#1: Insulin infusion. See “Adult Critical Care DKA” orders.

HOW TO TRANSITION FROM IV TO SUBCUTANEOUS INSULIN

1. Use the “Transfer from Adult LHS Critical Care Initial Subcutaneous Insulin Orders Post-Critical Care Intensive Insulin Drip Protocol” form.
2. Otherwise: Estimate the TDD requirement. Take the average hourly rate over the last 4 or 6 hours and multiply it by 20. If the patient was receiving nutrition (eating meals or on tube feeds) during that time, then this is the TDD. If the patient was not receiving a significant amount of nutrition, then double the number to get the TDD. Once you have the TDD, split it out into basal and nutritional components based on the nutritional regimen.

Pocket guide prepared by the Diabetes Across the Continuum Taskforce based on recommendations and examples from the Society of Hospital Medicine. For questions or feedback, please contact Beth Norman, Clinical Practice Support (503-413-3236), or Elena Valcarlos, Pharmacy (503-413-1321).