**Rationale**

Increasing data show a strong association between hyperglycemia and adverse inpatient outcomes. The American Diabetes Association and the American College of Clinical Endocrinology recommend all glucose levels be below 180-200 mg/dL in non-critically ill patients. Since hospitalizations are unstable situations, even patients who are well controlled on non-insulin agents as outpatients are usually best managed with insulin while they are inpatients.

Insulin may be safely administered even to patients without previously diagnosed diabetes. As long as the prescribed doses are below what is normally produced by the pancreas, the patient will not become hypoglycemic. If the glucose level drops, endogenous insulin secretion will reduce to compensate. The total daily insulin requirement in insulin-sensitive patients (e.g., type 1 diabetes mellitus [T1DM]) is approximately 0.5-0.7/units/kg/day. Insulin requirements in patients with insulin-resistant type 2 diabetes may vary greatly and can exceed 1-2 units/kg/day. A conservative estimate for initial insulin therapy in any inpatient with hyperglycemia is to start with the T1DM dose (i.e., approximately 0.5-0.7 units/kg/day).

# Overview

* Effective inpatient insulin regimens typically include 3 components
* **Basal** insulin (e.g., scheduled NPH, insulin glargine [Lantus], or insulin detemir [Levemir]), which is used to manage fasting and pre-meal hyperglycemia. Generally **half** of the total daily insulin dose.
  + **Nutritional** or **prandial** insulin (e.g., scheduled regular insulin, insulin lispro [Humalog], insulin aspart [Novolog], or insulin glulisine [Apidra]), which controls hyperglycemia from nutritional sources (e.g., discrete meals, tube feedings, total parenteral nutrition [TPN], IV dextrose). Generally **half** of the total daily insulin dose.
  + **Supplemental** or **correctional** insulin (e.g., regular insulin, insulin lispro, insulin aspart, or insulin glulisine), which is used in addition to scheduled insulin to meet unexpected hyperglycemia that is not covered by scheduled insulins.

**Sample Orders** for patient eating discrete meals (not for patients with uncontrolled type 1 diabetes, diabetic ketoacidosis, hyperglycemic hyperosmolar state, or other absolute need for IV insulin):

# Also see comment on CPOE subcutaneous insulin order sets at the end of this document

1. Check (fingerstick) capillary blood glucose QAC, QHS
2. NPH insulin SC units QAM, units QHS
3. Insulin aspart SC units pre-breakfast, units pre-lunch, units pre-dinner, hold if NPO or pre-meal blood sugar (BS) < 70 mg/dL; give 0-15 minutes before meals
4. Insulin aspart SC sliding scale (see table below) QAC, in addition to standing nutritional insulin, 0-15 minutes before meals
5. For BS < 70 mg/dL
   1. If patient can take PO
      1. Give 15 g of fast-acting carbohydrate (e.g., 4 oz apple, grape, or cranberry juice or 6 oz non-diet ginger ale)
      2. Repeat finger capillary glucose every 30 minutes and repeat above (5ai) if BG<80 mg/dL
      3. When BG > 80 mg/dL, give snack or meal
   2. If patient cannot take PO
      1. Give 25 g of D50 as an IV push
      2. Repeat finger capillary glucose every 30 minutes and repeat above (5bi) if BG<80 mg/dL
6. If patient cannot take PO and has no IV access
7. Give glucagon 1 mg IM and start IV as soon as possible
8. Repeat finger capillary glucose every 30 minutes and repeat above (5ci) if BG<80 mg/dL

# Guidelines

1. **Stop non-insulin diabetes agents** in most patients
2. **Check bedside blood glucose (BBG or “fingerstick”) QAC and QHS** (or 0600, 1200, 1800, 2400 if no discrete meals).

# Estimate total daily insulin requirement

* Weight-based estimate
* When to use
  + Patients not on insulin at home
  + Patients who are hyperglycemic on their home regimen (assuming the weight-based estimate is higher)
* How to calculate
  + For most patients, conservative estimate is 0.5-0.7 units/kg/day (actual requirement may be much higher)
  + Reasons for lower end of the range: renal insufficiency, small size, insulin sensitive (e.g., type 1), recent hypoglycemia, decreasing doses of steroids, older age
  + Reasons for higher end of the range: obese, initiation or increasing doses of steroids, marked hyperglycemia
* Home regimen-based estimate
* When to use
  + Patients well-controlled on home insulin regimen
* How to calculate
  + Add up total daily dose of all scheduled insulins

# Start BASAL insulin if any pre-meal BG > 140 mg/dL AND no recent glucose < 70 mg/dL off insulin.

# Note: Patients with T1DM require basal insulin at all times!!! Basal never should be held!!!

* If on basal insulin at home, use same type and frequency
  + If on detemir as outpatient, can change to NPH while in house at same frequency
* Starting dose is **½ of total daily insulin requirement**
* If NPO, do **not** reduce the basal insulin dose unless:
  + All of the patient’s insulin is being given as basal OR
  + Patient is on NPH and morning BG is < 140 mg/dL (then only reduce qAM dose of NPH)
* In general, maximum starting dose for someone new to insulin is 20 units/day
* Use same dose whether patient has previously diagnosed or undiagnosed diabetes

# Start Nutritional or Prandial Insulin– HOLD IF NUTRITION IS STOPPED/HELD or PRE-MEAL BS < 70 mg/dL

* If eating discrete meals
  + Use aspart 0-15 minutes before meals
    - If on lispro or glulisine as outpatient, can change to aspart while in house (note: can use lispro in obstetrical patients only – see order set for pregnant patients in CPOE system)
  + Can give immediately **after** the meal if PO intake unpredictable; adjust dose based on amount of meal eaten (will require a one-time order)
  + Dose is **½ of total daily insulin requirement**, split over 3 meals
    - May need less if poor or unknown appetite
* If on continuous tube feeding\* or IV dextrose
  + Use regular insulin SC q6h
  + Dose is **½ of total daily insulin requirement**, split into 4 doses
    - May need less if tube feedings not at caloric goal

\* If receiving cycled tube feedings, give nutritional insulin that will act only when feeds are running (e.g., 2400, 0600, ---, 1800)

# Start Supplemental/Correction Insulin in addition to nutritional (prandial) insulin

* Discrete meals: Insulin aspart SC QAC (with nutritional insulin)
* NPO or tube feedings: Regular insulin SC Q6 hours

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| --- | --- | --- | --- | --- |
| Example **Supplemental/Correction** Insulin Scales | | | | |
| Blood Glucose | < 40 units/day scheduled insulin “Low Scale” | 40-80 units/day scheduled insulin “Medium Scale” | >80 units/day scheduled insulin “High Scale” | Individualized |
| 150-199 | 1 unit | 1 unit | 2 units | units |
| 200-249 | 2 units | 3 units | 4 units | units |
| 250-299 | 3 units | 5 units | 7 units | units |
| 300-349 | 4 units | 7 units | 10 units | units |
| >349 | 5 units + call HOo | 8 units + call HO | 12 units + call HO | units + call HO |

# Note: Avoid supplemental insulin QHS unless patient is very hyperglycemic

**HO = House Officer**

1. **On a daily basis, adjust scheduled insulin** based on previous days’ blood sugars:

# Hypoglycemia: Any blood sugar < 70 mg/dL

* Identify possible precipitants: poor or unpredictable PO intake, ill-timed insulin administration, worsening renal function, decreasing steroids, improving medical condition (i.e., less stress)
* If no transient or reversible cause, decrease insulin orders by 20-100%, depending on the degree of hypoglycemia
* When adjusting basal vs. nutritional insulin, keep in mind that the fasting AM glucose reflects the action of basal insulin (e.g., qd glargine and qhs NPH), while glucose later in the day may reflect the action of both basal (e.g., qd glargine and qam NPH) and nutritional (e.g., qac aspart) insulin
* If PO intake is unpredictable, consider ordering insulin aspart to be given **immediately after** each meal, adjusting the dose for amount of PO intake (e.g., hold insulin if didn’t eat, give half if ate half the food tray, give full amount if ate entire food tray)

# Hyperglycemia: Any blood sugars > 180 mg/dL and no hypoglycemia

* Add up total insulin (scheduled + sliding scale) given the previous day to determine the new total daily dose (TDD)
* Increase the TDD:
  + If glucoses generally 140-180 mg/dL, increase by 10%
  + If glucoses generally 180-250, increase by 20%
  + If glucoses consistently > 250 mg/dL, increase by 30%

# Other Considerations

* Adjust the TDD further (up or down 10-20%) based on clinical considerations (e.g., give more if eating more, improving renal function, increasing steroids; give less if eating less, worsening renal function, tapering steroids, recovering from severe illness)
* Maintain a ratio of ~50% basal insulin and ~50% nutritional insulin, keeping the following in mind:
  + Hold nutritional insulin if patient is NPO
  + Patients may require proportionately less nutritional insulin if appetite is poor or unknown
  + Patients may require proportionally more nutritional insulin when treated with steroids
    - The fasting AM glucose reflects the action of basal insulin (e.g., qd lantus and qhs NPH), while glucoses later in the day reflect the action of both basal (e.g., qd lantus and qam NPH) and nutritional (e.g., qac aspart) insulin
* Adjust sliding scale if needed based on the new total scheduled insulin dose:
  + < 40 units/day scheduled insulin: low scale
  + 40-80 units/day scheduled insulin: medium scale
  + > 80 units/day scheduled insulin: high scale

# Discharge Orders

* Patient should be discharged home on a medication regimen that was similar to the admission regimen (**i.e., the regimen prescribed by the patient’s primary care physician’s PCP]**). Exceptions:
  + The patient has a contraindication to an admission medication
  + There is evidence of poor outpatient control (e.g., very high A1C) or hypoglycemia on admission regimen
* If a patient is ADMITTED WITH NO INSULIN, and REQUIRES INSULIN TO BE CONTINUED AS AN OUTPATIENT (e.g., newly-diagnosed T1DM, A1C is very high and contraindication to or on maximum oral regimen), limit discharge insulin regimen to as few injections per day as possible (e.g., in T2DM, qhs insulin glargine only, or glargine qhs plus one injection of insulin aspart with the biggest meal). An exception to this is for patients with T1DM who are optimally treated with 3-4 injections/day. Make sure the patient has prompt follow-up with his or her PCP and/or endocrinologist.
* Avoid discharging home on “sliding scale” insulin
* If a patient is going to require insulin injections and self-monitoring blood glucose as an outpatient, make sure the patient is instructed about how to do perform these; these patients may also require VNA assistance
* **Let nursing staff know early in admission** if patient will require insulin administration and/or glucose monitoring instruction before discharge so that they can plan patient education

# Indications for calling an Endocrine (Medicine or OB-GYN service) consult

* Labile blood sugars
* Prolonged periods of NPO (e.g., for procedures) especially in patients with T1DM
* Marked hyperglycemia despite following this guideline
* Question of type 1 vs. type 2 vs. other type of diabetes

# Subcutaneous insulin Order Sets

* Order sets are available in the CPOE system to assist with inpatient diabetes management. They can be found under [insert link or specify location].
* There are 3 templates, depending on the PO status of the patient: one for discrete meals, one for continuous tube feedingss, and one for NPO. There is also a template for pregnant patients eating discrete meals.
* The templates make it easy to order basal, nutritional, and supplemental insulin (including 3 strengths of sliding scales), diet orders, blood glucose monitoring, A1C testing, endocrine consultation, and hypoglycemia orders consistent with the above guidelines.