**Inpatient Blood Glucose Control Facts and Guidelines**

(For all patients who have diabetes or blood glucose control problems)

**In-hospital target blood glucose range:**
- Med/Surg/Telemetry areas = 70mg – 180mg
- Critical Care units = 80 – 110mg

**ADMISSION:**
- **General Points:**
  - Do not ignore the patient’s diabetes or hyperglycemia; even if it is not a primary diagnosis.
  - Poor blood glucose control during hospitalizations increases infectious complications, organ damage, delays wound healing, and increases costs and length of stay.
  - Distinguish between Type 1 and Type 2. Type 1 diabetes will ALWAYS require insulin injections even if NPO (to prevent ketosis).
  - Assess for pre-admission diabetes medications and insulin, blood glucose meter use, history of diabetes complications.
  - Explain to the patient that SJHC’s policy is to give insulin injections when blood glucose is >120mg; this does not mean the patient will go home on the insulin.
  - Obtain a FSBG upon admission.
  - In your history taking, always ask: if patient has been on insulin (not just pills); has a meter; verify Type 1 or Type 2; how long they have had diabetes; how often they check their FSGBs and what the FSGBs usually ran.
  - Implement the Blood Glucose Control Protocol.
  - **Blood Glucose Control Protocol**
    - Is to be implemented on ALL diabetes patients or patients without diabetes but have a blood glucose of >150.
    - Can be implemented without a MD signature, but will need one by end of admission; so use a red ‘Sign Here’ sticker.
    - It is not to be used on OPO/23hr admits, in OB, or patients with DKA.
    - Orders #1 – #9 and #13 are to be taken off automatically; Orders #10 - #15 are orders that must be checked by the MD for individualization.
    - It is important to get the A1c at admission because it can be altered by blood transfusions, iron treatment, or hemoglobinopathies.
    - Implement the Hypoglycemia Protocol at the same time.
  - **Hypoglycemia Protocol**
    - Must be started at the time of admission on all patients who are on the Blood Glucose Control standing orders.
    - General rule of thumb = about 15 grams of CHO will increase FSGB by 25-50mg
    - Do NOT over treat low blood glucose; take it one step at a time.
    - Definition = any blood glucose less than 70mg/dl.
    - If meal tray is available, feed patient immediately then check FSGB every 15-20 minutes until FSGB is greater than 70mg/dl. Treat as needed.
    - Treat with 15 to 30gms carbohydrate (tablets or gel) every 15 to 20 minutes until FSGB greater than 70mg/dl.
    - Severe Hypoglycemia = 40mg or less; treat with 1 amp D50; must get stat BG from Lab to confirm.
    - If patient is NPO for surgery or procedure, may give Glutose gel up to 2 hours prior to surgery/procedure. If less than 2 hours prior to surgery/procedure, treat as if severe hypoglycemia.
    - IM glucagon is used if severe hypoglycemia without IV access or if patient not willing or able to swallow; since glucagon can cause nausea and vomiting, remember to position the patient on his side to avoid aspiration.
    - DOCUMENT – DOCUMENT – DOCUMENT!!!

**Blood Glucose Monitoring**
- **Should be done AC & HS on most patients.**
- **For the first 48 hours, 0300 FSBG should also be done.**
- **If patient is NPO, on TPN or TF, then FSGB is q6h.**
- **Use the hospital’s Precision meter to check the FSGBs; if patient has brought in their own meter, explain we have to use our hospital meter since it documents the results.**

**Nutrition**
- **Goal = to achieve / maintain ideal body weight; FSGBs <180, and optimal blood lipid levels.**
- **Patient should be on a Consistent Carbohydrate (CHO) diet.**
  - Meals will have a consistent amount of CHO throughout the day.
  - Each meal should have 3 to 4 CHO servings.
  - 1 serving CHO = about 15 grams.

**SUBCUTANEOUS INSULIN THERAPY:**
- **Insulin therapy to control blood glucose has shown to improve hospital outcomes (i.e., decrease infections, LOS, morbidity and mortality).**
- **Insulin requirement in illness is typically higher than in health; even with the patient is not eating.**

**TYPE** | **ONSET** | **PEAK** | **DURATION** | **COMMENTS**
---|---|---|---|---
Fast-Acting | | | | Can give up to the end of a meal if used for nutritional bolus
Novolog, Humalog | 1 - 15 minutes | 1 – 2 hours | 3-6 hours | 
Apidra | | | | 
Short Acting Regular | 30-60 minutes | 2-4 hours | 6-8 hours | Only insulin used IV
Intermediate-Acting NPH | 2-4 hours | 6-10 hours | 10-18 hours | Can give BID as a basal insulin order
Long-Acting Lantus, Levemir | 1 - 3 hours | No Peak | 20 - 24 hours | Can not be mixed with any other insulin

**Once opened, insulin is good for only about 28 days. Date the bottle when it is opened.**
- Do NOT hold insulin unless there is a physician order.
- 2 nurses are to verify and document each insulin dose given.
- For Type 2 patients with uncontrolled FSGB and not previously on insulin, consider basal insulin dose. For Type 1 patients, continue home regimen.
- There are 4 insulin manufacturers:

**NovoNordisk**
- **Novolin Products:** Novolog, Levemir, 70/30, Regular; NPH; Novolog Mix 70/30
- **This is the company with whom SJHC has a contract**

**Lilly**
- **Humulin Products:** Humulin 70/30, Regular, 50/50, NPH; Humalog Mix 75/25

**Sanofi-Aventis**
- **Lantus, Apidra**

**Pfizer**
- **Exubera (Inhaled insulin)**
- **SJHC uses the Levemir pen device**
- **Patient has to bring in own Exubera**
Inpatient Blood Glucose Control Facts and Guidelines

Scheduled insulin regimen every day is based on the previous day’s FSBG results. For example:

| Increase the following Insulin: | To Decrease the following FSBG: |
|---------------------------------|---------------------------------
| AM NPH                          | Pre-supper                      |
| PM Lantus/Levemir               | AM Fasting                     |
| AM Regular/Novolog              | Pre-lunch                      |
| PM Regular/Novolog              | Bedtime                        |

Total Daily Dose (TDD) of insulin
✓ The TDD is based on the total amount of Basal and Bolus (nutritional and meal time) insulin given in a 24 hour period.
✓ This helps to determine how much insulin the patient needs.

Basal Insulin (Lantus, Levemir, NPH)
✓ If A1C is greater than 9%, consider basal insulin.
✓ To figure the starting insulin dose, can use 0.5units/kg (range is 0.3 to 1.0 units/kg).
✓ 50% of starting dose is the basal insulin; the other 50% is meal time insulin.
✓ Adjust insulin daily to attain glycemic goals.
✓ Consider IV insulin drip if unable to maintain FSBG less than 180mg/dl.

Nutritional (Meal time) Insulin
✓ Rapid acting insulin (Novolog, Humalog, or Apidra) is preferred.
✓ Only used for meal time and not for bedtime. It is held when patient is NPO.
✓ If patient does not eat meal, nutritional bolus should not be given.
✓ 50% of starting dose is nutritional insulin, divided in thirds to be given at each meal.
✓ This insulin can be given from before to the end of the meal.
✓ If regular insulin is used, it is given 30 minutes before meal.
✓ Both correction and mealtime insulin can be given together.

Correction Insulin
✓ Rapid acting insulin (Novolog, Humalog, or Apidra) is preferred.
✓ Use of correction insulin alone is not recommended as it can lead to cycles of low and high FSBGs.
✓ If correction insulin is only being used, encourage MD to consider use of basal insulin and nutritional insulin.
✓ For most insulin sensitive patients, 1 unit of insulin will lower blood glucose by about 50mg/dl.
✓ Do not hold when FSBG is elevated (even if patient is NPO).
✓ The Blood Glucose Control Protocol has a weight based scale for correction insulin. Ideally, it is better to individualize the treatment.
✓ To individualize treatment, a correction factor (CF) formula can be used:
  - 30000 divided by weight in Kg. OR, 1700 divided by the total daily insulin dose (TDD).
  - The CF is the amount of blood glucose that is lowered by one unit of insulin.
  - Example: 3000 divided by 90kg (TDD) = 33.3. Thus, one unit of insulin will lower BG by about 33mg/dl above the target blood glucose.

ORAL DIABETES MEDICATIONS:

General Points:
✓ If FSBG is well controlled (within target BG range) can possibly remain on his home medications.
✓ If FSBG is not well controlled, best to use a basal/bolus insulin regimen in the hospital.
✓ If pill is in XL or XR form, do not break or crush.
✓ Check Creatinine and LFT levels as most can affect these lab tests.

Sulfonylureas:
✓ Amaryl (Glimepiride); Glucotrol (Glipizide); Diabeta (Micronase, Glyburide).
✓ Action = insulin secretagogue = it stimulates release of insulin from the pancreatic beta cells
✓ Should be taken before meals.
✓ Hypoglycemia is main side effect.
✓ Use with caution in renal and hepatic patients because they are metabolized hepatically and cleared renally.
✓ Action is with use of:  NSAID’s, warfarin, salicylates, sulfonamides, allopurinol, probenecid, MAOI’s, cloramphenicol, alcohol, beta blockers.
✓ Action is with use of: steroids, diuretics, niacin, L-thyroxine, estrogens, progestins, phenytoin, diazoxide, INH, rifampin, phenothiazines, and sympathomimetinics.
✓ These can be in combination form with Metformin.

Meglitinides (Non-Sulfonylurea Secretagogues):
✓ Prandin (Repaglinide) and Starlix (Nateglinide).
✓ Action = insulin secretagogue = stimulates release of insulin from pancreatic beta cells; Effect is mainly post-prandial.
✓ Give right at beginning of meal.
✓ Do not give if meal is skipped or patient is NPO.
✓ Use with caution in patients with liver disease.

Biguanides:
✓ Glucophage (Metformin) and the combinations.
✓ Action = insulin sensitizer = decreases hepatic glucose production; increases peripheral glucose uptake and use; decrease intestinal absorption of glucose.
✓ Maximum dose is 2500mg.
✓ Give with food.
✓ Not recommended for use in patients >80 years.
✓ Avoid use in hypoxic states, hepatic or renal insufficiency, CHF, or excessive alcohol use.
✓ Stop drug at time of contrast dye use and hold for 48 hours.
✓ After surgery, hold until oral intake is resumed and renal function is considered normal.

Alpha glucosidase inhibitors:
✓ Precose (Acarbose) and Glynset (Miglitol).
✓ Action = Delays the digestion of ingested carbohydrates by inhibiting digestive enzymes; Effect is mainly post-prandial FSBG.
✓ Main side effect is flatulence.
✓ Give with first bite of meals. If NPO, do not give.
✓ Treat hypoglycemia with glucose tablets or Gel only.

Thiazolidinediones (TZD):
✓ Avandia (Rosiglitazone) and Actos (Pioglitazone).
✓ Action = insulin sensitizer = increases glucose uptake and use and inhibits hepatic glucose production.
✓ Monitor liver function; can cause hepatotoxicity and fluid retention.
✓ Avoid use in class III and IV heart failure.
**Inpatient Blood Glucose Control Facts and Guidelines**

**MISCELLANEOUS MEDICATIONS:**
- **Byetta (Exenatide) (Used for Type 2 Diabetes)**
  - Action = GLP-1 receptor agonist; mimics action of gut incretin hormone stimulating insulin secretion; suppresses glucagon secretion; delays gastric emptying; promotes satiety.
  - Is used with Glucophage &/or Sulfonylureas; it is not a substitute for insulin. Comes in injection form.
  - If forgot to take, skip that dose (can not be taken later).
  - Most common side effect is nausea.
  - Given via a pre-filled syringe (pen device).
  - Patient has to bring in own Byetta; this is not on SJHC formulary.
  - Is taken before morning and evening meals.

- **Symlin (Pramlintide) (Used in Type 1 or Insulin requiring Type 2)**
  - Action = GLP-1 receptor agonist; mimics action of gut incretin hormone stimulating insulin secretion; suppresses glucagon secretion; delays gastric emptying; promotes satiety.
  - Comes in injection form to be given before meals; Is used with insulin.
  - If forgets to take, skip that dose (can not be taken later).
  - Most common side effect is nausea.
  - Patient has to bring in own Symlin; this is not on SJHC formulary.

- **Januvia (Sitagliptin)**
  - Action = DPP-4 Inhibitor = Blocks the breakdown of the GLP-1 intestinal hormone to enhance the body's own ability to lower elevated blood glucose.
  - Is given only once a day.
  - Hypoglycemia is not generally a problem.
  - Dose adjustment needed if renal insufficiency or ESRD.

**Inhaled Insulin (Exubera)**
- Is a rapid-acting insulin that is breathed in before meals through an inhaler.
- MD order is needed in order for patient to use own inhaler; if patient did not bring inhaler in, an order for nutritional SQ insulin will be needed.
- Contraindicated in patients who smoke or have COPD.

**OTHER DRUG INTERACTIONS:**

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<th>Drugs that may raise blood glucose levels:</th>
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<td>Amprenavir</td>
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<td>Aripiprazole</td>
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**IV INSULIN INFUSIONS**
- Comes pre-mixed from pharmacy; concentration is 1 unit per 1ml.
- 2 nurses must verify and document rate changes for rates 10 units/hour or greater.
- IV insulin only has a half life of about 5-10 minutes once dc’d; therefore a SQ injection is needed before discontinuing drip:
  - If regular insulin used, give 30 to 60 minutes before dc drip.
  - If NPH, Lantus, or Levemir insulin used, give 2 hours before dc drip.
  - Novolog or Humalog are not recommended as transition insulin.
  - SQ transition insulin dose is determined based on 3 things:
    1. Action / Duration of SQ insulin to be given.
    2. How much IV insulin was given during the period of time equal to the duration of the SQ insulin to be given.
    3. When the next FSBG and insulin is to be given.

**PERIOPERATIVE BLOOD GLUCOSE CONTROL:**
- Perioperative Blood Glucose Control protocol is used on all patients with diabetes who come through the OPS department only.
- Surgery and procedures should preferably be scheduled for early AM to result in the least impact on FSBGs and insulin dosing.
- FSBGs should be checked every 1 to 2 hours before, during, and after procedure.
- Type 1 Diabetes needs insulin at all times even if NPO. Can become ketotic within 12 – 24 hours if insulin held.
- For Type 2 Diabetes on insulin, for the morning of surgery:
  - Recommended to give 1/2 NPH insulin dose (will need order).
  - If patient on bedtime Lantus or Levemir, can give usual dose.
  - Do not give fast or short acting insulin unless FSBG >200.
  - Consider starting IV insulin drip.
- For Type 2 Diabetes on oral medications:
  - Get order to hold sulfonylurea or other insulin secretagogues; to be resumed after patient eating.

**OTHER DRUG INTERACTIONS:**
- Standard Insulin Drip
  - May be adjusted every 1 to 2 hours.
  - Used primarily for the med/surg units.
  - Prior to stopping the drip, must give SQ insulin. When to give the insulin is based on when the insulin starts to work.
- Critical Care Insulin Drip
  - Should be adjusted hourly.
  - Only to be used in the Critical Care units.
  - Prior to stopping the drip, must give SQ insulin. When to give the insulin is based on when the insulin starts to work.
INSULIN PUMP MANAGEMENT:
- Place the External Insulin Pump standing orders on the chart. It will need an MD signature.
- Send a referral to the Diabetes Treatment Center for pump assessment.
- Patient can manage his/her own pump if cognitively and physically OK.
- If patient is not able to manage the pump, the pump is to be discontinued after a SQ insulin injection is given. Once dc’d, the pump is to be given to the patient’s family or to security. Document to whom the pump was given. Do NOT leave the pump in the patient’s room.
- Verify that the patient has brought in their own pump supplies.
- Insulin pumps deliver a continual, pre-set basal rate and provide the ability to give correction or meal time bolus.
- The pump CANNOT be off for more than one hour without intervention.
  - When the pump is off for brief periods as 1 to 4 hours, the amount of insulin that would have been given during that time, is to be given as a SQ injection.
  - Do NOT remove the insulin cartridge from the pump while the infusion set is still attached to the patient.
- X-RAYS = do NOT expose the pump to high electromagnetic fields as MRI, CT SCAN, or any X-rays.
  - The pump is to be kept outside the room during the procedure.
  - If you think the pump has been exposed, given SQ injection, disconnect the pump and call the Diabetes Educator. If the Diabetes Educator is not available, call the 1-800 number on the back of the pump.

DKA/HHS MANAGEMENT:
- General Diagnostic Criteria: Glucose ≥250mg/dl; arterial pH ≤7.3; HCO3 ≤18; anion gap >10; positive ketones; serum osmolality variable.
- Hyperglycemic Crises Standing Orders is the ONLY order set to be used.
- Insulin Drip is recommended per the Hyperglycemic Crises standing orders.

SPECIAL PATIENT SITUATIONS:
- Steroids
  - Blood glucose will increase when patient is on steroids.
  - Steroids as Prednisone in low dose of <40mg/day may not have an effect on the FSBG.
  - Insulin is used to help manage the blood glucose levels.
  - There might be a need for the patient to go home on insulin until steroid is done.
  - If 2 or more correction insulin doses are given in 24 hours, basal insulin may be considered.
- TPN
  - Blood glucose may increase when patient is on TPN.
  - FSBG's are usually done every 6 hours.
  - Insulin is used to help manage the blood glucose levels.
  - Insulin might be given per TPN bag or per SQ administration.
  - If 2 or more correction insulin doses are given in 24 hours, basal insulin may be considered.
- Enteral Feedings
  - If continuous, FSBG’s should be checked every 6 hours.
  - Insulin is used to help manage the blood glucose levels.
  - There might be a need for the patient to go home on insulin if FSBG’s remain elevated.
  - If 2 or more correction insulin doses are given in 24 hours, basal insulin may be considered.

DISCHARGE
- Try to obtain the patient’s at-home regimen as long as possible BEFORE discharge date.
- It is not recommended to convert patients from insulin to home regimen and vice versa on the day of discharge.
- Make sure patient is able to get medications and has a blood glucose meter.
- Ensure follow-up visits with MD overseeing patient’s diabetes.
- Provide contact numbers for problems/concerns.
- Provide community resources to access further diabetes education
  - Encourage diabetes outpatient class attendance.
  - SJHC’s Diabetes Treatment Center is available for outpatient education per order by PCP.
  - Most local health departments or hospitals will have diabetes classes.

RESOURCES:
- Diabetes Treatment Center Educators at 313-2958.
- Diabetes Treatment Center home page on the SJHC Intranet:
  - Diabetes Medication Guide
  - Diabetes Basics Booklet (in Spanish also)
  - Common Insulin Names guide
  - Why insulin is used in the hospital (patient teaching sheet)
  - Medtronic Insulin Pump Guide
- Endocrinology section of the Orders & Forms on the SJHC Intranet.
- Diabetes websites:
  - www.diabetes.org
  - www.diabeteseducator.org
  - www.eatright.org
  - www.changingdiabetes-us.com/Educators

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