Managing Diabetes in the Hospital Setting

Between 12% and 25% of hospitalized patients have diabetes or some degree of hyperglycemia (Kubacka, 2014). It is critical for healthcare providers to effectively manage their patients’ diabetes to prevent complications from hypoglycemia and hyperglycemia which can result in increased morbidity, mortality, hospital admissions, and length of stay. A brief review of diabetes mellitus classification and diagnosis is provided followed by recommendations for management in the hospital setting.

Classification & Clinical Findings

- **Type 1 diabetes** – deficiency of insulin secretion due to β-cell destruction
  - **Stage 1**: normoglycemia, no symptoms
  - **Stage 2**: dysglycemia, presymptomatic
  - **Stage 3**: new hyperglycemia, clinical symptoms
- **Type 2 diabetes** – progressive loss of β-cell insulin secretion often with concurrent insulin resistance
- **Gestational diabetes mellitus** (GDM) – diabetes in pregnancy, usually diagnosed around week 24 and resolves after delivery; characterized by glucose intolerance related to insulin resistance
- **Diabetes due to other causes**: genetic defect in β-cell function, medical conditions (i.e. cystic fibrosis) or drug/chemical induced (i.e. glucocorticoids, treatment of HIV/AIDS, or after organ transplantation)

### Comparing Type 1 and Type 2 Diabetes

<table>
<thead>
<tr>
<th>Type 1</th>
<th>Type 2</th>
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<tbody>
<tr>
<td>Polyuria (frequent urination)</td>
<td>Signs and symptoms of Type 1, plus:</td>
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<tr>
<td>Polydipsia (increased thirst)</td>
<td>o Fatigue</td>
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<tr>
<td>Polyphagia (increased hunger)</td>
<td>o Hand tingling or numbness</td>
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<tr>
<td>Weight loss</td>
<td>o Slow-healing wounds</td>
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<tr>
<td>Weakness</td>
<td>o Recurrent infection</td>
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<td>o Visual changes/blurred vision</td>
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**Diagnosis**

- **Fasting plasma glucose (FPG)** ≥ 126 mg/dL (7.0 mmol/L); fasting for at least 8 hours
- **Two-hour plasma glucose (2-h PG)** ≥ 200 mg/dL (11.1 mmol/L) after a 75-gram oral glucose tolerance test (OGTT).
- **A1C** ≥ 6.5%
  - Measures average glycemia over 3 months
  - Strong predictor of diabetes complications
  - Fasting not required
May vary with race/ethnicity
May be inaccurate in patients with abnormal red blood cell turnover (anemias, hemolysis, blood loss); in these cases, plasma blood glucose should be used for diagnosis

- **Random plasma glucose ≥ 200 mg/dL** (11.1 mmol/L) in patients with classic symptoms of hyperglycemia or hyperglycemic crisis.

*Note: After an abnormal result of FPG, 2-h PG, or A1C, a repeat test for confirmation is recommended.*

**Recommendations for Care**

**General Recommendations** (American Diabetes Association, 2018)
- Document type of diabetes (type 1 or type 2) or “no history of diabetes” in the medical record.
- Check A1C levels in all patients with diabetes or hyperglycemia (blood glucose > 140 mg/dL) admitted to the hospital if no result has been documented in the prior 3 months. An A1C value ≥ 6.5% (48 mmol/mol) on admission suggests that diabetes preceded hospitalization.
- Assess diabetes self-management knowledge on admission and provide diabetes self-management education (DSME) as appropriate.
- A validated written or computerized protocol in place for both insulin dosing and blood glucose monitoring is recommended. Protocols should (Kubacka, 2014):
  - Include frequent blood glucose monitoring
  - Be easy to follow
  - Achieve glycemic goals in a reasonable time frame
  - Maintain goals with minimal risk for hypoglycemia
- Monitor glucose in non-diabetic patients at high-risk for hyperglycemia, such as those:
  - Receiving enteral or parental nutrition
  - Prescribed glucocorticoids, octreotide or immunosuppressive medications
- Intravenous (IV) or subcutaneous insulin are the preferred methods of administration for glycemic control.
  - In some circumstances, it may be appropriate to continue oral antihyperglycemic medications.
  - If oral medications are held in the hospital, they should be resumed 1-2 days before discharge.

**Insulin**

*Follow your institution policies and written orders for insulin administration.*

**General guidelines** (American Diabetes Association, 2018):
- Monitor glucose before meals and at bedtime per orders.
- If a patient is not eating, or is NPO, monitor glucose every 4 to 6 hours and treat per orders.
• Subcutaneous rapid- or short-acting insulin injections are recommended.
• Administer insulin for persistent hyperglycemia ≥ 180 mg/dL (10.0 mmol/L).
• Target glucose range to 140-180 mg/dL (7.8 – 10.0 mmol/L).
  o Pre-meal target < 140 mg/dL (7.8 mmol/L)
  o Random or post-meal target < 180 mg/dL (10.0 mmol/L)
• Tighter glucose control < 140 mg/dL (< 7.8 mmol/L) may be used for some patients if it does not cause significant hypoglycemia.
• Higher glucose levels may be acceptable in terminally ill patients, in patients with severe comorbidities, and in patient care settings where frequent monitoring is not possible.
• Use clinical judgment and ongoing assessment of the patient’s clinical status, including changes in glucose levels and concomitant medications that may affect glucose levels (i.e. glucocorticoids).
• Important reminders:
  o Significant discrepancies among capillary, venous, and arterial plasma blood glucose samples may occur with low or high hemoglobin concentrations or hypoperfusion.
  o Point-of-care (POC) meters may have a +/- 20% error rate. Glucose results that do not correlate with the patient’s clinical status should be confirmed with a conventional lab-tested glucose sample.
  o Prohibit sharing of finger-stick lancing devices, needles, and meters to reduce the risk of transmission of blood-borne disease. Insulin pens are “for single patient use only.”
  o The following are NOT recommended in the hospital setting (American Diabetes Association, 2018):
    ▪ Sole use of sliding scale insulin
    ▪ Premixed insulin regimens
    ▪ Continuous glucose monitoring

Calculating Insulin Dose (Kubacka, 2014; Zitkus, 2014)
• If the patient was previously on insulin, the preadmission dose should be used as a starting point.
  o Typically based on weight and range from 0.4 to 1.0 units/kg/day
• If the patient was not on insulin at home, the total daily dose (TDD) of insulin needed by a patient in one day is calculated based on the amount of carbohydrates consumed.
• For non-critically ill patients with good nutritional intake, insulin therapy should include:
  o Basal insulin (long-acting dose): defined as the amount of insulin secreted throughout the day in someone without diabetes; helps control blood glucose between meals and during sleep.
  o Bolus/nutritional insulin (meal-time): calculated based on carbohydrate (grams) intake.
Correctional (supplemental) insulin for hyperglycemia above the target as needed and prescribed.

- For non-critically ill patients with poor oral intake or taking nothing by mouth (NPO), the recommendation is use of basal insulin or basal plus bolus correctional insulin regimen. Administer rapid-acting insulin immediately after the patient eats or calculate the carbohydrates consumed and cover accordingly.
- For type 1 diabetic patients, it is not recommended to dose insulin based on premeal glucose level alone as this does not account for basal insulin requirements or caloric intake and may lead to hypoglycemia, hyperglycemia, and diabetic ketoacidosis (DKA).
- Lower doses of initial insulin may be needed for the following patients (Kubacka, 2014):
  - Insulin-sensitive
  - New to insulin
  - Body mass index < 18.5
  - Age older than 70
  - Those with stress hyperglycemia
  - Those with renal dysfunction which may cause impaired insulin clearance
- Higher doses of initial insulin may be needed for the following patients (Kubacka, 2014):
  - Insulin-resistant
  - Obese
  - Receiving corticosteroids
  - Uncontrolled diabetes mellitus
- For insulin doses over 50 units, basal insulin may be given as two injections to improve absorption.
- For patients receiving enteral or parenteral feedings, please refer to the guidelines outlined by the American Diabetes Association (2018). Insulin degludec has been added as a basal insulin option for enteral/parenteral feedings.

**Titrating Insulin**
Titrate insulin as needed to reach glucose targets (Kubacka, 2014).

*Scope of practice related to insulin titration varies among clinicians. Be sure to follow the policies of the unit.*

- Compare bedtime glucose to fasting glucose.
  - If levels are almost equal, the basal insulin dose is correct.
  - If fasting glucose is significantly higher than bedtime level, increase the basal insulin dose.
  - If fasting glucose is significantly lower than bedtime level, decrease the basal insulin dose.
- Bolus insulin dose is adequate if:
  - Blood glucose < 140 mg/dL 4 hours after last dose of insulin
  - Blood glucose < 180 mg/dL 2 hours after meals
• Assess insulin doses daily and adjust as needed to meet patient’s individual needs. Consider:
  o Amount of insulin required in previous 24 hours
  o Patient’s response to insulin
  o Patient’s nutritional status
• If patient will be NPO:
  o For a short duration, continue basal insulin and correctional doses; hold bolus dose.
  o For a long duration, basal dose may cause hypoglycemia; treat with IV dextrose 5% in 0.9% sodium chloride or D5W.
  o Even if NPO, patients with type 1 diabetes should receive basal insulin to prevent ketosis.
• For patients on glucocorticoid therapy
  o Once daily, short-acting glucocorticoids (i.e. prednisone) peak in 4-8 hours: use intermediate insulin (NPH).
  o Long-acting glucocorticoids (i.e. dexamethasone), multidose, or continuous use: use long-acting insulin.
  o Higher dose glucocorticoids: increasing doses of prandial and supplemental insulin may be required in addition to basal insulin.

Hyperglycemia & Hypoglycemia
Please refer to the Nursing Pocket Card Managing Acute Diabetic Complications.

Hyperglycemia (Kubacka, 2014)
• In hospitalized patients, hyperglycemia is defined as blood glucose > 140 mg/dL (7.8 mmol/L), is the main cause of organ damage in diabetes, and is linked to poor patient outcomes (Zitkus, 2014).
• Most inpatients experience at least one blood glucose level > 250 mg/dL.
• Illness may cause stress hyperglycemia which results from the release of counterregulatory hormones (cortisol, glucagon, and adrenaline) which increase blood glucose by promoting the breakdown of glycogen in the liver.
• Adverse events associated with inpatient hyperglycemia include: infection and sepsis, increased duration of mechanical ventilation, increased risk of mortality after myocardial infarction or cardiac surgery, increased risk of acute kidney injury, poor wound healing, and an increased length of stay.
• Treat with correctional insulin as needed and prescribed.

Hypoglycemia (Kubacka, 2014)
• Early symptoms include shakiness, irritability, confusion, tachycardia, and hunger.
• Severe hypoglycemia is linked to adverse outcomes such as cardiovascular and cerebrovascular events, patient falls, seizures, coma, and death.
• A hypoglycemia management protocol is recommended and should include:
  o A plan to prevent and treat hypoglycemia for each patient.
Reassessment of the insulin treatment plan if blood glucose drops below 70 mg/dL (3.9 mmol/L).
- Documentation of each episode in the medical record.

- In-hospital triggers of hypoglycemia may include:
  - Sudden decrease of corticosteroid dose
  - Reduced oral intake
  - Emesis
  - New NPO status
  - Inappropriate timing of short-acting insulin in relation to meals
  - Improper prescribing of hypoglycemic medications
  - Decreased infusion rate of IV dextrose
  - Unplanned interruption of oral, enteral, or parenteral feedings
  - Inability of patient to report symptoms

<table>
<thead>
<tr>
<th>Level of hypoglycemia</th>
<th>Clinical Considerations</th>
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| Hypoglycemia alert value (level 1) ≤ 70 mg/dL (3.9 mmol/L) | • Requires titration of insulin  
• If patient is able to eat, treat with fast-acting carbohydrate (glucose 15-20 g) such as 4 ounces (120 mL) of juice or regular soda, 1 tube of glucose gel, or 3-4 glucose tablets.  
• Recheck blood glucose after 15 minutes and if level remains low, administer another dose of glucose until levels have stabilized. |
| Clinically significant hypoglycemia (level 2) < 54 mg/dL (3.0 mmol/L) | • If patient is able to eat, provide 30 g of fast-acting carbohydrate (as above).  
• If patient is NPO or unable to eat, administer 50 mg (25 g) dextrose 50% IV push or glucagon injection.  
• Recheck blood glucose after 15 minutes and repeat treatment until levels have stabilized. |
| Severe hypoglycemia (level 3): no specific glucose threshold | • Associated with severe cognitive impairment requiring external assistance for recovery.  
• May progress to loss of consciousness, seizure, coma, or death. |

Considerations for Special Settings (American Diabetes Association, 2018)

Critical Care
• Utilize a continuous intravenous (IV) insulin infusion for blood glucose ≥ 180 mg/dL (10.0 mmol/L).
• Titrate infusion carefully to prevent hypoglycemia per orders.
• Monitor blood glucose every 30 minutes to 2 hours while on a continuous IV insulin infusion, per orders.
• A validated written or computerized protocol that allows for titration of the infusion rate based on glycemic fluctuations and insulin dose is recommended.
• Regular or rapid-acting subcutaneous insulin should be given 1 hour before the infusion is stopped OR intermediate or long-acting subcutaneous insulin should be given 2-4 hours before the infusion is stopped.
• Failure to overlap the IV and subcutaneous insulin may result in rapid hyperglycemia and risk of diabetic ketoacidosis (DKA) in patients with type 1 diabetes.

Perioperative Care
• Recommended target glucose is 80-180 mg/dL (4.4-10.0 mmol/L).
• Perform a preoperative risk assessment for patients at high risk for ischemic heart disease and those with autonomic neuropathy or renal failure.
• Hold metformin the day of surgery.
• Hold other oral hypoglycemic agents the morning of surgery and give half the NPH dose or 60-80% of the dose of long-acting analog or pump basal insulin.
• Monitor blood glucose every 4-6 hours while NPO and treat with short-acting insulin as needed.
• In non-cardiac general surgery patients, basal insulin plus premeal regular or short-acting insulin (basal-bolus) coverage is associated with improved glycemic control and lower rates of perioperative complications compared with sliding scale regimens.

Use of Non-Insulin Therapies (American Diabetes Association, 2018)
The safety and efficacy of noninsulin antihyperglycemic therapies in the hospital setting are under active research. Studies have found:
• Dipeptidyl peptidase 4 inhibitor alone or in combination with basal insulin is well tolerated and has similar glucose control compared with a basal-bolus regimen.
• Saxagliptin and alogliptin should be discontinued in patients who develop heart failure.
• Glucagon-like peptide 1 receptor agonists, while showing promise, may cause gastrointestinal symptoms.
• Sodium-glucose transporter 2 (SGLT2) inhibitors are not recommended for routine in-hospital use.
  o May cause DKA, urosepsis, urinary tract infections, and kidney injury.
  o Should be avoided in severe illness, when ketone bodies are present, and during prolonged fasting and surgical procedures.
Patient Self-Management (American Diabetes Association, 2018)

- Patients may self-manage their diabetes in the hospital if the patient has:
  - A history of successful self-management of diabetes at home
  - Demonstrated the cognitive and physical skills needed to self-administer insulin and perform self-monitoring of blood glucose
  - Adequate oral intake
  - Shown proficiency in carbohydrate estimation
  - Been utilizing multiple daily insulin injections or continuous subcutaneous insulin infusion (CSII) pump therapy
  - Stable insulin requirements
  - An understanding of sick-day management

- If self-management is used, a hospital protocol is recommended requiring that the patient, nursing staff, and provider agree that self-management is appropriate.

Continuous Subcutaneous Insulin Infusion (CSII)

Patients with continuous subcutaneous insulin infusion pumps may continue to self-manage their infusion if they are mentally and physically capable to do so (Kubacka, 2014).

- Confirm that the patient has the supplies required to safely manage the pump.
- Having a policy and procedure in place to help guide inpatient CSII therapy is recommended.
- Document basal and bolus doses at least daily.
- If the pump is discontinued for procedures, diagnostic imaging or surgery, subcutaneous insulin should be prescribed.

Discharge Planning (American Diabetes Association, 2018)

Please refer to the Nursing Pocket Card Discharge Planning for Patients with Diabetes Mellitus.

The discharge plan should be individualized for each patient.

- Medication reconciliation
  - Cross-check the patient’s medications to ensure chronic medications were not stopped.
  - Check for drug interactions between new prescriptions and current medications; review with the patient and family.
  - Confirm that any pre-admission oral antihyperglycemic medications were resumed 1-2 days prior to discharge.

- Communicate with outpatient providers regarding:
  - Information on medication changes
  - Pending tests and studies
  - Follow-up needs
  - Discharge summaries
• Ensure the patient is discharged with medical equipment, medications, supplies (i.e. insulin pens), and prescriptions.

• Patient education is critical prior to discharge. Assess the patient’s level of understanding and review the following prior to discharge:
  o The health care provider who will provide diabetes care after discharge
  o Diabetes definition and diagnosis
  o Recognition, treatment and prevention of hyperglycemia and hypoglycemia and other complications
  o Self-monitoring of blood glucose levels and understanding of target glucose levels
  o When and how to take glucose-lowering medications and insulin
  o When to call the provider
  o Use and disposal of needles and syringes
  o Nutrition and meal planning
  o Managing diabetes when sick
  o Exercise

• The follow-up plan of care should include a visit with the primary care provider, endocrinologist, or diabetes educator within 1 month of discharge. Schedule follow-up appointment prior to discharge.

References:
