

Review

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Review

Comprehensive Insulin Management in the Inpatient Setting

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Abstract

Effective inpatient insulin management is a critical component of hospital medicine, aiming to maintain glycemic control, reduce complications, and optimize patient outcomes. This review synthesizes current recommendations and evidence-based strategies for managing insulin in the inpatient setting. It outlines insulin pharmacokinetics, dosing methodologies—including basal-bolus regimens, correction scales, and limited roles for sliding scale insulin—and considerations for special populations such as critically ill, perioperative, glucocorticoid-treated, and total parenteral nutrition (TPN) patients. The review also addresses diabetic ketoacidosis management, the impact of concurrent non-insulin medications, and practical protocols for transitioning between intravenous and subcutaneous insulin. Drawing from updated guidelines from the American Diabetes Association and recent clinical trials, this article emphasizes individualized treatment plans, interdisciplinary collaboration, and close monitoring to minimize hypoglycemia risk while achieving glycemic targets. Recommendations for adjusting insulin therapy in the context of comorbidities, medication interactions, and surgical interventions are also discussed. The goal is to provide hospital-based clinicians with a concise yet comprehensive reference to guide safe and effective inpatient insulin therapy.

Keywords: basal-bolus; blood glucose/therapy; diabetes mellitus; hyperglycemia; Inpatients; insulin; insulin therapy

1. Introduction

Glycemic control is a cornerstone of inpatient care for patients with diabetes mellitus, stress hyperglycemia, or other causes of dysglycemia [1]. Both hyperglycemia and hypoglycemia are independently associated with adverse outcomes, including increased inpatient mortality, prolonged hospital stay, higher readmission rates, and impaired recovery. Persistent hyperglycemia exacerbates microvascular (retinopathy, nephropathy, neuropathy) and macrovascular (myocardial infarction, stroke, peripheral arterial disease) complications. Conversely, iatrogenic hypoglycemia can precipitate arrhythmias, seizures, altered mental status, and long-term neurological sequelae. Current clinical guidelines from the American Diabetes Association (ADA) and Society of Hospital Medicine emphasize early recognition of abnormal glucose values, individualized targets (generally 140–180 mg/dL for most hospitalized adults), and proactive rather than reactive insulin strategies. Routine assessment of hemoglobin A1c (HbA1c) at admission provides valuable insight into pre-hospital glycemic control and can guide both inpatient management and outpatient follow-up planning.

2. Types of Insulin and Their Uses

In the inpatient setting, insulin formulations are broadly classified into long-acting, intermediate-acting, short-acting, and rapid-acting types. Long-acting insulin (e.g., glargine, detemir, degludec) provides basal coverage for ~24 hours and is typically administered once daily to maintain

steady-state insulin levels. Intermediate-acting insulin (e.g., NPH) has a shorter duration (10–12 hours) and distinct peak activity (6–10 hours post-injection), making it useful for steroid-induced hyperglycemia or as part of twice-daily regimens [2]. Short-acting insulin (regular human insulin) has onset within 30 minutes, peaks at 2–3 hours, and lasts ~6 hours; it is still used for continuous IV infusions and specific perioperative contexts. Rapid-acting insulin (aspart, lispro, glulisine) peaks in ~1 hour and lasts 3–5 hours, closely mimicking physiologic mealtime insulin release. Premixed formulations exist but are generally avoided in hospitalized patients due to reduced flexibility in dose adjustment. Understanding pharmacokinetics allows clinicians to match insulin action to physiologic and pathophysiologic needs [3].

3. Insulin Regimens in the Hospital

Admission Evaluation

All hospitalized patients with known diabetes, stress hyperglycemia, or unexplained hyperglycemia (random plasma glucose ≥ 140 mg/dL) should undergo a comprehensive glycemic assessment, including HbA1c measurement if not done within the prior 3 months. This distinguishes between chronic and acute dysglycemia and informs therapy adjustments [4]. In non-critically ill patients, glucose should be monitored before meals and at bedtime [4]; if NPO, monitoring every 6 hours is standard. Early identification of hyperglycemia allows timely initiation of therapy, improving outcomes and preventing metabolic decompensation.

3.1. Inpatient Insulin Dosing

3.1.1. Finding Total Daily Dose (TDD)

TDD can be estimated using: (1) Home regimen method – total basal and bolus doses over 24 hours; adjust to 75% if NPO or at high hypoglycemia risk, or 100% if hyperglycemic or acutely ill [5]. (2) Weight-based method – 0.25–0.3 units/kg/day for insulin-sensitive patients (elderly, CKD), 0.4 units/kg for average sensitivity (most type 1 diabetes), and 0.5–1.0 units/kg for insulin-resistant patients (type 2 diabetes, obesity, infection, corticosteroid use). (3) Insulin infusion rate method – steady 4-hour infusion rate $\times 6$. (4) Correction-dose method – total correction insulin administered over the prior 24 hours.

3.1.2. Dosing: Basal-Bolus Method

The basal-bolus regimen is the preferred inpatient insulin strategy recommended by the ADA [6] and the Endocrine Society. Approximately 50% of the TDD is administered as basal insulin (e.g., glargine once daily, detemir twice daily), with the remaining 50% divided into pre-meal bolus doses of rapid-acting insulin (aspart, lispro, glulisine). This approach more closely mimics physiologic insulin secretion, maintaining stable glucose levels between meals and providing coverage for carbohydrate intake. Pre-meal boluses are calculated based on anticipated carbohydrate load and supplemented by a correction factor for preprandial hyperglycemia. Correction scales should be individualized based on the patient's total insulin requirement—low (<40 units/day), moderate (40–80 units/day), or high (>80 units/day)—and applied consistently. This proactive regimen prevents hyperglycemia rather than responding to it after onset.

3.1.3. Dosing: Sliding Scale

Sliding scale insulin (SSI), using rapid-acting insulin doses based solely on point-in-time glucose readings, is no longer recommended as monotherapy for inpatient glycemic management [7]. The ADA's 2024 and 2025 guidelines emphasize that SSI is reactive rather than preventive, leading to greater glycemic variability⁹ and increased risk of both hypo- and hyperglycemia. Its primary utility lies as an adjunct to basal-bolus therapy [8], functioning as a correction mechanism for unanticipated hyperglycemia. SSI remains common in practice due to ease of implementation, but studies—most

notably Umpierrez et al. (2007)—demonstrate superior glycemic control and reduced complications with basal-bolus regimens.

3.2. Special Populations

3.2.1. Critically Ill Patients – ICU

Critically ill patients experience frequent and significant glucose fluctuations due to stress-induced hyperglycemia, variable nutritional intake, and altered insulin pharmacokinetics. The recommended target glucose range is 140–180 mg/dL for most ICU patients [5], as supported by the NICE-SUGAR trial, which found increased mortality with intensive glucose control [9] (81–108 mg/dL). Continuous IV insulin infusion using regular insulin is the preferred method in this setting, allowing rapid titration based on hourly glucose monitoring. Transition to subcutaneous insulin should be considered once the patient is hemodynamically stable and no longer requiring vasoactive support, with a 2–3 hour overlap between IV and subcutaneous dosing to prevent rebound hyperglycemia.

3.2.2. Perioperative Patients

Poor perioperative glycemic control is linked to higher rates of infection, impaired wound healing [10], fluid and electrolyte disturbances, and cardiovascular complications. Most surgical teams aim for an HbA1c <8.5% prior to elective procedures. Preoperatively, all oral antihyperglycemics should be held on the day of surgery; SGLT2 inhibitors require discontinuation at least 72 hours prior to reduce the risk of euglycemic ketoacidosis. DPP-4 inhibitors may be continued in selected low-risk patients, supported by the SITA-HOSPITAL trial [11]. For short surgeries (<4 hours), subcutaneous correctional insulin (lispro, aspart) every 2 hours with glucose checks is appropriate. For longer or hemodynamically unstable procedures, IV regular insulin infusion is preferred, with glucose monitoring every 1–2 hours. Postoperatively, stable patients tolerating oral intake may resume their preoperative regimens; those remaining hospitalized should receive standard inpatient basal-bolus therapy.

3.2.3. Patients on Glucocorticoids

Glucocorticoids induce hyperglycemia by reducing peripheral glucose uptake, increasing hepatic gluconeogenesis, and enhancing insulin resistance. Hyperglycemia typically peaks 4–8 hours after dosing. For patients receiving once-daily morning steroids, NPH insulin given concurrently is often effective due to its peak action profile [12]. For those on multiple or long-acting steroid doses, a basal-bolus regimen with appropriate correction scaling is preferred. Close glucose monitoring is critical, as insulin requirements may change rapidly with steroid tapering.

3.2.4. Patients on Total Parenteral Nutrition (TPN)

Hyperglycemia during TPN administration is associated with increased infectious complications, delayed recovery, and higher mortality [13]. Glycemic control can be achieved via subcutaneous basal-bolus regimens or IV insulin infusion; insulin may also be added directly to the TPN solution, though this reduces flexibility. Studies suggest insulin-to-dextrose ratios from 1:10 to 1:4 (units per grams carbohydrate) can be effective, with individualized titration [14]. Recommended carbohydrate delivery in TPN is ~2 g/kg/day, with total caloric intake for ICU patients targeted at 20–25 kcal/kg/day. Infusion rates exceeding 4 mg/kg/min markedly increase hyperglycemia risk [15].

3.2.5. Diabetic Ketoacidosis

DKA, one of the most feared complications in type 1 diabetics, is characterized by uncontrolled hyperglycemia, ketonemia, and metabolic acidosis due to absolute or relative insulin deficiency [16]. Initial management priorities are volume resuscitation, electrolyte correction—especially

potassium—and initiation of continuous IV insulin at 0.1 units/kg/hr. Primary therapeutic goals include reducing ketones [17] by ≥ 0.5 mmol/L/hr, increasing bicarbonate by 3 mmol/L/hr, and lowering glucose by ~ 50 –75 mg/dL/hr while maintaining potassium 4.0–5.5 mmol/L. Once glucose falls below 200 mg/dL, dextrose 5–10% infusion is added to allow continued insulin to suppress ketogenesis. Basal insulin should be initiated early to facilitate transition off IV insulin, with a 1–2 hour overlap.

4. Non-Insulin Medication Management in the Setting of Inpatient Insulin

Most oral and non-insulin injectable antihyperglycemics are discontinued upon admission [18] in favor of insulin due to safety concerns, altered pharmacokinetics, and the need for rapid titration. Metformin carries a risk of lactic acidosis in hypoperfusion or renal impairment; sulfonylureas risk prolonged hypoglycemia; GLP-1 agonists can cause nausea and delayed gastric emptying; SGLT2 inhibitors carry euglycemic ketoacidosis risk. Certain non-antihyperglycemic drugs also impact glycemic control: β -blockers can mask hypoglycemia symptoms; ACE inhibitors and ARBs may increase insulin sensitivity; thiazide and loop diuretics can induce hyperglycemia via hypokalemia; atypical antipsychotics promote weight gain and insulin resistance [19]; corticosteroids exacerbate hyperglycemia via multiple mechanisms. Each agent should be evaluated individually for continuation, substitution, or discontinuation.

5. Conclusions

Effective inpatient insulin management requires individualized, evidence-based regimens tailored to patient comorbidities, nutritional status, and illness severity. Basal-bolus strategies, supplemented with correctional doses, remain the preferred approach for most patients, with adjustments for special populations including the critically ill, perioperative patients, and those on glucocorticoids or TPN. Early and appropriate use of IV insulin is essential in DKA and ICU settings, with careful overlap during transitions to subcutaneous therapy. Non-insulin medications must be reviewed for potential interactions and impact on glycemic control. The overarching goal is to achieve safe, stable glucose levels that support recovery and reduce complications during hospitalization, using a multidisciplinary approach that incorporates physicians, nurses, dietitians, and pharmacists.

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Abbreviations

The following abbreviations are used in this manuscript:

TPN	Total Parenteral Nutrition
ADA	American Diabetes Association
HbA1c	Glycated Hemoglobin
NPH	Neutral Protamine Hagedorn insulin (A.K.A Normal Insulin)
NPO	Nil Per Os (Medical Latin term for “Nothing by Mouth”)
TDD	Total Daily Dose
CKD	Chronic Kidney Disease
SSI	Sliding Scale Insulin
ICU	Intensive Care Unit
IV	Intravenous
SGLT2	Sodium-Glucose Cotransporter 2
DPP-4	Dipeptidyl Peptidase-4
DKA	Diabetic Ketoacidosis
GLP-1	Glucagon Like Peptide-1

ACE Angiotensin-Converting Enzyme
ARB Angiotensin Receptor Blocker

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