# 13. Diabetes Care in the Hospital, Nursing Home, and Skilled Nursing Facility

*American Diabetes Association*

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POSITION STATEMENT

***Recommendations***

- Diabetes discharge planning should start at hospital admission, and clear diabetes management instructions should be provided at discharge. **E**
- The sole use of sliding scale insulin (SSI) in the inpatient hospital setting is strongly discouraged. **A**
- All patients with diabetes admitted to the hospital should have their diabetes type clearly identified in the medical record. **E**

**Critically Ill Patients**

- Insulin therapy should be initiated for treatment of persistent hyperglycemia starting at a threshold of no greater than 180 mg/dL (10 mmol/L). Once insulin therapy is started, a glucose range of 140–180 mg/dL (7.8–10 mmol/L) is recommended for the majority of critically ill patients. **A**
- More stringent goals, such as 110–140 mg/dL (6.1–7.8 mmol/L), may be appropriate for selected patients, as long as this can be achieved without significant hypoglycemia. **C**
- Critically ill patients require an intravenous insulin protocol that has demonstrated efficacy and safety in achieving the desired glucose range without increasing risk for severe hypoglycemia. **E**

**Noncritically Ill Patients**

- If treated with insulin, generally premeal blood glucose targets of $<$140 mg/dL (7.8 mmol/L) with random blood glucose $<$180 mg/dL (10.0 mmol/L) are reasonable, provided these targets can be safely achieved. More stringent targets may be appropriate in stable patients with previous tight glycemic control. Less stringent targets may be appropriate in those with severe comorbidities. **C**
- A basal plus correction insulin regimen is the preferred treatment for patients with poor oral intake or who are taking nothing by mouth (NPO). An insulin regimen with basal, nutritional, and correction components is the preferred treatment for patients with good nutritional intake. **A**
- A hypoglycemia management protocol should be adopted and implemented by each hospital or hospital system. A plan for preventing and treating hypoglycemia should be established for each patient. Episodes of hypoglycemia in the hospital should be documented in the medical record and tracked. **E**
- Consider obtaining an A1C in patients with diabetes admitted to the hospital if the result of testing in the previous 3 months is not available. **E**
- Consider obtaining an A1C in patients with risk factors for undiagnosed diabetes who exhibit hyperglycemia in the hospital. **E**
- Patients with hyperglycemia in the hospital who do not have a prior diagnosis of diabetes should have appropriate follow-up testing and care documented at discharge. **E**

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## HYPERGLYCEMIA IN THE HOSPITAL

Hyperglycemia in the hospital can reflect previously known or previously undiagnosed diabetes or may be hospital related. The difficulty distinguishing between the second and third categories during the hospitalization may be overcome by measuring A1C, as long as conditions interfering with A1C equilibrium (such as hemolysis, blood transfusion, blood loss, or erythropoietin therapy) have not occurred. A1C values ≥6.5% in undiagnosed patients suggest that diabetes preceded hospitalization (1). Hyperglycemia management in the hospital has often been considered secondary in importance to the condition that prompted admission. However, a body of literature now supports targeted glucose control in the hospital setting for improved clinical outcomes (2). Hyperglycemia in the hospital may result from stress or decompensation of type 1, type 2, or other forms of diabetes and/or may be iatrogenic due to withholding of antihyperglycemic medications or administration of hyperglycemia-provoking agents, such as glucocorticoids, vasopressors, and enteral or parenteral nutrition.

There is substantial observational evidence linking hyperglycemia in hospitalized patients (with or without diabetes) to poor outcomes. Cohort studies as well as a few early randomized controlled trials (RCTs) suggested that intensive treatment of hyperglycemia improved hospital outcomes (3,4). In general, these studies were heterogeneous in terms of patient population, blood glucose targets, insulin protocols, provision of nutritional support, and the proportion of patients receiving insulin, which limits the ability to make meaningful comparisons among them. Trials in critically ill patients have failed to show a significant improvement in mortality with intensive glycemic control or have even shown increased mortality risk (5). Moreover, RCTs have highlighted the risk of severe hypoglycemia resulting from such efforts (6–9).

The largest study to date, Normoglycemia in Intensive Care Evaluation-Survival Using Glucose Algorithm Regulation (NICE-SUGAR), a multicenter, multinational RCT, compared the effect of intensive glycemic control (target 81–108 mg/dL [4.5–6.0 mmol/L]; mean blood glucose attained 115 mg/dL [6.4 mmol/L]) to standard glycemic control (target 144–180 mg/dL [8.0–10.0 mmol/L]; mean blood glucose attained 144 mg/dL [8.0 mmol/L]) on outcomes among 6,104 critically ill participants, almost all of whom required mechanical ventilation (6).

Ninety-day mortality was significantly higher in the intensive versus the conventional treatment group in both surgical and medical patients, as was mortality from cardiovascular causes. Severe hypoglycemia was also more common in the intensively treated group (6.8% vs. 0.5%; $P < 0.001$).

The study results lie in stark contrast to a 2001 single-center study that reported a 42% relative reduction in intensive care unit (ICU) mortality in critically ill surgical patients treated to a target blood glucose of 80–110 mg/dL (3). The NICE-SUGAR findings do not disprove the notion that glycemic control in the ICU is important. However, they do strongly suggest that it may not be necessary to target blood glucose values <140 mg/dL (7.8 mmol/L) and that a highly stringent target of <110 mg/dL (6.1 mmol/L) may actually be dangerous.

In a meta-analysis of 26 trials ($n$ = 13,567), which included the NICE-SUGAR data, the pooled relative risk [RR] of death with intensive insulin therapy was 0.93 as compared with conventional therapy (95% CI 0.83–1.04) (9). Approximately half of these trials reported hypoglycemia, with a pooled RR of intensive therapy of 6.0 (95% CI 4.5–8.0). The specific ICU setting influenced the findings, with patients in surgical ICUs appearing to benefit from intensive insulin therapy (RR 0.63 [95% CI 0.44–0.91]), while those in other medical and mixed critical care settings did not. It was concluded that, overall, intensive insulin therapy increased the risk of hypoglycemia and provided no overall benefit on mortality in the critically ill, although a possible mortality benefit to patients admitted to the surgical ICU was suggested.

## GLYCEMIC TARGETS IN HOSPITALIZED PATIENTS

### Definition of Glucose Abnormalities in the Hospital Setting

Hyperglycemia in the hospital has been defined as any blood glucose >140 mg/dL (7.8 mmol/L). Levels that are significantly and persistently above this may require treatment in hospitalized patients. A1C values ≥6.5% suggest, in undiagnosed patients, that diabetes preceded hospitalization (1). Hypoglycemia has been defined as any blood glucose <70 mg/dL (3.9 mmol/L). This is the standard definition in outpatients and correlates with the initial threshold for the release of counterregulatory hormones. Severe hypoglycemia in hospitalized patients has been defined by many as <40 mg/dL (2.2 mmol/L), although this is lower than the ~50 mg/dL (2.8 mmol/L) level at which cognitive impairment begins in normal individuals (10). Both hyperglycemia and hypoglycemia among inpatients are associated with adverse short- and long-term outcomes. Early recognition and treatment of mild to moderate hypoglycemia (40–69 mg/dL [2.2–3.8 mmol/L]) can prevent deterioration to a more severe episode with potential adverse sequelae (11).

### Critically Ill Patients

Based on available evidence, for the majority of critically ill patients in the ICU setting, intravenous insulin infusion should be used to control hyperglycemia, with a starting threshold of no higher than 180 mg/dL (10.0 mmol/L). Once intravenous insulin is started, the glucose level should be maintained between 140–180 mg/dL (7.8–10.0 mmol/L). Greater benefit may be realized at the lower end of this range. Although strong evidence is lacking, lower glucose targets may be appropriate in select patients. One small study suggested that ICU patients treated to targets of 120–140 mg/dL (6.7–7.8 mmol/L) had less negative nitrogen balance than those treated to higher targets (12). However, targets <110 mg/dL (6.1 mmol/L) are not recommended. Insulin infusion protocols with demonstrated safety and efficacy, resulting in low rates of hypoglycemia, are highly recommended (11).

### Noncritically Ill Patients

With no prospective RCT data to inform specific glycemic targets in noncritically ill patients, recommendations are based on clinical experience and judgment (13). For the majority of noncritically ill patients treated with insulin, premeal glucose targets should generally be <140 mg/dL (7.8 mmol/L) with

random blood glucose <180 mg/dL (10.0 mmol/L), as long as these targets can be safely achieved. To avoid hypoglycemia, consideration should be given to reassessing the insulin regimen if blood glucose levels fall below 100 mg/dL (5.6 mmol/L). Modifying the regimen is required when blood glucose values are <70 mg/dL (3.9 mmol/L), unless the event is easily explained by other factors (such as a missed meal). There is some evidence that systematic attention to hyperglycemia in the emergency room leads to better glycemic control in the hospital for those subsequently admitted (14).

Patients with a prior history of successful tight glycemic control in the outpatient setting who are clinically stable may be maintained with a glucose range below the aforementioned cut points. Conversely, higher glucose ranges may be acceptable in terminally ill patients or in patients with severe comorbidities, as well as in those in patient-care settings where frequent glucose monitoring or close nursing supervision is not feasible.

Clinical judgment combined with ongoing assessment of the patient's clinical status, including changes in the trajectory of glucose measures, the severity of illness, nutritional status, or concomitant medications that might affect glucose levels (e.g., glucocorticoids, octreotide), must be incorporated into the day-to-day decisions regarding insulin dosing (11).

## ANTIHYPERGLYCEMIC AGENTS IN HOSPITALIZED PATIENTS

In most clinical situations in the hospital, insulin therapy is the preferred method of glycemic control (11). In the ICU, intravenous infusion is the preferred route of insulin administration. When the patient is transitioned off intravenous insulin to subcutaneous therapy, precautions should be taken to prevent hyperglycemia (15,16). Outside of critical care units, scheduled subcutaneous insulin that delivers basal, nutritional, and correction components (basal–bolus regimen) is recommended for patients with good nutritional intake. A basal plus correction insulin regimen is the preferred treatment for patients with poor oral intake or who are NPO. *SSI is strongly discouraged in hospitalized patients as the sole method of insulin treatment.*

For patients with type 1 diabetes, dosing insulin solely based on premeal glucose levels does not account for basal insulin requirements or caloric intake, increasing both hypoglycemia and hyperglycemia risks and potentially leading to diabetic ketoacidosis. It has been shown in an RCT that basal–bolus treatment improved glycemic control and reduced hospital complications compared with SSI in general surgery patients with type 2 diabetes (17). Typical dosing schemes are based on body weight, with some evidence that patients with renal insufficiency should be treated with lower doses (18). The reader is referred to publications and reviews that describe available insulin preparations and protocols and provide guidance in the use of insulin therapy in specific clinical settings, including parenteral nutrition (19), enteral tube feedings, and high-dose glucocorticoid therapy (11).

Recent studies have investigated the safety and efficacy of oral agents and injectable noninsulin therapies, such as GLP-1 analogs, in the hospital. A small study in general medicine and surgical wards showed that treatment with sitagliptin resulted in similar glycemic control as a basal–bolus regimen in patients with type 2 diabetes who had an A1C <7.5% and, in addition to a nutrition intervention, were treated with oral agents or low doses of insulin prior to hospitalization (20). Use of intravenous exenatide infusion resulted in improved glycemic control in patients admitted to a cardiac ICU (21). Further studies are needed to define the role of incretin mimetics in the inpatient management of hyperglycemia.

## PREVENTING HYPOGLYCEMIA

Patients with or without diabetes may experience hypoglycemia in the hospital setting in association with altered nutritional state, heart failure, renal or liver disease, malignancy, infection, or sepsis. Additional triggering events leading to iatrogenic hypoglycemia include sudden reduction of corticosteroid dose, altered ability of the patient to report symptoms, reduced oral intake, emesis, new NPO status, inappropriate timing of short- or rapid-acting insulin in relation to meals, reduced infusion rate of intravenous dextrose, and unexpected interruption of enteral feedings or parenteral nutrition.

Despite the preventable nature of many inpatient episodes of hypoglycemia, institutions are more likely to have nursing protocols for hypoglycemia treatment than for its prevention. Tracking such episodes and analyzing their causes are important quality-improvement activities (22).

## DIABETES CARE PROVIDERS IN THE HOSPITAL

Inpatient diabetes management may be effectively championed and/or provided by primary care physicians, endocrinologists, intensive care specialists, or hospitalists. Involvement of appropriately trained specialists or specialty teams may reduce length of stay, improve glycemic control, and improve outcomes (11). Standardized orders for scheduled and correction-dose insulin should be implemented, while sole reliance on an SSI regimen is strongly discouraged. As hospitals move to comply with "meaningful use" regulations for electronic health records, as mandated by the Health Information Technology for Economic and Clinical Health Act, efforts should be made to ensure that all components of structured insulin order sets are incorporated into electronic insulin order sets (23,24).

To achieve glycemic targets associated with improved hospital outcomes, hospitals will need a multidisciplinary approach to develop insulin management protocols that effectively and safely enable achievement of glycemic targets (25).

## SELF-MANAGEMENT IN THE HOSPITAL

Diabetes self-management in the hospital may be appropriate for competent youth and adult patients who have a stable level of consciousness and reasonably stable daily insulin requirements, successfully conduct self-management of diabetes at home, have physical skills needed to successfully self-administer insulin and perform self-monitoring of blood glucose, have adequate oral intake, are proficient in carbohydrate counting, use multiple daily insulin injections or insulin pump therapy, and understand sick-day management. The patient and physician, in consultation with nursing staff, must agree that patient self-management is appropriate while hospitalized.

Patients who use continuous subcutaneous insulin infusion (CSII) pump therapy in the outpatient setting can be candidates for diabetes self-management in the hospital, provided that they have the mental and physical capacity to do so (11). Hospital policy and procedures delineating inpatient guidelines for CSII therapy are advisable, and availability of hospital personnel with expertise in CSII therapy is essential. It is important that nursing personnel document basal rates and bolus doses taken on a daily basis.

## MEDICAL NUTRITION THERAPY IN THE HOSPITAL

The goals of medical nutrition therapy are to optimize glycemic control, provide adequate calories to meet metabolic demands, and create a discharge plan for follow-up care (2,26). The American Diabetes Association (ADA) does not endorse any single meal plan or specified percentages of macronutrients, and the term "ADA diet" should no longer be used. Current nutrition recommendations advise individualization based on treatment goals, physiological parameters, and medication use. Consistent carbohydrate meal plans are preferred by many hospitals as they facilitate matching the prandial insulin dose to the amount of carbohydrate consumed (27). Because of the complexity of nutrition issues in the hospital, a registered dietitian, knowledgeable and skilled in medical nutrition therapy, should serve as an inpatient team member. The dietitian is responsible for integrating information about the patient's clinical condition, meal planning, and lifestyle habits and for establishing treatment goals to determine a realistic plan for nutrition therapy (28).

## BEDSIDE BLOOD GLUCOSE MONITORING

Bedside point-of-care (POC) blood glucose monitoring is used to guide insulin dosing. In the patient receiving nutrition, the timing of glucose monitoring should match carbohydrate exposure. In the patient not receiving nutrition, glucose monitoring is performed every 4–6 h (29,30). More frequent blood glucose testing ranging from every 30 min to every 2 h is required for patients on intravenous insulin infusions.

Safety standards should be established for blood glucose monitoring that prohibit the sharing of finger-stick lancing devices, lancets, needles, and meters to reduce the risk of transmission of blood-borne diseases. Shared lancing devices carry essentially the same risk as sharing syringes and needles (31).

Accuracy of blood glucose measurements using POC meters has limitations that must be considered. Although the U.S. Food and Drug Administration currently allows a ±20% error for blood glucose meters, questions about the appropriateness of these criteria have been raised, especially for lower blood glucose readings (32). Glucose measures differ significantly between plasma and whole blood, terms that are often used interchangeably and can lead to misinterpretation. Most commercially available capillary blood glucose meters introduce a correction factor of ~1.12 to report a "plasma-adjusted" value (33).

Significant discrepancies between capillary, venous, and arterial plasma samples have been observed in patients with low or high hemoglobin concentrations, hypoperfusion, and interfering substances such as maltose (contained in immunoglobulins) (34). Analytical variability has been described with several meters (35). Increasingly, newer-generation POC blood glucose meters correct for variation in hematocrit and for interfering substances. Any glucose result that does not correlate with the patient's status should be confirmed through conventional laboratory sampling of plasma glucose. The U.S. Food and Drug Administration has become increasingly concerned about POC blood glucose meter use in the hospital and is presently reviewing matters related to their use.

## DISCHARGE PLANNING

Transition from the acute care setting is a high-risk time for all patients, not just those with diabetes or new hyperglycemia. Although there is extensive literature concerning safe transition within and from the hospital, little of it is specific to diabetes (36). Diabetes discharge planning is not a separate entity but is an important part of an overall discharge plan. As such, discharge planning begins at admission to the hospital and is updated as projected patient needs change.

Inpatients may be discharged to varied settings, including home (with or without visiting nurse services), assisted living, rehabilitation, or skilled nursing facilities. For the patient who is discharged to assisted living or to home, the optimal program will need to consider the type and severity of diabetes, the effects of the patient's illness on blood glucose levels, and the capacities and desires of the patient. Smooth transition to outpatient care should be ensured.

An outpatient follow-up visit with the primary care provider, endocrinologist, or diabetes educator within 1 month of discharge is advised for all patients having hyperglycemia in the hospital. Clear communication with outpatient providers either directly or via hospital discharge summaries facilitates safe transitions to outpatient care. Providing information regarding the cause of hyperglycemia (or the plan for determining the cause), related complications and comorbidities, and recommended treatments can assist outpatient providers as they assume ongoing care.

The Agency for Healthcare Research and Quality recommends that, at a minimum, discharge plans include the following:

### Medication Reconciliation

- The patient's medications must be cross-checked to ensure that no chronic medications were stopped and to ensure the safety of new prescriptions.
- Prescriptions for new or changed medication should be filled and reviewed with the patient and family at or before discharge.

### Structured Discharge Communication

- Information on medication changes, pending tests and studies, and follow-up needs must be accurately and promptly communicated to outpatient physicians.
- Discharge summaries should be transmitted to the primary physician as soon as possible after discharge.
- Appointment-keeping behavior is enhanced when the inpatient team schedules outpatient medical follow-up prior to discharge. Ideally, the inpatient care providers or case managers/discharge planners will schedule follow-up visit(s) with the appropriate professionals, including primary care provider, endocrinologist, and diabetes educator (37).

## DIABETES SELF-MANAGEMENT EDUCATION

Teaching diabetes self-management to patients in hospitals is a challenging task. Patients are ill, under increased stress related to their hospitalization and diagnosis, and in an environment not conducive to learning. Ideally, people with diabetes should be taught at a time and place conducive to learning: as an outpatient in a recognized program of diabetes education. For the hospitalized patient, diabetes "survival skills" education is generally a feasible approach to provide sufficient information and training to enable safe care at home. Patients hospitalized because of a crisis related to diabetes management or poor care at home require education to prevent subsequent episodes of hospitalization. Assessing the need for a home health referral or referral to an outpatient diabetes education program should be part of discharge planning for all patients. Expanded diabetes education can be arranged in the community.

Diabetes self-management education should start upon admission or as soon as feasible, especially in those new to insulin therapy or in whom the diabetes regimen has been substantially altered during the hospitalization.

It is recommended that the following areas of knowledge be reviewed and addressed prior to hospital discharge:

- Identification of the health care provider who will provide diabetes care after discharge
- Level of understanding related to the diagnosis of diabetes, self-monitoring of blood glucose, and explanation of home blood glucose goals
- Definition, recognition, treatment, and prevention of hyperglycemia and hypoglycemia
- Information on consistent eating patterns
- When and how to take blood glucose–lowering medications, including insulin administration (if going home on insulin)
- Sick-day management
- Proper use and disposal of needles and syringes

It is important that patients be provided with appropriate durable medical equipment, medication, supplies, and prescriptions at the time of discharge in order to avoid a potentially dangerous hiatus in care. These supplies/prescriptions should include the following:

- Insulin (vials or pens), if needed
- Syringes or pen needles, if needed
- Oral medications, if needed
- Blood glucose meter and strips
- Lancets and lancing devices
- Urine ketone strips (type 1 diabetes)
- Glucagon emergency kit (insulin-treated patients)
- Medical alert application/charms

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