

Michelle D. Lundholm, MD

Department of Endocrinology,
Diabetes, and Metabolism, Cleveland Clinic,
Cleveland, OH

Oscar L. Morey-Vargas, MD

Department of Endocrinology,
Diabetes, and Metabolism, Cleveland Clinic,
Cleveland, OH

Inpatient glycemic management in noncritically ill patients: Updated guidelines

ABSTRACT

Hyperglycemia is common in hospitalized patients and is traditionally managed with scheduled and correctional doses of insulin. The authors present an overview of the latest (2022) guidelines from the Endocrine Society on inpatient hyperglycemia management in noncritically ill patients, which includes a role for newer diabetes technologies and nontraditional insulin and noninsulin therapies.

KEY POINTS

The updated guidelines continue to endorse basal-bolus insulin as the preferred treatment for most noncritically ill hospitalized patients with hyperglycemia.

Dipeptidyl peptidase 4 inhibitors with or without correctional insulin are now offered as alternatives in patients with mild hyperglycemia who do not have type 1 diabetes.

For patients with type 1 or type 2 diabetes who have been using an insulin pump at home, the recommendations have changed to prefer continued use of insulin pumps and hybrid closed-loop pumps in the hospital.

A new suggestion is the use of continuous glucose monitors in patients at risk of hypoglycemia, in addition to point-of-care blood glucose testing.

HYPERGLYCEMIA, with or without underlying diabetes, affects nearly 40% of noncritically ill hospitalized patients.¹ Keeping blood glucose levels within a safe range can lower the risk of complications, infections, and death and shorten hospital stay. However, overly aggressive glucose control can lead to hypoglycemia, which has its own negative effects on health outcomes.

The Endocrine Society released guidelines for inpatient hyperglycemia management in 2012 for all inpatient healthcare professionals working in nonintensive care areas,² and updated them in 2022 to cover emerging diabetes technology, medications, and strategies to achieve glycemic control.³

WHO WROTE THE GUIDELINES?

A panel of 11 experts in endocrinology, internal medicine, primary care, nursing, pharmacy, and diabetes education and a patient representative collaborated to identify 10 key clinical questions, using the PICO format (patient or population, intervention, comparison, and outcome). A systematic review was conducted in July 2020 and updated in December 2021. Guidelines were developed using the GRADE method (grading of recommendations, assessment, development, and evaluation) to create 15 clinical recommendations.

WHAT ARE THE MAIN RECOMMENDATIONS?

The updated Endocrine Society guidelines³ include the following key recommendations for adult patients who are hospitalized for noncritical illness:

Insulin therapy is preferred over noninsulin therapies in most hospitalized patients. In noncritical settings, the goal is to maintain glucose within the target range of 100 to 180 mg/dL.

Dipeptidyl peptidase 4 (DPP-4) inhibitors (gliptins) can be used in combination with correctional insulin or scheduled insulin therapy for select patients with well-controlled type 2 diabetes (hemoglobin A1c < 7.5%, prehospitalization insulin dose < 0.6 units/kg/day) with mild hyperglycemia (glucose level < 180 mg/dL).

Correctional insulin alone can be used to treat newly recognized hyperglycemia or diabetes that is well managed (with admission blood glucose < 180 mg/dL) with noninsulin therapy. However, scheduled insulin therapy (basal with bolus or correctional doses, or both) should be used for patients with persistent hyperglycemia (2 or more glucose readings $\geq$ 180 mg/dL in a 24-hour period).

Hyperglycemia associated with glucocorticoid use or enteral nutrition should be managed with neutral protamine Hagedorn-based or basal-bolus insulin regimens, or both, as neutral protamine Hagedorn and intermediate-acting corticosteroids share a similar pharmacokinetic profile, with overlapping onset and duration of effect.

Insulin dosing based on carbohydrate counting can be considered as an alternative to fixed prandial insulin dosing in patients with type 1 diabetes or insulin-treated type 2 diabetes. In this scenario, the prandial insulin dose is determined by dividing the grams of carbohydrate consumed by the patient's pre-established insulin-to-carbohydrate ratio.

Patients using an insulin pump before hospitalization can continue to self-manage their insulin pump while hospitalized, with oversight by experienced hospital personnel (which includes endocrinology care team members and knowledgeable nonendocrinology providers based on variations in practice resources, provider familiarity, and hospital policies). This is preferred rather than changing to subcutaneous basal-bolus insulin therapy.

Continuous glucose monitoring with confirmatory bedside point-of-care blood glucose testing for adjustments in insulin dosing is recommended in patients with insulin-treated diabetes at risk of hypoglycemia, rather than point-of-care testing alone.

Targets. Patients with diabetes scheduled for elective surgery should aim for a preoperative hemoglobin A1c level less than 8% if feasible, and preoperative blood glucose concentrations in the range of 100 to 180 mg/dL.

Carbohydrate-containing oral fluids should be avoided preoperatively in patients with diabetes.

Inpatient diabetes education, ideally provided by diabetes care and education specialists, should be included as part of a comprehensive discharge planning process.

■ WHAT IS DIFFERENT FROM PREVIOUS GUIDELINES?

The new guidelines address emerging topics, particularly how to integrate diabetes technology into inpatient care by relying more on devices such as continuous glucose monitors and insulin pumps.

Glucose monitoring. The schedules for point-of-care blood glucose monitoring outlined by the 2012 guidelines still apply, ie, preprandial and bedtime checks if the patient is eating meals, or every 4 to 6 hours otherwise. The latest guidelines now suggest also using continuous glucose monitors in patients at high risk for hypoglycemia, regardless of whether the patient had been using one before admission. This addition is made possible by technological advancements over the past decade and growing evidence that continuous glucose monitoring is reliable and accurate in noncritical illness.⁴⁻⁷ The new guidelines still recommend continuing routine point-of-care blood glucose checks with continuous glucose monitoring.

Insulin pumps. The 2012 guidelines suggested that patients with type 1 or type 2 diabetes who were using insulin pumps at home could keep using them in the hospital.² The new guidelines more clearly endorse pump therapy, based on results from observational studies on insulin pump use in eligible hospitalized patients, predominantly those with type 1 diabetes. These studies have demonstrated safety without any increase in hypoglycemia or diabetic ketoacidosis.⁸⁻¹⁰

Patients who had been using hybrid closed-loop delivery systems can continue using them in the hospital. These systems integrate continuous monitoring information directly into the insulin pump settings and can automatically suspend insulin delivery to prevent hypoglycemia, though data on their use in the hospital is limited.¹¹

Scheduled basal-bolus insulin therapy is still the mainstay of inpatient glycemic management. However, the new guidelines also identify situations in which it is reasonable to deviate from scheduled insulin regimens in the hospital. In the past, noninsulin or oral therapies were recommended only in patients in stable condition resuming their home medications just before discharge.² While use of home noninsu-

lin therapies can still be considered during the discharge transition, the latest guidelines reflect newer data from randomized controlled trials showing that using DPP-4 inhibitors (whether new or continued) is reasonable and safe in hospitalized noncritically ill patients with mild hyperglycemia.^{12–14} The updated guidelines also define criteria for patients with mild hyperglycemia who could be considered for correctional insulin therapy alone.

Some topics not addressed. The update does not address many of the topics from the 2012 guidelines that remain relevant. These include the indications for and the timing and routine targets of point-of-care blood glucose testing, recognizing and managing hypoglycemia, the role of nutritional therapy, and how to transition from continuous insulin infusion to subcutaneous insulin injections.²

■ WHAT IS THE EXPECTED CLINICAL IMPACT?

We hope that these recommendations will lead to improved inpatient glycemic control with fewer episodes of hypoglycemia. Each recommendation was assessed using the GRADE method to summarize available data and consider the certainty of evidence, patient values, balance of desirable and undesirable effects, resources and costs, equity, feasibility, and acceptability to key stakeholders.

■ DO OTHER SOCIETIES AGREE OR DISAGREE?

The 2022 Endocrine Society guidelines were cosponsored by the American Association of Clinical Endocrinologists, the American Diabetes Association, the Association of Diabetes Care and Education Specialists, the Diabetes Technology Society, and the European Society of Endocrinology. A representative from the American College of Physicians also served as a member of the writing panel. As there was significant collaboration in developing these guidelines, there is agreement among these societies.

The recommendations of the latest (2023) standards of care guidelines released by the American Diabetes Association also address diabetes care in the hospital and are consistent with the Endocrine Society recommendations.¹⁵

■ HOW WILL THIS CHANGE DAILY PRACTICE?

The guidelines continue to endorse basal-bolus insulin as the preferred treatment for most noncritically ill hospitalized patients with hyperglycemia. DPP-4 inhibitors with or without correctional insulin are

newly offered as alternatives in patients with mild hyperglycemia who do not have type 1 diabetes. For those with type 1 or type 2 diabetes on an insulin pump, the recommendations have changed to prefer continuing pump therapy, and even allow for continuing hybrid closed-loop pump systems.

A new suggestion is to use continuous glucose monitors in patients at risk of hypoglycemia, in addition to point-of-care blood glucose testing. This suggestion lends support to adaptations made at some centers in response to the COVID-19 pandemic after the US Food and Drug Administration (FDA) granted emergency access to inpatient monitor use in 2020 to allow for remote monitoring of COVID-19 patients, preventing unnecessary exposure of health-care workers and reducing use of personal protective equipment. This trend continued in 2022 when the FDA granted a breakthrough designation for the Dexcom CGM device in the hospital setting. Given these FDA allowances, many hospitals have already started to use continuous glucose monitoring data in conjunction with point-of-care blood glucose testing to guide inpatient therapy.

Overall, the endorsement of using insulin pumps and continuous glucose monitors in the latest guidelines increases the role of diabetes technology in the hospital.

■ WHEN WOULD THE GUIDELINES NOT APPLY?

These recommendations are specific to noncritically ill adults and do not apply in pediatric or critical care settings. The guidelines are not a substitute for clinical judgment, and we must consider the limitations of and contraindications to each new intervention.

Medication interference. A few medications are known to affect the accuracy of continuous glucose monitors: acetaminophen (> 1 g taken every 6 hours), hydroxyurea, and hydroxycarbamide interfere with the Dexcom CGM device, while ascorbic acid (vitamin C) in doses higher than 500 mg/day interferes with the Abbott Freestyle Libre CGM device.

Inability to self-manage. Insulin pump therapy in the hospital is self-managed, so patients must be willing and able to perform pump adjustments and deliver boluses. Any limitation on physical or mental capabilities that would prevent the patient from properly operating their pump would require switching to scheduled basal-bolus insulin.

Continuing to use an insulin pump is also not recommended in a patient with diabetic ketoacidosis or hyperosmolar hyperglycemic nonketotic syndrome.

For these patients, continuous intravenous infusion of regular insulin is the mainstay of therapy, in keeping with institutional protocols.

Contraindications, cautions for DPP-4 inhibitors. DPP-4 inhibitors should not be used in patients with a history of type 1 diabetes or pancreatitis and are not recommended during pregnancy and lactation. Dose adjustment may be necessary for patients with chronic kidney disease receiving sitagliptin, saxagliptin, or alogliptin. Saxagliptin and alogliptin may increase the risk of heart failure, particularly in patients who already have heart or kidney disease.

Practical considerations. Any new medication or technology added in the hospital that is intended to be continued after discharge must be accessible, affordable, and agreeable to the patient, considering their values and preferences.

Ultimately, feasibility and practicality are the largest barriers to incorporating the latest guidelines

in the hospital setting. Centers need regular access to supplies and providers with expertise in diabetes technology to offer continuous glucose monitoring and to continue pump therapies, as well as access to diabetes care and education specialists to provide diabetes self-management education.

Given the high prevalence of diabetes and hyperglycemia in hospitalized patients, diabetes healthcare personnel and resources are important for improving patient outcomes. As always, the decision to involve endocrinology care team members is based on specifics of the patient's situation, the inpatient provider's knowledge and experience, and the hospital's resources and policies.

DISCLOSURES

The authors report no relevant financial relationships which, in the context of their contributions, could be perceived as a potential conflict of interest.

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Address: Oscar L. Morey-Vargas, MD, Department of Endocrinology, Diabetes, and Metabolism, F20, Cleveland Clinic, 9500 Euclid Avenue, Cleveland, OH 44195; moreyvo@ccf.org