International Journal of Medical Toxicology & Forensic Medicine

September 2025, Volume 15, Number 3

Review Paper

Hyperglycemia Management in Critical Units and End-Stage Hospitalized Patients

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Citation Saadon SJ, Helmy H, Mostafa FM. Hyperglycemia Management in Critical Units and End-Stage Hospitalized Patients. International Journal of Medical Toxicology and Forensic Medicine. 2025; 15(3):E49676.

https://doi.org/10.22037/ijmtfm.v15i03.49676

Article info:
Received: 10 Aug 2025
First Revision: 17 Aug 2025
Accepted: 25 Aug 2025
Published: 23 Sep 2025

Keywords:
Management, Hyperglycemia, Hospitalized, Patients

ABSTRACT

Background: Hospitalized patients frequently experience hyperglycemia, and numerous studies have demonstrated a substantial correlation between the risk of complications and hyperglycemia, extended hospital stays, and mortality for both diabetic and nondiabetic patients. The significance of hyperglycemia extends to patients with non-critical illness, as previous research has demonstrated that glucose control in the intensive care unit improves clinical outcomes by lowering the risk of multi-organ failure, systemic infection, and death. For the mainstream of adult patients with critical illness, stringent blood glucose control has been advised based on some previous observational and interventional investigations.

Methods: A comprehensive search of the literature was performed, followed by screening and eligibility assessment of the retrieved studies. Relevant data were then extracted and synthesized systematically. Finally, the manuscript was prepared through structured scientific writing.

Results: However, the recently randomized controlled studies have demonstrated that assertive glycemic control, contrasting to traditional control, which targets high blood glucose levels, may not enhance clinical results and is associated with a high risk of hypoglycemia. For most intensive care unit (ICU) hyperglycemic patients, the American Diabetes Association (ADA) recommends a glucose level of 140–180 mg/dL after medication is started in 2025.

Conclusion: Research shows that planned subcutaneous insulin (basal, nutritional, and correctional) is favored over sliding-scale insulin alone in non-ICU settings; intravenous insulin is the norm for patients in the critical care unit.

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Introduction

More than 537 million adults worldwide have diabetes, the most common metabolic disease. By 2020, this number is anticipated to increase to almost 800 million, or 10.9% of the adult population [1]. Patients diagnosed with diabetes are 3–4 times more liable to be hospitalized and 35% more likely to be referred for elective surgeries than people without diabetes [2]. According to US and Scottish data, 30% of people with a diabetes discharge diagnosis will need two or more hospital stays in a single year [3-5]. Over 7.86 million adults with diabetes were discharged from hospitals in the United States in 2020, either as a primary diagnosis, a secondary diagnosis, or a coexisting illness [6].

With 31.1 deaths per 100,000 people, diabetes ranked as the 18th most common cause of death in the US in 2021. Diabetes was classified as a contributing factor to death in an additional 120.3 out of 100,000 persons [7]. Diabetes not only has a major financial impact on those who have it, but it also places a heavy burden on the economy. In 2022, the total cost of treating diabetic individuals in the US will be 25% of healthcare costs in the US [8]. This included direct medical expenses of $306.6 billion. An additional $96.5 billion is expected to be spent as a result of decreased productivity [8].

Materials and Methods

A strict scientific approach was used in the development of this review article to guarantee correctness, dependability, and transparency:

1. A Comprehensive search of the literature

For research published between 2000 and 2025, many databases (PubMed, Scopus, Web of Science, and Google Scholar) were searched.

Hyperglycemia, insulin therapy, hospitalized patients, critical care, intensive care, end-of-life diabetes care, and glycemic objectives were among the keywords and MeSH phrases.

2. Screening and Eligibility

Observational studies, randomized controlled trials, systematic reviews, meta-analyses, and official clinical guidelines addressing hyperglycemia in intensive care units or end-of-life patients are among the inclusion criteria.

Pediatric-only research, papers written in languages other than English, case reports, opinion pieces, and abstracts with incomplete data are all excluded.

To guarantee impartial selection, duplicate records were eliminated, and two reviewers independently checked abstracts and complete texts.

3. Extraction and Synthesis of Data

The extracted data comprised study type, patient demographics, intervention (glycemic objectives, insulin protocols, monitoring measures), outcomes (mortality, complications, and hypoglycemia rates), and recommendations for guidelines. Narrative synthesis of the evidence revealed areas of agreement, disagreement, and ignorance.

4. Scientific Writing

Care was taken to guarantee critical analysis, fair reporting, and source transparency.

The text has been reviewed for linguistic and grammatical aspects.

Citations were presented uniformly so that readers could follow the chain of evidence.

Hyperglycemia Management in the Critical Care Unit

Glycemic targets

Glucose targets for patients with critical illness have been evolving during the last 20 years. Intense insulin therapy by intravenous injection improved mortality and morbidity in critically ill individuals in the surgical ICU by sustaining the level of blood glucose between 80 and 110 mg/dL [9]. This technique, however, may be harmful, according to later research conducted in medical and/or surgical ICUs [10-13].

Patients in mixed-type intensive care units, individuals without diabetes who received treatment in the intensive glucose target group, experienced a substantial decrease in complications. The study also revealed that the target blood glucose level of 81–108 mg/dL was effective. Last but not least, Krinsley et al. [14] Findings favor a blood glucose goal of 80–140 mg/dL for diabetic and nondiabetic individuals with an HbA1c of about 7%, but 110–160 mg/dL for those with A1C levels of 7%. In this regard, the study of van den Berghe showed that only individuals without diabetes benefited from stringent glycemic control achieved by intense insulin therapy [10, 11].

A tailored glycemic target may be beneficial for patients with critical illness, according to these statistics, which are similar to those developed for outpatient diabetes management. To address this crucial concern, further prospective interventional trials with continuous blood glucose monitoring are required. A higher incidence of severe hypoglycemia (6.8% vs. 0.5%) and a higher death rate (27.5% vs. 24.9%) were linked to 115 mg/dL as opposed to 140–180 mg/dL. Despite strategies like continuous monitoring of blood glucose level and decision making using a computer to lower hypoglycemia, research on children with critical illness was also unable to show any advantages of strict control of glucose level and ensure high rates of hypoglycemia [15, 16].

Most critically ill patients should have their blood sugar levels maintained between 140 and 180 mg/dL, according to the American Association of Clinical Endocrinologists and the American Diabetes Association. If this can be accomplished without causing severe hypoglycemia, some patients, especially those having heart surgery, may benefit from lower targets of 110 to 140 mg/dL. There is consensus on blood glucose levels. Maintaining the levels of blood glucose at 180 mg/dL is regarded as a safe target, but it may raise the risk of hospital complications [17].

Although it is not as well established, a blood glucose lower limit of 110 mg/dL is usually advised to decrease the risk of hypoglycemia. In patients undergoing heart surgery who had diabetes and those who do not, the GLUCO-CABG study20 found no differences regarding the rate of mortality or complications between the intensive required glucose target (100–140 mg/dL) and the conservative required target (141–180 mg/dL) but discovered that nondiabetic patients receiving treatment in the intensive required glucose goal group experienced a considerable decrease in complications. Lastly, research findings favor a blood glucose goal of 80–140 mg/dL for diabetic and nondiabetic individuals with HbA1c of 7%, but 110–160 mg/dL for those with A1C levels of 7% [14].

In this regard, the data showed that only individuals without diabetes benefited from the stringent glycemic control achieved by intensive therapy using insulin [10].

Insulin treatment

Using subcutaneous insulin is limited in patients with critical illness due to metabolic instability, a propensity for abrupt and significant increases in insulin demand, and the possibility of tissue hypoperfusion. Due to its quick onset and brief action duration, intravenous infusion of conventional insulin or rapid-acting insulin analogues is the recommended way of administering insulin in critical care settings. This allows for the matching of insulin requirements to quickly fluctuating glucose levels. The most effective way to reach glycemic goals has been demonstrated to be continuous insulin IV infusion, which ought to be carried out in accordance with approved written or computerized procedures [17-19]. Different populations of patients, glycemic targets, metrics evaluation, and hypoglycemia definitions used in different protocols make it difficult to determine efficacy and safety, and some protocols published regarding insulin infusion appear to be valuable [20].

Differences in insulin initiation and titration, bolus dosing, calculation requirements for insulin infusion adjustment, and insulin protocol adjustment methods are among the areas of variation among protocols; yet, those who employ the administration of insulin by using dynamic scales based on glycaemia typically submit improved results regarding control of blood glucose levels with low hypoglycemia frequency [18].

The frequency of glycemic monitoring is the primary element that plays a role in the protocol's safety. However, there are other significant factors as well, such as using infusion rates that are relatively low in the range of blood glucose levels near euglycemia, setting a less strict goal, initially at least, and considering what to do in the event of hypoglycemia.

Diabetic end-of-life care

The authors wanted to address the numerous helpful criticisms and suggestions made by working clinicians regarding the previous revisions.

According to Thomas Inman's 1860 description, the primary goal of any care provided is to "first not harm". [21]. Every time someone receives treatment, there is a chance that they could get hurt, and managing diabetes is no exception. Given that some people may not want to be aware that they are nearing the end of their lives, those who are capable of managing their diabetes for as long as possible should be allowed to talk about and choose their course of treatment. Blood glucose monitoring, possible pharmacological side effects, and preferred therapies or ones to stop if their health worsens should all be part of this.

This ability may be diminished or nonexistent in people who are nearing the end of their lives. This conversation can start much earlier with the creation of care planning documents like "Advance Directives." In the UK, planning documents come in three varieties [22]:

I. A decision made in advance: this document must be signed and witnessed in order to be legally enforceable.

It notifies everyone concerned in the person's care, including family, carers, and medical experts, that the person has a definite wish to decline certain treatments in the future. This becomes crucial if the person loses the capacity to communicate clearly.

II. An advance statement: this document outlines the person's desires, beliefs, and preferences regarding future care but is not legally binding.

III. Emergency Health for Care Planning (EHCP): In the case of a medical emergency, an EHCP facilitates communication. In the event of foreseeable circumstances or emergencies, it involves collaborative decision-making and documentation of the individual's and caretakers' expectations and capacities. A list of both routine and PRN drugs, as well as instructions for any medications of rescue that are kept in the patient's home for use in an emergency, should be part of the plan. It might involve a strategy for adjusting insulin levels or administering short-acting insulin analog rescue doses. People must consider using those tools because they still have the potential to do so, and their existence is known to families, caregivers, and general practitioners [23].

Suggestions for clinical treatment: The American Diabetes Association (ADA) and National Institute for Health and Care Excellence (NICE) have established precise clinical targets, such as those for blood glucose, blood pressure, and lipids, which individuals with diabetes are encouraged to meet throughout their lives [24]. To prevent both immediate and long-term issues, these goals are advised. These goals can be loosened when a person is in their final year of life because the goal would be to relieve symptoms of hypoglycemia or hyperglycemia rather than strict glycemic control. Since some people may interpret this adjustment as showing that the HCP is "giving up on them," it is crucial to address the relaxation of any clinical targets with the patient, their relatives, and/or caregivers when managing glycemia.

Any care plan would need to be decided jointly because they could also want to stick to their regular glucose objectives. Capillary blood glucose readings of 6.0–15.0 mmol/L are advised as blood glucose objectives in the final year of life. There is a low chance of hypoglycemia (blood glucose levels below 4.0 mmol/L) and overt hyperglycemia, which can result in acute metabolic diabetes consequences like:

A) Diabetic ketoacidosis (DKA) in individuals with type 1 diabetes, if the readings are maintained within these ranges. SGLT2 inhibitor-treated individuals with type 2 diabetes are also susceptible to euglycaemic DKA, particularly in cases of illness or dehydration [25].

B) Hyperglycaemic hyperosmolar state (HHS) in individuals with type 2 diabetes who have been diagnosed or in those who have already been diagnosed with the disease [26].

Since lowering the readings of blood glucose will result in hypoglycemic symptoms and higher blood glucose readings will result in hyperglycemic symptoms like fatigue, thirst, and dehydration, it is equally crucial to feel good if glycaemic levels are maintained within the prescribed range [23].

Fluids

The fluid withdrawal is controversial. Fluids should not be stopped unless the person specifically requests it; if they are unable to make this decision, family members or caregivers should be consulted. Neither the giving of therapeutic rehydration nor the idea that fluid abstinence may speed death is supported by any data.

Conclusion

Research shows that planned subcutaneous insulin (basal, nutritional, and correctional) is favored over sliding-scale insulin alone in non-ICU settings; intravenous insulin is the norm for patients in the critical care unit. Diabetes affects a person with the disease in all aspects of their life, including their final days. Diabetes management (along with the dangers and side effects) can make dying more challenging and unpleasant.

Conflicts of Interest

The authors report there are no competing interests to declare.

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