Association For Science

Junior researchers

ახალგაზრდა მკვლევარები

Vol. 4 Issue 1, 2026

https://doi.org/10.52340/jr.2026.04.01.16

Interdisciplinary Strategies for Perioperative Glycemic Optimization in Diabetic Patients: A Narrative Review

George P. Roy[1], Sirine Chettah[2], Raphael Michael Ngonyani[3], Safoora Irfan Karnalkar[4], Pagiel Jacob Cheriyan[5], Sreethu Sreekantan Geetha[6]

[1]Tbilisi State Medical University, Tbilisi, Georgia; [2]University Of Georgia, Tbilisi, Georgia; [3]Kyiv Medical University, Kyiv, Ukraine; [4]East European University, Tbilisi, Georgia; [5]New Vision University, Tbilisi, Georgia; [6]Tbilisi State Medical University, Tbilisi, Georgia

***Corresponding author*: George P. Roy[1], Faculty of Medicine, Tbilisi State Medical University, Georgia, 33, Vazha-Pshavela Ave, Tbilisi, Georgia, george.roy.work@gmail.com, Phone number: +995501778921.

***ORCID*: George P. Roy: 0009-0009-0257-3877; Sirine Chettah: 0009-0001-7684-8599; Raphael Michael Ngonyani: 0009-0000-2685-4205; Safoora Irfan Karnalkar: 0009-0002-2455-9557; Pagiel Jacob Cheriyan: 0009-0006-8363-6558; Sreethu Sreekantan Geetha: 0009-0004-1763-180X.

Abstract

Diabetes mellitus is one of the most common and important comorbidities in surgical patients, with an estimated 537 million people globally and 15-20% of all surgeries. In addition to patients with a known diagnosis, perioperative hyperglycemia occurs in up to 40% of non-cardiac surgical patients, including a significant proportion with undiagnosed prediabetes or stress-induced dysglycemia. The stress response to surgery, via activation of the hypothalamic-pituitary-adrenal axis and sympathetic nervous system, results in a release of counter-regulatory hormones that induce hepatic gluconeogenesis, peripheral insulin resistance, and systemic inflammation, all of which contribute to impaired glucose metabolism during the entire perioperative period. These derangements are independently linked to surgical site infections, wound healing complications, acute kidney injury, cardiovascular instability, extended hospital stays, and death. This narrative review examines the evidence from clinical trials, cohort studies, and practice guidelines published from 2016 to 2026 to assess the current multidisciplinary strategies for perioperative glucose management in adult surgical patients with diabetes. The review explores the pathophysiology of perioperative hyperglycemia, reviews preoperative risk stratification approaches including the use of glycated hemoglobin, reviews intraoperative glucose monitoring and insulin administration protocols, and reviews postoperative management strategies including basal-bolus-correction insulin protocols and discharge planning. The literature supports a glucose target of 140-180 mg/dL as a reasonable compromise between avoiding the adverse effects of hyperglycemia and the risks of iatrogenic hypoglycemia. The review concludes that better perioperative outcomes are not achieved through new interventions, but rather through the consistent application of current evidence through protocol-based management and interdisciplinary

collaboration between surgical, anesthetic, medical, nursing and pharmacy teams. Knowledge gaps exist in the area of individualised glucose targets, perioperative management of newer antidiabetic medications, the accuracy of continuous glucose monitoring in the dynamic intraoperative setting, and the wider adoption of interdisciplinary care models in different health care settings.

Keywords: perioperative glycemic management, diabetes mellitus, insulin therapy, surgical stress hyperglycemia, interdisciplinary care

Introduction

One of the most underrecognized major and growing global health burdens is diabetes. In 2023, approximately 537 million individuals were living with diabetes worldwide (1). In 2024, adults aged 20 to 79 who are living with diabetes worldwide were over 589 million, with projections estimating an increase to 700 million by 2045 and 852.5 million by 2050 (2). This corresponds to approximately to be 20%, nearly 1 in 5 adults globally by then (3). The dysglycemic burden in the surgical population is showing a highly noticeable rise lately. Prior data and studies have found that 15 to 20% of patients coming in for general surgery have diabetes (3). Excluding patients with diabetes, perioperative hyperglycemia is reported in up to 40% of those undergoing non-cardiac surgery alone, showing that glycemic disturbance extends beyond those diagnosed with diabetes (4). These findings alone demonstrate the need for optimization of perioperative glucose management. Prior work has also shown that 12 to 30% of surgical patients who develop hyperglycemia lack a formal diabetes diagnosis, with some having impaired fasting glucose, insulin resistance, or indicating signs of prediabetes (4,5). This is a large and deep reservoir of individuals, underscoring the need to improve perioperative identification and minimize unwanted risk. Hyperglycemia is considered a major cause of impairment of neutrophil activity, phagocytosis, and compromise of host defense, thus increasing susceptibility to infection, poor healing of wounds, increased hospital stay duration, and even eventual death (5–7). It is significant to point out that intensive glycemic control can be dangerous, as other studies have indicated that practicing tight targets may result in hypoglycemic events, which may result in cognitive dysfunction and brain death (7,8). These events have risen up to 11.9%, with other studies showing increasing mortality, mainly caused by cardiovascular issues (5,6). Hence, it is highly sensible to be aware and vigilant at all times, specifically as patients under sedation or general anesthesia may not exhibit hypoglycemic signs that normally signal for recognition and treatment action (8). One of the risk stratification tools in perioperative settings is HbA1c (5). Even though its strength and consistency as a tool in the postoperative period are debatable, it is recommended when not done in the previous three months before the procedure, as it informs physicians about the underlying glucose and insulin metabolism, which will assist in the appropriate dosing of insulin (9). Multiple papers have linked the relationship between HbA1c and postoperative complications, particularly related to wounds in both diabetic and non-diabetic patients(3). It serves as a very useful perioperative biomarker of glycemic status for patients (1).

A major setback in perioperative management is the lack of standard, universally recognized, and accepted protocols. Narrative reviews indicate that there are multiple existing guidelines, usually

proposing different glucose targets and strategies of management, resulting in variation among centers and even within the same region (1). Current guidelines insist on institutional-level standards, policies, and care to start being implemented in hospitals (10). External studies have also reported large variability in hospital protocols for perioperative diabetes management, revealing a lack of agreement and limited evidence (11). As stated in StatPearls, even the optimal glycemic target remains unestablished across professional institutions, showing an interdisciplinary gap in perioperative glycemic care, although several sources converge around the target range of 140 to 180 mg per dL (9–12).

Perioperative management spans preoperative, intraoperative, and postoperative phases, which tend to involve not only surgical departments but also anesthetic, nursing, and endocrine teams, as well as other multidisciplinary teams (13). Yet, coordination across them, particularly during handovers, is often unstable (10). Recent studies have called for safe, standardized handovers between the operating room, post-anesthetic care unit (PACU), and ward teams to ensure the best possible outcome for patients (10). The need for an interprofessional team approach cannot be stressed enough, with deliberate coordination required rather than passive handoffs (13). Perioperative glycemic management is quite often reactive rather than proactive, with evidence showing that many patients, mostly those without a diagnosed diabetes status, tend to receive limited monitoring of their metabolism, resulting in rises in sugar levels that go undetected (5,11). Multiple sources have encouraged the need for consistent, routine, protocolized surveillance of glucose, as it is currently not consistent (5). Guidelines are calling for frequent glucose assessment, as well as standardized insulin courses and ketone checks (10).

Taking into account the information documented so far, we have sought to review different studies to provide, among multiple specialties, an evaluation of perioperative glycemic management. Particularly, the objectives are to:

- Sum up the current understanding of the pathophysiology of perioperative. hyperglycemia, including stress-mediated hormonal activation and insulin resistance
- Survey and assess preoperative glycemic optimization strategies.
- Inspect intra- and postoperative management approaches.
- Recommend an integrated, unified framework to address existing issues among the multiple specialties involved.

Methods

This narrative review was conducted to explore multidisciplinary strategies for perioperative glycemic control in adult patients with diabetes mellitus undergoing surgical procedures. A systematic search of the literature was performed in PubMed.

The search was conducted using a combination of keywords and Medical Subject Headings (MeSH) terms, including "diabetes mellitus," "perioperative," "preoperative," "intraoperative," "postoperative," "glycemic control," "glycemic optimization," "insulin therapy," and "multidisciplinary" or "interdisciplinary care". Boolean operators (AND, OR) were used to narrow the search. To ensure the

use of up-to-date and clinically relevant evidence, we included studies published from 2016 to 2026. We included only English language studies on adults (≥18 years).

We included studies that focused on perioperative glucose management during the pre-, intra-, or post-operative period and included adult patients with diabetes who were undergoing surgery. We selected papers that focused on strategies for glycemic optimization, such as insulin protocols, medication adjustments, glucose monitoring, or multidisciplinary care. We included studies that reported clinically relevant outcomes, including wound healing, surgical site infections, hypoglycemia, hospital stay, ICU admission, or death. Randomized clinical trials, cohort studies, reviews, and practice guidelines were considered eligible.

Studies that focused on children, were not related to surgery or the perioperative period, or only focused on non-diabetic patients, were excluded. Editorials, case reports, abstracts, and in vitro or animal studies were also excluded. In addition, duplicate articles were removed.

Following a relevancy check of the titles and abstracts, the full text of the selected articles was reviewed. The key theme categories into which relevant information was collected and organised included the pathophysiology of perioperative hyperglycemia, preoperative optimization, intraoperative management, postoperative care, and interdisciplinary approaches. The findings of the selected studies were synthesized using a thematic synthesis method, offering a comprehensive review of perioperative glycemic optimization, including interdisciplinary approaches and their impact on patient outcomes.

Discussion

Pathophysiology

Increased production of cortisol, glucagon, growth hormone, and catecholamines results from surgical trauma's neuroendocrine stress response, which is mediated by the hypothalamic-pituitary-adrenal axis and the sympathetic nervous system (1,14). Elevated blood glucose levels are the consequence of these counter-regulatory hormones' stimulation of hepatic gluconeogenesis and glycogenolysis (1,14).

Concurrently, inflammatory cytokines such as interleukin-1, interleukin-6, and tumor necrosis factor-α cause considerable insulin resistance by reducing GLUT4-mediated glucose uptake and impairing insulin signaling (1,15). Hyperglycemia is made worse by increased lipolysis and proteolysis, and in patients who are vulnerable, insulin insufficiency may cause diabetic ketoacidosis (14,15).

These metabolic disorders increase vulnerability to infections and poor surgical outcomes by causing immunological dysfunction, endothelial damage, and reduced wound healing (6,15,16).

Preoperative optimisation

Coordinated multidisciplinary management involving surgeons, anesthesiologists, endocrinologists, and primary care physicians is necessary for effective perioperative glycemic optimization, which starts well before surgery (1,15). Assessments of fasting plasma glucose and glycated hemoglobin (HbA1c), which are crucial for risk stratification, are part of the preoperative evaluation (1,17).

Current guidelines recommend achieving an HbA1c target of <7% prior to elective surgery, although this should be individualized. In order to optimize and minimize perioperative consequences, individuals with poor glycemic control may have their elective procedures postponed (15,17).

Higher rates of surgical site infections and longer hospital stays are among the postoperative morbidities linked to elevated HbA1c levels (6,18). Furthermore, a thorough assessment of comorbidities associated with diabetes, including cardiovascular disease.

Intraoperative Glycemic Target

Hyperglycemia is a leading cause of morbidity and mortality in the intraoperative setting, mainly through various mechanisms including osmotic diuresis, ketogenesis, and secretion of proinflammatory cytokines (19–21). These mechanisms provoke mitochondrial injury, endothelial damage, and immune dysfunction. Hypoglycemia carries a similar mortality effect, with causes ranging from altered myocardium function and arrhythmias to neurological defects (9,15).

The extent of the counterregulatory response is dependent on the type of surgery as well as anesthesia. Surgeries involving the thoracic area and abdominal part have a higher risk for prolonged hyperglycemia, while minor surgeries, including laparoscopic procedures, showed decreased insulin resistance and hyperglycemia (15,20).

Earlier studies evaluating glucose levels affecting intraoperative situations suggest that a moderate control of glucose levels between 140 and 180 mg/dL is safer and demonstrates better outcomes, unlike tight control with glucose levels less than 100 mg/dL, as it increases the risk of developing hypoglycaemia and mortality rate (9, 15).

Glucose Monitoring Modalities

Current evidence shows that Point-of-Care (POC) is the standard method for intraoperative glucose assessment due to its easy, rapid bedside results, and convenient access, as they allow glucose checks during surgeries. However, POC capillary glucose testing results can be affected by oxygen and hematocrit levels, acid-base disturbance, and peripheral edema. And the use of vasopressor, therefore limiting its accuracy in critically ill patients. These results make central laboratory glucose testing and arterial blood gas glucose measurement more reliable in such settings, as they are not affected by peripheral circulation changes and are indicated in major surgeries, patients on intravenous infusions, and hemodynamically unstable patients (9, 15).

Continuous glucose monitoring (CGM) devices measure interstitial glucose levels, allowing early detection of alterations in glucose level (19, 22). However, during surgeries and situations featuring rapid fluctuations, such as insulin infusions and hemodynamic instability, a physiological lag between interstitial and plasma glucose occurs, decreasing CGM accuracy during hypoperfusion, hypothermia, surgical stress, and many other events (19, 22). Delayed detection of hypoglycemia and underestimation or overestimation of glucose levels during this period showed studies reporting Mean Absolute Relative Difference MARD 12-15% variability, depending on the condition. Intra-operative glucose monitoring involves a balance between practicality and accuracy, where arterial blood glucose

analysis provides the highest accuracy among other methods, point-of-care testing enables rapid bedside assessment, while continuous glucose monitoring provides continuous monitoring (9, 15).
Therefore, the selection of the method used to monitor patients' glucose levels is highly dependent on patients' hemodynamics and clinical context, with no single method providing both optimal accuracy and real-time practicality. Any unexpected or extreme glucose levels should not be acted on immediately, and values must be rechecked using another method. The frequency of glucose monitoring depends on the intensity of the procedure and of insulin therapy. Anesthesia guidelines recommend checking glucose levels at a regular interval of 30-60 minutes when insulin is infused, as it has a rapid and variable effect, and sometimes a low dose can lead to hypoglycemia quickly, while in short and lower risk procedures with stable hemodynamics, an interval of 1-2 hours is generally acceptable and recommended (9, 15).

Intraoperative Insulin Protocol

Intraoperative insulin therapy is primarily delivered via subcutaneous insulin or intravenous infusion (9,15). The choice of route of administration of insulin is dependent on surgical complexity and patient stability. Subcutaneous insulin is given in short procedures with clinically stable patients. However, it is unsuitable in situations that alter its absorption, such as vasoconstriction, hypothermia, and hypoperfusion, making it limited to short procedures only. In contrast, intravenous insulin is considered the preferred route in major procedures as well as in unstable patients with glucose levels reaching 180 mg/dL and more. It has a rapid onset as well as offset that enables precise titration in response to glucose measurements; these properties give it the advantage of being used in intraoperative settings where metabolic demands are fluctuating. Several protocols guide intravenous insulin infusion, including Yale, Portland, and Vanderbilt protocols. These protocols differ in their recommendations, where some rely on fixed dose adjustment while others prefer dose adjustment based on the response of the glucose levels. Protocols suggesting dose adjustment, such as The Portland, showed better control compared to fixed algorithms, especially in major surgical procedures (9, 23, 24).
Computer-assisted systems are now used to improve accuracy as they use real-time glucose values and suggest infusion changes automatically, often achieving better glucose stability than manual methods in ICU studies (23, 24).
The successful application of intraoperative insulin therapy also depends on the practical aspects, including adequate staff training, institutional resources, adherence to safety protocols, and frequent glucose monitoring to ensure safe insulin infusion during surgical settings.

Choice of Anesthetic Technique - Glycemic Implications

During periods of stress, our body's first goal is to maintain a physiological homeostasis mainly through secreting hormones and stimulating baroreceptors. During surgeries, a release of ACTH from the anterior pituitary is expected. ACTH then stimulates the adrenal cortex and leads to a surge in Cortisol, which stimulates gluconeogenesis, lipolysis, and most importantly suppresses the immune system. Certain drugs, such as dexamethasone, perform the same mechanism and enhance hepatic glucose secretion (15,19,20).

The sympathetic nervous system is also activated in periods of stress, mainly by an increase of catecholamines such as epinephrine and norepinephrine, leading to similar changes in body function. Similar stress responses can be activated by general anesthesia using volatile agents, as they increase sympathetic activity and stimulate catecholamines and cortisol release, leading to events promoting hyperglycemia (20).

In contrast, total intravenous anesthesia, such as propofol, reduces sympathetic response and decreases cortisol surge, resulting in more stable glucose levels and better surgical outcomes. Neuraxial anesthesia, including spinal and epidural techniques, blocks the afferent nociceptive transmission, leading to inhibition of the hypothalamic-pituitary-adrenal axis and maintaining proper glucose levels, making them the preferred anesthetic techniques in prolonged procedures. A similar mechanism is seen with regional anesthesia and peripheral nerve blockers, making them the primary anesthetic techniques in minor procedures or adjuncts to general surgery in major procedures (9,20).

Therefore, anesthetic techniques must be chosen based on the individual metabolic risk factors to minimize stress-induced hyperglycemia.

Fluid Management and Glucose - Containing Solutions

Intravenous fluid therapy affects glucose concentration as well as insulin requirements and may lead to acid-base disturbance in diabetic patients. Dextrose-containing fluid is an exogenous glucose administered in a low-rate D5W infusion; this approach prevents ketosis. Dextrose prevents hypoglycemia during prolonged fasting and is only used during surgeries or with type 1 diabetes mellitus during prolonged fasting to prevent diabetic ketoacidosis, but should not be used routinely, as it may induce hyperglycemia (9,20).

Balanced crystalloids, including Lactated Ringer's solution with its lactate content metabolized in the liver to bicarbonate, are preferred in perioperative settings as they improve acid-base disturbance by decreasing chloride to maintain renal perfusion and physiological pH when compared to normal saline, which can induce hyperchloremic metabolic acidosis (9).

The PACU: First-Line Postoperative Glycemic Management

The Post-anesthesia care unit represents a phase where diabetic patients are transitioning from preoperative management to intraoperative monitoring and to postoperative recovery, with patients going through residual anesthetic effects, stress hormones fluctuating, and interruption of the usual diabetic regimen, all altering glucose levels and requiring early recognition and management to reduce postoperative complications (9,19).

Type 1 diabetes patients and insulin-treated type 2 diabetes patients require resumption of basal insulin, as its omission leads to rebound hyperglycemia and ketosis, whereas hypoglycemia risk increases with excessive doses and delayed oral intake. Therefore, basal insulin should be administered before discontinuation of intravenous insulin infusion to prevent gaps in insulin coverage (9, 20, 21, 23).

Hypothermia is a common complication of major surgeries reduce perfusion and absorption of insulin, resulting in glucose lowering. Sedation can mask the symptoms of hypoglycemia; these complications make routine monitoring more important and accurate than symptom-based diagnosis (9, 20).

Postoperative nausea and vomiting are additional side effects altering glycemic planning in the PACU. In such cases, basal insulin is continued until the oral route is confirmed and tolerated (9, 23).
PACU is a high-risk metabolic transition zone where glucose levels can shift quickly prior to anesthesia cessation, making basal insulin continuity essential (9).

Inpatient Postoperative Glycemic Targets

In a postoperative inpatient setting, glucose levels are maintained depending on the individual's stability. For general ward patients, a level of 140 to 180 mg/dL is maintained as recommended by major endocrine and diabetes societies, as it decreases the risk of iatrogenic hypoglycemia. Similar ranges are maintained in critically ill patients and those in intensive care, as well as cardiac surgery patients (9,15). Abnormal glucose level is standardized in these settings, with hypoglycemia defined as blood sugar less than 70 mg/dL, with clinically significant hypoglycemia below 54 mg/dL, while severe hypoglycemia leads to altered consciousness, seizures, and other cognitive dysfunction (9,19,21). In contrast, levels above 180 mg/dL define hyperglycemia and requires initiating of insulin, while severe elevation above 250-300 mg/dL require underlying cause investigation including infections, diabetic ketoacidosis, or stress response (9,20,21).
Overall, studies emphasize avoidance of tight glycemic control in the postoperative period and recommend stable glycemic control with a defined target range to ensure improved postoperative outcomes (9).

Insulin Regimen on the Ward (Basal-Bolus-Correction)

The basal-bolus-correction (BBC) insulin regimen provides continuous basal insulin to suppress hepatic glucose release, schedule prandial insulin, and dose correction, making it preferred for inpatient glycemic management where stress-induced insulin resistance and acute illness cause unpredictable glucose changes. The basal component is provided using long-acting insulin analogs such as glargine, detemir, and degludec, which ensure stable 24-hour insulin coverage. Prandial insulin is given in relation to meals. Correctional insulin serves as a flexible component and is given as an adjunct in transient hyperglycemia (9, 20, 21).
The daily dose is calculated using a weight-based approach ranging from 0.3 to 0.5 per Kg per day, with it being adjusted in elderly patients and patients with renal dysfunction. Prandial insulin must be reduced in patients with poor oral intake while basal insulin is maintained to prevent metabolic decompensation (9, 20, 21).
Studies show that basal-bolus therapy reduced postoperative complications and improved glycemic control compared with sliding scale regimens, as it has been associated with prolonged hyperglycemia because it does not provide basal coverage. As a result, current clinical guidelines strongly discourage the use of sliding scale insulin as a monotherapy in stable hospitalized patients (22).

Resumption of Home Antidiabetic Medications

Restarting diabetes medications mainly depends on the patient's hemodynamic stability, renal function, ability to return to oral intake, infection status, and whether they are at risk for hypoglycemia or ketosis. Medications must be started individually and gradually. Metformin holds a high risk of lactic

acidosis; therefore its withheld in patients with renal impairment, hypoperfusion, hypoxia, or sepsis and can be restarted when normal creatinine levels are restored, ensuring adequate renal function and when patients are in a stable state with normal perfusion. In contrast, SGLT2 inhibitors require more prolonged withholding due to the risk of inducing euglycemic diabetic ketoacidosis in perioperative settings. These two agents can be continued only when the patient can restart oral intake and is metabolically stable (9,23).

GLP-1 receptor agonists are associated with delayed gastric emptying and predispose the patient to vomiting and nausea. GLP-1 receptor agonists can be restarted only when gastrointestinal function is intact and fully recovered, and the patient can tolerate oral intake. Sulfonylureas carry a high risk of hypoglycemia due to their prolonged insulin secretory effect and should be restarted only when the patient is eating regular meals with no nausea or vomiting (9, 23).

DPP-4 inhibitors are generally considered safe in the postoperative setting as they carry low hypoglycemia risk due to their glucose-dependent mechanism of action and may be restarted earlier compared to other agents. However, basal insulin should never be fully discontinued and remains essential to maintain a stable background level and prevent uncontrolled glucose levels (9).

Transition to Home and Discharge Planning

Transition from hospital to home carries a high risk of relapse as the patients move from a highly monitored and carefully managed environment to self-directed glucose control. Patients are required to perform regular home glucose monitoring to prevent undesired outcomes (9,19,21).

A key aspect in discharge planning is to determine which patients require temporary insulin therapy after leaving the hospital, as stress-induced hyperglycemia may persist even after the postoperative period, with patients having poor inpatient glycemic control, elevated HbA1c levels, infections, or exposure to corticosteroids carrying a higher risk and may require short-term insulin therapy until metabolic stability is ensured (9,20,21,23).

Postoperative HbA1c provides an overview of long-term glycemic control and distinguishes chronic dysglycemia from transient stress-related hyperglycemia. It is assessed during the following checkups to help with adjustment in outpatient therapy (9).

Referring the patient to an endocrinologist is recommended for individuals with complex glycemic needs. Patients with type 1 diabetes should also be referred to a specialist to ensure safe outpatient transition and prevent readmission. Structured diabetes education and awareness raising are essential in the discharge plan. Early outpatient follow-up is strongly recommended to adjust therapy as needed (9,20,23).

Continuous Glucose Monitoring (CGM)

Continuous glucose monitoring (CGM) systems provide interstitial glucose readings at frequent intervals. They include real-time CGM, which continuously transmits glucose readings to a receiver or smart device, with alarms sent in cases of high or low glucose levels, and intermittently scanned CGM, which requires manual scanning to read values and data (22).

The main advantage of CGM is the continuous assessment rather than isolated measurements. Although widely beneficial in detecting sudden drops or rises in glucose levels, most devices are not

approved alone and must include other glucose-measuring methods. However, several limitations decrease its accuracy as it measures interstitial glucose rather than plasma glucose, creating a physiological lag, especially during rapid fluctuations, and may decline more in the presence of vasoconstriction, hypoperfusion, or hypothermia during major surgical procedures. Technical issues may also be seen. These findings make it safe to use during surgery, but it remains insufficient for independent insulin dosing decisions, and it must be used as an adjunctive device only (22,23).
Future development may include integration with automatic insulin delivery to improve perioperative glucose control.

Insulin Pump (CSII) Management

An individual perioperative plan is required for patients using continuous subcutaneous insulin infusion, including reviewing the pump type, basal rates, battery status, bolus setting, and whether the pump is integrated with CGM or a hybrid closed-loop system (22).
The pump may be continued with a reduced basal rate of 70-80% in short and minor procedures with meal bolus suspension during fasting. While during prolonged procedures or when device access is limited, a shift to intravenous infusion is preferred to allow rapid and safe control (9,23).
Transition protocols should avoid interruption of insulin delivery, especially in type 1 diabetic patients, as cessation may predispose the patient to ketosis. Pump therapy may be continued later on in the postoperative period when the patient is awake and able to self-manage safely (9).

Digital and Technology-Assisted Glycemic Management

Computer-assisted insulin dosing systems are software programs that recommend insulin dosing and infusion rate using a built-in algorithm (23). These are systems developed to minimize manual calculation inaccuracies and ensure continuous and faster responses. Unlike static sliding scales, these systems use current glucose values as well as previous ones, readings stating rise or fall in glucose levels, prior insulin sensitivity, and recent doses, resulting in continuously updated infusion rate and recommendations providing personalized planning (9,23,24).
Several reports have shown lower rates of hypoglycemia compared to manual titration methods, particularly in perioperative settings when glucose levels fluctuate rapidly (19,21,23).
Staff training is essential to understand system operation and to ensure practical implementation. Some limitations may be seen, including the unavailability of technological resources or institutional costs, but despite these challenges, the computer-assisted insulin dosing system represents an important step to safer inpatient glycemic management (9). The use of telemedicine has become increasingly important in assessing glycemic control before surgery, aiding in reducing delays in surgical procedures due to poor diabetes control, and most importantly, allowing earlier detection and intervention in uncontrolled diabetes (19).
Remote monitoring systems are commonly used to track HbA1c trends and identify surgical risks prior to surgery, including risks related to drugs such as SGLT2 inhibitors or insulin regimens that require temporary discontinuation. Digital education tools improve consistency of preoperative preparations by correcting insulin doses. Within the hospital, electronic health record decision report systems can

detect high risks of patients, including those with elevated HbA1c or complex therapies. Overall, telehealth connects inpatient and outpatient care. improving safety across the perioperative period (23).

Infectious Complications

Perioperative hyperglycemia carries a high risk of complications, including surgical site infections, pneumonia, urinary tract infections, and sepsis (19,21). Elevated glucose impairs neutrophil chemotaxis, phagocytosis, and collagen formation, as well as promoting inflammatory dysfunction and poor wound healing. Multiple surgical studies show that glucose levels above 180mg/dL are associated with higher surgical site infection, particularly in cardiac, orthopedic, and abdominal surgery (9,19). Some reports suggest that each gradual rise in perioperative glucose level increases infection risk. Earlier trials recommended intensive insulin therapy, but later evidence showed an increase in hypoglycemia with no survival benefit. Therefore, practice shifts into a targeted level of 140 – 180 mg/dL, which ensures a safe outcome with reduced infection rate (9,19,21,23).

Cardiovascular Outcomes

In cardiac surgical patients, poor glycemic control contributed to increased sternal wound infection, atrial arrhythmias, prolonged ventilation, and mortality (21). Hyperglycemia affects cardiac pathophysiology by worsening tissue perfusion and increasing thrombotic events due to glucose-mediated endothelial dysfunction, oxidative stress, increased platelet activation, and impaired ischemic preconditioning (9). Moderate glucose control is now preferred through protocol-driven insulin management over intensive regimens because it balances cardiovascular benefits with lower hypoglycemia risk and more stable hemodynamics (9,19,21,23).

Renal and Neurological Outcomes

Acute kidney injury is linked to hyperglycemia in perioperative settings through osmotic diuresis, causing volume depletion and initiating an oxidative stress reaction with tubular injury and impaired renal perfusion autoregulation (9, 19, 21). The risk is not only linked to hyperglycemia but to fluctuating glucose as well, and it has been associated with delirium and postoperative cognitive dysfunction (19). The risk increases among patients with preexisting diabetic autonomic neuropathy and predisposes the patients to hypotension, heart rate instability, and impaired thermoregulation (21).

Hospital and Economic Outcomes

Patients who develop hypoglycemia or hyperglycemia postoperatively often require more monitoring and medical adjustments with longer hospital stay, higher ICU utilization, delayed recovery, and sometimes even readmission (9,21,23). An increase in cost is seen among infectious complications, particularly surgical site infection (SSI), mainly through reoperations, antibiotic use, and prolonged hospitalization (19,21). Therefore, effective glycemic control improves not only clinical outcomes but also patient well-being and resource utilization.

Interdisciplinary Care Model

Ideal perioperative diabetes management requires teamwork among anaesthesiology, internal medicine, surgery, nursing, and pharmacists. Responsibilities must be distributed based on the

perioperative phase, as glycemic control changes according to the pathway. In the first step of perioperative management, endocrinologists and internal doctors should optimize glycemic control by assessing HbA1c, review patients history and diabetes medications, identifying each possible outcome and complication. The surgery team determines the procedure urgency and whether it should be delayed or postponed. While an anesthesiologist evaluates perioperative risk, fasting status, and expected intraoperative glucose or insulin needs and requirements, as well as whether an insulin pump is required or insulin infusion is preferred during the operation (9,23).

Nursing staff carry responsibilities on the day of operation by confirming medication holds and measuring baseline glucose levels. During surgery, the anesthesiology team leads glucose monitoring, insulin titration, and fluid management, while surgeons communicate in cases of blood loss and if a change in operation delay is expected, as it affects glucose control (9,23).

Postoperatively, recovery room staff perform glucose assessment and monitoring with the internal medicine team supervising the patient's regimen, while an endocrinologist assesses in cases of difficult glycemic control in patients with type 1 diabetes, or pump users (9, 23). The shared responsibility model is crucial for a safer postoperative outcome.

Communication and Coordination Tools

A standardized perioperative diabetes documentation tool must be used in all surgical patients with diabetes, which includes their diabetes type. HbA1c levels, previous medications, insulin regimen, and target glucose range (23). This ensures effective care with all team members working based on a shared management plan.

Electronic health care tools aid in improving glycemic management and planning through personalized insulin infusion and correcting insulin scales. Automated prompts can also help doctors remember when to discontinue or restart medications such as SGLT2 inhibitors or metformin. A criterion can be established for automatic endocrinology referral in patients with type 1 diabetes, insulin pump therapy, recurrent hypoglycemia, or severe hyperglycemia (15).

Handover from operating room to PACU and from PACU to ward must be performed under a structured protocol covering current glucose value, insulin administered, the timing of next glucose check, the ability of the patient to resume oral intake, complications such as nausea or vomiting, and medication adjustments (21,23).

Institutional Implementation

Hospitals should establish perioperative committees consisting of representatives from anesthesiology, internal medicine, surgery, endocrinology, pharmacy, and nursing to design personalized protocols, review patients' possible outcomes, and update practices throughout the surgical pathway, with staff training programs provided regularly for all team members (23).

Standardized hospital insulin infusion protocol is essential to minimize variability among departments and ensure patient safety. Institutions must monitor rates of hypoglycemia, severe hyperglycemia, postoperative infections, and readmission rates to identify any system gaps that require corrective interventions (15).

Hospitals can create sustainable perioperative diabetes management systems through staff education, leadership support, and continuous assessment to improve both operational efficiency and clinical outcomes (9,15,21,23).

Unresolved Clinical Questions

The optimal intraoperative glucose target is one of the most debated issues despite the progress in perioperative diabetes management. Current studies recommend a range of 140 – 180 mg/dL, yet the ideal range may differ based on the patient's stability and the operating setting. Therefore, more randomized studies are needed to determine whether better outcomes are seen with individual targets or a universal threshold. Another topic is the perioperative management of GLP-1 receptor agonists, perioperative withholding duration, and its effect on delayed gastric emptying and aspiration risk. Similarly, SGLT2 inhibitors require safe timing of discontinuation or restart, especially due to their risk of euglycemic ketoacidosis. Continuous glucose monitoring accuracy is another unresolved topic, mainly due to its inaccurate readings in settings of hypoperfusion, hypothermia, and vasopressor use, while emerging closed-loop systems require larger clinical trials to prove their safety and efficacy (9,19,21,23).

Finally, the relative importance of glycemic variability compared with mean glucose levels remains vague, with new evidence suggesting that rapid change in glucose levels may contribute to adverse outcomes.

Implementation Science Gap

Basal-bolus insulin regimen and intravenous insulin protocols remain limited and underused in routine clinical practice, mostly due to staff unfamiliarity with them, fear of hypoglycemia, untrained staff, and unavailable monitoring resources. Few studies have measured the efficacy of intradisciplinary perioperative diabetes care models, thus underquantifying the true impact of such models. In addition, the cost-effectiveness of perioperative diabetes optimization remains unclear (9,15,21,23).

Underrepresented Population

Several patient populations are neglected in current perioperative diabetes research, including elderly patients who have frequent altered insulin sensitivity, renal impairment, and higher hypoglycemia risk, yet protocols are limited in their case (9). Another population is ambulatory and short-stay surgical patients, although they require practical medication adjustment and discharge planning (23). Further research is needed to cover perioperative diabetes protocols in low-resource health care settings where staff training and technology access are limited (15,21). Addressing the previously stated gaps will show improvement in the global efficacy of perioperative diabetes care.

Conclusion

This narrative review synthesises a broad spectrum of clinical trials, cohort studies, and practice guidelines published from 2016 to 2026 on perioperative glucose management in adult surgical patients. A common theme across the literature is that disturbances in glucose homeostasis, whether hyperglycemia, hypoglycemia, or excessive glycemic variability, are strongly linked to adverse surgical

outcomes, such as higher rates of surgical site infections, delayed wound healing, cardiovascular instability, renal dysfunction, longer hospital stays, and increased mortality. Crucially, these disturbances are not limited to patients with a diagnosis of diabetes, as many surgical patients experience stress-induced hyperglycemia, often undiagnosed, reflecting the systemic metabolic response to surgery. This effect, mediated by hormonal and inflammatory mechanisms, leads to insulin resistance and impaired glucose homeostasis, exacerbating the risk of complications. Although most studies agree on a target glucose range of 140-180 mg/dl as a safe and practical balance between avoiding hyperglycemia and hypoglycemia, achieving this in clinical practice is difficult due to differences in institutional protocols, monitoring practices, and communication between perioperative teams. A consistent message across the evidence is that better outcomes are not necessarily achieved through the introduction of new interventions, but rather through the consistent use of existing strategies, with protocol-based management and effective communication between disciplines being key to achieving stable glucose levels and minimising complications.

The results contextualise perioperative glycemic control, demonstrating that it is not just a metabolic problem but also a key factor in surgical outcomes. Glycemic control should start well before surgery, with risk assessment and optimization, and extend through the intraoperative and postoperative phases, as dysglycemia is associated with complications. This justifies the integration of structured glycemic protocols into routine surgical practice rather than reactive approaches, as well as the recognition of stress-induced hyperglycemia in patients without a known diagnosis of diabetes and a more comprehensive approach to early identification of at-risk patients. The key to improving perioperative outcomes is translating current knowledge into practice through improved coordination, protocols, and a more integrated interdisciplinary approach to care, including early identification and preoperative optimization, structured and individualised medication management with continuation of basal insulin, routine intraoperative monitoring with protocol-driven insulin therapy, proactive postoperative strategies using basal bolus correction strategies, frequent context-specific glucose monitoring, and avoidance of glycemic variability. Structured handovers between the phases of the perioperative period, shared accountability between surgical, anesthetic, medical, and nursing staff, and the judicious use of supportive technologies such as continuous glucose monitoring and computer-assisted insulin dosing systems also improve safety and prevent errors. The perioperative period should also be considered a chance to enhance both short-term surgical outcomes and long-term metabolic outcomes, which requires institutional protocols, training, and communication. While progress has been made, there are still questions about individualised glycemic targets, the use of newer antidiabetic medications in the perioperative period, and the role of new technologies, as well as how to implement these strategies in different health-care settings. In summary, better perioperative glycemic management relies on consistent and coordinated implementation of existing evidence and recognition of the need for glycemic optimization as a system-wide priority to minimise complications and enhance outcomes.

Acknowledgements

We affirm that all authors contributed equally to the conception, writing, and refinement of this narrative review. All authors developed the concept together, reviewed the literature, wrote the manuscript collaboratively, and approved the final version. The order of authorship is non-hierarchical and was determined arbitrarily. We wish that our work will be useful to the readers and contribute, even in a small way, to the general knowledge of this area.

Conflict of Interest

The authors declare no conflicts of interest related to this work.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

AI Disclosure Statement

The authors acknowledge the use of artificial intelligence (AI) tools, including language models, to assist with language refinement, grammar correction, and structural organization of this manuscript. All scientific content, interpretation, and conclusions were developed independently by the authors. The authors take full responsibility for the accuracy, originality, and integrity of the work, and all sources have been appropriately cited in accordance with academic standards.

References

1. Crowley K, Scanaill PÓ, Hermanides J, Buggy DJ. Current practice in the perioperative management of patients with diabetes mellitus: a narrative review. Br J Anaesth. 2023 Aug;131(2):242–52. doi:10.1016/j.bja.2023.02.039

2. Magliano D, Boyko EJ. Diabetes atlas. 11th edition. Brussels: International Diabetes Federation; 2025. 1 p.

3. Todd LA, Vigersky RA MD. Evaluating Perioperative Glycemic Control of Non-cardiac Surgical Patients with Diabetes. Mil Med. 2021 Sep 1;186(9–10):e867–72. doi:10.1093/milmed/usaa467

4. Shuford R, Miller-Ocuin JL. Hyperglycemia in the Perioperative Period. Clin Colon Rectal Surg. 2023 May;36(03):198–200. doi:10.1055/s-0043-1761153

5. Ernst C. Stress hyperglycemia and treatment in perioperative care. Nurse Pract. 2025 Nov;50(11):22–7. doi:10.1097/01.NPR.0000000000000372

6. Bellon F, Solà I, Gimenez-Perez G, Hernández M, Metzendorf MI, Rubinat E, et al. Perioperative glycaemic control for people with diabetes undergoing surgery. Cochrane Metabolic and Endocrine Disorders Group, editor. Cochrane Database Syst Rev. 2023 Aug 1;2023(8). doi:10.1002/14651858.CD007315.pub3

7. Jin X, Wang J, Ma Y, Li X, An P, Wang J, et al. Association Between Perioperative Glycemic Control Strategy and Mortality in Patients With Diabetes Undergoing Cardiac Surgery: A Systematic

Review and Meta-Analysis. Front Endocrinol. 2020 Dec 17;11:513073. doi:10.3389/fendo.2020.513073

8. Rajan N, Duggan EW, Abdelmalak BB, Butz S, Rodriguez LV, Vann MA, et al. Society for Ambulatory Anesthesia Updated Consensus Statement on Perioperative Blood Glucose Management in Adult Patients With Diabetes Mellitus Undergoing Ambulatory Surgery. Anesth Analg. 2024 Sep;139(3):459–77. doi:10.1213/ANE.0000000000006791

9. Dogra P, Anastasopoulou C, Jialal I. Diabetic Perioperative Management. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2026 [cited 2026 Apr 25]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK540965/ PubMed PMID: 31082009.

10. Levy NA, El-Boghdadly K, Lobo DN, Stubbs DJ, Avari P, Buggy D, et al. Peri-operative management of diabetes mellitus: a multidisciplinary consensus statement from the Association of Anaesthetists and the Joint British Diabetes Societies for Inpatient Care group. Anaesthesia. 2026 Feb 16;anae.70181. doi:10.1111/anae.70181

11. Hulst AH. Current perioperative management of patients with diabetes mellitus in Dutch hospitals [Internet]. 2018. doi:10.13140/RG.2.2.17210.64960

12. Shanks AM, Woodrum DT, Kumar SS, Campbell DA, Kheterpal S. Intraoperative hyperglycemia is independently associated with infectious complications after non-cardiac surgery. BMC Anesthesiol. 2018 Dec;18(1):90. doi:10.1186/s12871-018-0546-0

13. Centre for Perioperative Care (CPOC). Guideline for perioperative care for people with diabetes mellitus undergoing elective and emergency surgery [Internet]. London: Centre for Perioperative Care; 2021 [cited 2026 Apr 19]. Available from: https://cpoc.org.uk/sites/cpoc/files/documents/2021-03/CPOC-Diabetes-Guideline2021.pdf

14. Cheisson G, Jacqueminet S, Cosson E, Ichai C, Leguerrier AM, Nicolescu-Catargi B, et al. Perioperative management of adult diabetic patients. Postoperative period. Anaesth Crit Care Pain Med. 2018 Jun;37:S27–30. doi:10.1016/j.accpm.2018.02.023

15. Sreedharan R, Khanna S, Shaw A. Perioperative glycemic management in adults presenting for elective cardiac and non-cardiac surgery. Perioper Med. 2023 Apr 29;12(1):13. doi:10.1186/s13741-023-00302-6

16. Allyn S, Bentov N, Dillon J. Perioperative Optimization and Management of the Oral and Maxillofacial Surgical Patient: A Narrative Review on Updates in Anticoagulation, Hypertension and Diabetes Medications. J Oral Maxillofac Surg. 2024 Mar 1;82(3):364–75. doi:10.1016/j.joms.2023.11.015

17. Partridge H, Perkins B, Mathieu S, Nicholls A, Adeniji K. Clinical recommendations in the management of the patient with type 1 diabetes on insulin pump therapy in the perioperative period: a primer for the anaesthetist. Br J Anaesth. 2016 Jan 1;116(1):18–26. doi:10.1093/bja/aev347

18. Morey-Vargas OL, Aminian A, Steckner K, Zhou K, Kashyap SR, Cetin D, et al. Perioperative management of diabetes in patients undergoing bariatric and metabolic surgery: a narrative review and the Cleveland Clinic practical recommendations. Surg Obes Relat Dis. 2022 Aug 1;18(8):1087–101. doi:10.1016/j.soard.2022.05.008

19. Goron AR, Connolly C, Valdez-Sinon AN, Hesson A, Helou C, Kirschen GW. Anti-Hyperglycemic Medication Management in the Perioperative Setting: A Review and Illustrative Case

of an Adverse Effect of GLP-1 Receptor Agonist. J Clin Med. 2024 Oct 20;13(20):6259. doi:10.3390/jcm13206259

20. Setji TL, Freeman LG& S. Perioperative diabetes management. Diabetes Manag. 2018 Jun 1;8(3):67–73.

21. Siddiqui K, Asghar M, Khan M, Khan F. Perioperative glycemic control and its outcome in patients following open heart surgery. Ann Card Anaesth. 2019;22(3):260. doi:10.4103/aca.ACA_82_18

22. Vellanki P, Cardona S, Galindo RJ, Urrutia MA, Pasquel FJ, Davis GM, et al. Efficacy and Safety of Intensive Versus Nonintensive Supplemental Insulin With a Basal-Bolus Insulin Regimen in Hospitalized Patients With Type 2 Diabetes: A Randomized Clinical Study. Diabetes Care. 2022 Oct 1;45(10):2217–23. doi:10.2337/dc21-1606

23. Chaves KF, Panza JR, Olorunfemi MA, Helou CM, Apple AN, Zhao Z, et al. The prevalence of hyperglycemia and its association with perioperative outcomes in gynecologic surgery: a retrospective cohort study. Perioper Med. 2023 Jun 2;12(1):19. doi:10.1186/s13741-023-00307-1

24. Kinio AE, Gold M, Doonan RJ, Steinmetz O, Mackenzie K, Obrand D, et al. Perioperative Glycemic Surveillance and Control—Current Practices, Efficacy and Impact on Postoperative Outcomes following Infrainguinal Vascular Intervention. Ann Vasc Surg. 2023 Sep;95:108–15. doi:10.1016/j.avsg.2023.03.009