The Review Of
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The Impact Of Healthcare Providers On Effective Diabetes Management

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Abstract

Background
Diabetes mellitus represents a growing global health crisis, with rising prevalence of type 1 and type 2 forms driving morbidity from acute hypoglycemia and hyperglycemia across care settings. Nurses are pivotal in glycemic management, integrating monitoring, education, and coordination to mitigate these disturbances and their clinical burdens.

Methods
This narrative review synthesized contemporary evidence from global epidemiological data, clinical guidelines, and studies on nursing interventions. Sources encompassed systematic reviews, randomized trials, and quality improvement reports detailing nurses' roles in assessment, insulin titration, patient education, and care models for hypo- and hyperglycemia prevention.

Results
Nurse-led interventions, including protocol-driven insulin adjustments, continuous glucose monitoring integration, and self-management education, improved HbA1c by 0.3-2.0%, reduced hypoglycemic events, and enhanced patient self-efficacy. Barriers like workload and knowledge gaps were offset by training and standardized protocols, yielding better outcomes in inpatient and community settings.

Conclusions
Empowering nurses through education, protocols, and resources optimizes diabetes care, preventing glycemic extremes and supporting integrated management. Policy and practice should prioritize nursing competencies to address the escalating diabetes burden effectively.

Keywords Nurses, diabetes mellitus, hypoglycemia, hyperglycemia, glycemic management, patient education, insulin titration, continuous glucose monitoring, nurse-led interventions, self-management.

Introduction
Diabetes mellitus is a rapidly expanding global public health challenge, with a marked rise in the prevalence of type 1 diabetes (T1DM), type 2 diabetes (T2DM), and other less common forms such as

gestational diabetes and monogenic diabetes, leading to substantial clinical and economic burdens worldwide. At the same time, acute glycemic disturbances particularly hypoglycemia and hyperglycemia in both inpatient and outpatient settings remain major drivers of preventable morbidity, mortality, and healthcare utilization, underscoring the need for coordinated, continuous, and patient-centred approaches to glycemic management in which nurses play a central role. This review is situated at the intersection of these trends and focuses on the critical contribution of nurses to integrating care for hypoglycemia and hyperglycemia across the continuum of diabetes care, from community and primary care to acute and critical care settings, with a view to informing practice, education, and policy (Khan et al., 2020).

The epidemiology of diabetes mellitus reflects a sustained and accelerating rise in disease burden, with estimates indicating that hundreds of millions of adults worldwide currently live with diabetes and that this number will continue to increase over the coming decades, driven largely by T2DM associated with population ageing, urbanization, and lifestyle changes. Recent global analyses show that diabetes is among the leading causes of mortality and disability, with T2DM accounting for the vast majority of cases, while projections suggest that prevalence may exceed 700 million individuals within the next decade and approach or surpass 780 million by 2045, with the steepest relative increases expected in low- and middle-income countries where health systems are often least prepared (Hossain et al., 2024). Although T2DM dominates numerically, the burden of T1DM is also growing, with contemporary estimates suggesting that more than 8 million people worldwide live with T1DM and that prevalence will rise further by 2040, reflecting changes in incidence across many regions. Emerging analyses from global burden of disease studies indicate that both T1DM and T2DM in adolescents and young adults have increased over recent decades, with important geographic and socioeconomic disparities that translate into differences in access to insulin, monitoring technologies, and comprehensive diabetes education and support. In addition, other forms of diabetes including gestational diabetes and specific types due to genetic defects or pancreatic disease contribute to the heterogeneity of clinical presentations and risks, reinforcing the need for nurses to be knowledgeable about diverse phenotypes and trajectories of diabetes across the life course and to tailor glycemic management strategies accordingly (Ogrotis et al., 2023).

Acute glycemic disturbances, particularly hypoglycemia and hyperglycemia, impose a substantial burden on patients, health services, and societies, with both extremes linked to adverse outcomes such as cardiovascular events, neurological injury, infections, and death. In the hospital setting, episodes of hypoglycemia and uncontrolled hyperglycemia are consistently associated with increased length of stay, higher rates of complications, and elevated costs, and they often serve as markers of overall care quality and system-level performance in diabetes management (Naser et al., 2020).

Multiple studies of hospitalized patients have demonstrated that hypoglycemia is not only distressing and potentially life-threatening in the short term but is also associated with increased in-hospital mortality and may contribute to excess mortality after discharge, particularly when recurrent or severe. Economic evaluations from various regions show that hospitalizations for hypoglycemic events carry non-trivial costs, with higher expenditures and longer stays observed in older adults, individuals with longer diabetes duration, and those requiring intensive care unit admission, thereby magnifying the economic footprint of otherwise preventable episodes (Hulkower et al., 2014).

Similarly, persistent or severe inpatient hyperglycemia has been linked to prolonged hospitalization, increased risk of infection and organ dysfunction, and higher overall hospital costs, particularly in patients admitted with comorbid conditions such as heart failure or acute coronary syndromes. Beyond the hospital, recurrent hypoglycemia in community-dwelling individuals with diabetes can lead to fear, reduced quality of life, loss of driving or occupational privileges, and increased emergency medical service utilization, whereas chronic hyperglycemia accelerates microvascular and macrovascular complications, amplifying long-term morbidity and health system costs. Against this backdrop, interventions that prevent, promptly detect, and effectively manage both hypoglycemia and hyperglycemia particularly those embedded in routine nursing practice offer considerable potential to improve outcomes and reduce resource use (Dailah, 2024).

Nurses are uniquely positioned at the frontline of diabetes care due to their continuous 24/7 presence in hospitals, their sustained contact with patients in primary care and community settings, and their central role in monitoring, education, and coordination, making them critical actors in preventing and managing acute glycemic disturbances. In inpatient environments, nurses are responsible for frequent capillary

blood glucose monitoring, timely administration and adjustment of insulin and other glucose-lowering therapies according to protocols, recognition of early signs and symptoms of hypo- and hyperglycemia, and rapid implementation of corrective measures, all of which directly influence the incidence, severity, and outcomes of glycemic events (Haque et al., 2021).

Beyond technical tasks, nurses play a pivotal role in patient and family education, supporting individuals to understand their condition, recognize risk situations for hypoglycemia and hyperglycemia, master self-monitoring and medication administration skills, and adopt sustainable lifestyle modifications, thereby strengthening self-management and reducing preventable emergencies. Nurse-led and nurse-coordinated interventions such as structured diabetes self-management education programs, telehealth and telephone follow-up, and dedicated diabetes nurse specialists or nurse practitioners have been associated with improved glycemic control, enhanced diabetes knowledge, better psychological outcomes, and, in some cases, reduced healthcare utilization and costs (Davidson, 2021).

Nurses also act as key care coordinators within interprofessional teams, bridging gaps between endocrinologists, primary care physicians, dietitians, pharmacists, and other professionals, and ensuring continuity of glycemic management during transitions between hospital and home, or between different levels of care. Through systematic review of electronic health records, proactive outreach, and protocol-driven follow-up, nurses can identify patients at high risk for hypo- or hyperglycemic crises, facilitate timely adjustments in therapy, and organize referrals to specialized services, thereby operationalizing integrated models of diabetes care across the continuum. This multi-faceted and longitudinal engagement supports the argument that strengthening the nursing contribution is indispensable to achieving safer and more effective glycemic control at population level (Romero-Castillo et al., 2022).

The overarching aim of this review is to synthesize contemporary evidence on the critical role of nurses in the management of diabetes mellitus, with a particular emphasis on how nursing practice integrates care for hypoglycemia and hyperglycemia across diverse settings and stages of the disease trajectory. Specifically, the review seeks to (1) describe the global and regional burden of diabetes and acute glycemic disturbances, (2) delineate the spectrum of nursing roles and competencies involved in glycemic management, including monitoring, education, medication management, and care coordination, and (3) assess the effectiveness of nurse-led and nurse-coordinated interventions in preventing, detecting, and treating hypoglycemia and hyperglycemia and in improving clinical and patient-reported outcomes.

Nursing Roles in Diabetes Care

Nursing roles in diabetes care have evolved from a narrow focus on executing physician orders and performing technical tasks to advanced, autonomous, and nurse-led functions that span prevention, acute management, and long-term support for people living with diabetes, including the integrated prevention and treatment of hypoglycemia and hyperglycemia. Contemporary diabetes nursing encompasses clinical decision-making, protocol-driven insulin titration, therapeutic education, and coordination of multidisciplinary care, positioning nurses as central agents in achieving safe glycemic control and reducing acute and chronic complications (Rodríguez-García et al., 2025).

Historically, nurses in diabetes care were primarily responsible for bedside glucose monitoring, insulin administration according to fixed medical orders, and basic diet reinforcement, reflecting a task-based, subordinate role within physician-dominated models of chronic disease management. Over recent decades, epidemiologic growth of diabetes, increasing complexity of insulin regimens, and recognition of the importance of self-management have driven expansion toward diabetes nurse specialists, advanced practice nurses, and certified diabetes care and education specialists who independently assess metabolic control, adjust treatment within protocols, and deliver structured education focused on preventing both hypoglycemia and hyperglycemia. In many countries, nurse-led diabetes clinics and shared-care models now assign nurses primary responsibility for ongoing titration of insulin and non-insulin agents, interpretation of continuous glucose monitoring (CGM) outputs, and individualized troubleshooting of glycemic variability, thereby directly influencing day-to-day prevention of severe hypoglycemia and sustained hyperglycemia (Alharbi et al., 2019).

Regulatory and scope-of-practice reforms have been pivotal in enabling this transformation, with nurse prescribing, independent ordering of laboratory tests, and authority to initiate or intensify insulin under

evidence-based algorithms increasingly embedded in legislation and institutional policies. Advanced practice nurses and diabetes nurse specialists operating within defined protocols can modify basal–bolus doses, adjust correction factors, and initiate treatments such as GLP-1 receptor agonists or SGLT2 inhibitors in collaboration with physicians, which facilitates timely responses to trends in CGM and capillary glucose data that might otherwise result in recurrent hypoglycemia or chronic hyperglycemia. At the same time, regulatory frameworks often mandate ongoing competency assessment, continuing education in diabetes pharmacotherapy and technology, and adherence to national diabetes standards of care, which together support safe, high-level nursing autonomy while safeguarding patients from inappropriate prescribing or insulin adjustment (Yago-Esteban et al., 2022).

Core competencies in diabetes nursing encompass an extensive knowledge base that includes detailed understanding of diabetes pathophysiology, the pharmacokinetics and pharmacodynamics of insulin and non-insulin therapies, principles of nutritional and exercise management, and the operation and interpretation of technologies such as blood glucose meters, insulin pumps, and CGM systems. Nurses also require familiarity with acute metabolic emergencies, including diabetic ketoacidosis and hyperosmolar hyperglycemic state, and with risk factors, prodromal symptoms, and trajectories of hypoglycemia and hyperglycemia across different populations, so that they can anticipate problems, tailor targets, and guide patients in real-time dose and lifestyle adjustments. Frameworks such as national diabetes nursing competencies and diabetes educator standards emphasize that this knowledge must be updated continuously in response to emerging pharmacologic agents, hybrid closed-loop systems, and evolving evidence on individualized glycemic targets (Alharbi et al., 2019).

In terms of skills, diabetes nurses need advanced assessment capability, including systematic evaluation of glycemic profiles, identification of hypoglycemia unawareness, recognition of psychosocial barriers to self-management, and appraisal of patients' health literacy and numeracy as they relate to insulin dose calculations and carbohydrate counting. Educational and communication skills are central: nurses must be able to deliver structured diabetes self-management education and support, employ motivational interviewing to address ambivalence, and coach patients in self-monitoring, sick-day rules, and prevention and early treatment of hypo- and hyperglycemic episodes, using both in-person and telehealth modalities. Competence also extends to protocolized interventions such as nurse-led insulin titration algorithms, nurse-directed telemonitoring of glucose and adherence, and the use of digital tools or mobile phone interventions to promote self-care, all of which have demonstrated improvements in HbA1c, self-efficacy, and quality of life (Dailah, 2024).

Attitudes and values underpinning effective diabetes nursing are grounded in person-centred care, cultural competence, and advocacy, recognizing that the experience and risks of hypoglycemia and hyperglycemia are shaped by social context, ethnicity, economic constraints, and personal beliefs. Person-centred diabetes care frameworks describe the need to focus on the individual's priorities and lived experience, to use respectful, non-stigmatizing language, and to co-create goals and strategies that reflect the patient's preferences and capacity, rather than imposing rigid regimens that may inadvertently increase hypoglycemia risk or undermine adherence. Cultural humility and sensitivity to health disparities are particularly important when teaching about symptom recognition, carbohydrate intake, and insulin adjustment in communities with diverse dietary practices or limited access to diabetes technologies, and nurses frequently act as advocates for access to resources, equitable services, and inclusive, culturally appropriate care (Dragomanovich & Shubrook, 2021).

Applying the nursing process to diabetes creates a structured, cyclical approach assessment, diagnosis, planning, implementation, and evaluation that allows nurses to integrate the risks and management of hypo- and hyperglycemia at every step of care. Comprehensive assessment includes collection of biomedical data such as HbA1c, fasting and postprandial glucose profiles, renal function, and cardiovascular risk markers, combined with focused examination for complications, evaluation of medication adherence, review of injection technique or pump use, and detailed exploration of hypoglycemia frequency, severity, awareness, and triggers. Nurses also assess dietary patterns, physical activity, sleep, psychosocial status, and social determinants such as food insecurity and access to monitoring supplies, all of which influence glycemic variability and the feasibility of recommended regimens (Dragomanovich & Shubrook, 2021).

Based on this assessment, nurses formulate nursing diagnoses that may include ineffective health management, risk for unstable blood glucose level, impaired knowledge, or fear of hypoglycemia, which then inform individualized, measurable goals for both glycemic outcomes and psychosocial

adaptation. Planning involves co-developing care plans that specify target glucose ranges, frequency and timing of self-monitoring or CGM scanning, strategies to prevent nocturnal and exercise-related hypoglycemia, and interventions to address persistent hyperglycemia such as stepwise insulin titration, adherence support, or referral for advanced therapies, while also delineating early warning signs and action thresholds for both extremes. Implementation encompasses direct clinical actions (e.g., adjusting insulin using agreed algorithms, administering rescue carbohydrates, initiating or escalating basal insulin), structured education sessions, coordination with dietitians, pharmacists, and physicians, and use of telehealth or mobile messaging to reinforce behaviors and rapidly address emergent glycemic issues (Azami et al., 2018).

Evaluation within the nursing process focuses on whether planned outcomes such as target HbA1c, reduced glycemic variability, fewer severe hypoglycemic episodes, and improved quality of life have been achieved, and it relies on ongoing review of glucose data, complication screening, and patient-reported outcomes. When goals are not met or new issues arise such as recurrent nocturnal hypoglycemia after intensification of therapy or persistent postprandial hyperglycemia in spite of acceptable fasting levels nurses revise assessments and diagnoses, renegotiate goals with the patient, and modify interventions, illustrating the dynamic nature of the process. This iterative approach is particularly important in transitions of care, such as hospital admission or discharge, pregnancy, or initiation of insulin pumps, where risks of both hypo- and hyperglycemia change rapidly and require close nursing surveillance and adjustment (Sun et al., 2025).

Multiple models of care have emerged that place nurses in central, often leading roles in diabetes management, including nurse-led clinics, diabetes nurse specialist services embedded in primary or secondary care, case management programs, and liaison roles that bridge hospital and community settings. In nurse-led clinics, advanced practice nurses or diabetes nurse specialists conduct comprehensive reviews, adjust therapy within agreed protocols, deliver intensive education, and coordinate multidisciplinary input, often acting as the principal ongoing provider for patients with complex diabetes, while in case management models, nurses provide longitudinal follow-up, telephone or digital contact, and rapid response to deteriorating control, thereby smoothing care transitions and preventing acute decompensation. Liaison nurses in hospital settings focus on optimizing inpatient glycemic control, educating ward staff, reconciling medications, and ensuring that discharge plans include clear instructions and follow-up arrangements for managing insulin and recognizing symptoms of hypoglycemia and hyperglycemia at home (Holloway et al., 2023).

There is substantial evidence that nurse-led or nurse-intensive interventions improve biomedical, behavioral, and patient-reported outcomes in diabetes, including better HbA1c, enhanced self-management behaviors, and improved quality of life, with some studies also reporting favorable effects on hypoglycemia incidence. Systematic reviews and randomized controlled trials of nurse-led diabetes self-management education and support programs demonstrate clinically meaningful reductions in HbA1c (typically in the range of 0.3–2.0 percentage points), increased self-efficacy, healthier lifestyle behaviors, and sustained benefits beyond the formal intervention period, particularly when interventions are culturally tailored and use interactive methods or technology-assisted follow-up. Nurse-led telehealth, mobile phone, and web-based programs further enhance accessibility, allowing rapid feedback on glucose trends, reinforcement of sick-day and hypoglycemia management rules, and early identification of patterns of hyperglycemia, while recent meta-analytic evidence supports integrating such nurse-led models into routine diabetes care to optimize long-term glycemic control and patient empowerment (Azami et al., 2018).

Assessment and Early Recognition of Hypoglycemia and Hyperglycemia

Routine capillary blood glucose (CBG) monitoring remains the cornerstone of nursing assessment of glycemic status in both inpatient and outpatient settings, with schedules typically aligned to meals (before meals and at bedtime) for eating patients and at fixed intervals (every 4–6 hours) for those who are fasting, receiving enteral nutrition, or critically ill. For hospitalized adults with diabetes or stress hyperglycemia, many practice guidelines recommend maintaining CBG generally within approximately 140–180 mg/dL, recognizing values below about 70 mg/dL as hypoglycemia and persistent readings above about 180 mg/dL as clinically relevant hyperglycemia; nurses interpret these results not only in isolation but as trends over time, linking them to symptoms, insulin administration times, and dietary intake to identify patterns such as dawn phenomenon, postprandial spikes, or recurrent nocturnal lows

that warrant treatment modification. Importantly, nursing assessment includes critical appraisal of measurement reliability considering factors such as peripheral perfusion, hematocrit abnormalities, and timing relative to insulin dosing because inaccurate or poorly timed point-of-care testing can lead to inappropriate insulin adjustments and subsequent iatrogenic hypoglycemia or uncontrolled hyperglycemia (Dhatariya & Umpierrez, 2024).

In addition to scheduled monitoring, nurses employ symptom-triggered CBG checks based on early clinical cues of hypoglycemia (sweating, tremor, tachycardia, confusion, behavioral changes) or hyperglycemia (polyuria, polydipsia, blurred vision, fatigue), recognizing that older adults, those with long-standing diabetes, or individuals with hypoglycemia unawareness may present with atypical or blunted manifestations. Assessment integrates laboratory measures such as glycated hemoglobin (HbA1c) where available, which provides context about chronic glycemic exposure and helps nurses distinguish between acute dysglycemia and long-standing poor control; high HbA1c values support intensified surveillance for both hypo- and hyperglycemic episodes during acute illness and transitions of care. Nurses also observe the timing and composition of meals, interruptions to nutrition (e.g., procedures requiring fasting), and gastrointestinal symptoms, because mismatches between carbohydrate intake and insulin or sulfonylurea action are a frequent source of preventable glycemic excursions and are often most visible to nursing staff overseeing day-to-day care (Haghighatpanah et al., 2018).

The growing integration of continuous glucose monitoring has transformed nursing assessment by providing near real-time glucose trends, rate-of-change arrows, and configurable alerts for impending hypo- or hyperglycemia that can prompt earlier intervention than intermittent fingerstick testing. In hospitals that support inpatient CGM often via policies allowing continuation of patients' personal CGM systems nurses validate CGM readings against point-of-care CBG at defined intervals and document both values in electronic health records, using protocolized decision-support tools to determine whether alarms meet criteria for action such as carbohydrate administration, insulin titration, or physician notification. Evidence suggests that, when supported by standardized workflows and clear alarm thresholds, CGM can reduce recurrent hypoglycemia, decrease the burden of frequent fingersticks, and improve nursing efficiency; however, effective integration requires training nurses to interpret CGM trends, troubleshoot device connectivity issues, and balance alarm sensitivity with alarm fatigue in busy clinical environments (Tian et al., 2023).

Risk stratification for hypoglycemia is a core nursing responsibility that begins with identifying patient-related vulnerabilities such as advanced age, multiple comorbidities, impaired renal or hepatic function, malnutrition, frailty, and cognitive impairment, all of which diminish physiological counterregulation and increase the likelihood that standard antidiabetic regimens will provoke low glucose levels. Systematic reviews and hospital-based cohort studies have consistently linked inpatient hypoglycemia to factors including sepsis, renal insufficiency, heart failure, malignancy, low body mass index, and low serum albumin, underscoring the need for nurses to recognize these conditions as triggers for heightened surveillance, more conservative insulin dosing, and closer monitoring during periods of acute clinical change. Prior history of severe hypoglycemia, long duration of diabetes, use of long-acting insulin or sulfonylureas, and endocrine comorbidities further amplify risk, prompting nurses to advocate for individualized glycemic targets and frequent reassessment whenever the clinical status, nutrition, or medication profile shifts (Pratiwi et al., 2020).

Treatment-related and organizational factors represent another major domain in nursing hypoglycemia risk assessment, particularly the use of high-risk regimens such as complex basal-bolus schedules, aggressive sliding-scale insulin, or intravenous insulin infusions without adequately synchronized nutrition plans. Studies have highlighted that inadequate coordination between CBG testing, insulin administration, and meal delivery such as administering rapid-acting insulin too early or too long after food arrival significantly increases the risk of both postprandial hyperglycemia and subsequent hypoglycemia as insulin peaks in the absence of sufficient carbohydrate, a problem that nurses are well placed to detect and correct through workflow redesign and communication. Organizational contributors include limited staffing, lack of clear insulin and hypoglycemia protocols, unclear or illegible medical orders, and insufficient access to rapid-acting carbohydrate or glucagon, all of which can delay recognition and treatment of falling glucose; nurses' input into protocol development, staff education, and escalation policies is crucial to mitigating these systemic risks (Dhatariya & Umpierrez, 2024).

From a nursing perspective, formalizing hypoglycemia risk assessment into structured tools or checklists helps ensure consistent identification of high-risk patients at admission and during key transitions such as perioperative periods, initiation of enteral or parenteral nutrition, or de-escalation of steroids. Such tools often incorporate variables like age ≥65 years, estimated glomerular filtration rate thresholds, use of insulin or sulfonylureas, impaired oral intake, history of recent hypoglycemia, and presence of sepsis or liver disease, prompting predefined actions such as more frequent CBG checks, preventive bedtime snacks, or pre-emptive dose reductions. Nurses using these instruments can stratify patients into low, moderate, or high hypoglycemia risk categories and use this classification to prioritize monitoring resources, inform handovers, and guide patient and caregiver education on early symptoms and immediate self-reporting of feeling "unwell" or "different" before overt hypoglycemic manifestations occur (Pratiwi et al., 2020).

Risk stratification for hyperglycemia centers on recognizing indicators of poor glycemic control such as persistent elevations in pre- and postprandial CBG, wide glycemic variability, and repeated excursions above target ranges despite apparently adequate therapy, all of which predict higher risk of infection, delayed wound healing, and prolonged hospital stay. Population-based studies have shown that obesity, irregular clinic follow-up, low medication adherence, and unhealthy lifestyle behaviors are strongly associated with poor long-term glycemic control, and nurses translate these findings into clinical practice by identifying nonadherence, psychosocial barriers, and health literacy issues during routine interactions and by reinforcing the importance of consistent medication use and self-monitoring in both inpatient and ambulatory settings. Within hospital environments, additional hyperglycemia risk factors such as high-dose glucocorticoid therapy, enteral or parenteral nutrition, acute stress responses to illness or surgery, and interruptions in usual diabetes regimens require nurses to anticipate rising glucose levels and coordinate timely insulin adjustments to prevent sustained hyperglycemia (Yahaya et al., 2023).

Early recognition of diabetic ketoacidosis (DKA) and hyperosmolar hyperglycemic state (HHS) depends heavily on nursing vigilance for "red flag" clinical features in combination with biochemical data, given that both syndromes may initially manifest with non-specific symptoms. DKA often evolves over hours to a day in patients with absolute or relative insulin deficiency and is heralded by polyuria, polydipsia, nausea, vomiting, abdominal pain, tachypnea or Kussmaul respirations, fruity breath odor, and varying degrees of altered mental status; nurses are frequently the first to detect this constellation, especially when accompanied by marked hyperglycemia and positive ketones in blood or urine. HHS, more common in older adults with type 2 diabetes, typically presents with profound dehydration, polyuria, extreme hyperglycemia (often >600 mg/dL), hypotension, tachycardia, and neurologic signs ranging from confusion and focal deficits to seizures and coma, with minimal or absent ketoacidosis; recognition requires nurses to link neurological changes and hemodynamic instability to very high CBG levels and elevated serum osmolality, prompting urgent escalation of care (Dhatariya & Umpierrez, 2024).

Given the high morbidity of DKA and HHS, nurses play a critical role in monitoring at-risk patients such as those with infection, missed insulin doses, new-onset diabetes, or major intercurrent illness for early biochemical and clinical signs of metabolic decompensation. Persistent hyperglycemia despite escalating subcutaneous insulin, episodes of vomiting with inability to tolerate oral intake, or new confusion in a patient with high glucose values should trigger rapid diagnostic workup (venous blood gas, electrolytes, ketones, serum osmolality) and activation of institutional emergency pathways for DKA/HHS management. Use of standardized nursing care plans for DKA and HHS in some institutions supports systematic assessment of volume status, neurologic function, and laboratory trends, ensuring timely escalation of insulin, fluids, and electrolyte replacement in collaboration with medical teams (Dhatariya & Umpierrez, 2024).

High-quality documentation and communication are essential for safe glycemic management, as they allow nurses and the wider team to detect trends, correlate glycemic patterns with clinical events, and coordinate timely interventions across shifts and disciplines. Electronic health records increasingly support structured recording of CBG and CGM data, insulin and oral hypoglycemic administrations, nutrition changes, and episodes of hypo- or hyperglycemia, enabling graphical trend visualization and automated alerts when readings breach defined thresholds; nurses contribute by entering complete, timely data and by annotating contextual factors such as missed meals, procedures, or patient refusals that explain unusual values and guide subsequent decision-making. Integration of standardized

hypoglycemia and hyperglycemia documentation templates, including fields for symptoms, treatment given, response, and follow-up monitoring, further enhances continuity and supports quality improvement audits targeting preventable dysglycemic events (Tian et al., 2023).

Structured communication tools and early warning scores incorporating glycemic parameters strengthen interdisciplinary responses to patients at risk of deterioration from hypo- or hyperglycemia. National and local early warning systems often include heart rate, blood pressure, respiratory rate, temperature, and level of consciousness, but some institutions also flag severe hypoglycemia or extreme hyperglycemia as triggers for escalation; nurses using these scores can more rapidly mobilize medical review when abnormal glucose readings coexist with physiological instability, thereby preventing progression to seizures, coma, or metabolic crisis. At the same time, structured handover frameworks such as ISBAR are recommended to improve clarity during shift changes and interdepartmental transfers, encouraging nurses to explicitly communicate glycemic trends, recent hypo- or hyperglycemic episodes, current insulin regimens, CGM status, and individualized risk factors so that receiving teams can maintain vigilant monitoring and adjust therapy appropriately (Nadr Ebraheim et al., 2023).

Nursing Management of Hypoglycemia

Nurses play a pivotal role in implementing standardized protocols and guidelines for hypoglycemia management in diabetes patients, ensuring prompt and evidence-based interventions to prevent complications from low blood glucose levels typically defined as below 70 mg/dL, with thresholds varying slightly by clinical context such as intensive care settings where targets between 140-180 mg/dL are recommended for most patients to balance risks. Recommended treatment algorithms emphasize a stepwise approach starting with 15 grams of fast-acting carbohydrates for mild cases, escalating to glucagon or intravenous glucose for severe episodes, and incorporate nurse-driven standing orders that allow immediate action without physician approval, such as adjusting insulin doses based on carbohydrate intake or initiating glucose infusions during fasting periods. These protocols, often embedded in electronic health record systems, have demonstrated significant reductions in hypoglycemia incidence such as from 0.34 to 0.19 events per day through measures like relating prandial insulin to actual meal consumption and ensuring intravenous glucose during prolonged fasting, while nurse-initiated treatment protocols enhance early recognition and corrective actions, achieving full congruency in episode management over time (Lowe et al., 2022).

At the bedside, nurses execute stepwise management tailored to hypoglycemia severity: mild cases (blood glucose 50-70 mg/dL with minor symptoms) receive oral glucose like juice or glucose tablets (15g), moderate episodes (40-50 mg/dL with neuroglycopenic symptoms) may require repeated oral doses or intramuscular glucagon if oral intake is feasible, and severe hypoglycemia (below 40 mg/dL or unconsciousness) demands immediate intravenous dextrose (typically 25-50g D50W) or glucagon injection to rapidly restore glucose levels. When oral intake is unsafe due to altered mental status, nausea, or coma alternative routes prioritize intravenous glucose for quickest absorption, followed by glucagon (1 mg intramuscular or subcutaneous for adults), with nurses selecting based on availability and patient stability, ensuring recheck of blood glucose 15 minutes post-administration and repeating as needed until resolution above 70 mg/dL. This structured, nurse-led approach minimizes delays, with tools like timers improving recheck compliance to 75% and reducing time to euglycemia, while protocols in long-term care emphasize simplified regimens to avoid sole reliance on sliding-scale insulin (Mathew et al., 2022).

Post-treatment monitoring requires frequent bedside blood glucose checks every 15-30 minutes initially until stable above 70 mg/dL, then hourly for 4-6 hours to detect recurrence or rebound hypoglycemia, a risk heightened by overcorrection with carbohydrates leading to subsequent hyperglycemia and insulin surges. Nurses identify underlying causes through comprehensive assessment, including medication review (e.g., polypharmacy, insulin stacking), dietary intake patterns, renal function impacting gluconeogenesis, and comorbidities like advanced age or recent hospitalization, while implementing preventive strategies such as adjusting basal insulin to 50-75% of prior needs or switching to long-acting formulations. Root cause analysis via nurse-driven tools, including continuous glucose monitoring patterns, prevents rebound by attenuating aggressive insulin responses post-rescue, with quality improvement initiatives showing substantial reductions in events through enhanced surveillance and protocol adherence (Shea et al., 2019).

Nurses deliver targeted education on recognizing early autonomic (sweating, tremors) and neuroglycopenic (confusion, seizures) symptoms, empowering patients and caregivers with the "15-15 rule" consume 15g fast-acting carbs, wait 15 minutes, recheck, and repeat if needed alongside glucagon training for severe home events using traditional kits or newer nasal formulations, integrated into personalized emergency action plans for home, work, and school settings. Structured nurse-led diabetes self-management education (DSME) programs, including booklets, videos, group sessions, and follow-up calls, significantly improve knowledge, self-efficacy, and behaviors like problem-solving for hypo/hyperglycemia, yielding sustained HbA1c reductions and fewer events over 3-6 months. These interventions extend to lifestyle modifications, medication adherence, and psychosocial support, with evidence showing decreased complications, better quality of life, and cost savings from fewer emergency visits (Kedia, 2011).

Nurse-led hypoglycemia bundles integrate education, protocol standardization, meal-insulin coordination, and incident reporting with root cause analyses, resulting in dramatic reductions like 10.27 events per 1000 patient days and improved insulin-with-food administration to 76.2%. These programs, including superuser training and electronic decision support, lower recurrence rates, shorten length of stay, and enhance outcomes through real-time monitoring and automated order sets, with nurse coordinators ensuring adherence via rounding. Broader quality initiatives, such as bundled care in high-risk insulin-treated patients, demonstrate sustained decreases in severe events and mean glucose levels, underscoring nurses' impact on safety and efficiency (Marelli et al., 2015).

Nursing Management of Hyperglycemia

Nurses play a pivotal role in achieving evidence-based glycemic targets across diverse clinical settings, including hospital wards, intensive care units (ICUs), perioperative environments, outpatient clinics, and care for frail or elderly patients, where targets must balance the risks of severe hyperglycemia against hypoglycemia to optimize patient outcomes and prevent complications such as infections, prolonged length of stay, and mortality. In non-ICU hospital settings, the American Diabetes Association (ADA) recommends initiating insulin therapy for persistent hyperglycemia at ≥180 mg/dL (≥10.0 mmol/L), with a target range of 140–180 mg/dL (7.8–10.0 mmol/L) for most patients, while allowing more flexible goals up to 100–180 mg/dL (5.6–10.0 mmol/L) if achieved without hypoglycemia, particularly emphasizing individualized adjustments based on nutritional status, comorbidities, and prior glycemic control. For critically ill ICU patients, a glycemic goal of 140–180 mg/dL (7.8–10.0 mmol/L) remains standard following evidence from trials like NICE-SUGAR, which demonstrated increased mortality and hypoglycemia risk with tighter targets (80–110 mg/dL), underscoring nurses' responsibility in frequent point-of-care (POC) monitoring every 1–2 hours during insulin infusions and vigilant reassessment to maintain this range while avoiding neuroglycopenic events. Perioperative glycemic management requires similar moderation, with targets of 80–180 mg/dL (4.4–10.0 mmol/L) advised against stricter limits due to heightened hypoglycemia risks during fasting and surgical stress, where nurses coordinate preoperative carbohydrate-controlled meals, intraoperative insulin infusions, and postoperative basal-bolus regimens tailored to surgical type and patient factors like cardiac surgery. In outpatient and frail/elderly settings, less stringent targets (e.g., <200–250 mg/dL or 11.1–13.9 mmol/L) accommodate reduced physiological reserve, polypharmacy, and cognitive impairments, with nurses prioritizing hypoglycemia prevention through patient education on self-monitoring, simplified regimens, and integration of continuous glucose monitoring (CGM) where feasible to detect excursions early and promote adherence. Balancing these dual risks demands nurse-led protocols incorporating CGM for trend analysis, multidisciplinary rounding for real-time adjustments, and proactive screening for factors like glucocorticoids or enteral feeds that exacerbate variability, ultimately reducing composite outcomes such as readmissions and adverse events across the care continuum (Roth* et al., 2021).

Nurse-led insulin titration using basal-bolus regimens outperforms traditional sliding-scale approaches in hospitalized patients, achieving superior glycemic control with reduced variability and complications, as evidenced by randomized trials showing lower mean blood glucose levels and fewer postoperative issues without increased insulin dosing or hypoglycemia when nurses follow structured protocols. Basal-bolus therapy, comprising long-acting basal insulin (e.g., glargine) for background coverage and rapid-acting prandial/correction boluses matched to carbohydrate intake, aligns physiological insulin needs, enabling nurses to titrate doses via algorithms that adjust basal by 10–20%

based on daily averages and boluses per 1–2 units per 50 mg/dL above target, with implications including enhanced patient safety through pre-meal POC testing, meal insulin coordination, and avoidance of stacking in variable intake scenarios. Sliding-scale insulin, limited to correction doses without basal coverage, is discouraged as sole therapy due to recurrent hyperglycemia and delayed control, contrasting with basal-bolus where nurses mitigate risks via weight-based initiation (0.2–0.4 units/kg basal, 0.1 units/kg prandial), frequent reassessments every 4–6 hours, and transitions from IV infusions by overlapping subcutaneous basal 2 hours prior to minimize rebound. Safe administration practices hinge on nurse vigilance, including verification of insulin pens for single-patient use, education on analog vs. human insulin differences to curb errors, and integration of electronic health record (EHR) alerts for high-risk transitions like NPO status or glucocorticoid therapy, where prandial doses may require 40–60% increases. In type 1 diabetes, nurses ensure uninterrupted basal delivery even during nil-by-mouth periods, preventing diabetic ketoacidosis (DKA), while for type 2 patients, hybrid approaches with DPP-4 inhibitors support milder cases, all under nurse-driven protocols that have demonstrated 30–40% reductions in hyper/hypoglycemic events via virtual specialist input (Di Luzio et al., 2020).

Nurses manage non-insulin pharmacotherapies across key classes metformin (biguanide for hepatic glucose suppression), sulfonylureas/meglitinides (insulin secretagogues risking hypoglycemia), DPP-4 inhibitors (enhancing incretin effects with low hypo risk), GLP-1 receptor agonists (delaying gastric emptying and promoting satiety), SGLT2 inhibitors (promoting glycosuria with cardioprotective benefits), and others like thiazolidinediones by assessing continuation feasibility in mild-moderate hyperglycemia, monitoring adherence, and educating on timing with meals to optimize efficacy while minimizing gastrointestinal upset or dehydration. Common nursing issues include sulfonylurea-induced prolonged hypoglycemia in renal impairment, requiring frequent POC checks and 15g carbohydrate rescue protocols, contrasted with safer DPP-4/GLP-1 options suitable for hospital resumption in stable type 2 patients, where nurses track injection sites and nausea to sustain therapy. SGLT2 inhibitors warrant caution in hospitalized heart failure patients post-acute phase, with nurses monitoring for euglycemic DKA, volume depletion via daily weights/input-output, and pausing 3–4 days pre-surgery per FDA guidance, yet continuing in select cases for outcome benefits. Adverse effect surveillance encompasses metformin-associated lactic acidosis risks in hypoxia/renal failure (contraindicated if eGFR <30 mL/min), GLP-1 pancreatitis signals prompting lipase checks, and SGLT2 genitourinary infections necessitating hygiene education, all integrated into nurse-led medication reconciliation. Drug interactions altering glycemia, such as beta-blockers masking sulfonylurea hypo symptoms or corticosteroids amplifying needs (necessitating 20–50% insulin boosts), demand nurses' proactive adjustments, patient counseling on sick-day rules (e.g., hold metformin in dehydration), and coordination with pharmacy for combinations like metformin-DPP4 to achieve A1C goals without excess polypharmacy (Feingold, 2024).

In acute severe hyperglycemia, DKA, and hyperosmolar hyperglycemic state (HHS), nurses shoulder primary responsibilities for fluid resuscitation (initial 1–1.5 L/hour isotonic saline, titrated to hemodynamics), continuous IV insulin infusions at 0.1 units/kg/hour targeting 140–180 mg/dL with hourly POC glucose/ketones, and electrolyte monitoring (potassium 4–5 mEq/L before insulin, magnesium/phosphate replacement), while tracking vital signs for tachycardia, hypotension, or altered mental status indicative of dehydration or shock. Frequent reassessments every 1–2 hours guide therapy progression closing anion gap in DKA signals transition to subcutaneous insulin, while HHS demands slower correction (<50 mg/dL/hour) to avert cerebral edema, with nurses preventing complications like arrhythmias via continuous telemetry, cerebral edema vigilance through neuro checks (e.g., pupil response, headache escalation), and hemodynamic instability by serial labs and fluid balances. Nurse-driven protocols standardize two large-bore IVs, hourly insulin/glucose/electrolyte trending, and bicarbonate avoidance unless pH <6.9, incorporating cerebral protection via mannitol readiness and arrhythmia prophylaxis with antiarrhythmics if QT prolongation emerges. Prevention extends to complication surveillance neurological exams for HHS osmolar shifts, cardiac monitoring for hypokalemia-induced ectopy, and renal function tracking amid rhabdomyolysis risks ensuring multidisciplinary handoffs with full-hourly data logs for seamless ICU-to-ward transitions (Ghimire et al., 2023).

Nurses drive long-term hyperglycemia management through systematic screening and intervention for microvascular (retinopathy, nephropathy, neuropathy) and macrovascular (cardiovascular, peripheral

artery disease) complications, integrating annual retinal exams via dilated fundoscopy referrals, urine albumin-creatinine ratios for early nephropathy, and monofilament foot exams into routine visits to halt progression. Foot care protocols encompass daily inspections for ulcers, offloading with custom orthotics, and multidisciplinary wound clinics for neuropathy-driven Charcot arthropathy, where nurses educate on hygiene, moisturizing, and prompt referral for infections reducing amputation risks by 50%. Retinal screening pathways involve nurse-coordinated teleretinal imaging and A1C-driven triage (e.g., <7% stabilizes progression), while nephropathy surveillance includes ACE inhibitor titration per eGFR, dietary sodium counseling, and home BP logs to preserve renal function. Routine nursing care embeds multifactorial risk reduction statin/lipid screening, smoking cessation, exercise prescriptions (150 min/week), and CGM for pattern recognition enhancing quality of life via patient empowerment groups and telehealth follow-ups bridging hospital-to-community care (Aalaa et al., 2012).

Patient Education and Empowerment

Nurses play a pivotal role in delivering diabetes education grounded in adult learning principles, which emphasize practical, problem-centered approaches that respect learners' life experiences and self-directedness, while integrating health literacy strategies to ensure materials are accessible through simple language, visuals, and teach-back methods. Cultural tailoring enhances effectiveness by adapting content to patients' backgrounds, such as incorporating community-specific dietary examples or faith-based motivations, which has shown improvements in self-efficacy and behaviors among diverse groups. Motivational interviewing equips nurses with collaborative techniques to explore patients' ambivalence toward change, fostering behavior change through techniques like open-ended questions and reflective listening, leading to better self-management and glycemic control (Peek et al., 2012).

Nurses educate patients on self-monitoring strategies, including frequent blood glucose checks aligned with medication timing, balanced meal planning with consistent carbohydrate intake, and activity adjustments to prevent exercise-induced lows, empowering individuals to recognize early symptoms like shakiness or confusion and respond with the 15-15 rule of fast-acting carbohydrates followed by rechecking. Specialized guidance covers driving precautions, such as pre-trip glucose testing and carrying glucose sources, occupational risks in high-demand jobs requiring hazard-free environments, and nocturnal hypoglycemia prevention through bedtime snacks or adjusted insulin doses, with family alerts for overnight monitoring. These tailored interventions reduce incidence by enhancing recognition and rapid treatment protocols (Ryan & Swift, 2014).

Nurses teach sick day rules emphasizing continued medication with hydration, frequent glucose and ketone monitoring, and temporary dose adjustments using algorithms to avert diabetic ketoacidosis, alongside recognizing triggers like illness or dehydration. Addressing adherence barriers involves tackling stigma through normalization discussions, distress screening with coping strategies, and personalized plans linking hyperglycemia risks to long-term complications like neuropathy. This holistic approach improves sustained management and quality of life metrics (Dhatariya & Umpierrez, 2024).

Nurses train family members and caregivers in recognizing glycemic emergencies through symptom checklists, hands-on glucagon administration practice, and home action plans, fostering a supportive network that extends hospital education to daily life. Community-based nursing leverages public health models like church-led sessions or group classes for peer reinforcement and resource linkage, promoting widespread adherence via culturally resonant formats. These strategies amplify individual efforts through collective involvement (C Diriba et al., 2021).

Barriers and Facilitators to Optimal Nursing Practice in Glycemic Management

Nurses frequently encounter significant individual-level barriers in glycemic management of diabetes mellitus, including persistent knowledge gaps in areas such as insulin administration, diabetes device usage, and lifestyle modification strategies, compounded by low self-reported confidence in delivering patient education on hypoglycemia and hyperglycemia prevention, which hinders timely recognition and intervention during glycemic emergencies. Heavy workloads and burnout exacerbate these issues, as nurses managing high patient volumes under time constraints often prioritize acute tasks over proactive glycemic monitoring, leading to delayed responses to fluctuating blood glucose levels and increased risk of adverse events like severe hypoglycemia. Ethical tensions further complicate practice, where nurses must balance patient autonomy in self-management decisions against safety imperatives

for strict glycemic targets, particularly in scenarios involving frail elderly patients or those with cognitive impairments, raising dilemmas about overriding patient preferences to avert harm from hypo- or hyperglycemia (Orozco-Beltrán et al., 2024).

At the system level, suboptimal protocol availability and inconsistent staffing ratios severely impede nurses' ability to maintain glycemic stability, as inadequate nurse-to-patient ratios during peak hours force rushed assessments and limit adherence to evidence-based insulin titration guidelines for both hyper- and hypoglycemia correction. Limited access to essential equipment like continuous glucose monitors and real-time point-of-care testing devices, coupled with scarce training opportunities, restricts nurses' proficiency in advanced glycemic interventions, particularly in under-resourced hospital wards handling complex diabetes cases with comorbidities. A weak safety culture, characterized by punitive incident reporting systems and insufficient leadership support, discourages nurses from documenting near-miss hypoglycemic events or hyperglycemia escalations, perpetuating a cycle of unaddressed systemic failures in diabetes care delivery (Nikitara et al., 2019).

Continuous professional development programs, including simulation-based training for acute glycemic emergencies, significantly bolster nurses' competencies by providing hands-on practice in hypoglycemia rescue and hyperglycemia management protocols without patient risk, fostering higher confidence and adherence to best practices. Implementation of standardized nurse-led protocols for insulin adjustment and quality-improvement initiatives, such as multidisciplinary audits targeting glycemic variability, enable systematic reductions in hypo- and hyperglycemic incidents through data-driven refinements in care delivery. Mentorship frameworks pairing novice nurses with diabetes specialists, alongside competency-based evaluation tools, promote sustained skill enhancement and knowledge transfer, ultimately elevating overall nursing effectiveness in integrating holistic diabetes management (Persad et al., 2025).

Conclusion

Nurses serve as pivotal frontline providers in diabetes care, integrating prevention, detection, and management of hypoglycemia and hyperglycemia across inpatient, outpatient, and community settings to mitigate global disease burden and improve patient outcomes. Nurse-led models, including structured education, protocol-driven insulin adjustments, and care coordination, consistently demonstrate reductions in HbA1c, fewer acute events, enhanced self-efficacy, and lower healthcare costs, underscoring their essential role in achieving person-centered glycemic control. Strengthening nursing competencies through training, protocols, and technology integration remains imperative for policy, education, and practice to address rising diabetes prevalence and disparities effectively.

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