Enhancing Perioperative Diabetes Care: Strategies and Challenges

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People with diabetes are more likely to have surgical interventions than the general population and account for as many as 25% of surgical cases (1). They face increased risks of postoperative surgical and dysglycemic complications, prolonged lengths of stay, increased readmissions, and elevated mortality rates (2–4). To mitigate these challenges and reduce the financial burden on health care systems, it is crucial for specialist diabetes teams and perioperative/surgical teams to implement effective systems for safer perioperative diabetes care.

Key strategies include use of national guidelines, setting glycemic target ranges, employing networked capillary blood glucose (CBG) meters with alert systems, defined insulin regimens, and having specialist diabetes teams to proactively identify and intervene in high-risk patients.

Despite the availability of national guidelines, adherence has been inconsistent, leading to variable perioperative management practices (5–7). In England, the National Confidential Inquiry Into Patient Outcomes' "Highs and Lows" in 2018 revealed that while >90% of hospitals had guidelines, their recommendations were frequently not followed, with >60% of hospitals identified as needing improvement in perioperative diabetes care (7).

Initial expectations that tight glycemic control would reduce mortality in intensive care unit (ICU) patients, based on positive findings from van de Berghe (8), were not realized in the larger multicenter Normoglycemia in Intensive Care Evaluation–Survival Using Glucose Algorithm Regulation (NICE-SUGAR) study, where 90-day mortality rates were higher (9). Conversely, in a landmark study, Umpierrez et al. (10) demonstrated that addressing hyperglycemia with a basal bolus insulin regimen resulted in fewer complications, particularly infections, compared with a sliding-scale insulin regimen in non-ICU patients. While this regimen is recommended in all hospitalized patients with diabetes in the U.S., it requires significant nursing support and, as such, has not been widely adopted in other countries where the continuation of oral therapies is standard practice except under specific circumstances, such as temporary stoppage of sodium–glucose cotransporter 2 (SGLT2) inhibitors.

Proactive diabetes teams using networked CBG alert systems have been successful in reducing severe hypoglycemia and hyperglycemia (11–13). Indeed in their previous study, the Randomised Study of Inpatient Diabetes Service (RAPIDS) trial (13), the authors of the Specialist Treatment of Inpatients: Caring for Diabetes in Surgery (STOIC-D Surgery) trial, reported in the current issue of *Diabetes Care* (14), showed that early intervention through electronic glycemic surveillance and early bedside management by a diabetes team significantly reduced hyperglycemia and hospital-acquired infections (HAI). Despite these promising outcomes, the pilot study did not secure continued funding. Their subsequent RAPIDS extension observational study found a return to baseline of both hyperglycemia and HAI after cessation of the pilot, underscoring the importance of sustained efforts in diabetes management (15).

The STOIC-D Surgery trial (14) represents an evolution of RAPIDS that uses a potentially more sustainable model with electronic tools for patient identification, communication of recommendations, therapy intensification, and ongoing electronic review by the specialist team, supplemented by bedside consults by the diabetes team, where appropriate. It bypasses traditional consults, streamlines care delivery, reduces delays, and improves access to care. The trial showed improvements in glycemic control and reductions in HAI very similar to those seen in the previous RAPIDS study conducted in general and surgical wards.

While commendable for its well-designed prospective randomized controlled methodology, the STOIC-D Surgery trial lacks data on some important outcomes, such as length of stay, readmissions, and admissions to critical care units, which are vital in assessing the cost-effectiveness of service improvements and ongoing funding.

A limitation recognized by the authors is the generalizability of their findings. Most diabetes services do not have access to electronic medical records (EMR), let alone EMR-integrated networked CBG meters. In the U.K., only 40% of hospitals had an automated system to flag people with diabetes on admission, 30% did not have an electronic system to facilitate rapid referral to the diabetes team, and although 85% had networked glucose meters, few had alerts to out-of-range results (16). Nevertheless, this hybrid

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model of care, integrating EMR with networked blood glucose meters, presents a novel and important approach but primarily focuses on inpatient glycemic control.

A patient journey approach from primary care referral to discharge advocated by the U.K. Centre for Perioperative Care (CPOC) emphasizes collaboration, workforce development, and patient engagement and may present a more effective model (17).

This clinical reasoning was fundamental in the Improving the Perioperative Pathway of People with Diabetes (IP3D) intervention piloted in Ipswich Hospital, Ipswich, U.K. (18). The complexity of this multistep pathway (Fig. 1) includes several initiatives based on a diabetes "perioperative passport" designed to empower the person with diabetes by promoting communication between staff and patients. The passport contained information regarding preparing for surgery, and it addressed preadmission arrangements regarding eating and drinking, diabetes medication adjustments, and what to expect during the inpatient stay. Admission care included an inpatient diabetes care pathway chart, a rapid electronic referral system, and a point-of-care web-based CBG monitoring system with alerts. These were implemented and led by a designated perioperative diabetes specialist nurse. The positive results, particularly on length of stay, led to a National Health Service England Diabetes and the Getting It Right First Time (GIRFT) program to fund a pilot across 10 National Health Service hospital trusts to determine whether the benefits were site specific or could be realized in other organizations (19). The GIRFT program is a national initiative to reduce variation in practice across England (20). The outcome was a significant reduction in lengths of stay and admissions to the ICU. However, the most striking changes were related to the reduction of dysglycemia, diabetes-specific complications, and postprocedural wound complications, including wound infection. Furthermore, patient experience improved across a number of measures. This, the first multicenter study of a multifactorial intervention, has become an ongoing national GIRFT initiative.

The RAPIDS, STOIC-D Surgery, and IP3D studies, as well as others, have all shown that improved glycemic control is associated with reductions in inpatient infections, providing strong evidence of a causative association. There are many theoretical pathological and mechanistic explanations, including neutrophil and macrophage dysfunction and impaired immune responses, which require further investigation (21,22). That only a relatively modest reduction in CBG (0.3–0.4 mmol/L) is required is intriguing.

Returning to the differences in therapeutic practice between the U.S. and other countries, it would appear from the Melbourne and Ipswich experiences that continuation of oral therapies with monitoring is not disadvantageous. This is an important message for those with limited nursing provision.

Future directions include leveraging artificial intelligence (AI) to examine primary and secondary care electronic patient records to triage those at high risk of postoperative complications for early intervention. AI, together with the inpatient EMR, networked meters, and laboratory information systems, could be used to alert staff to those with impending adverse glucose events and other metabolic events, such as acute kidney injury. Furthermore, inpatient use of wearable sensors and hybrid closed-loop systems will significantly change the landscape of inpatient glucose monitoring and insulin delivery, and AI is likely to play an important role in resolving issues presented by the density of available data.

In conclusion, there is a growing body of evidence that investment in various

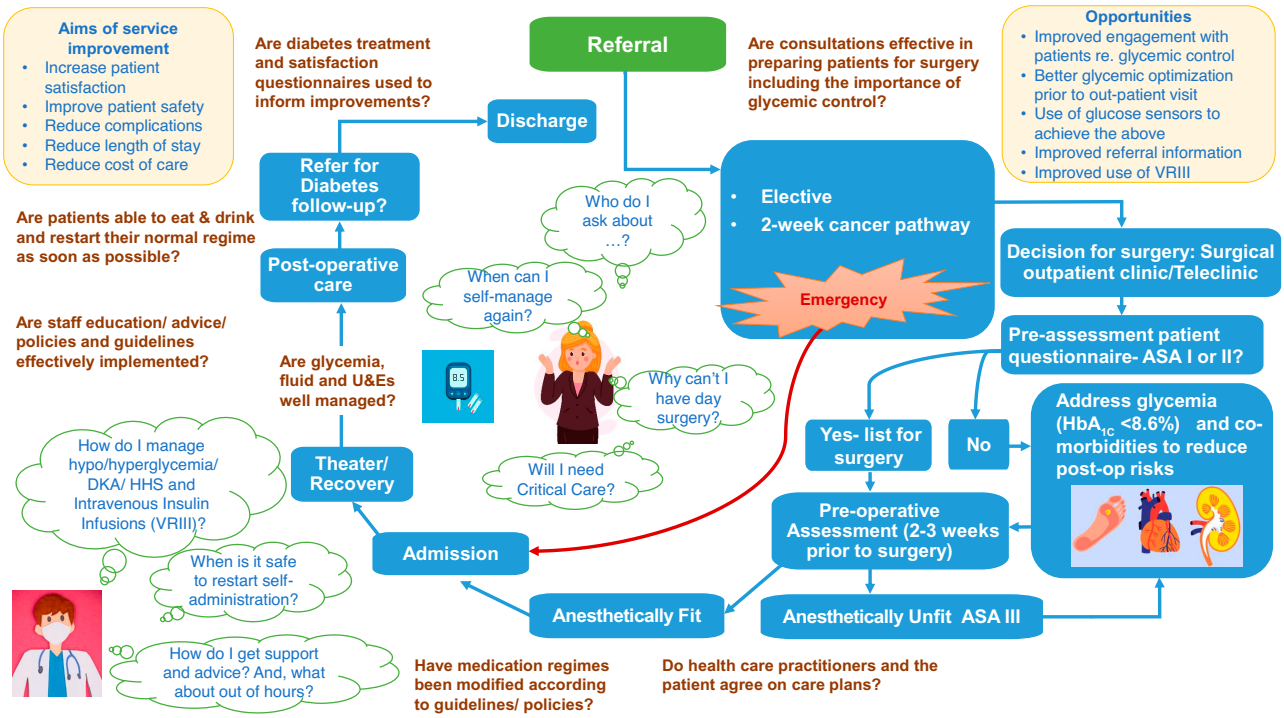

Figure 1—The complexity of the multistep, multidisciplinary care for perioperative diabetes care. ASA, anesthetically unfit; DKA, diabetic ketoacidosis; HHS, hyperosmolar hyperglycemic state; U&E, urine and electrolytes. Illustration drawn by Kim Howson, a perioperative diabetes specialist nurse.

aspects of inpatient diabetes care improves outcomes, reduces health care costs, and improves patient experience. The outcomes of the STOIC-D Surgery trial are promising and serve as a catalyst for other services to innovate and advocate for investment based on potential savings and improvements in care.

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