Preoperative Diabetes Optimization Program

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IN BRIEF "Quality Improvement Success Stories" are published by the American Diabetes Association in collaboration with the American College of Physicians, Inc., and the National Diabetes Education Program. This series is intended to highlight best practices and strategies from programs and clinics that have successfully improved the quality of care for people with diabetes or related conditions. Each article in the series is reviewed and follows a standard format developed by the editors of *Clinical Diabetes*. The following article describes a successful effort to improve glycemic control in presurgical patients with an A1C >8%.

Describe your practice setting and location.

The Froedtert Hospital preoperative clinic is a multidisciplinary clinic whose mission is to prepare patients for surgery by defining, stratifying, and, mitigating risk for their specific surgeries in a timely manner. Providers in the clinic include internal medicine physicians, physician anesthesiologists, physician's assistants, and nurse practitioners. Froedtert Hospital is the flagship hospital for the Medical College of Wisconsin physicians and, as a tertiary referral and academic institution, serves a broad referral base that extends from northern Illinois through the state of Wisconsin into Michigan's Upper Peninsula region. The preoperative clinic serves a wide variety of patients scheduled for a broad spectrum of surgeries.

Describe the specific quality gap addressed through the initiative.

This program focused on improving glycemic control in patients scheduled to have surgery with an initial A1C >8%.

Given the epidemic levels of diabetes in the overall population, hyperglycemia around the time of surgery is commonly found, with estimated rates of 80% in cardiac and 40% in noncardiac surgical patients (1). This is of particular significance because hyperglycemia has been associated with increased morbidity and mortality in patients undergoing cardiac surgery and is thought to be the most important predictor of surgical site infections in noncardiac surgical patients (2,3).

To decrease the risk of complications, a common approach in patients with poorly controlled diabetes is to postpone surgery until glycemic control has improved. This potentially results in increased health care utilization from progression of the pathology for which surgery was originally planned, as well as patient and surgeon dissatisfaction. In other instances, however, patients undergo surgery with suboptimal glycemic control, carrying a potential increased risk for perioperative complications. Patients may also present on the day of surgery with significant hypergly-

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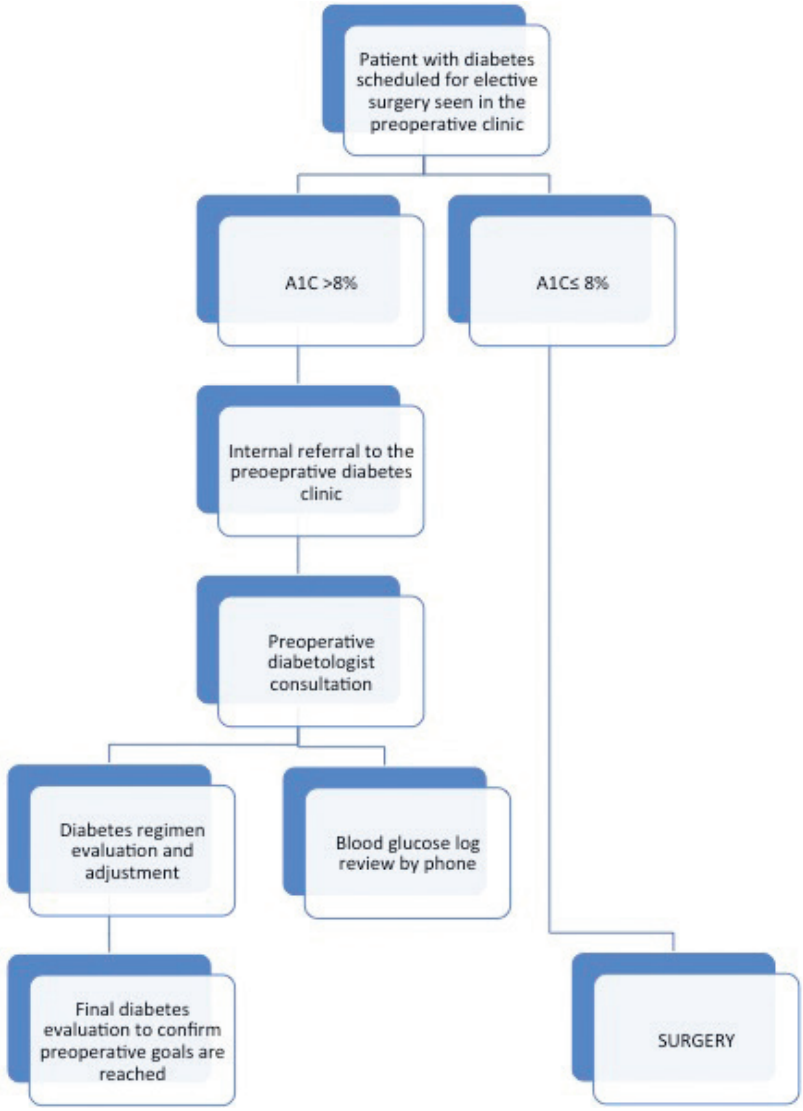

FIGURE 1. Froedtert Hospital's preoperative diabetes clinic patient flowchart.

cemia, a risk for same-day procedural cancellation.

In our institution, patients with poor glycemic control are usually identified by elevated A1C levels. Although there is no consensus as to the A1C level that is considered safe to proceed with surgery, values > 8% usually raise concern for an increased risk of perioperative complications. Hence, for patients with an elevated A1C level who are seen at the preoperative clinic, it is often recommended that they be referred to their primary care providers or to diabetes specialists to work on improving their glycemic control. However, the final decision on whether to proceed with surgery despite an elevated A1C or to postpone the surgery to address glycemic control is made by surgeons and patients. Changes in glycemic control after optimization attempts are usually evaluated through repeat A1C measurements obtained after 2–3 months, which negatively affects time to surgery.

Fructosamine as a marker of glycemic control is an underutilized tool that can aid in the assessment of short-term glycemic control before surgery. The fructosamine assay measures the degree of glycosylation of circulating proteins, including albumin, for which a half-life has been estimated at 20 days and a correlation with mean glucose levels has been well established (4). Therefore, fructosamine assay results can serve as a surrogate for glycemic control over a period of ~2 weeks. This can be used to inform intensive management of diabetes before surgery and to minimize delays, unlike the current process, which is slowed by the use of A1C (5).

How did you identify this quality gap? In other words, where did you get your baseline data?

Although the preoperative evaluation clinic had been successfully established in our institution, no systematic strategies focusing on optimizing diabetes control in a timely manner were in place. Moreover, literature describing other interventions and their impact on perioperative complications and health care utilization is limited. Baseline data for this initiative were obtained through a query of the electronic medical records (EMR) system. We identified patients with an A1C >8% who were evaluated at the preoperative clinic and proceeded to have surgery on the scheduled date without delays from January through December 2016. The variables examined from this chart review included, age, sex, surgical specialty, A1C value within 3 months of the preoperative visit, days from preoperative clinic visit to surgery, fructosamine levels if available, fasting glucose on the day of surgery, and any complications documented within 30 days of the procedure. Subjects were separated into two groups: those who participated in the preoperative diabetes process and those who proceeded to surgery with an elevated A1C. Data from subjects in these two groups were then compared.

Summarize the initial data for your practice (before the improvement initiative).

The data query revealed that, during the study period, 25 patients with an A1C >8% were evaluated at the preoperative clinic and proceeded to

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TABLE 1. Subjects' Baseline Characteristics

	Intervention Group (*n* = 14)	Comparison Group (*n* = 25)
Age (years)*	57 (10.14)	61 (14.72)
Sex (female/male)	14/2	12/13
Surgical procedure (orthopedic/other)	9/5	9/16
Previsit A1C (%)*	9.50 (2.22)	8.59 (0.49)

**Reported as mean (SD).*

TABLE 2. Diabetes Regimen Interventions (*n* =14)

	Patients (*n*)
Insulin initiation	3
Insulin dose adjustment or intensification	9
Addition of oral agents (e.g., metformin, glipizide, or sitagliptin)	2

undergo surgery as scheduled without any focused diabetes intervention (Table 1). These subjects were well distributed between males and females, with a mean age of 61 years. The most common procedures were orthopedic surgery. The mean baseline A1C in this group was 8.6%, consistent with an average glucose of ~200 mg/dL. No fructosamine levels were obtained. The mean fasting glucose on the day of surgery was 179 mg/dL, ranging from 85 to 320 mg/dL. The average time from the preoperative clinic visit day to the day of surgery was 14 days. Complications occurring within 30 days of surgery were documented in the charts of 3 of the 25 subjects. One patient presented to the emergency department 3 days after a gynecological procedure with atrial fibrillation and rapid ventricular response. Another patient presented 10 days after a skin and cartilage graft on the forehead with wound infection and face cellulitis. A third patient was found to have a surgical site infection 20 days after colon resection.

What was the time frame from initiation of your quality improvement (QI) initiative to its completion?

The process was initiated in January 2016, and data for its evaluation were obtained in December 2016.

Describe your core QI team. Who served as project leader, and why was this person selected? Who else served on the team?

The project was originally proposed after the hiring of a fellowship-trained diabetologist with previous experience in outpatient and inpatient diabetes management. The core QI team included the chief of the perioperative medicine section, the medical director of the preoperative clinic, and the physician diabetologist. The necessary logistics for the designed interventions were coordinated by the medical director, and the physician diabetologist carried out the intervention.

Describe the *structural* changes you made to your practice through this initiative.

The initiative involved the development of a nested diabetes clinic within the existing preoperative clinic. This was advertised to all the providers working in the clinic to solicit internal referrals of patients with suboptimal glycemic control, defined as having an A1C >8% at the time of their visit or within the previous 3 months. These patients were then scheduled to see the physician diabetologist as soon as possible for diabetes-focused preoperative evaluation and management. Flexibility in the clinic schedule template allowed for a short lag time until this visit.

Describe the most important changes you made to your *process* of care delivery.

After advertising the pilot of the new diabetes clinic, referrals from other preoperative clinic providers were received. Appointments were scheduled within 1–5 days on average.

At the initial diabetes clinic visit, patients with uncontrolled diabetes underwent a full consultative evaluation. In most instances, changes were made to the management plan, including dietary interventions, home self-monitoring of blood glucose, initiation or intensification of insulin therapy, or the addition of noninsulin therapy agents such as metformin, sulfonylureas, or dipeptidyl peptidase 4 inhibitors (Table 2).

Follow-up visits were usually scheduled within 1–2 weeks either via phone or in person. At these visits, glucose meter data were reviewed and further regimen changes were made as necessary. Once glycemic control was considered to be improved, a final visit was scheduled, and a fructosamine level was obtained. The fructosamine assay is a "send-out" test in our institution, with a turnaround time of ~3–5 business days and a cost of ~$30. Direct contact with the surgical team was made, and a note documenting changes in glycemic control via the results of the glucose meter review and fructosamine test was entered in the EMR. In most cases, surgery was rescheduled shortly thereafter.

Summarize your final outcome data (at the end of the improvement initiative) and how it compared to your baseline data.

From January to December 2016, the records of 14 patients identified as participants in the preoperative diabetes clinic who proceeded to have surgery were reviewed. Table 3 shows variables of interest for the intervention and comparison groups.

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TABLE 3. Outcomes of Interest Between Groups

	Intervention Group (*n* = 14)	Comparison Group (*n* = 25)
Glucose day of surgery (mg/dL)*	138 (42.69)	179 (63.75)
Maximum	225	320
Minimum	92	85
In range (80–180 mg/dL) (%)	85.7	52.0
Hypoglycemia (*n*)	0	0
Preoperative fructosamine (µmol/L)*	282.22 (52.61)	N/A
Complications (*n*)	0	3
Time to surgery (days)*	45 (32.72)	14 (8.39)

**Reported as mean (SD).*

For the intervention group, the mean A1C before the intervention was 9.5%, consistent with an average blood glucose level of 226 mg/dL and reflecting poor preoperative glycemic control. This was substantially higher than the mean A1C of the comparison group (8.6%). After the intervention, mean fructosamine level obtained at the last preoperative visit was 282.22 µmol/L, which was indicative of a mean glucose level of 145 mg/dL and a mean A1C <7% and was consistent with significant improvement in glycemic control. In accordance, the mean fasting glucose on the day of surgery was 138 mg/dL, which was notably lower than that of the comparison group (179 mg/dL). No hypoglycemia was observed in either group.

In contrast to the comparison group, in which complications were found in three patients, no complications were documented in the charts of any of the intervention group participants within 30 days of surgery.

Finally, it took on average 45 days from initial evaluation in the preoperative diabetes clinic to the day of surgery, suggesting a reduction of ~50% compared to the 90-day delay that usually occurred when using A1C to assess changes in glycemic control.

What are your next steps?

From the results of this pilot, we concluded that the proposed strategy can be safely executed, leading to improved preoperative glycemic control. This was accomplished in a shorter time frame than with the historical process, in part because we evaluated improvement in glycemic control my measuring fructosamine instead of A1C.

Based on these preliminary results, we plan to formally establish a perioperative diabetes program. Offering these new services to all of the surgical specialties already using the preoperative clinic will likely result in greater referral rates. Once patient volume increases, addition of ancillary services such as diabetes education, pharmacy services, and the capacity to download meters and continuous glucose monitoring systems will follow. In addition, a thoughtful integration of our interventions with the existing perioperative diabetes management policies is being designed to secure a safe and effective transition to the inpatient setting. Importantly, we also intend to offer short-term follow-up visits to participants in the ambulatory postoperative period, with the goal of maintaining optimal diabetes control and reducing postoperative complications.

What lessons did you learn through your QI process that you would like to share with others?

The introduction of a program aimed to improve glycemic control in patients with an A1C >8% within the established preoperative clinic proved feasible. Evaluation of the safety and efficacy of this pilot program suggested that participants experienced significant improvement in glycemic control and underwent their surgeries without complications. Using fructosamine as a short-term surrogate for glycemic control allowed patients with improved glycemic control to undergo their procedures in a shorter period of time than if A1C had been used to assess glycemia. Prospective follow-up of the process may help us better understand weaknesses in the program and barriers to its success and provide opportunities for further improvements that may have an additional direct positive effect on clinical outcomes. Thus far, the most important limiting factor seems to be generation of new external referrals. Establishing clear and effective communication channels will prove essential for identifying and seeking buy-in from key participants to ensure the success of the project.

Duality of Interest

No potential conflicts of interest relevant to this article were reported.

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