

Glycemic Control and Reduction of Deep Sternal Wound Infection Rates

A Multidisciplinary Approach

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Objective: To demonstrate the multidisciplinary interactions and tools required to effect changes in the processes of care to achieve tight glycemic control (TGC) and reduce deep sternal wound infection (DSWI) rates in patients undergoing cardiac surgery.

Design: A retrospective cohort analysis comparing the rate of DSWI before and after implementing a multidisciplinary TGC initiative.

Setting: A cardiac surgical program in a tertiary care community hospital in New England.

Patients: A total of 3065 consecutive adult patients undergoing cardiac surgery who were operated on between January 1, 2004, and December 31, 2006.

Interventions: Evidence demonstrating the relationship between hyperglycemia and DSWI was presented to the multidisciplinary group caring for patients undergoing cardiac surgery. In addition, special emphasis was placed on nursing feedback and in-service training. A cum-

bersome glycemic management text protocol was replaced with a novel color-coded bedside tool (nomogram) to guide the bedside management of hyperglycemia. Subsequently, an algorithm for the transition to a home regimen was developed, which further improved standardization of care and ease of management.

Main Outcome Measures: Hourly blood glucose level monitoring and the incidence of DSWI.

Results: Eighteen months after the new program was initiated, the DSWI rate decreased by more than 60% from 2.6% to 1.0%, when compared with the preceding 18 months ($P < .001$).

Conclusion: A TGC program using a novel tool in a multidisciplinary setting was successfully and safely established, resulting in sustained improvement in the DSWI rate.

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EVER SINCE THE LANDMARK ARTICLE by van den Berghe et al¹ and the series of reports by Furnary et al²⁻⁵ and Zerr et al,⁶ there has been an awareness by the cardiac surgical community of a need for tight glycemic control (TGC) during the perioperative period and, more

recently, intraoperatively. Doenst et al⁷ showed that intraoperative hyperglycemia is an independent risk factor for morbidity and mortality. The 2004 position paper from the American College of Endocrinologists⁸ outlines the advantages of gly-

emic control in many acute care settings, where varying degrees of insulin resistance are manifest. The effects of optimal glycometabolism have been well described.⁵⁻⁸ Some of these effects are the optimization of intracellular metabolism, amelioration of impaired leukocyte function, inhibition of lipolysis, inhibition of inflammatory growth factors, stimulation of endothelial nitric oxide synthase, and inhibition of proinflammatory proteins. While it is important to correct hyperglycemia in counterregulated states in patients with and without diabetes mellitus, it is apparent that there are beneficial effects of insulin that are distinct from the simple reduction of the blood glucose (BG) level.

While other centers were reporting excellent results with TGC in the cardiac sur-

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Maine Medical Center R1 and CTICU

General Principles

- Rigid blood glucose level management results in a correction of altered glycometabolism with consequent improvement in immune status, energy, and general metabolism, with attendant decrease in such things as wound infection, arrhythmias, and other causes of morbidity and mortality
- In other words, patients will feel better, do better, and go home sooner
- All postoperative patients, whether or not they have diabetes mellitus, usually have some degree of insulin resistance
- CII will be a central strategy for postoperative management of *all* patients undergoing CT surgery

CII

- Target blood glucose level range, 80 to 150 mg/dL
- CII will be continued for 3 d postoperatively (day of operation is day 0) unless average blood glucose level is <120 mg/dL for 24 h
- When CII is discontinued, if blood glucose level is <120 mg/dL on 3 consecutive occasions (AC and HS), then discontinue blood glucose level determinations
- If patient on CII at POD 3 has blood glucose level of ≥ 120 mg/dL, continue CII
- Maximum CII rate, 6 U/h
- The standard concentration of insulin will be 100 U of insulin in 100 mL NS (1:1 concentration in 0.9% sodium chloride)
- All CII and push doses are regular insulin
- For patients with diabetes, the home regimen of oral medications and/or insulin should be started when they start eating in CSRU or R1
- For newly discovered patients with diabetes, begin oral agents or insulin if necessary on POD 2
- Until the target blood glucose level range is reached (80-150 mg/dL), hourly blood glucose level determinations will be done
- If the blood glucose level remains stable (no adjustments necessary), blood glucose level determinations will be done every 3 h
- Blood glucose level determinations are to be done 1 h after any adjustments are made

Starting Insulin Infusion

- Blood glucose level of <110 mg/dL, no CII, check blood glucose AC and HS
- Blood glucose level of 110-219 mg/dL, start CII at 2 U/h
- Blood glucose level of 220-299 mg/dL, start CII at 2 U/h and give 5-U insulin IV push
- Blood glucose level of 300-400 mg/dL, start CII at 2 U/h and give 15-U insulin IV push

Titration Schedule

- If next blood glucose level is 50-80 mg/dL, decrease CII by 1 U and give appropriate liquid carbohydrate
- If next blood glucose level is 80-150 mg/dL, no change; check blood glucose level in 1 h
- If next blood glucose level is 151-200 mg/dL, increase CII by 1 U
- If next blood glucose level is 201-250 mg/dL, increase CII by 1 U and give 5-U insulin IV push
- If next blood glucose level is 251-300 mg/dL, increase CII by 2 U and give 10-U insulin IV push
- When blood glucose level is 80-150 mg/dL, do not change drip
- Daytime: if blood glucose level is >300 mg/dL, or if drip is at 6 U/h, notify PA or MD

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Figure 1. Example of orders from the first attempt to establish a tight glycemic control program using a more complex format than the one that was ultimately adopted. AC indicates before meals; CII, continuous insulin infusion; CSRU, cardiac surgery recovery unit; CT, cardiothoracic; CTICU, CT intensive care unit; HS, bedtime; IV, intravenous; MD, physician; NS, normal saline (isotonic sodium chloride solution); PA, physician assistant; POD, postoperative day; and R1, inpatient nursing unit. To convert glucose levels to millimoles per liter, multiply by 0.0555.

gical population, our center initially had minimal success with the TGC program regarding optimal BG levels and deep sternal wound infection (DSWI) despite a standardized order set and a general commitment by the staff. Initially, there was a modest decrease in BG levels and a sense that the patients with DSWI were less likely to present with sepsis, but the DSWI rate remained the same. The poor success with this early effort was likely owing to the complexity of the order set coupled with a weak educational program.

This article describes the multidisciplinary process used to achieve TGC in our center and reports the initial outcomes.

Maine Medical Center (MMC) is a tertiary care, 600-bed teaching hospital in Portland with a cardiac surgery program that was initiated in the mid-1950s. During this analysis, the MMC cardiac surgery team performed more than 1000 cardiac surgical procedures annually. The MMC Division of Cardiothoracic Surgery stresses protocol-driven, evidence-based best practices delivered in a multidisciplinary setting. The cardiac surgical team is a combination of a private-practice model (surgeons and physician assistants) working closely with hospital-based nurses, perfusionists, technicians, and physicians to develop and refine protocols and guidelines in a multidisciplinary setting.

The MMC Division of Cardiothoracic Surgery collaborates closely with the 7 other centers in The Northern New England Cardiovascular Diseases Study Group, Dartmouth Medical School epidemiologists, and graduate students from the Center for Evaluative Clinical Sciences at Dartmouth (now known as the Dartmouth Institute for Health Policy and Clinical Practice). The MMC Division of Cardiothoracic Surgery employs a full-time database coordinator (D.W.) and a full-time research coordinator, both of whom are registered nurses. Because it is a part of the MMC Department of Cardiac Services and the MMC Division of Cardiology, there is close collaboration between the cardiologists and cardiac surgeons.

METHODS

With internal review board approval, we reviewed 3065 consecutive adult patients undergoing cardiac surgery who were operated on between January 1, 2004, and December 31, 2006. In January 2004, a comprehensive order set was developed for continuous insulin infusion (CII) and approved, which set a BG target level of 80 to 150 mg/dL (to convert glucose to millimoles per liter, multiply by 0.0555) (**Figure 1**). This order set was accompanied by an explanatory protocol, which included a narrative and sets of instructions for various BG levels in different settings, as well as maneuvers to manage hypoglycemia. By early 2005, it was clear that, although BG levels had declined modestly (**Figure 2**) along with the sepsis rate from DSWI, the DSWI rate had not decreased. Nurses found the orders cumbersome, and there was significant concern regarding avoidance of hypoglycemia.

The cardiac team, led by its own multidisciplinary quality improvement group, worked with a group of Dartmouth graduate students. They focused on our clinical microsystem and especially addressed nursing workflow issues. They collaborated with the staff and designed a color-coded nomogram of the orders for CII (**Figure 3**) to be used as a bedside tool for nurse decision making. Introduction of the nomogram was combined with multiple intensive in-service sessions that stressed the dangers of hyperglycemia and the relatively lesser danger of hypoglycemia. The target BG level range was narrowed to 80 to 120 mg/dL.

The old text-driven order set was complex and unwieldy compared with the new single-page color nomogram. When use of the color nomogram was combined with the educational component of the program, there was widespread nursing acceptance of the new program in both the cardiothoracic intensive care unit and in the inpatient nursing unit, to which

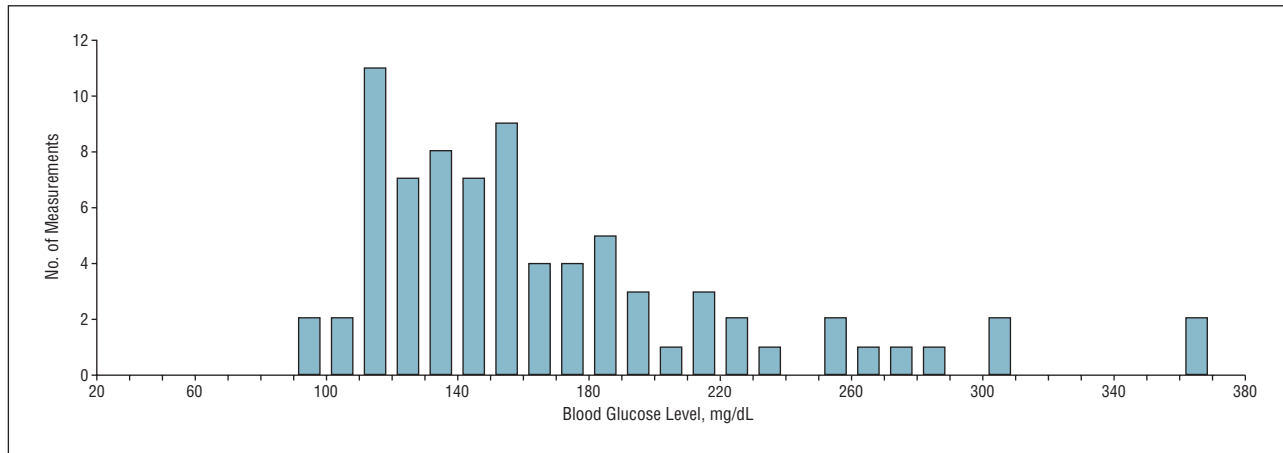


Figure 2. Histogram depicting the range and frequency of blood glucose levels obtained during early attempts at tight glycemic control. To convert glucose to millimoles per liter, multiply by 0.0555.

Current capillary glucose concentration, mg/dL: if no change required for 3 consecutive hours, next check in 3 h; otherwise hourly checks											
	<40	40-60	61-80	81-100	101-120	121-150	151-170	171-200	201-250	251-300	>300
<40	Hold insulin Give 25 mL D50 (repeat as needed) Call PA/MD	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	Hold insulin Recheck in 1 h May give 60 mL juice	If insulin drip is stopped for ≥ 1 h, restart drip according to insulin start chart. If patient is eating while on insulin drip, give 0.1 U/kg insulin aspart (NovoLog) SC with meals (refer to order set for weight-based chart).							Call PA/MD
40-60	Hold insulin Give 25 mL D50 (repeat as needed) Call PA/MD	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	May give 60 mL juice Recheck in 1 h Hold insulin								Call PA/MD
61-80	Hold insulin Give 25 mL D50 (repeat as needed) Call PA/MD	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	May give 60 mL juice Recheck in 1 h Hold insulin	No change	No change	Increase by 1 U	Increase by 2 U	Increase by 2 U	Increase by 2 U Give 5-U insulin push	Increase by 3 U Give 10-U insulin push	Call PA/MD
81-100	Hold insulin Give 25 mL D50 (repeat as needed) Call PA/MD	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	May give 60 mL juice Recheck in 30 min	No change	No change	Increase by 1.5 U	Increase by 2 U	Increase by 2 U	Increase by 2 U Give 5-U insulin push	Increase by 3 U Give 10-U insulin push	Call PA/MD
101-120	Hold insulin Give 25 mL D50 (repeat as needed) Call PA/MD	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	No change	No change	Increase by 1.5 U	Increase by 2 U	Increase by 2 U	Increase by 2 U Give 5-U insulin push	Increase by 3 U Give 10-U insulin push	Call PA/MD
121-150	Hold insulin Give 25 mL D50 (repeat as needed) Call PA/MD	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	Decrease 50% and recheck in 30 min	No change and recheck in 30 min	Increase by 2 U	Increase by 2.5 U	Increase by 2.5 U	Increase by 2 U Give 5-U insulin push	Increase by 3 U Give 10-U insulin push	Call PA/MD
151-170	Hold insulin Give 25 mL D50 (repeat as needed) Call PA/MD	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	Decrease 25% and recheck in 30 min	No change	Increase by 1.5 U	Increase by 2.5 U	Increase by 2 U	Increase by 2 U Give 5-U insulin push	Increase by 3 U Give 10-U insulin push	Call PA/MD
171-200	Hold insulin Give 25 mL D50 (repeat as needed) Call PA/MD	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	Decrease 50% and recheck in 30 min	Decrease 50%	Increase by 1 U	Increase by 1.5 U	Increase by 2 U	Increase by 2 U Give 5-U insulin push	Increase by 3 U Give 10-U insulin push	Call PA/MD
201-250	Hold insulin Give 25 mL D50 (repeat as needed) Call PA/MD	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	Decrease 50% and recheck in 30 min	Decrease 50%	Decrease 25%	No change	No change	Increase by 2 U Give 5-U insulin push	Increase by 3 U Give 10-U insulin push	Call PA/MD
251-300	Hold insulin Give 25 mL D50 (repeat as needed) Call PA/MD	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	Decrease 50% and recheck in 30 min	Decrease 50%	Decrease 25%	Decrease 25%	Decrease 25%	Increase by 2 U Give 5-U insulin push	Increase by 3 U Give 10-U insulin push	Call PA/MD
>300	Hold insulin Give 25 mL D50 (repeat as needed) Call PA/MD	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	Hold insulin Give 60 mL juice or 10 mL D50 Recheck in 30 min	Decrease 50% and recheck in 30 min	Decrease 50%	Decrease 50%	Decrease 50%	Decrease 25%	No change	Call PA/MD	Call PA/MD

Target range, 80-120 mg/dL Maximum drip, 9 U/h See transition chart to discontinue September 18, 2007

Figure 3. Nomogram for the administration of continuous insulin infusion. Insulin administration is based on historical and current blood glucose (BG) levels. The cell at the intersection of the row opposite the previous BG and the column opposite the current BG (where the previous BG and the current BG converge) determines the action taken to maintain glycemic control. D50 indicates 50% dextrose solution; MD, physician; PA, physician assistant; and SC, subcutaneously. NovoLog is manufactured by NovoNordisk, Inc, Princeton, New Jersey.

Insulin start/restart chart		
Use for initiating insulin infusion or anytime insulin infusion is restarted		
Blood Glucose Level, mg/dL	Action	
	4 AM to midnight (20 h)	Midnight to 4 AM (4 h)
<121	Do not start drip, recheck glucose every hour \times 3 then q3h	
121-150	Start drip at 2 U/h	Start drip at 1 U/h
151-219	Start drip at 3 U/h	Start drip at 2 U/h
220-300	Start drip at 4 U/h + give 5-U regular insulin push	Start drip at 3 U/h + give 5-U regular insulin push
>300	Call PA or MD	

August 21, 2007

Figure 4. Insulin start/restart chart used to start or restart continuous insulin infusion according to the nomogram. MD indicates physician; PA, physician assistant; and q3h, every 3 hours. To convert glucose to millimoles per liter, multiply by 0.0555.

the patients were transferred after their intensive care experience and where the insulin drip was continued in every case.

The key points of the educational program were (1) to explain that TGC involves more than BG level control; (2) to emphasize that hyperglycemia during the perioperative period in patients undergoing cardiac surgery poses more danger than does hypoglycemia; and (3) to explain that the management of hypoglycemia, although sometimes dramatic, has safe, easily administered remedies.

Fundamentals were stressed during the in-service sessions, such as hyperglycemia's being an independent risk factor for DSWI and other morbidities that start in the operating room.⁷ Once the nursing staff shifted their concern from hypoglycemia to hyperglycemia and had a relatively simple tool to use for decision making, the average BG level began to decrease and wide variations in BG levels were minimized.

THE NOMOGRAM

The left side of the color-coded nomogram (Figure 3), the graph's vertical axis, lists the ranges of historical BG levels; the top, the horizontal axis, shows the current readings. The cell in the nomogram that is located where the previous and current BG levels converge indicates the action necessary to maintain glycemic control. The CII rate is driven by the amount of change in the BG level and the frequency of BG level determinations. Initial dosing or restart dosing are found on a "start/restart chart" (Figure 4). The nomogram went through numerous iterations until it was satisfactory to the bedside nurses. The nomogram worked satisfactorily in nearly all instances and allows for the flexibility needed by physician assistants and surgeons when treating a small percentage of patients, such as those with brittle diabetes. The cardiovascular physician assistants are available in the hospital for consultation at all times.

THE TRANSITION

Because CII was initiated in the operating room and continued until the morning of the third postoperative day, a transition plan was needed. This algorithm was also presented in a graphic format (Figure 5), and was driven by 3 variables: (1) whether the patient had known diabetes mellitus; (2) the glycemic history based on the hemoglobin A_{1c} (HbA_{1c}) concentration; and (3) whether the BG level was less than 150 mg/dL

or 150 mg/dL or more. Before the transition protocol was created, the transition's management was up to the individual practitioner and consequently was variable. The new protocol gave clarity to time frames and actions.

RESULTS

During the first 6 months (July 1, 2005, to December 31, 2005) of using the new bedside tool for management of the CII, there were no DSWIs. By the end of the first year's experience (July 1, 2005, through June 30, 2006), the annual DSWI rate had decreased by 50% from 1.8% to 0.9%. This report represents 18 months' experience with this protocol, which was used in 1388 patients and resulted in a DSWI rate of 1.0%. In the 18 months preceding the use of the new nomogram, the DSWI rate was 2.6%. The new rate of 1.0% represented a 62% decrease in the DSWI rate and a significant change ($P < .001$) (Figure 6).

The profile of patients with DSWI has changed. Patients with DSWI now tend to have more comorbidities and poorly controlled diabetes preoperatively; some have an HbA_{1c} concentration of 10% or greater. These patients are also more likely to have had a complex perioperative hospital course.

One of the keys to the success of this program has been the ongoing multidisciplinary interactive process. Designed as a graphic algorithm, the nomogram helps with glucose management at the patient's bedside. Despite its static appearance, it is a dynamic document because it is always in a state of refinement that is based on frontline feedback.

The frequency of hypoglycemia was low and was the same before and after the establishment of a more aggressive BG level management program. In the 18 months preceding the establishment of TGC with the nomogram, 13 451 BG levels were measured during the first 2 days in the inpatient nursing unit; of these, only 53 BG levels were less than 50 mg/dL, a rate of 0.004%. After TGC was established with more aggressive management, 11 842 BG levels were obtained; of these, only 47 measurements were less than 50 mg/dL, also a rate of 0.004%. The patients with hypoglycemia were uneventfully treated.

COMMENT

Our study design includes a limitation in that a blood conservation program was initiated in the same time frame as the TGC program. Inasmuch as the lower transfusion rate may have contributed incrementally to the lower DSWI rate, TGC was the major factor. This type of confounding is frequently an issue in observational studies.

ACCOMPLISHMENTS

We have demonstrated that TGC can be accomplished safely and effectively in a cardiac surgery program and with excellent results. Evidence-based protocols were introduced to a multidisciplinary team, a useful bedside tool was provided, and weekly in-service sessions were held, both to educate the frontline workers and to obtain feedback from them regarding ways to improve the bedside tool. The protocol went through numerous iterations

HbA _{1c} Level, % of Total Hb	Patients With Known Diabetes Mellitus*		Other Patients		All Patients
	Any AC or HS BG Level of <150 mg/dL After CII Discontinued	Any AC or HS BG Level of ≥150 mg/dL After CII Discontinued	Any AC or HS BG Level of <150 mg/dL After CII Discontinued	Any AC or HS BG Level of ≥150 mg/dL After CII Discontinued	
<7	Resume home regimen	Resume home regimen plus order correctional aspart†	No additional Rx, no glucometer, F/U with PCP, discontinue BG level monitoring if <150 mg/dL 4 times in a row	Order correctional aspart†; F/U with PCP	Send all patients home with most recent bedside BG level determinations along with discharge orders and instruct them to contact their PCP for plans ASAP Dictate letter to referring physician; ask PCP to comment on BG management
7-9	Resume home regimen	Order correctional insulin aspart† and adjust home medications <i>Patient needs to see PCP within 1 wk of discharge</i>	No additional Rx; monitor BG levels	Order correctional insulin aspart† and consider initiating metformin hydrochloride, 500 mg BID, or glipizide, 2.5 mg/d <i>May contact PCP, whom patient needs to see within 1 wk of discharge</i>	
>9	Request endocrinologist consultation and resume home regimen	Request endocrinologist consultation and order correctional insulin aspart† and adjust home medications May restart CII	No additional Rx; request endocrinologist consultation as soon as possible	Restart CII and request endocrinologist consultation	Request endocrinologist consultation; nurse will call diabetes nurse specialist regarding all patients with an HbA_{1c} level > 9%

*Basal insulin glargine (Lantus): at HS, give 50% of total previous day's insulin dose.
†For correctional insulin aspart (NovoLog) coverage, see the insulin aspart table in the patient's order set, which gives dose dependent on BG level range and includes information on insulin drip, regular insulin push doses, and correctional insulin aspart doses.

Figure 5. To make the transition from continuous insulin infusion (CII), hemoglobin A_{1c} (HbA_{1c}), the current blood glucose level, and the patient's history of diabetes are the variables that determine the management strategy. AC indicates before meals; ASAP, as soon as possible; BG, blood glucose; BID, twice daily; F/U, follow up; HS, bedtime; PCP, primary care physician; and Rx, prescription. To convert glucose to millimoles per liter, multiply by 0.0555; HbA_{1c} to the proportion of total hemoglobin, multiply by 0.01. Lantus is manufactured by Sanofi-Aventis, Bridgewater, New Jersey; NovoLog, by Novo Nordisk Inc, Princeton, New Jersey.

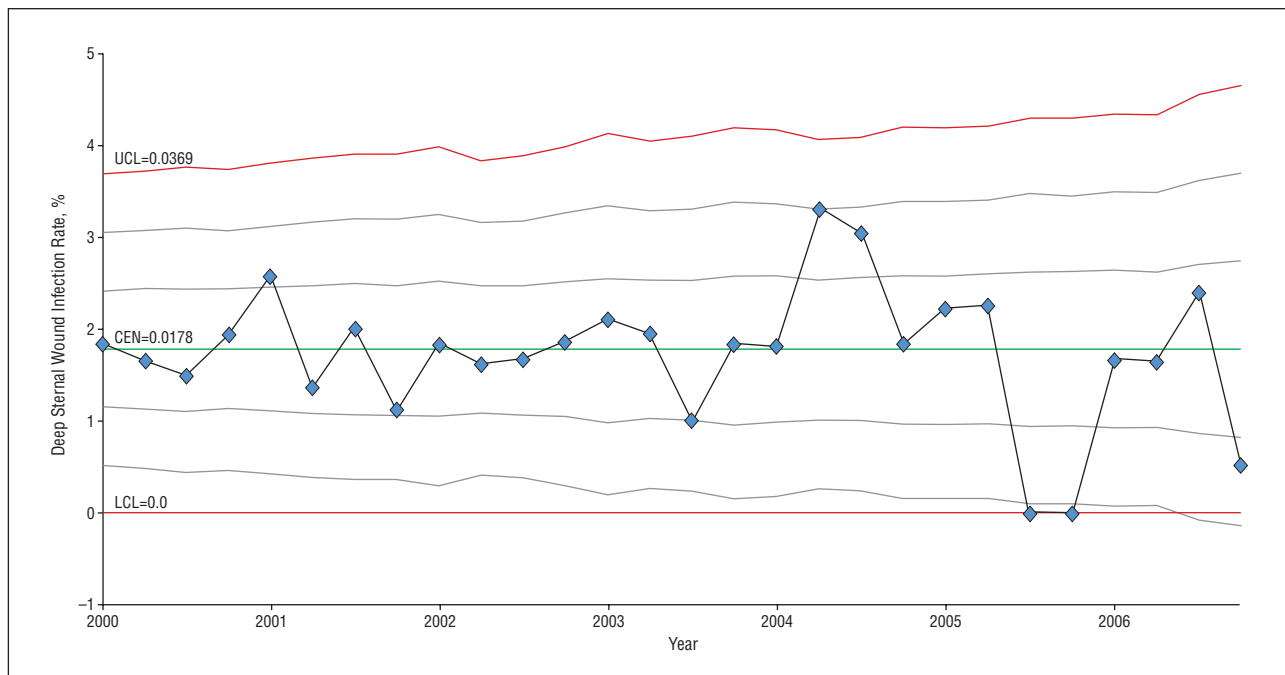


Figure 6. Statistical process control chart depicting the deep sternal wound infection rate. Deep sternal wound infection involves muscle, bone, and mediastinum and has 2 of the following: (1) positive deep culture, (2) organisms and white blood cells on Gram stain, or (3) radiographic evidence of infection (Northern New England Cardiovascular Diseases Study Group definition). CEN indicates central tendency (mean); LCL, lower confidence limit; and UCL, upper confidence limit. Each of the faint gray curves represents 1 SD.

based on feedback from the frontline workers, the nurses, and cardiovascular physician assistants.

Our clinicians learned the value of collaboration between disciplines for maintaining the sustainability of a challenging practice change. This collaboration has been effective in implementing other practice changes made in an attempt to maximize the standardization of care without taking away the practitioners' ability to be innovative and creative at times.

A key part of the in-service education was for the team to learn that hyperglycemia posed more danger to the patient than did hypoglycemia. Their concern was shifted from hypoglycemia to the risks of hyperglycemia and its consequences. Hourly BG level determinations guided by the nomogram allowed the nurses to respond to the rate of BG changes, and with experience they were able to detect, anticipate, and respond to impending hypoglycemia, resulting in the low hypoglycemia rate in this report.

Stress-induced insulin resistance, the counterregulated state, occurs over a wide spectrum during the perioperative period in patients undergoing cardiac surgery. All of the patients undergoing cardiac surgery at MMC receive CII, but not all of them are highly counterregulated. Nevertheless, this protocol seemed to fit all of our patients.

NEXT STEPS

Blood glucose level is now more precisely controlled, from the start of the cardiac surgical operation until the time of discharge. The next steps are to focus on preoperative and postdischarge glucose management and to continue to fine-tune perioperative TGC.

We are currently working with our cardiology colleagues to improve BG level management in patients during the preoperative period. The new algorithm will be modeled after our transition protocol. This protocol will also be driven by 3 variables, as follows: (1) whether the patient has a diagnosis of diabetes mellitus; (2) the patient's HbA_{1c} concentration; and (3) the patient's current BG level. Some patients with high HbA_{1c} and BG levels will be transferred to the cardiac surgical service preoperatively and given the same regimen they will receive postoperatively.

Discharge planning focuses on patient education and communication with primary care providers. In the group of patients who did not previously have a diagnosis of diabetes, we have found some patients newly diagnosed as having diabetes and some patients with prediabetes. For these patients and those with known diabetes, especially those with poor BG level control, education and ownership of their disease management is central to their outpatient treatment regimen.

In summary, a TGC program was successfully implemented in a moderate-sized cardiac surgery program by a multidisciplinary team, who used a novel bedside tool

and engaged in frequent interactive in-service sessions with nurses. The TGC program resulted in a sustained improvement in BG level control and a reduction in DSWIs. The next steps include establishing a preoperative BG level management protocol, tightening up the BG level target range, and fine-tuning patient education and communication with primary care providers at patient discharge.

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