Improved Cardiac Surgical Outcomes with Use of Total Quality Management

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Abstract

- *Objective:* To describe a program to improve processes of care for coronary artery bypass graft (CABG) patients.
- *Methods:* A director and clinical coordinator were appointed and system improvements were implemented, including use of checklists, EuroSCORE, monthly morbidity and mortality conferences, and daily patient progress tracking.
- *Results:* There was a decrease in the 30-day mortality rate from 3.5% preintervention to 1.25% postintervention ($P < 0.05$).
- *Conclusion:* A cardiac surgery clinical improvement program was successful in reducing the CABG mortality rate at our hospital.

Public reporting and third-party-payer scrutiny of surgeons' clinical results are prevalent and growing. Although high surgeon volume has been linked to improved patient outcomes, recent reports have linked outcomes to surgeon volume per hospital, suggesting that individual hospital system factors are more important than individual surgeon experience [1,2].

Parkview Hospital, a 500-bed multispecialty hospital in Fort Wayne, Indiana, was assigned a 1-star rating in coronary artery bypass graft surgery (CABG) in 2006 by a Web-based hospital rating agency. A 1-star rating denoted underperformance as compared with national norms. The report was initially discounted by the hospital surgeons, who noted that the data were derived from billing data and were several years old. This prompted a review of private payer and hospital internal clinical data, which confirmed that the hospital CABG survival rate was 95.5% for 2006, lower than the Society of Thoracic Surgeons risk-adjusted national norm of 98%. The hospital board of directors, senior hospital management, cardiologists and cardiac surgeons agreed that an immediate quality improvement program was indicated. This paper describes the program's implementation and outcomes.

Methods

At the outset, 2 decisions were made:

1. One person would be appointed to be the overall director of the effort, would "own" the program, and would have the full support of the board, physicians, and senior management.
2. The senior cardiac surgeon presently practicing at the hospital would be hired as the director.

After the director was appointed, a nurse clinical coordinator was hired to make complete patient rounds daily and review every patient's status with the director. The clinical coordinator was an experienced cardiac surgical intensive care unit (ICU) nurse familiar with the process of cardiac surgery as well as all the surgeons and cardiologists at the hospital. Cardiac surgeons and cardiologists were kept apprised of their patients' clinical status via daily discussion with the clinical coordinator in addition to completing their individual daily rounding. The director concurrently maintained a database on a laptop computer that tracked 31 data points for each patient, including comorbidities, medications, cross-clamp times, and ventilator times, which he obtained via chart review at the patients' bedside.

The director initiated 4 specific process improvement functions:

1. Checklists
2. EuroSCORE
3. Monthly morbidity and mortality conferences
4. Daily patient progress tracking

Checklists

Checklists were printed on 3" × 5" laminated cards and distributed to ICU nurses. The cards list the steps of a

From Parkview Hospital, Fort Wayne, IN.

Table 1. Cardiac Surgery Checklist

Every shift

1. Vital signs (BP, HR, CVP, PAD, CI) in proper range
2. Ventilator set correctly, chest moves with inspirations, bilateral breath sounds
3. Chest tubes on suction and working
4. IVs running—stopcocks turned the right way
5. IV drips as ordered and at proper rate
6. Sequential depression device on
7. Labs drawn as ordered
8. Urine output > 30 mL/hr
9. All orders reviewed and verified on chart

Normal values

Systolic BP 90–140	PA systolic 15–28
Diastolic BP 60–90	PA diastolic 5–16
Mean 70–105	Mean 10–22
CVP 6–14	CI 2.4–4.2
SVR 900–1400	Urine output > 30 mL/hr
pH 7.35–7.45	PO2 80–120 mm Hg
PCO2 35–45 mm Hg	O2 sat > 92%
SVO2 > 69 (change of SVO2 is important)	

BP = blood pressure; CI = cardiac index; CVP = central venous pressure; HR = heart rate; O2 sat = oxygen saturation; PA = pulmonary artery; PAD = pulmonary artery diastolic pressure; PCO2 = partial pressure of carbon dioxide; PO2 = partial pressure of oxygen; SVO2 = systemic venous oxygen saturation; SVR = systemic vascular resistance.

standard systems check to be completed at the beginning of each shift as well as the normal values for cardiovascular variables (**Table 1**). Preoperative medication checklists were also distributed to cardiology nurses for use in medication adjustment pre- and postoperatively.

EuroSCORE

The European System for Cardiac Operative Risk Evaluation (EuroSCORE) system [3] was utilized. The system is used for predicting early mortality in cardiac surgical patients on the basis of objective risk factors. The required data can be entered into a datasheet by any nurse in less than 5 minutes. It was agreed by all cardiologists and surgeons that a EuroSCORE of 12 (denoting an operative mortality risk of 25%) would generate a mandatory second opinion by a second surgeon and cardiologist before the patient was scheduled for elective surgery. It was understood that in an emergency situation the standard practices would apply and surgery would not be delayed pending completion of the Euroscore datasheet.

Morbidity and Mortality Conferences

The director held a monthly morbidity and mortality (M & M) conference at which all adverse events of the previous month were discussed, including deaths, return to surgery, renal failure, sternal infection, and pulmonary failure. These meetings initially were attended by only surgeons and cardiologists; however, as acceptance of the program grew among the physicians, operating room, ICU, cath lab, and floor nurses attended as well. Adverse events were discussed with a view to identify best practices to prevent similar problems in the future. The philosophy of the meeting was "fix the problem, not the blame." Minutes were distributed to all cardiologists and surgeons as well as to physicians on vacation or attending to clinical duties to inform them of agreed upon best practices. The nurse clinical coordinator attended the meetings to make sure that agreed upon clinical protocols and practices were put into daily practice.

Daily Tracking

The director placed a 4' × 8' white board in his office to facilitate daily tracking of every patient in the system. This helped to ensure that no patient was overlooked, particularly those with a prolonged ICU stay. Daily tracking also facilitated discharge medication coordination in accordance with Society of Thoracic Surgeons and Medicare guidelines.

The clinical improvement program was reviewed by the hospital patient health information protection and surveillance department and was judged compliant with HIPAA regulations and standards.

Results

To assess our improvement project, we measured 30-day operative mortality, which included patients who died within 30 days of their operation or who died during the same hospitalization, regardless of duration of hospitalization. A total of 1085 patients underwent isolated CABG at Parkview Hospital during 2004 through 2008 (**Table 2**). Prior to the improvement program (2004–2006), the 30-day operative mortality rate was 3.5%. Following implementation, the rate declined to 1.25% in 2007 and 2008 (**Figure**).

Discussion

We systematically implemented process changes with regard to preoperative evaluation and preparation and intraoperative and postoperative care of CABG patients at our hospital. System improvement was driven by daily quality monitoring of patient progress and systematic elimination of errors that occur in the course of treatment.

As Berwick [4] has described, system improvement involves social change in a complex, unstable, and nonlinear process, and improvement programs are not readily evaluated by randomized control trials. We are unable to quantify which, if any, of our system changes were responsible for the improvement in outcomes, but we believe that they all had a positive effect and focused the attention of all personnel

Table 2. Patient Characteristics

	Preintervention Group (*n* = 685)	Postintervention Group (*n* = 400)	*P* Value
	n (%)	*n* (%)	
Age, yr	65.2 ± 10.68	64.1 ± 10.92	NS
Female	159 (23.2)	108 (27.0)	NS
White race	649 (94.7)	374 (93.5)	NS
Body mass index			
< 18.5	5 (0.7)	2 (0.5)	NS
18.5–24.5	146 (21.3)	73 (18.3)	NS
25.0–29.9	241 (35.2)	140 (35.0)	NS
30.0–34.9	181 (26.4)	101 (25.3)	NS
35.0–39.9	70 (10.2)	47 (11.8)	NS
> 40	42 (6.1)	35 (8.8)	NS
Diabetes	252 (41.2)	181 (45.3)	< 0.01
Hypertension	583 (85.1)	387 (96.8)	< 0.01
Dyslipidemia	588 (85.9)	359 (89.9)	NS
Family hx CAD	255 (37.2)	145 (36.3)	NS
Current smoker	175 (25.5)	62 (15.5)	< 0.01
Chronic obstructive pulmonary disease			
Mild	88 (12.8)	69 (17.3)	< 0.05
Moderate	50 (7.8)	28 (7.0)	NS
Severe	16 (2.3)	14 (3.5)	NS
Congestive heart failure	69 (9.9)	54 (13.5)	NS
Peripheral vascular disease	121 (17.7)	72 (18.0)	NS
Cerebrovascular accident	44 (6.4)	16 (4.0)	NS
Dialysis	7 (1.0)	7 (1.8)	NS
Previous CABG	19 (2.8)	9 (2.3)	NS
Elective surgery	266 (38.8)	184 (46)	< 0.05
Urgent surgery	370 (54)	191 (47.8)	< 0.05
Emergent surgery	46 (6.7)	24 (6.0)	NS
Emergent salvage surgery	2 (0.3)	1 (0.3)	NS
Hx of MI	363 (53)	126 (31.5)	< 0.01
Current MI < 8 days	171 (25)	95 (23.8)	NS
Left main disease	255 (37)	175 (43.8)	< 0.05
Ejection fraction, % (range)	57 (10–80)	55 (10–85)	NS
Mean STS predicted risk	2.76	2.77	NS

CABG = coronary artery bypass graft; CAD = coronary artery disease; MI = myocardial infarction; NS = not significant; STS = Society of Thoracic Surgeons.

involved with the cardiac surgery program. There was a shift from more urgent surgeries preintervention to more elective surgeries postintervention, while the rate of emergent (surgery same day as catheterization) and salvage (direct cath lab to surgery) surgeries remained the same, suggesting that the program enhanced preoperative preparation without affecting the care of critically ill patients.

Cardiac surgery demands a high degree of skill and

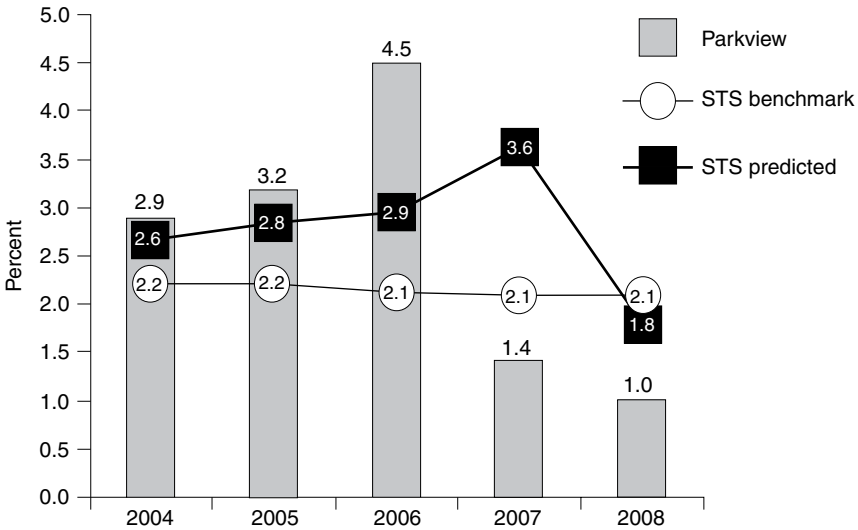

Figure. 30-day operative mortality for isolated CABG at Parkview Hospital, 2004 to 2008. STS = Society of Thoracic Surgeons.

judgment on the part of the surgeon. It is also a complex process involving the interaction of hundreds of caregivers, including physicians from multiple specialties, nurses, and allied health professionals over many days to weeks [5]. Dziuban reported that a collaborative atmosphere among all caregivers is important to driving system change, and that surgical outcomes are no longer seen as the responsibility of the surgeon alone [6]. Our project reflected this view.

Postoperative management of patient comorbidities is essential in preventing serious complications and death. Song [7] attributed the improved survival of CABG patients between 1988 and 2005 to comorbidity risk control. Daily patient rounds by the clinical coordinator and consultation with the cardiac surgery director were essential to securing immediate consultation from fields such as pulmonology and nephrology for treatment of patient comorbidities. A personal phone call from the director to the particular specialist physician being consulted facilitated more prompt consultation than would have been obtained from a standard request to the physician's office personnel. We believe that this direct communication between physicians played an important role in improving care.

The M & M conference is a staple of quality improvement and education in surgical training programs [8]. Events were discussed with the purpose of making system changes that would prevent similar events in the future. Minutes of the meeting reported only clinical aspects of the cases without identifying patient or physician data. As comfort level with the confidentiality of the M & M conference increased, it became a venue for useful and timely system improvements. Physicians came to see that the director was not out to "get" anyone but was just interested in using adverse events as examples of system weaknesses that needed improvement. As physician comfort level increased, operating room, cath lab, floor nurses and others involved in designing and implementing system improvements were invited. The widespread attendance at meetings allowed all personnel to benefit from lessons learned, not just the particular caregivers connected with the patient event.

M & M meetings also led to specific process improvement actions. For example, sternal infection incidents were discussed at an M & M meeting and the ICU nurses reported that changing the chest tube dressings caused the sternal wound covering adhesive medication to be removed with the tape, thus exposing the wound to possible contamination. The operating room (OR) nurses then changed their chest-tube taping protocol to avoid placing tape over the sternal wound. It was also noted at a meeting that patients were being transported from the OR to the ICU at the end of surgery hypothermic and hyperglycemic. The OR nurses worked with the anesthesiologists to establish a procedure for transport that included re-warming and insulin drip protocols.

Conclusion

There is controversy regarding the effectiveness and unintended consequences of public reporting of outcomes data, particularly on an individual physician level [9,10]. Our program shows that the net effect of reporting hospital-level results can be to encourage all personnel within the hospital to cooperate on system-level changes.

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