

Decreasing Turnaround Time Between General Surgery Cases

A Six Sigma Initiative

Rella Adams, PhD, RN

Pam Warner, BSHA, RN

Blake Hubbard, MBA

Tom Goulding, MBA

A major problem in the operating room is the length of turnaround time between surgical cases. By decreasing this turnaround, staff overtime can be reduced and more cases can be scheduled during the day shift. In an era when cost cutting for hospitals is vital to maintain an operating margin, solving this problem is crucial. In addition, this can be a great satisfier for surgeons who can increase their daily workload in a more orderly, organized manner. To achieve our goal of decreasing turnaround time in the operating room, the authors review the implementation and outcomes of the application of Six Sigma.

One of the greatest dissatisfiers in the surgical setting is the time surgeons have to wait between their to-follow cases. The length of waiting time also affects patients, who have to wait in the holding area, which may be uncomfortable and sometimes frightening. The surgeons, anesthesiologists, and hospital staff were strong advocates for shortening this time and were open to change.

The other impetus for shortening the turnaround time is to conserve the investment of both time and money for the physicians and hospital. With reimbursement shortfalls, it is vitally impor-

tant to maintain a market position and find ways to perform more efficiently without loss of patient safety or quality. Clearly, there will always be room for improvement.

It was necessary for the hospital to become more efficient because of the possible loss of surgical procedures from competitive ambulatory surgery centers and other hospitals. More surgeons were also demanding block schedules. These were either new staff surgeons or those who did mostly short cases, which usually were accommodated at the end of the schedule. The question was how to solve this complex problem?

In the spring of 2002, Six Sigma was introduced by the president of our healthcare system. It was one of the hospital's seven strategic initiatives, which are: disciplined offering of services; e-business; Six Sigma quality; innovation; relentless customer service; employee partnership; and growth. The president stated, "It is my belief that the implementation of Six Sigma and its components will change the very culture of the hospital. It will become our way of thinking and the basis of our expectations. It will become the core of our philosophy and the lifeblood of our organization" (oral communication). Our president became the champion of the Six Sigma initiative. This sent a strong message throughout the hospital and the health system that could not be ignored.

Six Sigma was embraced by the executive group, the hospital and system boards, the medical board, the physicians, and hospital staff. In May 2003, the president, with approval of the hospital and system boards, contracted with General Electric Medical Systems Healthcare Services to provide

Authors' affiliations: Senior Vice President (Dr Adams), Executive Division; Administrative Director (Ms Warner), Medical Staff Services; Master Black Belt (Mr Hubbard), Six Sigma Division; Vice President (Mr Goulding), Materials Management and Decision Support, Valley Baptist Medical Center, Harlingen, Tex.

Corresponding author: Dr Adams, Valley Baptist Health System, 2101 Pease Street, Harlingen, TX 78550-2588 (rella.adams@valleybaptist.net).

the education for the Six Sigma process and tools. This corporation would coach the hospital staff in Six Sigma application to problems in healthcare.

Six Sigma is a highly disciplined process that helps us focus on developing and delivering near-perfect service to our patients. The word "sigma" is a statistical term that measures the variations in the process. The central idea behind Six Sigma is that if you can measure how many defects you have in a process, you can systematically figure out how to eliminate them and get as close to zero defects as possible.¹ Six Sigma, being rooted in statistical analysis, uses data to drive decisions and not a generally perceived thought or biased opinion of one or more persons. Through a rigorous process, Six Sigma obtains the true source of the problem from the customer's perspective. Six Sigma was positioned as the key element in the effort to move more energetically toward the hospital's mission. It is a dedicated quality initiative to reduce defects and drive improvements. The end result of Six Sigma will be sustainable change through process redesign. It is more than a goal; it is a commitment woven deeply into the culture of the organization.²

The president and executive group selected the first 6 initiatives, one of which was to decrease the turnaround time between cases in the operating room (OR). The time frame for education and completion of the initiative was 8 months, with classes starting May 29, 2002. The training was intense. This meant General Electric educated the selected employees, chosen by the president and executive group, as green belts and change agents.

A black belt is the team leader, who is responsible for defining, measuring, analyzing, improving, and controlling key processes that influence customer satisfaction or productivity and growth. Black belts are full-time positions. Green belts are trained in Six Sigma and can run initiatives, but they have their full-time positions. Change agents are facilitators who move a group through the change process so that solutions to complex problems can be achieved at an accelerated rate.

The tools used by change agents are change acceleration process (CAP) and Work-Out. CAP examines barriers to change and effectively works through those barriers to accomplish the established goal. Its use accelerates the rate of change within the organization, whereas Work-Out brings people together who are most closely related to the situation to concentrate their efforts on reaching the best decision for improvement or change. A work-out usually lasts 4 to 8 hours, and the work-

out team consists of 10 to 12 people. It is used when a solution must be generated by a group in a short time frame and implemented within 30 to 60 days.³

" $Q \times A = E$ " is a proven formula for results. It means the effectiveness (E) of the results is equal to the quality (Q) of the solution times the acceptance (A) of the idea. This formula is the basic working premise of Six Sigma. These tools produced significant results in the first wave of Six Sigma on reducing OR turnaround time.

The executive group, physicians, and trustees used the book *The Six Sigma Way—Team Fieldbook*.² This book introduces the reader to the following six components needed to achieve Six Sigma capability to meet the needs of the hospital's customers: genuine focus on the customer; data- and fact-driven management; process focus, management, and improvement; proactive management; collaboration across disciplines; and drive for perfection, but tolerance of failure. As can easily be seen, Six Sigma shares process similarities with other quality initiatives, such as Total Quality Management and Continuous Quality Improvement. However, several distinct differences exist. Six Sigma's emphasis is on hard data, statistical tools, tracking measures, and sustaining the achieved results, the latter being the most difficult.

The book also introduces the reader to the 5 stages of Six Sigma. These are often spoken of as DMAIC. Each letter stands for a planning phase: D, define the opportunity; M, measure to establish baseline performance; A, analyze the data and critical elements; I, improve the new process; and C, control the new process. This became our vision for continued improvement. It is systematic, scientific, and fact-based. DMAIC is a closed-loop process that eliminates unproductive steps, focuses on new measurements, and applies technology for improvement.²

Six Sigma Education Process

Our Six Sigma initiative was an educational process integrated into the first-wave projects. It was a new learning experience for hospital employees and physician staff. We were well acquainted with Total Quality Management and Continuous Quality Improvement; however, an investment with General Electric Medical Systems Healthcare Services was imperative because we had to learn the Six Sigma process, which is logical, but complex.

The education was extensive: leadership training for 13 executives (7 days); management training for 91 managers (4 days); green belt training for 11 green belts (35 days); change agent training for 16

change agents (7 days); team planning and training for 36 team members (21 days). The champion was the president of the health system. The executive leadership/steering committee/sponsors were the senior management, which numbered 13 people. The project leader was the human resource officer. The core team was composed of eight members, some from executive management and some from hospital departments. Each Six Sigma initiative in the first wave had a sponsor, 2 green belts, and a team. Sixteen change agents were available when a work-out and/or CAP were needed.

The sponsor chose the 2 green belts from a group of 11 who had originally been selected by the executive leadership. The sponsor for the OR initiative was a senior vice president, and the 2 green belts were the vice president of materials management and the director of medical staff services, who is also the director of performance improvement. Performance improvement was totally decentralized in the hospital, with the performance improvement resource committee (PIRC) and the improving organization performance committee (IOP) managing our quality and Joint Commission on Accreditation of Healthcare Organizations (JCAHO) preparation and review. These 2 committees have now integrated Six Sigma into their working process.

The core committee for decreasing the OR turnaround time included the sponsor, 2 green belts, the OR nursing administrative director, the clinical nurse manager of surgical services, 2 OR managers, the chief of surgery (plastic surgeon), and the chief of anesthesia (anesthesiologist), who also chairs the OR committee. The stakeholders were all the surgical staff, surgeons, and anesthesiologists, the core committee, the executive committee, and the president. The surgery committee and the OR committee, as well as the medical board, played key roles in this initiative. The monthly planning of the initiative occurred in the OR committee. The OR committee was composed of those persons on the core committee, plus a neurosurgeon, orthopedic surgeon, maxillofacial surgeon, a cardiovascular surgeon, a urological surgeon, an otolaryngological surgeon, an ophthalmological surgeon, and a general surgeon. The initiation of this endeavor started May 29, 2002, with the final review being given on February 14, 2003.

Performance Measurement and Data Analysis

One of the ways OR performance is measured is by the efficiency of the room turnaround process. Data

used in process measurement are derived from the operating room scheduling system (ORSOS). The content of the ORSOS database originates from the OR schedule and the intraoperative patient record. Specific data elements were extracted from this database.

The surgeons' expectation is that wait time between each of their "to-follow" cases is minimized, less than 30 minutes for patient-out to patient-in. The metric turnaround time is measured from the time a surgeon leaves the OR after completing a case to the time the surgeon arrives in the OR for the following case, with components of the total time measured in minutes. The overall turnaround time of surgeon-out to surgeon-in contains 3 component times. These are: (1) surgeon-out to patient-out, (2) patient-out to patient-in, and (3) patient-in to surgeon-in.

The general surgery cases were selected as the sample population for data analysis and process improvement initiative. All "to-follow" cases for the general surgeons, a total of 96 cases, were extracted from the ORSOS database for the base period January 1, 2002, through March 31, 2002. A measurement system analysis was conducted on a sample of 20 general surgery cases. For the analysis, a second circulating nurse independently observed the surgeon-in and surgeon-out time and recorded the results. For 17 hours, 17 minutes of case time, there was a total of 12 minutes absolute difference between measurement samples by the 2 nurses. This gave us the reproducibility and repeatability we needed to proceed with the analysis. Analysis of overall turnaround times for the base period established a mean of 60.9 minutes and a standard deviation of 23.8 minutes.

Subcomponent metrics were also established for the base period. Hypothesis testing revealed some factors (day of week, time of day) thought to influence overall turnaround time showed no statistical significance.

Regression analysis was performed on the 3 components of overall turnaround time. The results showed that variation in the patient-out to patient-in component explained 53.7% of the variation in overall turnaround time. Improvement efforts were then focused on that component.

Process changes were trialed for the general surgery cases starting October 7, 2002, and concluding January 10, 2003. Performance metrics were computed on the trial data and showed statistically significant improvement in both the overall turnaround time, a 13% improvement in the mean, and the patient-out to patient-in component, a 32% improvement in the mean.

Performance against upper specification limits established by the OR Committee and OR Staff (60 minutes for surgeon-out to surgeon-in, and 20 minutes for patient-out to patient-in) was also measured and showed improvement as a result of the trialed process changes. Computation of the Z score (Sigma) based on the proportion of cases within the upper specifications also revealed substantial improvement.

Communication of the OR Turnaround Time Initiative

One critical success factor and an important focus of any Six Sigma initiative is communication. For this reason, the OR initiative and the other Six Sigma initiatives were widely communicated on a continuous basis throughout the organization. Not only did this allow us to present important information, but it also allowed us to champion success and continuously promote Six Sigma as our management and quality culture. The performance measurement data from this initiative were disseminated throughout the entire course of the project to the following groups:

1. Health system board of trustees—monthly progress reports.
2. Health system executive council—weekly updates and feedback of Six Sigma progress.
3. Medical center senior management team—weekly updates and feedback of Six Sigma progress.
4. Medical staff/medical board—monthly updates.
5. Operating room committee—monthly presentations for reviews, feedback, proposals, and decision making.
6. Operating room staff—monthly feedback on their accomplishments and reinforcement of “control” (part of the DMAIC).
7. Health system and medical center employees—monthly updates.
8. Health system Six Sigma project manager—weekly and as needed updates, recommendations, and guidance.

The DMAIC methodology of Six Sigma requires reviews at the end of each phase of the initiative. The 5 reviews are R0 (define); R1 (measure); R2 (analyze); R3 (improve); R4 (control).^{2,3}

The OR turnaround project was no exception. Its team members regularly presented formal reviews to many of those mentioned. Our timetable for reviews was June 16, 2002, for R0; August 20, 2002, for R1; September 24, 2002, for R2; October 15, 2002, for R3; and February 14, 2003, for R4.

The reviews were conducted in a conference center at the hospital. Various people were invited: the president of the health system and the chief executive officer of the hospital, physician leaders, executive staff, core teams, any hospital staff who had participated and wished to attend, as well as the consultants from General Electric. It was presented on Power Point software, with the core team participating (Figure 1). This represents the summation for R4.

In addition to the review presentations, the medical center maintained several bulletin boards promoting this initiative specifically and Six Sigma generally. The medical center also published several newsletter articles and a Six Sigma handbook for all employees. The ongoing Six Sigma initiatives were topics at all executive council meetings, senior management team meetings, management meetings, retreats, and department-level meetings.

Performance Improvement Actions

Performance improvement actions began on August 13, 2002, with a meeting of the OR committee. This committee, made up of anesthesiologists, surgeons, OR managers, and hospital administration, was briefed by the green belts on initial performance measurements and analysis and the plans for upcoming work-out sessions.

Because analysis of surgeon-out to surgeon-in measurement data showed that 53.7% of the variance was patient-out to patient-in, improvement actions were focused on that time frame. Because the OR staff predominantly own this portion of the process, work-out sessions began with them.

Before the initiation of work-out sessions, the green belts spent 2 days observing in the OR. This not only gave them a better understanding of the process and potential barriers, but also exposed them to the OR staff, anesthesiologists, and surgeons they would be interacting with during the next 6 months.

On September 13, 2002, a sensing session was held with all the OR staff.³ The all-day event was instrumental in informing the staff of the current data measurement. The core team outlined the goals of this improvement initiative and requested baseline feedback on the staff's perceptions about specific processes involved in turnaround time and the level of teamwork; the core team asked for ideas for improvement. This information would again be evaluated after process changes were implemented. Buy-in from the OR staff took place at this time and contributed to the success of the initiative. By identifying surgeons, as well as patients, as their primary customers, the staff set out to change the process and improve outcome.

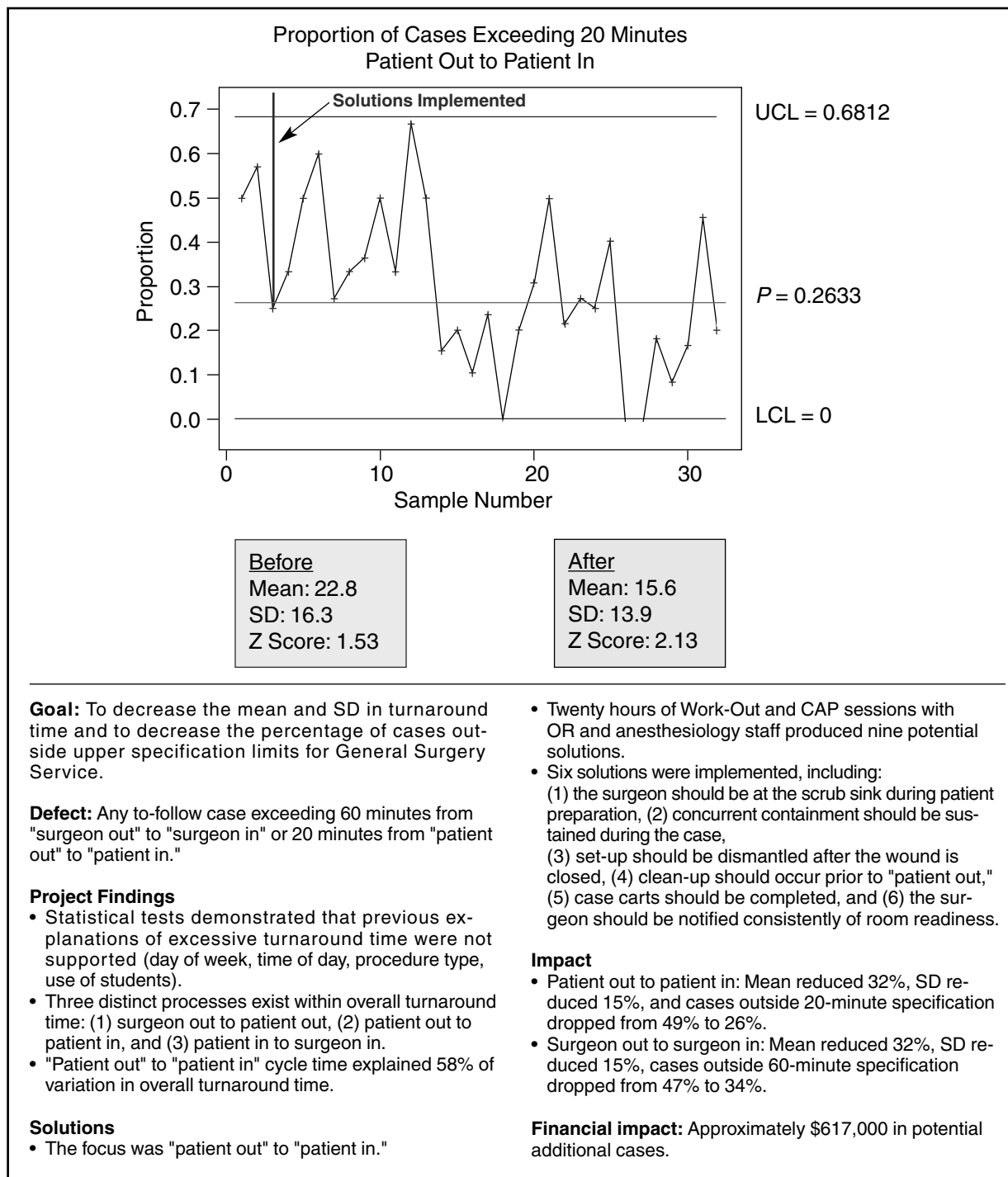


Figure 1. Reduction in OR turnaround time. UCL = upper control limit; LCL = lower control limit.

The first work-out included all OR circulators, scrub technicians, and aides. During this 8-hour session, they created a process map (Figure 2) and a fishbone diagram (Figure 3), brainstormed possible solutions, and came up with an action plan. They identified 6 improvement actions to pilot, which were implemented on October 7, 2002. The process changes were:

1. Concurrent room cleanup and containment by entire team.
2. Cleanup and dismantling of surgical setup immediately after wound closure and dressing application.
3. Consistent staff assignments.
4. Complete case carts.

5. Consistent and timely notification to surgeon of room readiness.
6. Increased assistance from anesthesia personnel.

The core team conducted a failure mode effects analysis (FMEA) on process changes to assess the possible effects. They agreed with a pilot project. Data collection and analysis continued during the pilot time period to determine success and sustainability of improvement actions.

Another work-out of 6 hours was held in October with staff who prepare patients for surgery. This group again used tools such as process mapping and brainstorming to identify causes for delay in preoperative readiness. Two changes, related to communications, resulted in a smoother process.

On November 1, 2002, the core team met with anesthesiologists for a 2-hour CAP session. The goal was to obtain buy-in from this key group of stakeholders. After review of the data and changes made by the OR staff, this group agreed to expedite and assist with the project. Similar meetings were held with general surgeons, both individually and as a group. Most of them were very committed to this project. The results of the pilot changes were evaluated on January 10, 2003. The goal was to decrease the mean and standard deviation and to increase the percent of cases that turn around in less than 20 minutes from patient-out to patient-in. An increase in patient, physician, and staff satisfaction was also anticipated.

Results of the OR Turnaround Time Initiative

The results revealed a statistically significant improvement. The Z score (Sigma) was moved from 1.53 to 2.13. The mean time from patient-out to patient-in decreased from 22.8 minutes to 15.6 minutes (32%), and the standard deviation decreased from 16.3 minutes to 13.9 minutes (15%). Cases outside specification dropped from 49% to 26%.

The time from surgeon-out to surgeon-in also was positively affected. The mean time was reduced 32%, the standard deviation reduced 15%, and the percent of cases outside the 60-minute specification dropped from 47% to 34%.

The reduction in turnaround time met our goal of reduced wait time for surgeons, patients, and families. Before and after OR staff satisfaction surveys reveal 95% improvement in teamwork (Figure 4).

Physician surveys also demonstrate improved satisfaction with turnaround time. Representative surgeons' comments were:

“Significant improvement. Everything has been going great. The turnaround time has been very impressive.”

“Tremendous improvement in turnaround time and customer-friendly approach by the operating room staff.”

“Significant improvement. Excellent operating room staff. The best I have ever had.”

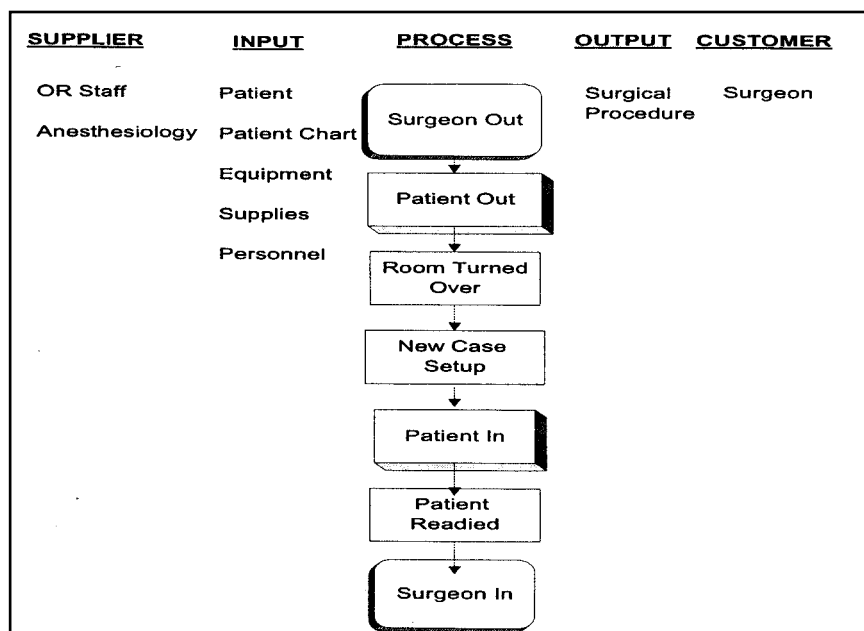


Figure 2. Process map for surgeon-out to surgeon-in.

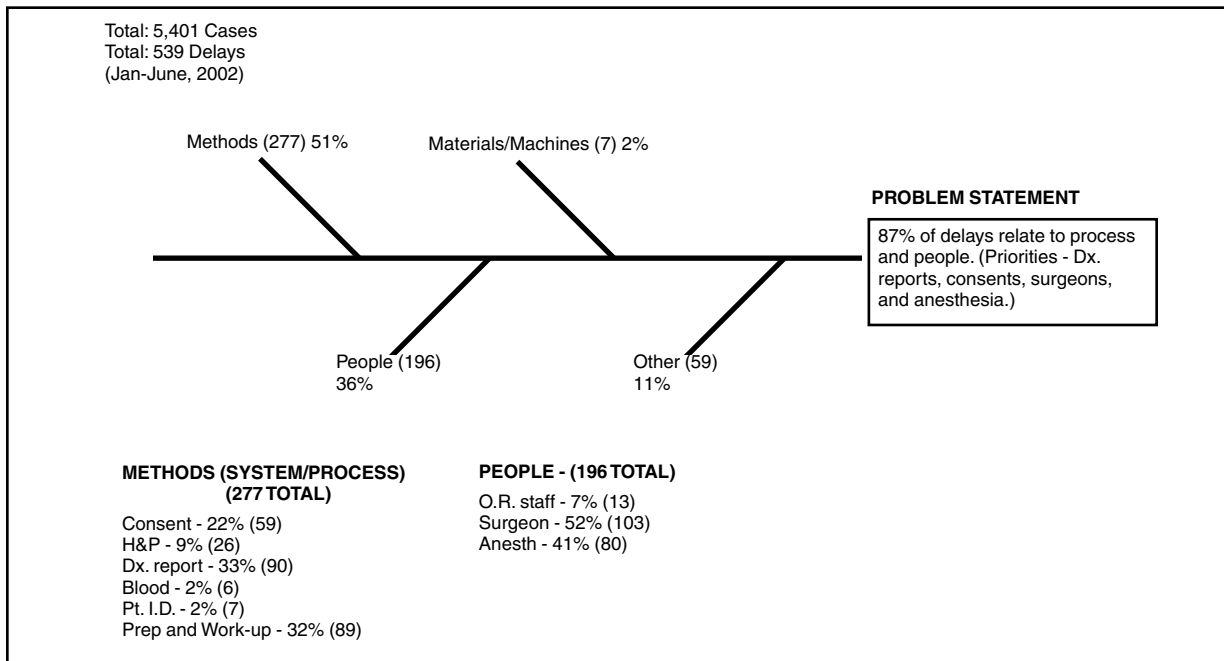


Figure 3. Operating room turnaround time cause-and-effect diagram. Dx = diagnosis; H&P = history and physical; ID = identification; pt = patient; OR = operating room.

Patient satisfaction has also increased. On one outpatient surgical unit, the results of surveys conducted by an independent outside source demonstrate that patients perceive improved teamwork among physicians, nurses, and staff. Also measured is the discharge process, which reflects the patient's perception of timeliness and efficiency. The mean percentile ranking in this question went from 67.3 to 98. Another survey, conducted in March 2003, of 28 surgical patients showed that 100% felt they were treated and released in a timely manner.

At a minimum, by sustaining the mean turnaround time resulting from the process changes, there exists the potential of adding 11 cases per month in General Surgery. The average surgical services contribution margin would be \$1225 per case, and the annual potential benefit to the hospital would be approximately \$162,000. Should the improvement in general surgery turnaround time be replicated in all surgery cases, there exists the potential of adding 42 additional cases per month, or 504 cases per year. With the same average sur-

General Surgery			
Turnaround Time on "To-Follow" Cases			
How would you rate the current turnaround time?			
0%	18%	59%	23%
No change	Slight improvement	Moderate improvement	Significant improvement
Have you noticed the following process improvements?			
	<u>Yes, %</u>	<u>No, %</u>	
1. Improved teamwork in OR	95	5	
2. Concurrently/early cleaning of room	97	3	
3. Earlier breakdown of set-ups	95	5	
4. Fewer missing supplies	54	46	
5. Patient's preoperative preparation complete	74	26	
6. You can finish earlier	92	8	

Figure 4. Operating room staff satisfaction questionnaire.

gical services contribution margin, the potential benefit approximates an additional \$617,400 per year.

Since the final report, on January 27, 2003, weekly control charts of all major surgical specialties have been generated and shared with OR staff, anesthesia, surgeons, and administration. This has motivated staff and provided evidence to reinforce behavioral acceptance of process changes in the OR. It is necessary that these improvements are sustained. There have been weeks when Six Sigma in turnaround time has been achieved (Table 1). This represents one of the weekly measurements.

This Six Sigma initiative will continue for another 4 months. However, the focus in wave 2 is patient-in to surgeon-in. This segment affects the anesthesiologists. The same process improvement strategies and goals will be used.

The hospital contracted General Electric Medical Systems Healthcare Services for wave 1. Wave 2 has already started for 6 more Six Sigma initiatives, during which 3 full-time master black belts, as well as 2 master change agents, will be certified by GE. The task of the 3 master black belts will be to educate managers in the organization as green belts. With the education of 3 master black belts and 2 master change agents, the hospital will be self-sufficient in its continuation of a Six Sigma culture.

Other healthcare organizations could easily replicate this performance improvement process as long as the following are present:

- The Six Sigma initiative is leadership-driven.
- The team remains customer focused.
- The process is based on sound measurement data.

Table 1. Turnaround Time for To-Follow Cases (Week Ending: June 20, 2003)

Service	Patient Out to Patient In					Surgeon Out to Surgeon In				
	Cases Within Upper Spec	Cases Outside of Upper Spec	Total	Within Spec, %	Sigma	Cases Within Upper Spec	Cases Outside of Upper Spec	Total	Within Spec, %	Sigma
Cardiovascular	5	1	6	83.3	2.47	4	2	6	66.7	1.93
Dental										
ENT	1	0	1	100.0	6.00+	1	0	1	100.0	6.00+
General	10	0	10	100.0	6.00+	6	4	10	60.0	1.75
Neurology	2	0	2	100.0	6.00+	1	1	2	50.0	1.50
OB-GYN	25	1	26	96.2	3.27	18	8	26	69.2	2.00
Orthopedic	17	3	20	85.0	2.54	13	7	20	65.0	1.89
Urology	9	0	9	100.0	6.00+	5	4	9	55.6	1.64
Other	5	4	9	55.6	1.64	2	7	9	22.2	0.00
Total	74	9	83	89.2	2.73	50	33	83	60.2	1.76
	Patient Out to Patient In					Surgeon Out to Surgeon In				
	Within	Outside	Total	%	Sigma	Within	Outside	Total	%	Sigma
4-Week Trend										
5/30/2003	43	14	57	75.4	2.19	35	22	57	61.4	1.79
6/2/2003	52	12	64	81.3	2.39	41	23	64	64.10	1.86
6/13/2003	64	17	81	79.0	2.31	45	36	81	55.60	1.64
6/20/2003	74	9	83	89.2	2.73	50	33	83	60.2	1.76
Year to date:	1265	282	1547	81.8	2.41	944	631	1575	59.9	1.75
	Upper Specification Limits, min									
Service	Patient Out to Patient In		Surgeon Out to Surgeon In		Service	Patient Out to Patient In		Surgeon Out to Surgeon In		
Cardiovascular	29		74		Orthopedic	20		63		
Dental	14		59		Urology	31		52		
ENT	10		51		Other: Plastic	15		44		
General	20		60		Other: Ophthalmology	21		62		
Neurology	21		63		Other: Anesthesiology	20		60		
OB-GYN	20		48		Other: Podiatry	33		62		

Spec = specification; ENT = ear, nose, and throat; OB-GYN = obstetrics and gynecology.

- The staff are trained in the use of Six Sigma tools (or an equivalent); and
- The organization has a strong desire to improve outcomes.

Conclusion

The obstacles, problems, and resistance to the OR initiative have been minimal because of the extensive education in Six Sigma tools and strong administrative leadership. The staff and physicians

were well prepared for process change and were enthusiastic about making improvements. Celebrations along the way have motivated the entire team. Before beginning this initiative, each part of the team was quick to blame someone for long turnaround times. With emphasis on customer service and data-driven decision making, the OR team is very proud of the accomplishments thus far and eager to continue the thrust toward Six Sigma.

References

1. Ettinger WH. Six Sigma adapting GE's lessons to healthcare. *Trustee*. 2001; Sept:10-14.
2. Pande PS, Neuman RP, Cavanaugh RR. *The Six Sigma Way—Team Fieldbook*. 1st ed. New York: The McGraw-Hill Co.; 2002.
3. GE Medical Systems. *Performance Solutions*. General Electric Co.; 2003.

The Journal of Nursing Administration

Instructions for Authors

Instructions for Authors can be found online at the address below. To ensure that your manuscript is in compliance with new submission procedures, you should read this document carefully before manuscript preparation. All manuscripts must be submitted electronically through this system.

Please visit <http://Jona.EdMgr.com>.