Patient Access and Clinical Efficiency Improvement in a Resident Hospital–based Women's Medicine Center Clinic

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Objectives: To apply the Six Sigma tools of Change Acceleration Process and Work-Out and to improve patient access in an outpatient clinic in a hospital-based residency training program.

Study Design: Observational study.

Methods: Comparison of productivity in an obstetrics and gynecology clinic after implementation of the Six Sigma principles, with a comparable internal medicine clinic as a control group. Productivity from January 1 through December 31, 2005, was assessed in both clinics. After applying the Six Sigma tools to obstetrics and gynecology, outputs from both clinics from January 1 through December 31, 2006, were analyzed.

Results: Wait times for new obstetrical visits decreased from 38 to 8 days. The patient time spent in the clinic dropped from 3.2 to 1.5 hours. Initial gynecologic visits increased by 87% (from 453 to 850 per year), return gynecologic visits increased by 66% (from 1392 to 2311 per year), initial obstetrical visits increased by 55% (from 520 to 808 per year), repeat obstetrical visits increased by 45% (from 2239 to 3243 per year), and the mean patient satisfaction scores increased from 5.75 to 8.54 (on a 10-point scale). The gross clinic revenue increased by 73% in the first 6 months of 2006 over that of the previous year. By contrast, internal medicine patient wait times for new patients and for revisits, patient satisfaction scores, total number of clinic visits, and revenues remained unchanged.

Conclusion: Application of the Six Sigma principles resulted in a team approach to solving the clinic's productivity issues.

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Charleston Area Medical Center (CAMC) is the largest hospital in West Virginia and is a nonprofit, academic, regional tertiary referral center. The hospital system performs 37 454 inpatient discharges and 530 861 outpatient visits annually. Major services include cardiology, obstetrics and gynecology, neurology, orthopedics, urology, trauma, general surgery, cardiothoracic, and neonatology services. Charleston Area Medical Center has a level III neonatal intensive care unit and a level I trauma center. It contributes more than $20 million per year in subsidies for educational programs and provides training for 140 medical residents. Charleston Area Medical Center trains 12 obstetric and gynecologic residents (3 per year) in an approved American Board of Obstetrics and Gynecology residency training program. Women and Children's Hospital, as a part of the CAMC system, performs more than 3000 deliveries per year, with approximately 50% of the deliveries performed by the resident service. Substantial barriers to access existed in our obstetrics and gynecology clinic system, with a 38-day wait for the third next available appointment. Furthermore, the appointment visit length was 3.2 hours, the mean patient satisfaction score was 5.75 on a 10-point scale, and the volume of visits had dropped from 16 392 visits in 2003 to 11 746 visits in 2004.

Major companies that have touted the Six Sigma quality improvement program since the 1980s include Motorola, General Electric, Allied Signal, Black & Decker, Kodak, Polaroid, Sony, Toshiba, and Quest Diagnostics. General Electric claims that they gained $750 million in 1998 because of the Six Sigma processes and more than $1.5 billion in 1999; they continue to make notable performance improvements that are credited to the Six Sigma system.[1] Motorola is one of the companies that pioneered the Six Sigma program. During more than 10 years in use, the company has experienced a 500% growth in sales and has estimated savings of more than $14 million and a 20% profit growth.[1]

Only recently have the Six Sigma tools been applied to the nonmanufacturing realm, particularly the service industries. Previous attempts at clinic efficiency improvement have involved the redesign of ambulatory clinics using mathematical modules[2] and teaching modules.[3] Baker and Mamlin[2] first attempted to use mathematical modeling in an internal medicine ambulatory teaching clinic. Modification of factors enabled the clinics to develop an optimal mix of

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residents and time management. A more recent attempt by Regan-Smith et al[3] chronicled how obstetrics and gynecology teaching clinics could be changed to improve patient care efficiency and resident and student learning. In addition, Shortell and Hull[4] were some of the first investigators to look at what core characteristics might be included in an organized delivery system.

We performed a review of the literature using any of the following terms or combinations of terms: *Six Sigma*, *clinic productivity*, *university* or *teaching clinic*, *clinical organizational efficiency*, *resident/student education*, *financial productivity*, or *obstetrics and gynecology clinic improvement*. Our search in the MEDLINE research database from 1966 through 2007 revealed no previous studies in the English literature that included the Six Sigma tools of management. No studies were found that integrated all 3 aspects of clinic operations, namely, clinical organizational efficiency, resident and student education, and financial productivity.

METHODS

Charleston Area Medical Center deployed the Six Sigma tools in the same manner as General Electric and Motorola to improve clinic performance.[1] Productivity in the obstetrics and gynecology clinic after implementation of the Six Sigma system was compared with that of a comparable internal medicine clinic, which served as a control group. Baseline productivity from January 1 through December 31, 2005, was assessed in the obstetrics and gynecology and internal medicine clinics. After applying the Six Sigma principles to improve productivity in the obstetrics and gynecology clinic, outputs from the obstetrics and gynecology and internal medicine clinics from January 1 through December 31, 2006, were analyzed.

The 4 key concepts in the utilization of a structured Six Sigma approach in a clinical teaching environment include the following: (1) Utilization of the Change Acceleration Process. Projects to improve patient-centered care processes must involve a unified team with a common tie that binds and fits quality as a product of acceptance and effectiveness. The key variable in this equation is acceptance. (2) Recognition of the voice of the customer. This process focuses on getting input and feedback not only from the persons providing care (ie, attending physicians, resident physicians, and nursing and clinical staff) but also from all persons who are stakeholders in the need to improve the current level of performance (eg, team members who schedule and register patients, administration, suppliers, and patients). (3) Identification of and attempt to control variation and reduction of waste. Concepts of "doing today's work today" and "pulling work" vs "pushing work" are all changes in the culture and approach to work that are needed to reduce variation. (4) Commitment to driving improvement based on data. All members of the team must identify and commit to a defined set of quantifiable data points that will be used to monitor performance on a continuous basis.

Key to the success of any project is the designation of a project champion. The champion supports the project and navigates organizational barriers as they present. Our obstetrics and gynecology clinical improvement champions consisted of the chief operating officer of the health system and the dean of the university health science center. In addition to project champions, other critical success factors consisted of alignment between the operational administration and an academic faculty expert, a well-respected clinic manager with a Six Sigma Green Belt, a detailed and updated action and communication plan, and a designated Black Belt to maintain focus on the project and to mentor the Green Belt. Access and clinical efficiency improvement in resident obstetrics and gynecology training clinic was managed using the following well-tested Six Sigma 5-step approach to define, measure, analyze, improve, and control (DMAIC).

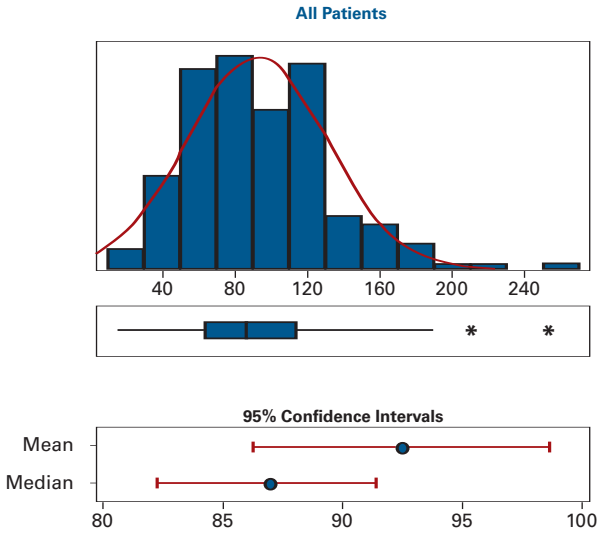
Define

Critical to the process was deployment of the DMAIC principles. First, we sought to define tools for collecting the voice of the customer, consisting of interdisciplinary resident collaborative sessions, staff Work-Out sessions (including representatives from all internal customer segments), patient satisfaction surveys, and safety and grievance reports.

We identified our customers as internal to the organization (staff, residents, attending physicians, and scheduling and registration support) and as external to the organization (patients and their families). The patient voice of the customer indicated that the customer could not get an appointment, the clinic was too slow, and there was difficulty in scheduling follow-up appointments. The resident and staff voice of the customer indicated that canceled clinics, changing coverage schedules, competing priorities (surgery), and work-hour restrictions were the biggest issues.

The next step in this stage was to clearly identify what factors in the project were critical to quality (CTQ). This is important to ensure that the team is unified and is focused on the critical *X* variables. The external customer (patients and families) factors that were CTQ were found to be the following: I want to be seen when I need an appointment, I want my visit to be less than 1 hour, and I want care I need. The internal customer (residents and staff) factors that were CTQ were

Figure 1. Total Clinic Visit Length in Minutes



Anderson-Darling Normality	
A-squared	1.28
P-value <	0.005
Mean	92.494
StDev	39.128
Variance	1530.974
Skewness	0.85687
Kurtosis	1.44592
N	156
Minimum	15.000
1st Quartile	63.500
Median	87.000
3rd Quartile	115.000
Maximum	253.000
95% Confidence Interval for Mean	
86.305	98.682
95% Confidence Interval for Median	
82.291	91.419
95% Confidence Interval for StDev	
35.215	44.027

Visit length at 1.5 hrs.

the following: We want a smoothly running clinic (ie, resident work-hour rules), we want a schedule that is dependable, and we want the clinic to fit with our other requirements (ie, surgery, hospital duty, and on-call status).

Paramount to the Change Acceleration Process and Work-Out process in the teaching hospital environment was to clearly establish a teaching environment within a business model that is viable and economically sustainable. Estimates based on improved access and resulting clinical activity placed the direct economic effect for increased gross revenue on the obstetrics and gynecology resident training clinic to be $700 000 annually. The critical Xs to develop a system that promotes access, clinical efficiency, and reliability of care were staffing mix, resident timeliness, attending physician supervision, scheduling and registration, rooms and equipment available and operational, and actionable information on hand.

Measure

Next in the DMAIC process was performance measurement (Figure 1 and Figure 2). The current performance revealed a 38-day wait to access a new obstetric appointment and a 60-day wait for a new gynecologic appointment, with a new obstetric patient spending 3.2 hours in the clinic and with 46.7% of patients spending more than 30 minutes in the waiting room.

We believed that we needed to find the right Y variables to measure that were CTQ. We chose the following Ys: the time to the third next available appointment and the clinic throughput time.

Defects in the present system would be to wait for a new obstetric appointment that was 10 days longer than the current wait or time spent in the waiting room for a clinic visit that was 60 minutes longer than the current wait. Measures used included the third next available appointments on a monthly basis for obstetric new visits and revisits and for gynecologic new visits and revisits so that access benchmarking could begin immediately. Initial work centered on performing a detailed series of throughput analyses that resulted in quantifiable data that were graphed using a commercially available computer program (Minitab; Minitab Inc, State College, Pa).

Analyze

Once measures were identified and agreed on from the standpoint of importance, an analysis of data became paramount. An examination of the data revealed many sources of variation that led to clinical inefficiency and to wasted resources.

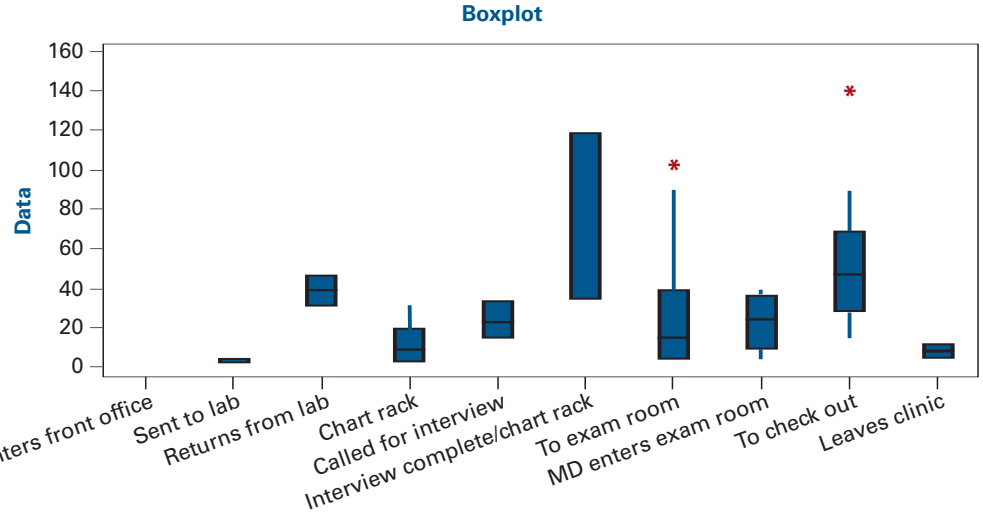
Improve

Next in the DMAIC process, improvements followed from the changes implemented. An overview included the following 5 changes: (1) Resident scheduling templates were changed, and new clinic sessions were added, increasing appointment access and streamlining the demand for service. (2) Physician extenders (1.3 full-time equivalent nurse practitioner and certified nurse midwife) were hired to streamline the supply of providers. (3) Certain sequential steps in the patient throughput process were eliminated or were performed in parallel, which increased the throughput time. (4) Creation of a weekly new obstetric patient–only clinic. (5) Through application of the Change Acceleration Process, a cultural change occurred in which staff, residents, and attending physicians committed to holding each other accountable for on-time clinic starts, information readiness, and communication.

Control

In an environment that is historically variable, ongoing

Figure 2. Measuring the Problems at Charleston Area Medical Center



tests of change and repeat cycles of learning are beginning to demonstrate elements of improved control. By no means do we have the type of Six Sigma scores that are represented in automobile manufacturing or in the air travel industry, but we have the capacity and knowledge to use control charts to monitor performance for improvement of variation.

To control for other effects in the CAMC system that might account for our changes, we compared the findings in our obstetrics and gynecology clinic with those of a similar residency primary care clinic in the internal medicine department. The internal medicine clinic access times for new patients (third next available appointments) and for revisits did not change substantially during the study period. The new patient mean wait times were 50 days in 2005 and 46 days in 2006. The revisit wait times were 40 days in 2005 and 45 days in 2006. Similarly, the mean patient satisfaction scores in the internal medicine clinic did not change.

RESULTS

As a consequence of implementation of the DMAIC process and the changes made in personnel behaviors and in clinic templates, we saw new obstetrical visit wait times decrease from 38 days to 8 days. The total patient time spent in the clinic decreased from 3.2 hours to 1.5 hours. During the 2-year period compared, initial gynecologic visits increased by 87% (from 453 to 850 per year), return gynecologic visits increased by 66% (from 1392 to 2311 per year), initial obstetrical visits increased by 55% (from 520 to 808 per year), repeat obstetrical visits increased by 45% (from 2239 to 3243 per year), and the mean patient satisfaction scores increased from 5.75 to 8.54 (on a 10-point scale). The gross clinic revenue increased by 73% in the first 6 months of 2006 over that of the previous year.

By contrast, the internal medicine patient wait times for new patients were unchanged (50 days in 2005 vs 46 days in 2006), revisit wait times were unchanged (40 days in 2005 vs 45 days in 2006), and patient satisfaction scores did not change notably. The total number of internal medicine clinic visits remained static (10 626 in 2005 vs 10 896 in 2006), and revenues remained unchanged ($1 123 203 in 2005 vs $1 247 737 in 2006).

Several areas are targeted by our Six Sigma process for continued improvement. These include room utilization (we average only about 45% overall utilization, with variance from 20%-100% use depending on the availability of providers), a decrease in the total time spent in the clinic to less than the current 1.5 hours, and increased patient satisfaction to greater than 90%.

DISCUSSION

Application of the Six Sigma management principles to our residency teaching outpatient clinic resulted in a team approach to solving the clinic's productivity issues. Focused problem assessment, verification of process, and validation of outcomes anchor the attempts to couple increased resident training opportunities with cost-effective care. More efficient use of time improves resident exposure to more patients without sacrificing education. Better throughput provides more financial security to fund resident education. The use of physician extenders to fill excess service needs may provide the balance necessary to maintain resident education while securing

Take-away Points

The Six Sigma Change Acceleration Process and Work-Out tools provide the necessary framework to improve access, decrease wait times, increase satisfaction, and provide profitable operations. The key to the success of the program is strong clinical and administrative leadership, with tangible goals and rewards.

- Charleston Area Medical Center deployed the Six Sigma tools in the same manner as General Electric and Motorola to improve clinic performance.
- Our project supported redeployment of our resident clinic resources for more efficient use of time, with enhanced resident education.

financial viability. In summary, our project supported redeployment of our resident clinic resources for more efficient use of time, with enhanced resident education.

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