

A Literature Review on Six Sigma Approach to Healthcare Quality

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Abstract: For decades the U.S. health care industry has been operating on its own way ignoring emerging factors such as competition, patient safety, skyrocketing health care cost, liability, malpractice insurance cost and use of DRG for Medicare and insurance payment. However, as these factors became more prevalent and competition within the industry intensified, many U.S. hospitals have been becoming increasingly aware of the critical needs of controlling the operating costs and meet and even exceeds the expectations of patient care quality. This paper presents a model of Six Sigma approach to health care quality management for hospitals in the U.S. and abroad.

Keywords: six sigma, quality and productivity management in healthcare

I- INTRODUCTION

The health care industry in the U.S has been operating on its own traditional economic domain ignoring current emerging factors such as competition, patient safety, skyrocketing health care cost, liability from malpractice lawsuits and more government control on Medicare payment. (Hansson, 2000). But in recent years, these factors have become more prevalent and competition within the industry has been intensified, and many U.S. hospitals has been becoming increasingly aware of the critical needs of controlling their operating costs and meet the expectations of patient care quality (Chow-Chua et.al,2000). In current competitive environment, many health care organizations are taking steps to ensure that they are providing the "absolute best care at the lowest possible costs". However, many hospital administrators still have to learn how to lower operating

costs without compromising on providing consistent good quality patient care (Griffith, 2000). In 1993, Choufournier et al. reported that 44% of 1,083 hospitals surveyed in the U.S. were embracing some kind of quality management approach such as CQI (Continuous quality improvement), Kaizen, and TQM (Total Quality Management) to improve health care quality (Choufournier, 1993). Also, in 1994, Hertz, et. al suggested that Malcolm Baldrige National Quality Award (MBNQA) concepts could help stimulate health care quality improvement (Hertz et.al. 1994). In 2001, Leggit, and Anderson reported that the Malcolm Baldrige National Quality Award (MBNQA) assessment criteria for performance excellence developed by National Institute of Standards and Technology has been successfully applied for organizational-wide performance improvement at Hartford Hospital at Hartford, Connecticut (Leggit, 2001).

Under the current environment which contains many forces such as increased customer expectations, steeper competition, and government agency pressures the health care delivery system has been undergoing formidable challenges since early 1990s (Chow-Chua et.al. 2002), and this paper presents a Model of a Six Sigma approach to quality management to improve productivity and quality in a health care delivery system.

Six sigma approach to quality improvement

Six Sigma approach to improve quality has been used in many organizations since its inception. at Motorola Corporation in the 1980s to measure and improve product and service quality. Six Sigma is focused on defects per million opportunities,. Six Sigma is based on a quality statistic that equates to 3.4 defects per million

opportunities. This is the target level of performance for a process.

Six Sigma DMAIC Quality Improvement Model

The Six Sigma quality improvement model as applied by Robert Galvin at Motorola, Inc refers to the five step process problem solving approach known as DMAIC:(Define, Measure, Analyze, Improve and Control) as explained below

- Define: this step defines who the customers are, what the customers want, the process capabilities, and provides objectives for project-based improvement efforts.
- Measure: this step measures the quality characteristics that reflects improvement in customer satisfaction and product performance and provides the metrics of data on which the improvement efforts will be based..
- Analyze: in this step, data collected in previous steps are analyzed using analytical tools such as Pareto analysis, process flow diagram, fish-bone diagram, statistical process control charts, for identifying necessary design and process modifications for achieving customer satisfaction and performance objectives.
- Improve: in this step resources are allocated so that design and process modifications needed for improvement can be implemented.
- Control: in this step the process is monitored using quality management tools such as Pareto charts, and statistical process control charts to ensure that the performance improvements are maintained.

The Six Sigma process is highly measurement and data driven. Data has to be gathered to determine the baseline performance of a process in order to validate that an improvement has been made. Decisions are made on statistics and facts, rather than instinct or past history. Six Sigma projects can be lead by Black Belts or Green Belts. ninjas (experts) who are trained for quality problem solving. The Master Black Belt ninjas usually serve as advisors to the project leaders while local champions promote Six Sigma in their organizations. All of these roles require extensive training to become familiar with the tools of Six Sigma. Six Sigma projects that focus on improving/solving existing quality problems follow the process of DMAIC (Define, Measure, Analyze, Improve, and Control) as described above. While projects that involve developing a new product, process or procedure follow the DFSS (Design for Six Sigma) process that focus on meeting customer needs and expectation, on time and on budget.

Six Sigma's ability to reduce errors, improve customers satisfaction, and bring in financial gains has lead many companies such as General Electric, Texas Instruments, 3M, IBM, Citibank, Xerox, The Dow Chemical , and Boeing Aircraft to adopt the Six Sigma process.

Six Sigma approach to service industry

Citibank is a service based company, used Six Sigma approach to reduce cycle times within the company. Service based industries usually struggle with Six Sigma approach because of its intense data focus. There are three main challenges to overcome for implementing Six Sigma approach in service industries (Lanser,2000).

- First, it is sometimes difficult for service industries to identify an indicator to measure the performance level of a service in their organization. Manufacturing plants can use measures such as no of defects per million parts produced. But it does not always translate into service industries. Customer variability also needs to be considered when using Six Sigma in service industries. A service might be acceptable to one customer but viewed as sub-par by another customer.
- A second issue to overcome in service industries is the difficulty in creating cultural changes for empowering Six Sigma leaders.
- The final challenge service organizations face in Six Sigma implementation is that it fails to capture the benefits of Six Sigma application immediately. Cost savings from Six Sigma projects may take time to realize, and frequently, managers give up too soon before cost savings are realized.

Six Sigma approach to healthcare industry

The challenge for health care industry to benefit from the use of Six Sigma is paramount. Patient care significantly involves human element as compared to machine elements, in which the variability is subtle and very difficult to quantify. Therefore, challenge in adopting Six Sigma approach to healthcare is to find a way to leverage the data from Six Sigma to drive human behavior. Success will come only when the Six Sigma technical strategy is combined with a cultural strategy for change acceleration and a sound operational mechanism (Lasarus, Ian, and Neely, 2003)

There are usually four metrics (indicators) that can be used by singly or in combination to define level of performance of a healthcare organization. These metrics are service level, service cost, customer satisfaction, and clinical excellence. While these metrics are applicable in healthcare organizations, they are also very difficult to apply in a health care setting.. Despite the challenges in using Six Sigma in the healthcare industry, many hospitals within the healthcare industry is beginning to use Six Sigma approach to improve patients' satisfaction (Lasarus, Ian, and Neely, 2003).

Improving patient satisfaction in health care

In healthcare organizations, patients may be considered as customers. Keeping patients satisfied are considered as a top priority by many healthcare organizations the traditional concept, that people need healthcare and will continue to use the same health care providers out of necessity, even if they are not happy with their services they receive, have been changing rapidly. A patient can now access more information on healthcare providers and can make more informed choices about their treatment. Quality is now playing a more important role as patients have started choosing healthcare providers based on quality of care and their level of satisfaction with the organization from their previous experiences At the same time many hospital administrators have already started using the views and perceptions of their patients to organize their service and staff and for continuous improvement in the overall organizational performance.

Three approaches to improve patient satisfaction

Torres et, al (2004) reported three approaches to quality improvement in the healthcare industry to improve patient satisfaction. They are

- measuring the patient's perspective,
- improving patient outcomes, and
- using Six Sigma approach.

Regardless of which approach or approaches are used, support of senior level management is critical to the success of such programs.

Measuring the patient's perspective

It is important to measure patient's perspective to the health care services. The services that patients receive is intangible, can't be physically viewed or touched like a manufactured product. There are three ways to measure patient perspective.

- First method is to determine patients' preferences. This method involves qualitative measures, such as focus group, interviews, and surveys, to determine patients' desires and expectations about various health care services.
- The second method is patient's evaluation of the services they received This method involves a questionnaire survey given to patients after they have received healthcare services to measure their level of satisfaction to the services received.
- The final method is to measure patient's perspective through reports of objective observations from the

patient, such as how many times they were seen by a doctor during their stay in a hospital or how long they waited in the waiting room for seeing a doctor etc.

All three of these methods can provide valuable insight into patients' expectations of healthcare and their evaluations of services received. Patient views can be used to improve quality and gain business for healthcare organizations.

Improving patient outcomes

Improving patient outcomes can also increase patient satisfaction. One example of this was in Dayton, Ohio where a community based approach was used to improve patient outcomes. In this community, five competing hospitals worked together to determine the best way to treat certain illnesses. The theory is that if many people work together, a better solution can be found than if one hospital works alone. In Dayton, the mortality rate from acute myocardial infarction declined from 9.68 percent in 1999 to 6.3 percent in 2002 after the community based approached was implemented (Crane,2000).

Using Six Sigma approach

Six Sigma is a powerful approach to quality improvement that can be used in healthcare organizations to meet needs and expectations of patients as well as to improve profitability and cash flow. A model of Six Sigma approach to health care quality improvement is presented in figure 1, which involves a six step process as described below:

- Define the goal and scope of the project, for example, improve patient satisfaction, reduce average patient waiting time, etc
- Create a performance baseline to compare data evidencing errors, for example, develop a quantifiable Upper and Lower Control limits the average level of performance indicator of patient satisfaction (average performance level (+/-) Six Sigma of std deviation)against which performance can be measured., and for patient waiting time, determine average waiting time expected by average patient, and its upper and lower limit.
- Continuously, monitor performance and collect performance related data using patient satisfaction survey, and for waiting time, design the patient appointment scheduling and patient waiting line system, implement the system, and continuously monitor the performance of the patient waiting line system.

- If the level of performance goes below the lower limit of expected performance level, then analyze root causes of the problem, solve (not just fix) the problem by removing the root cause.
- Implement procedures to remove the root cause of the problem and improve performance level of the system

Evaluate the performance of the system before and after implementation of the improvement to measure the results of the improvement (Evaluate patient satisfaction levels before and after Six Sigma, and for waiting line, measure waiting time before and after Six Sigma implementation).

In addition to increasing patient satisfaction, Six Sigma can be used in other areas of healthcare such as reducing

medication mistakes, reducing diagnostic laboratory errors, and capability studies and improvement of various medical and surgical procedures.

Six Sigma in Health Care Some success stories

The following success stories of Six Sigma implementations have been recorded in literature.

Six Sigma at Mount Carmel Health System at Columbus, Ohio

Schwall and DeYoung (2003) presented the story of successful in implemented Six Sigma in Mount Carmel Health System in Columbus. In the spring of 2000, Mount Carmel Health System, a three hospital system in Columbus, Ohio with 7300 employees and a medical staff of 1200 physicians was experiencing significant financial challenges and began implementing Six Sigma with a two day training session for senior management to gain their support. Next, a new role was established in the organization, Vice President for Six Sigma. Six Sigma champions were selected from the senior management team to be trained to identify and oversee Six Sigma projects. A cross functional Six Sigma core team was established to manage issues such as training, communication, and compensation for Six Sigma in the Mount Carmel Health System.

After the Six Sigma infrastructure was in place, 44 black belts and 4 brown belts went through four weeks of training on Six Sigma methodology. The black belts worked on Six Sigma projects full time while the brown belts assist as needed. All functions within the Mount Carmel Health System are expected to use Six Sigma to solve problems that decrease financial performance and

act as a source of patient, employee, and physician dissatisfaction.

The first year, Six Sigma projects at Mount Carmel Health System focused on projects that were the biggest operational headaches. The next year, projects focused on six key business themes: revenue enhancement, bad debt reduction, patient throughput in all operational units, labor/right staffing, labor retention and recruitment, and patient safety. To date, financial savings of \$3.1 million have been realized through Six Sigma projects, with more savings expected. Also, employee and physician satisfaction has improved and is shown by improved employee retention rates. Six Sigma is now the established methodology in Mount Carmel Health System’s Performance Improvement Plan.(18)

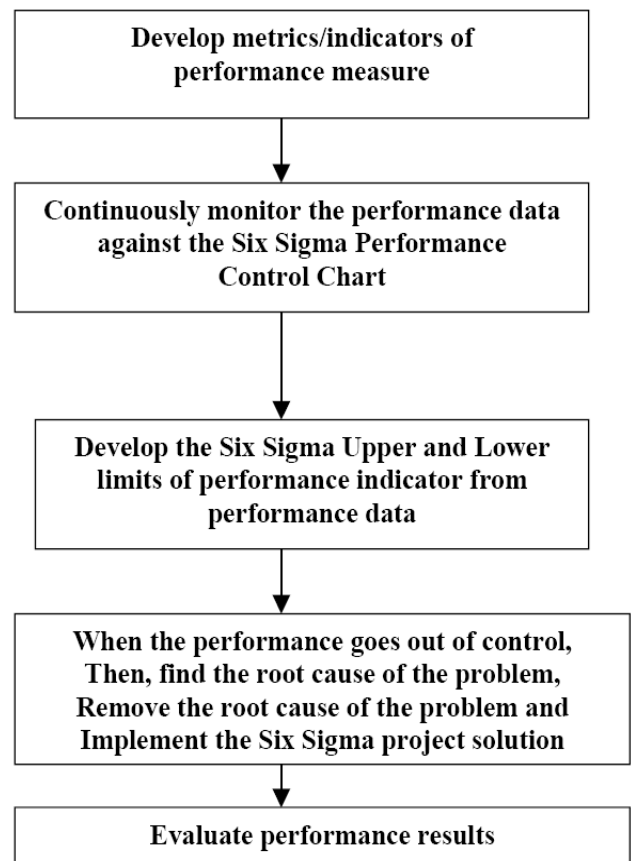


Figure1. A model of Six Sigma approach to health care quality improvement (Source: Bandyopadhyay and Coppens.)

Six Sigma at Red Cross hospital at Beverwijk, Netherland

JaapVan den Heuvel, Ronald Does, and Soren Bisgaard (2005) reported the successful implementation of Six Sigma in Red Cross Hospital at Beverwijk, the Netherlands .. The Red Cross Hospital at Beverwijk is a

384 bed general with a staff of 930 and a annual budget of \$70 million. It also runs a 25 bed burn care center. In 2002 the hospital admitted 11,630 patients, performed 8269 out patient treatments and received 190,218 visits to its outpatient units. During the past four years, the hospital invested significant resources to build a quality assurance system and in 2000 they received ISO 9002 certification. Employees of the hospital were good at solving quality problems, but did not have a project management system to evaluate and prioritize projects.

Problems in project management at Red Cross Hospital included issues such as misalignment of project goals with strategic goals, lack of a process to determine project relevance, lack of a procedure for evaluating project cost effectiveness, poor project decision making,

lack of ability to access potential savings of other projects, and lack of project monitoring and project comparison tools. All of these issues led to wasted time and money in project planning and execution.

Another problem for Red Cross Hospital was that employees were not relieved of other job responsibilities to work on quality improvement projects. They had limited time to spend on these projects which often resulted in delayed implementation and delayed savings from the projects.

Management at Red Cross Hospital knew they needed a change and turned to Six Sigma for a project management approach. They believed the structure of Six Sigma would help their organization in many ways, including decision making based on scientific facts and data, project milestones for monitoring progress, well defined project roles and responsibilities, tools and statistical techniques to use, and well defined interfaces with the existing organization.

Six Sigma was initiated at Red Cross Hospital by an external consulting company at the end of 2001. At first, the upper management received a one day training class. Then, the quality manager was trained as a Six Sigma black belt followed by green belt training for a group of employees. Additional waves of training were held to educate more black belts and green belts on the Six Sigma process. The minimum projected cost savings to initiate a project was set at \$25,000. A master black belt from outside the company was hired to accelerate the adoption of Six Sigma at Red Cross Hospital.

The first group of green belts initiated seven projects and successfully completed six.

The first successful project shortened the length of stay of patients with chronic obstructive pulmonary disease. This resulted in more possible patient admissions and an annual savings of \$40,000. The second success for Red Cross Hospital came by reducing errors in invoices from temp agencies. This project resulted in annual savings of \$75,000 and a one time savings of \$35,000. The third project involved standardizing payment policies for the

hospital suppliers. This standardization brought in \$35,000 in savings. Reducing mistakes in invoices was the fourth project. The percentage of invoices with mistakes was reduced from 9% to 1% which resulted in savings in excess of \$200,000. The fifth project provided accommodations for parents to stay with their hospitalized children. Having parents with children resulted in shorter hospital stays for the children. In addition to helping children go home earlier, the hospital saved \$30,000 annually.

The sixth and the final project reduced the number of patients on intravenous antibiotics. In addition to developing a standard operating procedure for administering antibiotics, Red Cross Hospital also realized annual savings of \$25,000. These Six Sigma projects not only helped Red Cross Hospital in their quest for happier and healthier patients but also resulted

in \$440,000 in savings for the hospital. Red Cross Hospital plans to continue using Six Sigma as part of its quality management system (Heuvel, Ronald, and Bisgaard, 2005).

Good Samaritan Health Systems in Kearney, Nebraska
Lazarus, Fache, and Neely(2003) reported the successful implementation of Six Sigma in Good Samaritan Health System in Kearney, Nebraska, a 287 bed regional medical center.

To improve patient throughput in their operating room, where there were many cancelled or delayed surgeries. After reviewing data, the Good Samaritan found that most cancelled surgeries were cancelled within 48 hours of the scheduled time. This makes it difficult to schedule other surgeries in the available time. The Six Sigma project was to define the causes for the delays and cancellations, so that throughput through operating room can be improved. The hospital has been collecting cancellation data for years and is now finally able to use it. for improved scheduling and improved throughput through operating room. (Lazarus, Ian, and Neely, 2003)

The Charleston Area Medical Center (CAMC) in West Virginia

Lazarus, Fache, and Neely(2003) also reported the successful implementation of Six Sigma in Charleston Area Medical Center (CAMC) in West Virginia. They used a process they called PDSA (Plan, Do, Study, Act) to reduce cycle times and change many processes at their facility. Since, PDSA did not show any statistically significant improvements in reducing cycle times. CAMC needed a better process. The executive team did not believe they were able to get commitment from employees for change or that they were able to alter processes for lasting change. Six Sigma seemed like a

good choice to bring change, however there was some management resistance to the program. Most of the resistance centered on competition for resources and the fear that Six Sigma was another passing trend that would come and go quickly. To engage management support, executives were given the opportunity to select the first projects and data was used to show the gaps that existed between actual and desired performance. Trained Black Belts were hired and employees at CAMC were trained in Six Sigma. Managers were required to have Six Sigma competency within five years. Six Sigma has now been successfully used at CAMC in medication safety, coordination of care, recruitment of new employees, reduction in denials of payment, and reduction of inventory.

As these examples show how Six Sigma have been effectively used in the healthcare industry. Even though Six Sigma was originally designed for the manufacturing industry, it has already been leveraged into service industries to help them achieve Six Sigma level of performance.(12).The entire service industry in the United States has an average sigma level between 2.0 and 2.5 which translates to between 158,700 and 208,500 defects or failures per million opportunities. Specific examples in healthcare include a sigma level of 1.0 in the use of beta blockers to treat high blood pressure and other cardiac problems, a sigma level of 2.0 in treating depression, a sigma level of 4.0 in treating injuries, and a sigma level of 3.0 in antibiotic use These sigma levels are quite low, indicating that Six Sigma approach to improving quality and productivity could be beneficial to health care organization in improving patient care(Lasarus, Ian, and Neely, 2003)

CONCLUSION

Understanding, meeting and exceeding patients' needs and expectations, a healthcare organizations can improve patient outcomes, and at the same time can remain competitive by cutting costs and improving quality.Six Sigma is relatively new to the healthcare industry so there are more opportunities that can be explored. Patients or prospective patients could be used as team members on Six Sigma projects. An outside perspective can also be beneficial in determining what patients want and do not want. For example, some Six Sigma projects may look into minimizing patient length of stay in hospitals after a certain procedure. Most patients want to go home as soon as possible, however some patients

might not be able to take care of themselves or might be in too critical of a condition to risk leaving the hospital. This is where a patient representative on a Six Sigma team could be beneficial. Six Sigma may also be applied to the triage process in emergency rooms. Patients may be interviewed when they arrive at the emergency room to determine the extent of their illness and their priority to see a doctor. This process could be streamlined by the use of Six Sigma so that critically ill patients can quickly see a doctor and not get stuck in the triage process.

Six Sigma can also be used to decrease the time patients spend in the emergency room. by getting patients admitted to hospital rooms or discharged quicker. Patient rooms are more comfortable than the emergency room and it is also very expensive to stay in the emergency room. Also, this could allow emergency rooms to treat more patients.

Hospital laboratories are another area of healthcare that could benefit from Six Sigma. Laboratory turnaround times can be lengthy and the workload could be sporadic rather than constant. Six Sigma can be used to help manage these issues by optimizing resources. Laboratory procedures can also be investigated to ensure that unnecessary steps are minimized while still obtaining the desired results.

.Six Sigma can also be used to optimize the scheduling of time for the testing equipment such as MRI machines and the resources to operate these equipment. Also, scheduling can be done in such a way that patients most in need of the services can be scheduled giving higher priority

The Six Sigma approach can also be used for designing new hospital facilities and also remodeling existing ones. The flow of patients should be considered for facility planning and layout of operating rooms, laboratories, and waiting rooms, considering factors such as convenient locations for the patients, doctors and visitors. A patient voice of customer study may be done so the décor and layout of patient rooms are comforting and pleasing to patients while remaining functional for doctors and nurses. Operating room layouts may also be optimized for surgical procedures.

Thus, Six Sigma approach to quality and productivity improvement can be successfully used in health care industry similar to the ways Six Sigma approach is being used successfully in manufacturing industries.

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