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Six Sigma: Improving the Quality of Operation Theatre
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Abstract

Aligning Total Quality Management (TQM) by applying SIX-SIGMA in the health care setup gives a strategic dimension to hospital manager to reform the system & functions to obtain zero error hospital. This study proposes the DMAIC Six Sigma approach of Define, Measure, Analyse, Improve/Implement and Control (DMAIC) to improve the process in the Operation Theatre of a corporate multi specialty hospital in Bangalore, India. The DMAIC approach showed a wider application and how the healthcare organisation can achieve competitive advantages, efficient decision-making and problem-solving capabilities within a business context. The paper identifies each stage in detail, discusses the tools required and points out the limitations to the success of the improvement initiatives. The paper develops a Design DMAIC Model that can be used as a template for improving the Operation Theatre Process in hospitals. Six Sigma is complimentary to other initiatives such as ISO, JACHO, TQM, NABH etc. The study recommends many OT related solutions for framing policies, for consultants and for supportive staff, engineering and IT services.

Keywords: operation theatre; six sigma; Define, Measure, Analyse, Improve/Implement and Control; DMAIC; total quality management; hospitals; service quality.

1. Introduction

The Advancement in technology, globalization, privatization and liberalization policies have significantly changed the health care scenario all over the World. Management of
Quality is the key issue of all the private, public as well corporate healthcare organizations. Corporatisation and competition in healthcare sector are forcing healthcare organisations to look for new ways and means for improving their processes. This is for improving quality of the hospital’s products and services and reducing patient dissatisfaction. As healthcare sector is becoming more complex, the opportunities for errors abound.

The optimization of work forces with zero (minimal) error strategy is achieved best by applying the Six-Sigma concept to hospitals. Six Sigma is a business improvement approach that seeks to find and eliminate causes of defects and errors in manufacturing and service processes by focusing on outputs that are critical to customers and results in a clear financial return for the organization. The Six Sigma concept characterizes quality performance by defects per million opportunities (dpmo), computed as DPU*1,000,000 opportunities for error (or, as is often used in services, errors per million opportunities – epmo). To reduce the errors and to move towards perfection, most of the corporate hospitals are now functioning at Three Sigma or Four Sigma quality levels. There is a need to breakdown the traditional boundaries that separate physicians, hospital administrators, pharmacists, technicians and nurses by shifting away from a culture of blame and by working together to systematically design safer, more effective and efficient systems. Six Sigma methodologies can help in this and can change the face of modern hospital and healthcare delivery system. Six Sigma can reduce variability and waste, translating to fewer errors, improve customer satisfaction, provide better processes, greater patient satisfaction rates, and happier and more productive staff. The popularity of Six Sigma is growing in healthcare industry.

The healthcare organization in this study initiated a Six Sigma initiative to improve the situation and attain quality sustainability with the following specific objectives:

- study the Existing Model of OT functioning with respect to Infrastructure, Process & Outcome.
- find out the Overall OT Utilization
- To identify & Describe the Performance Gap.
- identify the Root causes to address the Performance Gap
- develop action plans for implementation
- standardize & implement the Action plans
- identify the Benefits, Difficulties & lesson learned

The paper is organised into four sections to tackle these objectives. In Section 2, a literature review of Six Sigma in healthcare is provided. In Section 3, a background description of the methodology is presented. Section 4 draws conclusions on the DMAIC Model adopted in the study.
2. Six Sigma in Healthcare

In the health care area Six Sigma applications have been reported to shorten the patient visiting time in hospitals, improve quality of care and contribute to more efficient administrative processes (van Heuvel et al., 2004)). Practical applications of Six Sigma in health care are described in e.g. van Heuvel et al. (2004), Woodard (2005) and Frings and Grant (2005). Stahl et al. (2003) argue that processes in the health care area often are poorly designed compared to industrial processes. Hence, Stahl et al. (2003) believe that the limitations of improvements in health care will be experienced earlier than in industrial processes. Further, the need of a defined process owner and a process management system has been identified as a key factor for sustained long-term improvements from Six Sigma implementation in healthcare (Simmons et al., 2004). In their review of quality improvement efforts in healthcare, Boaden et al. (2008) conclude that ‘given the relatively unobjective accounts of Six Sigma in healthcare to date, it is not possible to give independent views on the reported outcomes’ (Tseng, 2009).

Lean and Lean Six Sigma applications in healthcare require an understanding of how the tools and methodologies translate to the people-intensive processes of patient care. Once applied, the possibilities are endless. Using Lean Six Sigma, Morton Plant Hospital in Clearwater, FL, improved patient satisfaction over 50%, reduced emergency department length of service by 21%, and recovered over $4 million in cost of quality (http://asq.org/healthcaresixsigma/)

A study by Janice Ahlstrom, etal (2007) explains the lean methodology implications in health industry & involvement of cost, & certain factor which are critical to quality in hospital scenario. Vinukondiah.K, Ananthakrishnan.N, Ravishankar.M. explored the time gap between two cases i.e. end of previous case till the start of next case. This is one of the important phases in OT, where many activities are overlapped viz., information to the next case, coordination with next case surgeons, anesthetists, nurses, technicians. A research study by Dexter F, Macario A, Traub RD.(1999) carried out at a tertiary care hospital with the objective of assessment of utilisation of OTs and identification of bottlenecks(Tseng, 2009). The authors suggest a centralized structure & policy making for the better utilization of the OT; here the authors emphasise on the variable factors like surgical timings benchmarking which was done in the specialization categories such as Gastro,Cardio, Neuro, and Dermatology. The study revealed that the utilisation though satisfactory could be further maximised by increasing the operational timing of OT, functioning two shifts of 08 hours each and performing minor procedures in minor OTs of the OPD. The study identified the non availability of the Operating Room Manual and non adherence to OT timings as the main bottleneck.

The present Interventional Study has been carried out over a period of six months in a Multispecialty Corporate Hospital situated in Bangalore, Karnataka, India. A sample of five hundred and ten [Enumerative sampling] has been used for the study.

- The primary data comprised of: The Observational Data collected in OT; Direct Tracking of the Cases in the OT; Direct Interaction with DyMS, DMS, OT HOD,
Anesthesiology HOD, OT Manager, OT Secretary, Six-sigma Coordinator, and Survey of Consultants.

- The Secondary Data is gathered from the OT records (Track Sheet, OT register, Case file Register, Back office Register, Housekeeping Registers, Travel Record); Patient Files (MRD, EMR’s); Literature Reviews and Guidelines Data from JCI Manuals.

Various tools such as Measures of central tendency & Measures of Dispersion fish bone analysis model, Pareto charts, graphical representations were used for analysing the data.

3. The DMAIC Approach

The methodology used in this study is DMAIC, considering the baseline data of 6 months. As this is experimental study it involves the data before & after the implementation of the corrective steps.

3.1 DEFINE PHASE: [DMAIC]

In the Define step, a Six-sigma team refines its problem statement & goals, identifies the factors which are critical to quality. This also ensures the business goal, priorities & expectations. 3 major outputs from the define stage are;

- Project Charter
- Measurable customer Requirements
- High level process Map

3.2 MEASURE PHASE: [DMAIC]

Measurement process was done as per the Phases predesigned; a proper Performa was developed for each phase to collect the valid data with the reasons. Here the DCP (data collection plan) was made.

3.3 ANALYSIS PHASE: [DMAIC]

This phase falls into 2 categories: Data analysis & Process Analysis

Process Analysis: A detailed look at the key processes that supply customer requirements in order to identify cycle time, rework, down time, & other steps don’t add value for the customer.

Data Analysis: Using the data collected to find patterns, trends, & other differences that can suggest, support, or reject the factors about the causes of defects at service or production.
**Reasons for case Delay & Cancellations**

The diagram shown below gives a detailed plan for the future to look into the various reasons & timings to be noted in the control phase. Noticeable factors in this cause & effect diagram are, Delay in cleaning work, delay in administrative coordination work, delay in OT arrangement work, and importantly status of patient readiness.

**Reasons for Increased TAT between Cases**
3.4. IMPROVE PHASE: [DMAIC]

In this study the improve stage was functioned through a strong brain storming session with all the team members & experts of the department, lead to the formation of 2 protocol designs for the smooth functioning of OT addressing major issues like; Scheduling cases & Schedule adherence of 1st cases.

3.5. CONTROL PHASE: [DMAIC]

It’s the most crucial phase among all, being this project in the OT which is the vital to the hospital, still made work at this project much fundamental & Trent oriented. At this phase various supervisory activities are designed for all the team members & it took lots from the top management also.

Table 1: Comparison of Sigma status from baseline sigma to current sigma state

| Events        | Defects/Errors | Opportunities | DPMO     | Errors per Year | Baseline Sigma | Cost of Error per year |
|---------------|----------------|---------------|----------|-----------------|----------------|------------------------|
| First case Delay | 49             | 182           | 269231   | 590             | 2.11           | 2,65,50,000             |
| Cancellations  | 92             | 341           | 269795   | 1108            | 2.11           | 4,98,60,000             |

Table 2: Sigma status after Implementation Phase

| Events        | Defects/Errors | Opportunities | DPMO   | Errors per Year | Sigma status | Cost of Error per year |
|---------------|----------------|---------------|--------|-----------------|--------------|------------------------|
| First case Delay | 10             | 182           | 54945  | 120             | 3.11         | 54,00,000               |
| Cancellations  | 12             | 421           | 28504  | 144             | 3.4          | 64,80,000               |

First cases delay cost was Rs 2, 65, 50,000/- Rs & cancellation of cases cost amounted to Rs. 4, 98, 60,000/-. The overall amount was Rs.7, 64, 10, 000/- . This interventional research study helped the hospital to increase the OT Utilization and also gave a annual financial savings of amount 6, 45, 30, 000 Rs.
4. Recommendations

The study recommends the following points under the broad headings:

- Recommendations with respect to Policies:
- Recommendations with respect to consultants:
- Recommendations with respect to supportive staff:
- Recommendations with respect to Engineering & IT services:
- Special Recommendations
- Operation Room management System
- Scientific OR Management:

The entire six sigma problem solving process is summarised in Table 4.

Table 4: The six sigma problem solving process

| Phase   | Step               | Primary Activity                                                                 | Primary Output |
|---------|--------------------|----------------------------------------------------------------------------------|----------------|
| DEFINE  | Establish the Focus| 42 % Utilization                                                                  | Project Objective |
|         |                    | Zero % 1st case adherence                                                        |                |
|         |                    | 0.3 % Schedule Adherence                                                         |                |
|         |                    | Goal towards 90 % Adherence of cases                                             |                |
|         |                    | Basic ailments, First case Delay & Cancellations                                 |                |
| MEASURE | Examine the Current Situation | Process Mapping Done                                                               | Strategies & their Measures |
|         |                    | Baseline Sigma 2.11 sigma                                                         |                |
|         |                    | Cost of Error per Annum, 2649.00, 690.00, 10,000 Rs                              |                |
| ANALYZE | Analyze the Causes | Brainstorm & Prioritize Root Causes                                               | Root Causes     |
|         |                    | First case Delay & Cancellations                                                  |                |
|         |                    | Schedule adherence & Fishbone Analysis                                           |                |
| IMPROVE | Act on the Causes  | Brainstorm Possible Actions                                                       | Actions         |
|         |                    | Protocol designing for Booking & Scheduling                                       |                |
|         |                    | SOP's for Incision at 8.00 AM                                                    |                |
|         |                    | Implement actions on a small scale                                               |                |
|         | Study the Results  | study the results & modify Action plans                                           | Received action Plans |
|         | Standardize the changes | Implement Actions on a Large Scale                                               | Control Plan    |
|         |                    | First case sigma 3.11, Yield of 94.52 %                                         |                |
|         |                    | Cancellations 3.4 sigma, Yield of 97.13 %                                        |                |
|         | Draw Conclusions   | Cost savings from this project 6.45, 30, 000 Rs                                  | Project Summary |
|         |                    | Discuss Future plans                                                              |                |
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