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Six Sigma and its application in Biomedical Domain revisited

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1. Introduction

Six Sigma, as indicated by its name, requires any process or product to reduce its error or defect into 3.4 defects per million opportunities [1]. Six sigma methodologies is initiated by Motorola and made popular by General Electric Company [2]. Six Sigma helps the organization to reduce the cost of operation, reduce waste or errors or defects, increase the customer satisfaction and increase employee engagement. Six Sigma is not only confined to quantitative aspect but includes many other quality related process such as management commitment, continuous training, inculcation of quality culture in the organization etc. This paper provides an overview of Six Sigma methodology, its usefulness in Biomedical Domain, its process and tools used in the Six Sigma process.

2. Uses of Six Sigma in biomedical domain

Six Sigma is widely used in the biomedical domain [3, 4, 5, 6, 7] especially in the hospitals [8, 9, 10, 11] to solve the problems in the areas such as medication errors, diagnostic errors, patient waiting times and patient safety. The cost and impact of poor quality is usually very high in clinical field as it involves the life of human beings and implementation of Six Sigma plays a vital role in reducing the cost and impact of poor quality.

The hospitals which have implemented Six Sigma have the enhanced quality of health care delivery[8,9] by streamlining the patient care process which includes reducing registration time, length of stay, optimum use of resources i.e. physician, nurse, operation theaters and materials etc.

The application is Six Sigma in laboratories [12] is significant as the precision and quality of the results are vital for the clinical decision making.

Six Sigma when applied in Clinical trial setting, It also improves the efficiency in the different stages of the clinical trial process.

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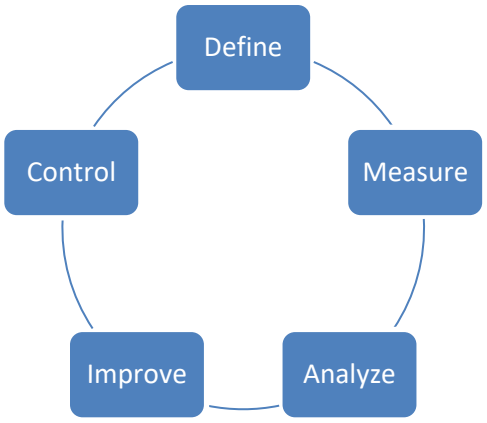
The following section discusses the hospitals were Six Sigma is implemented to improve the process

1. The University Medical Center Groningen is a level I trauma center in Netherlands improved Discharge Procedure of Patients by means of Six Sigma [13]
2. Six Sigma initiative at Mount Sinai medical center improved both patient care and business processes and outcomes [14]
3. implementation of Six Sigma at the Red Cross Hospital in Beverwijk, the Netherlands resulted in €1.2 million in annual savings [8]
4. Successful implementation of a Six-Sigma quality program in an Australian hospital Royal Victorian Eye & Ear Hospital improved the overall performance of the hospital. [15]
5. Newyork-Presbyterian hospital used six sigma to build a culture of quality and innovation [16].
6. The Richard L. Roudebush VA Medical Center (RLR VAMC) located in Indianapolis, Indiana redesigned a Joint Replacement Program Using Six Sigma [17]
7. University Medical Center Groningen (UMCG), Netherlands implemented the Six Sigma program and improved the quality of care and reduced cost of its current activities. [18]

3. Six Sigma Process

Six Sigma describes the management as project owners and middle managerial people as project leaders (Black belts) and at the next level as Green Belts. Six sigma processes are implemented in 5 phases (DMAIC) [1, 2]



1. Define

   In the define phase, the problem to be solved is identified and cost benefit analysis of solving that problem is analyzed in the subsequent steps and if it is feasible, a project is defined to solve the problem with the formation of project team comprising of Champions(project owners), Black belts (project leaders) and Green Belts.

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2. Measure
   During the measure phase, the base line data to be collected is defined and problem is defined in terms of quantifiable measurements which are Critical to Quality (CTQ).
3. Analyze
   During the analysis phase, the cause and effect relationships are identified

4. Improve
   During the improvement phase, based on the analysis carried out the team suggestion solution to solve the problem and also defines processes to implement the solution
5. Control
   Control systems are developed to monitor the improvements and improvements are sustained over time before handing over to the staff at the operation level for day to to implementation

4. Tools used during the different phases of DMAIC

The following section provides an overview of different quality tools [1,2] used during the DMAIC phase

1. Define phase

   During the define phase the following tools are used to define the problem and create a project to solve the problem

   a. Brainstorming
   b. Focus group discussion
   c. Process mapping
   d. Cost benefit analysis
   e. Pareto diagram
   f. Fish bone diagram
   g. Gantt Chart
2. Measurement Phase
   a. Benchmarking
3. Analysis phase
   a. Descriptive
   b. Inferential statistics
   c. Pareto Diagram

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   d. Fish bone diagram
   e.
4. Improve phase
   a. Design of Experiments
   b. Hypothesis testing
   c. Process Capability analysis
5. Control phase
   a. Statistical Quality Control charts

Readers can refer author's book [19] for the statistical methodologies which are used in Six Sigma processes

5. Conclusion

Six Sigma process though started in manufacturing sector now it is being implemented across different sectors including the health care sector. The paper provided an overview Six Sigma, its phases and tools used and usefulness in biomedical domain.

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