PERFORMANCE MEASURES, ANALYSIS AND IMPROVEMENTS IN HEALTHCARE SECTOR BY IMPLEMENTING TQM TOOLS AND TECHNIQUES

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ABSTRACT

To maximize the profit of organization and achieving selling target, the industries are in position to satisfy the customer needs and expectation. To stay in global business, it is necessary to indentify customer expectations and fulfil their needs. Achieving customer satisfaction is an essential task for any kind of organization such as manufacturing, service sector and trading. The main aim of this paper was to measure, analyse and improve the performance of the healthcare sector. Parasuraman et al (1985) developed the service quality dimensions model, namely SERVQUAL model. There were five service quality dimensions described in that model such as tangibles, reliability, responsiveness, assurance and empathy. Based on this model, questionnaire based market survey was conducted from patients, employer and employee of the hospital. This study was done at various hospital located at Karur and Coimbatore region of Tamilnadu hospitals. The questionnaire survey was conducted for finding the performance of the healthcare sector, 5 linker scale method used for conducting the survey, and it was evaluated and validated by SPSS software. Totally, 2500 patients, 350 nurses, 125 doctors and 25 top management people responded in this survey. Based on their suggestions, some modifications identified in hospital and implemented through applying TQM tools and Techniques. The following tools were utilized starting from 5S, kaizen, FMEA, Six Sigma, Cause and Effect Diagram, Brain storming method and QFD. These tools applied in the appropriate places to improve the performance of the hospital. The outcome of this work was explained by comparing the improvements before and after implementing the TQM and tools and techniques. The comparative study was also done to exhibit the performance of the hospital. This study helped to understand the patient's expectation towards quality of service, the scope of improvements in hospital.

KEYWORDS: *Performance Improvements, TQM Tools and Techniques, Healthcare Sector & Patient's Satisfaction*

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INTRODUCTION

Achieving customer satisfaction and fulfilling their needs are primary function of service sector. Understanding the customer requirements are difficult task in service sector due to changing customer choice and competitor performance towards attracting new customers, in day to day life. In this proposed work, the lean concepts applied to service sector to enhance the performance of the healthcare sector, and the customer requirements were identified through proper market survey. There were 2500 customers participated in this survey. The purpose of the survey was to know more about the customer choice in services and their expectation towards hospital service quality. The initial stages of work continue with time study, the time study helped us to know the service complete time for a patient, this service time varied customer to customer, because of nature of diseases. Furthermore, this study helped us to know the non-value added activities in hospital during in and out services. The

5S concepts implemented for identifying wastes produced in hospital.

In this paper, section 2 clearly explains literature surveyed, related to the proposed work. The problem identification and objective of this work are explained in section 3. The flow chart of proposed work, the methodology adopted for this work, the market survey and data collection were explained in section 4. The obtained results are explained in session 5. Results discussion and research limitations are explained in section 6. The final section 7 explains the conclusion of our proposed work.

LITERATURE SURVEY

Parasuraman et al (1985) developed the service quality dimensions model, namely called SERVQUAL model. There were five service quality dimensions described in this model such as tangibles, reliability, responsiveness, assurance and empathy. Our proposed survey was conducted based on this SERVQUAL model. According to P. Punnakitkashem (2013), Lean management has been widely recognized from manufacturing and service organizations as managerial philosophy, to reduce wastes and increase values to customers. Gabriela S. Spagnol et al (2013) conducted research on lean principles in healthcare. This study explained the various challenges and improvements in healthcare through applying lean principles. Silva et al (2013) presented the hypothesis of using Lean Startup in the healthcare segment as a way of improving the process of creation and development of new products and services in the industry. Jaroslava Kadarova et al (2016) explained the applications of lean manufacturing in healthcare sectors. James R. Langabeer et al (2009) explained the better understands how Lean and Six Sigma fit in the healthcare industry and to explore goal and value attainment. Karine Borges de Oliveira et al (2016) developed Lean Healthcare as a Tool for Improvement: A Case Study in a Clinical Laboratory. According to Nathan Houchens (2013), Modern healthcare organizations comprise complex processes and are in significant need of improvement in the domains of safe, efficient, timely, and appropriate delivery of care to patients. John S. Toussaint et al (2013) provided a template for health care leaders to use in considering the implementation of the Lean management system or in assessing the current state of implementation in their organizations. Antonio D'Andreamatteo et al (2015) done comprehensive review of lean in healthcare, the application of lean concepts in healthcare sector, the scope, advantage of lean discussed elaborately. Chris Hicks et al (2015) applied the lean concepts to design of healthcare facilities, this paper evaluates the application of the Lean 3P (production, preparation, process) participative design method. Linda A. Winters-Miner et al (2015) explained the lean case studies with example, the key tools of lean explained. The application of lean discussed with various case studies.

PROBLEM IDENTIFICATION

From the literature work and market survey, the following problems were identified

- Day to day life changing in Customer choice / customer expectation towards hospital services: The customer choice varied from customer to customer, they were expected complete service from organization. It is very difficult task for identifying in varying customer expectation.
- Increase in competitor performance: The competitors are doing market survey effectively to know the customer expectation towards service quality and they are changing in their business strategy frequently for attracting the new customer by implementing new policies.
- The lack of managerial concepts among in healthcare sector: the healthcare sector not adopted the new managerial

or not updated continuous improvement tools and techniques in their organization.

OBJECTIVE OF THIS WORK

Identifying customer expectation through proper questionnaire based market survey, Identifying non-value added activities and elimination of waste produced in hospital, Improving overall effectiveness of the hospital: improving the benefits of customer, employee and employer of the hospital, to achieve the customer satisfaction in healthcare services & calculation of hospital benefits before and after implementing lean concepts.

METHODOLOGY

FLOW CHART

The above flow chat shows the step by step procedure for conducting research on implementation of lean concepts in healthcare sectors.

MARKET SURVEY

Parasuraman et al (1985) developed the service quality dimensions model, namely called SERVQUAL model. There were five service quality dimensions described in this model such as tangibles, reliability, responsiveness, assurance and empathy. There were questionnaire based 2500 responses, collected from customers to know about their expectation towards hospital services.

TIME STUDY

The time study was conducted for calculating the standard time required for servicing a patient and allowance time needed for a staffs in their work. The time study applied for servicing a patient for consulting and treatment time. The service time varied from customer to customer, because of the nature of diseases and treatment. The time study calculated the hospital nurse performance rating, allowance time for a service and standard time required for servicing a patient.

LEAN MANUFACTURING

Lean manufacturing is an effective tool for identifying systematically non-value added activities in a process. After conducting time study, the non-value added activities identified & eliminating wastes produced in hospital.

5S

The 5S concepts implemented for keeping our workplace make clean and neat. Through 5S, the waste were identified and eliminated in hospital.

DATA COLLECTION

MARKET SURVEY

The questionnaire based survey was conducted from patients. For responding the survey, 2750 patients had been selected randomly and 2500 of them were participated in the survey and returned their answers. In order to obtain data regarding the patient's expectations, perceptions and important weights of service elements, a 20-item SERVQUAL questionnaire was employed (four questions for each SERVQUAL dimension). Responses were on a 5-point Likert scale from (1) to strongly disagree (5). The Cronbach - Coefficient Alpha was used to test the construct reliability (92.1 for expectations, 92.6 for perceptions, and 93.8 for indicating importance weights).

For this survey, first we found the average score of each question. Then, by computing average for each section (corresponding to a SERVQUAL dimension), we found the average score of each dimension. Finally, we used importance weights as coefficients for each dimension. The difference between weighted averages of expectation and perception data reveals the existing service gaps in service quality of this hospital organization. If the gap amount is positive, this means that patients are satisfied with the level of service quality and they do not expect better service from the hospital. The negative value of the gap denotes that the patient's expectation regarding hospital services is more than what they perceive from the currently offered services.

OBTAINED RESULT

IMPORTANCE WEIGHTS

By patients' perspective, the most important of services in the hospital were Responsiveness and assurance. From the patient's point of view, tangibles, reliability and empathy are respectively less important. Table 1, shows the dimensions and their assigned weightings.

Table 1: Assigned Importance Weights

S. No	Dimension	Importance Weight
1	Tangibles	0.16
2	Reliability	0.17
3	Responsiveness	0.26
4	Assurance	0.25
5	Empathy	0.18

SERVICE GAPS

Table 2 shows the results of gaps analysis for each service dimension based on SERVQUAL model. Considering the table, it can be concluded that there is a gap in every aspect of hospital service quality.

Table 2: Service Gaps

S. No	Dimension	Perceptions (Avg.)	Expectations (Avg.)	Difference (Gap)	Weighted (Gap)
1	Tangibles	3.35	6.2	-2.85	-4.1
2	Reliability	4.20	6.70	-2.5	-0.31

Table 2: Contd.,					
3	Responsiveness	3.37	6.10	-2.73	-0.66
4	Assurance	3.65	6.01	-2.66	-0.62
5	Empathy	3.75	5.9	-2.15	-0.44

The negative sign for computed gap shows that the average of observed expectations is more than current perceptions. The gap in tangibles dimension (-2.85) is caused, because of the leakage in physical facilities, personnel care and hospital equipments. This was the biggest gap without considering the important weightings and shows that the patients are not completely satisfied with the level of service quality in tangibles dimension. Responsiveness is another big gap, which means that the hospital staffs do not pay enough attention to address the patient's requirements. From the findings, it is obvious that patients are not enough satisfied from the responsiveness of the hospital staff. The gap size is -2.66. Also, a meaningful gap can be seen in assurance, empathy, and reliability dimensions. But the amount of dissatisfaction is less than the other existing gaps.

It is clear that all the dimensions of hospital service quality do not have same importance from the patient's point of view. By considering the importance weights, the ranking of the results will change. Table 3, shows the ranking of service quality dimensions regarding the amount of gap by taking the importance weights into account.

Table 3: Dimensions Ranking

Rank	Dimension	Weighted Gap	Percentage
1	Responsiveness	0.68	44.23
2	Assurance	0.62	38.26
3	Empathy	0.53	32.48
4	Reliability	0.42	29.45
5	Tangibles	0.31	22.43

In Table 3, the percentage column represents the final share of each service dimension in the overall service quality gap.

FAILURE MODE AND EFFECTIVE ANALYSIS

Failure Mode and Effect Analysis (FMEA) is an effective tool for continuous improvement in any processes and services. In FMEA method, the Risk Priority Number (RPN) calculated for finding the high risk failure mode. The RPN is calculated by multiplication of Severity (S), Occurrence (O) and Detection (D). Severity is the assessment of the seriousness of the failure effect, Occurrence is the chance that one of the specific causes will occur, and detection is assessments of the likelihood that the current controls that detect the cause of the failure mode. In this proposed method, the failure mode predicted for health care services to improve the operations, functions, services etc. In this proposed work, 2500 responds were collected from patients to know more about their response in severity (S) of the service components. The 350 responds were collected from staff nurse, receptionists for identifying the Occurrence (O) and for detection (D) 125 doctors and 30 responds collected through customer relation officers, those who are working in healthcare sectors.

Table 4: Rank of Risk Priority Number (RPN)

Service Component	RPN value	Rank
Tangibles	294	4
Reliability	504	1
Responsiveness	336	3
Assurance	228	5
Empathy	392	2

From this calculation of risk priority number, we understand that, the patients expected reliability in services as the most important service components and reliability got first rank in risk priority number. The empathy got second rank in RPN, the patient expected individual caring and attention to their problem. The other service component responsiveness, tangibles and assurance got third, fourth, fifth rank in risk priority number, respectively.

The table 5 shows the calculation of risk priority number for different service component, 5 likert scale method, used for conducting questionnaire survey, and it was evaluated and validated by SPSS software.

Table 5: Calculation of Risk Priority Number (RPN)

Process Function	Potential Failure Mode	Potential Effect(s) of Failure	Severity(S)	Potential Cause(s)/ Mechanism(s) of Failure	Occurrence(O)	Current Process Controls	Detection(D)	RPN = S*O*D
Analysis of healthcare service quality	Tangibles	Unable to meet the patient expectation, so dissatisfied in service which leads to reduce the profit of the hospital	6	The improper planning in layout and facilities of hospital	7	The proper facilities to be provided	7	294
	Reliability		9	The diseases not cured after enough treatment	8	The committed services provided to patient	7	504
	Responsiveness		8	Not understand the patient requirement and needs	7	Respond to customer quires immediately	6	336
	Assurance		8	The insufficient of specialist for all diseases.	6	The employee should be professional to deal the patient in better way	6	228
	Empathy		8	Not given individual care of each and every patient	7	Take care of every patient in hospital (individual care)	7	392

CONSTRUCTION OF CAUSE AND EFFECT DIAGRAM

The cause and effected diagram was constructed for Patient dissatisfaction in hospital service quality. The main causes for the patient dissatisfaction were low reliability in hospital treatment and services, empathy in dealing with the patient, the insufficient of facilities provided by hospital, no responsiveness in services and no assurance in the hospital services. Hence, the brainstorming performed to enhance the service quality and solve the various problems arrived in hospital.

CONDUCTION OF BRAINSTORMING TECHNIQUE

In this proposed work, three methodologies were adopted, namely FMEA, Cause and Effect diagram and brain storming techniques. FMEA: the failure mode identified by calculation of risk priority number (RPN), Cause and Effect diagram constructed for finding the root cause of the failure and brainstorming session performed to make some remedial action to reduce the RPN.

REVIEW OF RISK PRIORITY NUMBER

Table 7: Review of Risk Priority Number (RPN)

Process Function	Potential Failure Mode	Potential Effect(s) of Failure	Severity(S)	Occurrence(O)	Detection(D)	RPN = S*O*D
Analysis of healthcare service quality	Tangibles	Unable to meet the patient expectation, so dissatisfied in service which leads to reduce the profit of the hospital	6	5	6	180
	Reliability		7	7	6	294
	Responsiveness		6	4	5	120
	Assurance		6	5	4	120
	Empathy		5	5	5	125

The above table 7 shows the Review of Risk Priority Number (RPN) after implementing some suggestions given by the experts' team during brainstorming session. From this result, the risk priority number reduced in all service components, still the reliability got first rank in risk priority number, which shows the patient strongly expected reliability in hospital services. The tangible was second highest RPN value and got second rank, the patients expected more physical facilities from hospital services. The responsiveness and assurance got fourth rank in RPN, and Empathy got third rank in RPN.

The expert's team suggested to implement lean concepts to improve the services, the following lean concepts was implemented

CALCULATION OF STANDARD TIME

Normal Time: Normal time or basic time is the time for carrying out a work or an element of

Work at standard rating,

$$\text{Normal Time} = \text{Observed time} \times \text{Rating factor \%} \quad (1)$$

Observed time for a patient = 7 min

The above observed time was average of 100 patient service times.

Rating factor = 0.7 was calculated by taking average of 28 staff nurse.

Normal time = 4.9 min

Allowance = 3 min was calculated by getting suggestion from chief staff nurse under various circumstance

Standard time = Normal time + allowances = 4.9 min + 3 min = 7.9 min

From the time study, the calculated servicing time for a patient was 7.9 min.

IDENTIFIED NON-VALUE ADDED ACTIVITIES

The staffs were spending more time to search the patient history document, medicine in rack and improper handling of medical equipment in hospital. Due to improper layout of hospital, the patient guiding, shifting time from one place to another place increased, the staffs went around the hospital to get multiple signatures from higher authorities. Collection of patients' personal information took long time in hospital during services.

RESULTS & DISCUSSIONS

By adopting Lean concepts, the healthcare sector is benefited in the following aspects. The benefits were calculated before and after implementing lean concepts in hospitals.

Benefits of Patient: The service time reduced for a patient from 12 min to 7.9 min and also customer satisfaction level improved. This was achieved through calculation of standard time for a patient service time during time study.

Benefits of employee: Before implementing lean concepts, the skill matrix not identified for staff nurses and the skill matrix identified by lean concepts and skill based training promoted. The average salary of the employee (Staff nurse) increased from Rs.10000 to Rs.10500 per month.

Benefits of employers: The arrival of the customers increased from 60 numbers to 85 numbers per day, by achieved customer satisfaction through lean concepts. The average revenue generated in hospital is Rs.10000/day, and it was increased by Rs.15000 per day.

Through implemented 5S concepts, by waste elimination, Rs.150 per day revenue was generated.

RESEARCH LIMITATION

This research was done at private hospital located at Karur & Coimbatore, Tamilnadu, India. The sample size taken for this research was limited. This results and benefits may not be applicable for all healthcare sectors. This research method is one of the ways to improve the organization in continuous manner. There is lot of other lean tools that were not

utilized in this research; the other lean tools were kaizen concepts, value chain mapping, visual control methods, pull system, Kanban systems, etc.

CONCLUSIONS

From this work, we identified that there was a lot of scope for applying lean concepts in healthcare sector and these lean concepts are helpful in identifying non-value added activities and systematically eliminating the waste produced in hospital. By this approach, the patient (customer), employee and employer of the hospital got benefited and satisfied. From the above mentioned literature review section 2, we identified the lean tools and techniques used in healthcare sector and understood the basic concepts and principles in lean manufacturing. The scope of improvements in healthcare sector was identified through literature review. We conclude, from the market survey, the customers were expecting more in responsiveness and assurance from hospital. Time study was conducted for calculating the standard service time for a patient, and this time study may vary from customer to customer due to the nature of diseases and treatment. Through 5S, the waste produced in hospital is minimized and non-value added activities are identified. As results show, the number of customers increased the profit of the organization by 50%. By this lean concepts, the employee of the hospital benefited by increase in their salary. The conclusion is made based on the comparison of before and after implementing the lean concepts in hospital.

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