

Using lean six sigma to improve throughput efficiency at tertiary care eye hospital

Suneeta Dubey¹, Lokesh Chauhan¹, Nishi Gupta¹, Ashok Singh¹, Arun Arora¹

Abstract

Objective: To determine the impact of Lean Sigma (LS) on waiting time of patients at different stations of outpatient department (OPD), pre-surgical area and operation room (OR). **Methods:** In this prospective quality study Define, Measure, Analyse, Improve and Control (DMAIC) model of lean sigma was used for improvement. Lead time of patients during measure phase of DMAIC was assessed using time motion study. This lead time was used as control to compare lead time after LS initiatives. Lead time is the total time taken by one patient in Eye OPD. Lead time include cycle time (time taken to perform procedure) and waiting time at each station. It is calculated using value stream map at every station of OPD. Reduction in median lead time of patients in OPD and OR was used as measure of improvement. **Result:** Median lead time measured before implementation of LS initiatives was 86 minutes in Eye OPD. There was 19% reduction in lead median time in Eye OPD. This reduction in lead time generated capacity in OPD for new patients. The median time in pre surgical clinic was reduced from 1hr 22 minutes to 33 minutes. **Conclusions:** Lean approaches can have an immediate and sustained impact on patient's waiting time in OPD, presurgical area and OT with no negative effect on quality. Lean intervention generated consistent results independent of personnel during the busiest months of the year at a tertiary care eye hospital in North India.

Continuous quality improvement initiatives has become an integral component of healthcare¹. Increased patient awareness and medical insurance have led to increased expectations of patients from healthcare providers and therefore there is a need for scientific, reliable and sustained methods of quality improvement in health care. Although the lean Six Sigma (LSS) methodology has been used by many industries for quality improvement, its effectiveness has not been studied well in healthcare². This study presents a model of lean six sigma approach to health care quality management system in improving throughput efficiency.

In early 1950, Taiichi Ohn revolutionized thinking about process inefficiency or "waste"³. Application of this thinking resulted in the term lean in many industries including health care. Lean methodology focuses on needs of the customer. It maps every step of a process as value added and non value added activities. Lean methodology improves the processes by removing non-value added activities⁴. One of the most commonly used tools in lean methodology is called value stream mapping (VSM). This tool graphically displays the process of services with use of inputs, throughputs and outputs. (Fig 1)

Six sigma was originally a concept for company-wide quality improvement introduced by Motorola in 1987. The program is characterized by its customer-driven approach, emphasis on decision making based on careful analysis of quantitative data. Six Sigma deploys five phases—define, measure, analyze, improve, and control (DMAIC)—that are rigorously followed whenever a problem, large or small, is approached⁵.

Lean six sigma is the synthesis of lean and six sigma. It focuses on dramatically improving flow in the value stream and eliminating waste and reducing variation in processes and thereby reducing errors. It offers a structure for organizing continuous improvement of routine task⁶.

The aim of this study was to determine the impact of Lean six sigma on waiting time of patients at different stations of Eye outpatient department (OPD), pre-surgical area and operation room (OR) to increase throughput efficiency in operation room and thereby improving the OR utilization

Material and method:

Lean sigma team including six core members, two champions and six stake holders was identified. A Kaizen

¹Dr. Shroff's Charity Eye Hospital, 5027, Kedar Nath Road, Daryaganj, New Delhi, India.

Corresponding Author : Dr. Suneeta Dubey, E-mail: suneeta@sceh.net

Received on : 20/08/2016, Revision accepted on : 30/11/2016

Conflict of Interest : None, Financial Disclosure : None

●Presented at AIOC 2016 in Kolkata

© Current Indian Eye Research.

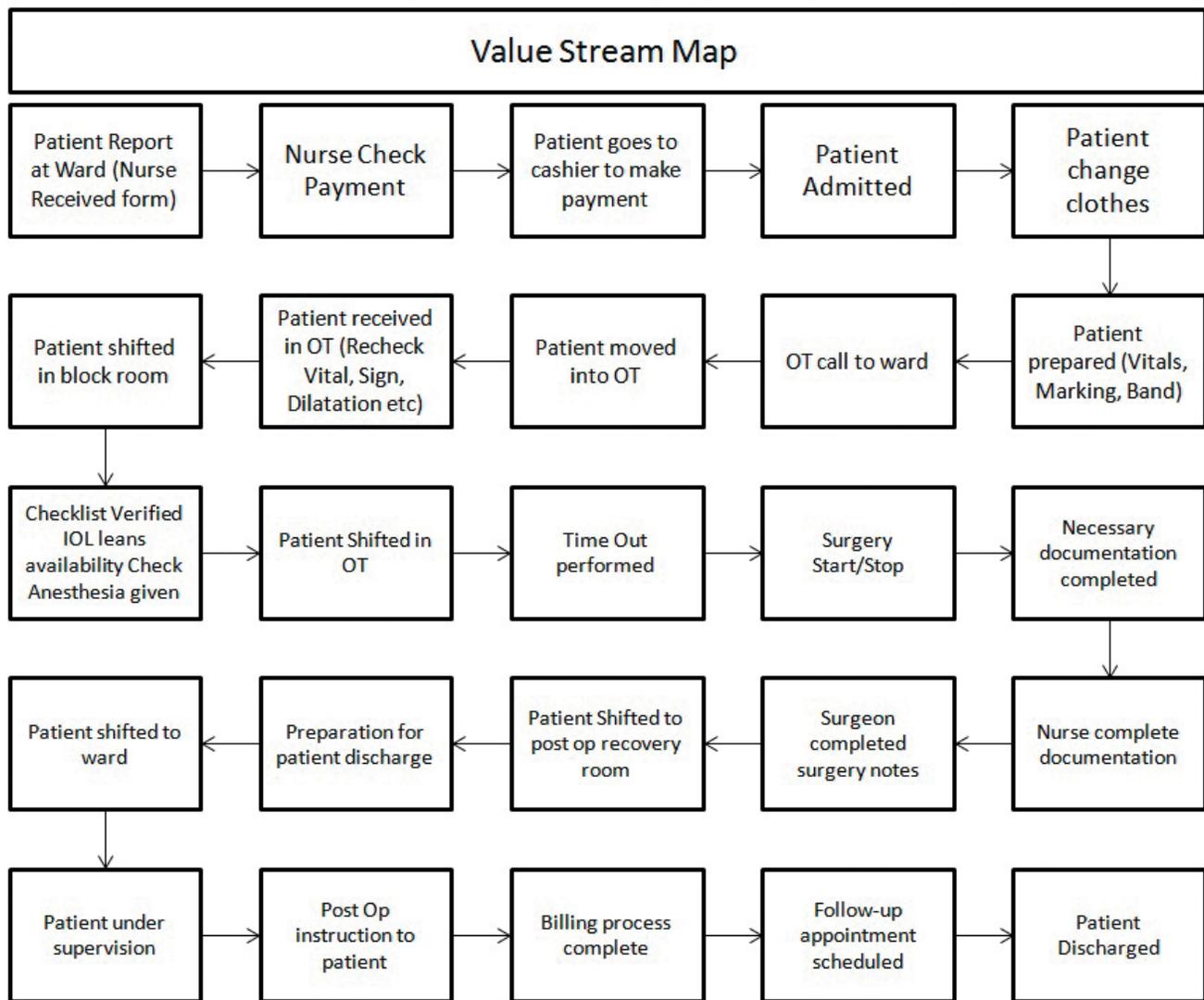


Fig 1: Value Stream Map

event was held ⁷. Kaizen is a Japanese word typically translated to “continuous improvement” wherein the team sits in one room to do brainstorming.

In the first phase of the DMAIC process, that is the define phase, a charter is drafted to highlight the problem. The hospital is a 100-year-old tertiary care eye and ENT hospital in north India. The problem statement in project charter was “EYE operation room does not have the capacity to accommodate patient growth. The operational challenges included unpredictability of cases per day, room turnover time, OPD workflow (from registration to surgery preparation), waiting time, registration process and delayed OT start time”. The expected benefits of achieving these goals are: increased number of OPD patients, decrease

in delays for first case in OR, optimal flow for workspace, eliminate unnecessary motion and re-work steps, increased patient capacity. All these would lead to increased patient satisfaction which remains the ultimate goal of any health care organization.

In the measure phase, value stream map of current processes were made (Fig 1). The problem was translated into quantifiable characteristics and baseline data was collected. Lead time of patients using time motion data of every step of value stream map was collected by independent team on predefined formats. Waiting time was captured at each step. This lead time was used as control. Reduction in median lead time of patients in OPD and OR was used as measure of improvement.

Table 1: Results of improvement

Metrics	Original	Goal	Pilot	Post Event	% Change
Eye OT Starting Time	—	8:45 AM	ON TIME		
Eye OT Finish Time	—	4:45 PM	4:14 PM		
Lead Time Eye OPD	118 Min	22% Reduction	—	95 Min	19% Reduction
Lead Time Eye OT	245 Min	—	—	230 Min	6% Reduction

In analysis phase identification of non-value added activities was done on value stream map. Value stream map was critically reevaluated and suggestion of improvement was discussed with stake holders. Factors contributing to the delay or waiting at a particular step were identified. Spaghetti diagram was made to identify redundancies in the work flow. Spaghetti diagram is the visual creation of workflow. Gemba walk was done to assess the actual workflow of OPD and OR. Gemba is a Japanese term meaning “the real place”. LSS team visited the OPD and OR area to assess the actual workflow. Based on spaghetti diagram and gemba, staff reallocation and possible modification of standard workflow were discussed with stake holders. During this phase, four area of concern were identified. They were complex scheduling, lack of operational standardization, excess motion and waiting.

In improvement phase, lean improvements were determined and implemented. New protocol was made for scheduling of OR. Template was made for OR scheduling as per the new capacity. Visual matrix was made for each OR to capture and display OR starting time (Fig 2).

Unnecessary and repeated steps in the workflow were removed. File holders was placed in ward and registration area for first in first out (FIFO). One registration counter was started for giving appointments in registration area. One counselor was placed in OPD to reduce motion of the patients. Color maps were made for patients in key areas in hospital. This color map was printed in the instruction sheet given to patient. Patients were instructed to report in the designated area for their follow-up. Announcement system was started in the OPD. Floor manager was appointed in the OPD to guide patients. Pilot was done before implementing the new workflow.

After completion of improvement phase results of pilot were discussed with stake holders. All the stake holders were agreed for staff relocations, modification in the standard workflow and other recommendations. All these changes were inculcated in the standard workflow. Training was given to concerned staff on modified standard workflow. The modified standard workflow was implemented. A control plan was developed with defined responsibilities to monitor and measure improvement taken.

Visual Matrix Data

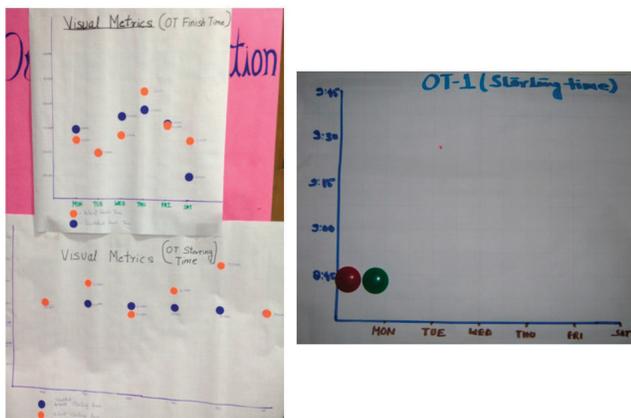


Fig 2: Visual matrix started for each OT

Results:

Median lead time measured before implementation of LSS initiatives was 118 minutes in EYE OPD. There was 19% reduction in lead median time EYE OPD. This reduction in lead time generated capacity in OPD for new patients. The median time in pre surgical clinic was reduced from 1hr 22 minutes to 33 minutes. EYE OR on time start had increased from 63% to 83%. Reduction of median lead time of EYE was 6%. In eye OR median number of surgery increased from 9 surgeries to 14 surgeries per day. (Table1). Patient satisfaction improved from 73% to 87%.

Discussion:

Operational inefficiencies in OPD and operation room affect hospital throughput and leads to crowding and increased

waiting. It contributes not only to the increased cost but also to decreased patient satisfaction. In literature the lean is reported to increase productivity, however the challenges of implementing lean in healthcare has not been reported to best of our knowledge². Pepper in 2007 reported that a closure integration of lean and six sigma must be achieved with scientific underpinning to provide theoretical foundation for lean six sigma⁸. Heuvel (2006) reported that Red Cross Hospital in Netherlands were able to do additional 400 surgeries in a year. They have also reported the reduction of length of stay in delivery room from 11.9 to 3.4 Hrs⁹. Our study also showed the similar improvements in increasing number of surgeries per day. Wiles KR reported the implementation of error reporting module within biorepository by identifying and addressing operational inefficiencies using lean six sigma methodology¹⁰. This study also implemented new protocol for OR scheduling using same methodology. Beck MJ reported improvement in throughput efficiency of inpatient pediatric service similar to this study¹¹. Goldsack et al reported significant reduction in patient fall rate using lean six sigma¹². Study by Bender et al reported outcome of lean six sigma on OR efficiency. They have reported room utilization improved from 56% to 68%¹³. In systemic review done by Meason et al, 88% of the reported studies showed improvements¹⁴. Cavaleiro (2015) used lean six sigma methodology can be used in measuring quality of care in physical therapy setting. They recommended that this methodology provides opportunity for management to identify areas for improvement¹⁵. Hina (2013) reported improvement in quality of patient care in Immunization programme. They recommended that this methodology can have far-reaching implications in terms of promoting patient health and improving the quality of care delivered by the healthcare systems and teaching hospitals¹⁶. Martens (2014) reported that structured Lean Six Sigma approach to process optimization in a hospital setting improved the efficiency and diagnostic yield. They reported 24% reduction on the number of tests and 59% reduction in median time from admission to diagnosis. The efficiency improvements came together with an increased diagnostic yield: from 42% before the implementation of new processes to 73% with the new systems¹⁷. Lean six sigma methodology has been used in variety of healthcare facilities for doing quality improvements. The results have been reported in terms of increase in number of patients, efficiency of a process, reduction in number of clinical errors and reduction in waiting time etc. All these key areas can lead to increase in patient satisfaction and ultimately the

yield of the healthcare facility. The results of our study are comparable with all other reported healthcare facilities. Since the Lean Six Sigma in our hospital is still expanding, we expect to achieve better outcomes in near future.

Lean six sigma can have an immediate and sustained impact on process efficiency with no negative effect on quality in healthcare. It can be utilized for process improvement by identification of issues, finding barriers and elimination of waste and thereby achieving continuous improvement.

Acknowledgements:

Authors acknowledge the support provided by Ms. Heather Bye-Kollbaum (Black belt- Lean Six Sigma), Ms. Kim Puleo (Black belt- Lean Six Sigma) as facilitator and Mr. Ananth Annaswamy, Ms. Sonal Sahni, Sis. Alice John, Sis. Praveen and Mr. Satyapal as core team member.

References:

1. Djulbegovic B. A framework to bridge the gaps between evidence-based Medicine, Health Outcomes, and Improvement and Implementation Science. *J Oncol Pract* 2014;10:200-2.
2. Aij KH, Simons FE, Widdershoven GA, Visse M. Experiences of leaders in the implementation of Lean in a teaching hospital—barriers and facilitators in clinical practices: a qualitative study. *BMJ open* 2013;3:e003605.
3. Young D. Pittsburgh hospitals band together to reduce medication errors. *American Journal of Health-System Pharmacy* 2002;59:1014.
4. Endsley S, Magill MK, Godfrey MM. Creating a lean practice. *Family practice management* 2006; 13:34-8.
5. De Mast J, Lokkerbol J. An analysis of the six sigma DMAIC method from the perspective of problem solving. *International Journal of Production Economics* 2012;139:604–14
6. Does RJ, De Mast J, De Koning H, Bisgaard S, editors. *The Scientific Underpinning of Lean Six Sigma*. Proceedings of the 56-th Session of the International Statistical Institute; 2007 Aug 22-29; Lisbon, Portugal.
7. Amedee RG, Maronge G., Pinsky WW. Improving the transition of care in patients transferred through the Ochsner Medical Center Transfer Center. *The Ochsner Journal* 2012;12:318-22.

8. Pepper M PJ, Spedding TA. The evolution of lean Six Sigma. *International Journal of Quality & Reliability Management* 2010;27:138-55.
9. Heuvel J, Does RJMM, Bogers AJJC, Berg M. Implementing Six Sigma in the Netherlands. *Joint Commission Journal on Quality and Patient Safety* 2006;32:393-9.
10. Wiles KR, Washington MK. Implementation of an Error-Reporting Module Within a Biorepository IT Application to Enhance Operations. *Biopreservation and biobanking* 2014;12:365-73.
11. Beck MJ, Gosik K. Redesigning an inpatient pediatric service using Lean to improve throughput efficiency. *Journal of hospital medicine* 2015;10:220-7.
12. Goldsack J, Bergey M, Mascioli S, Cunningham J. Hourly rounding and patient falls: What factors boost success?. *Nursing* 2015;45:25-30.
13. Bender JS, Nicolescu TO, Hollingsworth SB, Murer K, Wallace KR, Ertl WJ. Improving operating room efficiency via an interprofessional approach. *The American Journal of Surgery* 2015;209:447-50.
14. Mason SE, Nicolay CR, Darzi A. The use of Lean and Six Sigma methodologies in surgery: A systematic review. *The Surgeon* 2015;13:91-100.
15. Cavaleiro LV, Eid RA, Talerma C, Prado CD, Gobbi FC, Andreoli PB. Design of an instrument to measure the quality of care in Physical Therapy. *Einstein (São Paulo)* 2015 ;13:260-68.
16. Hina-Syeda H, Kimbrough C, Murdoch W, Markova T. Improving Immunization Rates Using Lean Six Sigma Processes: Alliance of Independent Academic Medical Centers National Initiative III Project. *The Ochsner Journal* 2013 Sep;13:310-8.
17. Martens L, Goode G, Wold JF, Beck L, Martin G, Perings C, et al. Structured syncope care pathways based on lean six sigma methodology optimises resource use with shorter time to diagnosis and increased diagnostic yield. *PLoS One* 2014; 9 :e100208.

Cite this article as:

Dubey S, Chauhan L, Gupta N, Singh A, Arora A. Using lean six sigma to improve throughput efficiency at tertiary care eye hospital. *Current Indian Eye Research* 2016; 3:79-83.