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LEAN THINKING IN HEALTHCARE
SECTOR: EXPERIENCE FROM
AN INDIAN HOSPITAL

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LEAN THINKING IN HEALTHCARE SECTOR: EXPERIENCE FROM AN INDIAN HOSPITAL

Experience of implementing lean thinking (LT) in a multispecialty hospital located in southern part of India is discussed. Case hospital was chosen and problems associated with various processes were identified and they were mapped to seven wastes. Solutions based on lean principles/practices were implemented and improvements were evaluated through performance measures.

Keywords: *Lean healthcare, Lean thinking, Lean production, Indian healthcare, Case study, India*

INTRODUCTION

Health care services accessibility and quality in India significantly varies across population primarily depending upon the income and location. Wide disparity is seen between India and other countries across the world in the affordability and accessibility for healthcare. By comparing the status of 2010 and 2011 health care expenditure of India with US, UK and China, it was clearly evident that for a heavily populated country like India, private expenditure on health is significantly higher than the general government expenditure on health and in particular, private expenditure contributed to nearly 70% of the total expenditure on health (2013 World Health Statistics). However, a diametrically opposite scenario prevails in a developed country such as United Kingdom where nearly 80% of expenditure on health is funded by government and only 20% by private expenditure. In China and USA, almost equal proportion of expenditure on health was shared between private and government. General government expenditure as a percentage of total expenditure on health was also observed to increase by nearly 3% from 2010 to 2011 which showed that Indian Government was attempting to increase its funding percentage towards healthcare. But the increase still remains insufficient for the increasing population and to overcome the increasing cost of living as evident from a decrease of only 3% in private expenditure in the same period (2007-2011 World Health Statistics). Simultaneous increase in population over the time period nullifies the net effect of increment in government funding for healthcare. Also, within urban and rural India, the quality and infrastructure resources available for providing health care services vary considerably. Unfortunately, according to the recent census, 70% of India's total population lives in rural India, which do not have access to quality health care (2011 Census of India). It is also to be noted that half of all residents of rural India live below the poverty line. As mentioned, even though attempts are made by the Indian Government to make health care accessible, still wide gap is noticed between per capita government expenditure on health and per capita total expenditure on health which makes quality healthcare an unaffordable luxurious good for common man in India. Therefore, there exists a real need for developing a solution to reduce the

private health care expenditure significantly and also to efficiently utilize the sparsely allocated general government funds to make the healthcare maximally affordable and in turn accessible.

On the other hand, it was a surprise to notice that India is considered to be a preferred destination for availing high quality health care at lowest cost especially by the people in other developed and developing countries. There is a marked increase in the annual medical tourism and it is predicted to earn India an amount of US\$2 billion by 2012 (Connell, 2006). Moreover, Mochi et al. (2013) too have commented that India has adequate resources and potential to meet these demands when compared to other foreign countries. For example, Fortis Healthcare Group from India mentioned in August 2013 that its international business (patients from other countries) has grown 20-25 per cent a year over the past two years and it expects 28 per cent growth in the current year (Mishra, 2013). Reasons for increasing medical tourism from foreign countries are attributed to the low cost treatment and high quality facilities (Gupta, 2008).

Thus, to achieve low cost-high quality healthcare for Indian population and to sustain the rapid increase in medical tourism i.e., to cater to the international population, application of Lean Thinking (LT) within the Indian healthcare sector can be seen as one of the potential solutions. Hence, in this study, an attempt has been made to understand the feasibility of implementing LT in Indian hospital by trying to document the experience of a case study hospital, which attempts to implement the principles and practices of LT for their health care processes. Figure 1 takes through the steps followed in carrying out this current research.

Rest of the paper is arranged as follows: Section 2 presents the literature review of studies on LT in healthcare. Section 3 describes the implementation of LT in a case hospital by listing the practices and performance measures adopted to overcome the problems. Section 4 ends with conclusions and lists out the scope for future research along with research and managerial implications.

LITERATURE REVIEW

Many studies already exist in literature discussing the LT implementation in healthcare services. Almost all studies have been reported in past seven years which indicates the importance and relevance of LT in healthcare in the present context. De Souza (2009) and Mazzocato et al. (2010) have also carried out review on studies discussing implementation of LT in healthcare. Almost all articles published confirm positive outcome after implementation of LT in healthcare. In the literature, it was also observed that most of the UK and USA hospitals have already adopted LT philosophy in healthcare and harvested significant benefits which also acts as a potential motivation for Indian hospitals to adopt them. Literature review has been performed to identify and understand the implemented practices and performance measures related to LT in healthcare all over the world (as shown in table 1 and table 2). Review also attempted to capture the country in which study was conducted, nature of data used, problem faced by the case

hospital, process in which LT was implemented, principle adopted, practices implemented, performance measures and outcome achieved.

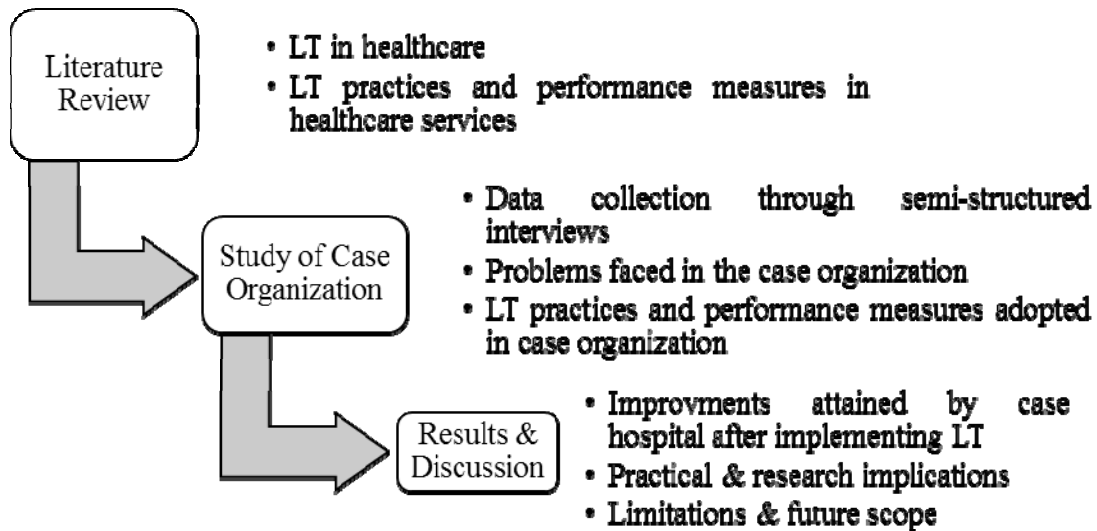


Figure 1 - Steps followed in carrying out this piece of research.

From the review carried out, no detailed study exists from the Indian context describing the procedure to understand, develop and implement LT in healthcare. The current research attempts to contribute to lean healthcare literature from Indian context by studying the feasibility of applying LT to Indian hospitals to achieve accessibility and affordability. In particular, the current study attempts to find answers for the following research questions (RQ):

RQ1: What are the lean practices and performance measures adopted in healthcare? Can Indian hospitals and other health care firms use the same practices and performance measures?

RQ2: Can LT be applied to healthcare services providing hospitals in India? If yes, how to achieve successful implementation of LT (demonstrate through a case hospital experience)?

Table 1 - Literature on LT in healthcare.

Authors	Year	Country	Case Hospital	Problem faced	Data Used	Process
Jimmerson et al.	2005	USA	Intermountain Healthcare (IHC) & Community Medical Center	Poorly specified activity and a complex pathway	Real time	Multiple processes
King et al.	2006	Australia	Flinders Medical Centre	To establish streams for patient flows in a teaching general hospital ED.	Real time	Emergency department
Weber	2006	USA	Virginia Mason Medical Center	Improve process efficiency	Real time	General processes
Ben-Tovim et al.	2007	Australia	Flinders Medical Centre	Redesigning of care	Real time	Multiple processes
Pham et al.	2007	USA	The Virginia Mason Medical Center	Redesigning care delivery	Real time	Multiple processes
Balle and Regnier	2007	Paris	Nord 92 in Villeneuve-La-Garenne, Paris	Teaching lean thinking	Real time	Nursing
Kim et al.	2007	Michigan, USA	University of Michigan Medical School	Improve patient care access and reduce excess work	Real time	Multiple processes
Kollberg et al.	2007	Sweden	Nil	Assessment of lean requirement was felt	From literature	Not mentioned.
Smith et al.	2011	U.S.	U.S. academic health system	Process improvement was required	Real time	Cystic fibrosis centers
Toussaint and Berry	2013	USA	Bellevue Clinic, ThedaCare, and Christie Clinic in Champaign	Multiple problems in the healthcare processes	Real time	Scheduling in radiology

Table 2 - Literature on LT principles, practices and performance measures in healthcare.

Authors	Year	Principles	Practices	Performance Measures	Outcome
Jimmerson et al.	2005	Defect free and no waste	(1) VSM (2) One-page problem-solving A3 report	(1)Turnaround time for reports, (2)Treatment delays (3)Number of labelling errors in laboratories.	Complexity in implementation was found to be varying from one process to another.
King et al.	2006	Waste reduction and flow establishment	(1)Process mapping with staff (2)Identification of value streams (3)Minimizing complex queuing in the ED	(1)Waiting time (2)Overall time (3)Average number of patients in the ED at any time (4)Number of patients not waiting	Emergency department patient flows was redesigned with value streams
Weber	2006	Waste reduction	(1)U-shaped cell (3)Standardized work sequencing for physicians (4) No-	(1)Number of patients getting same-day appointments (2)Walking	General process efficiency improved

			layoff policy	distances of staff (3) Defect rate	
Ben-Tovim et al.	2007	Improving the flow of patients and reducing the waste	(1)Work prioritization (2)Production “cells” aligned with value streams (3)“plan-do-study-act”-PDSA (4)Employee training programs (5) Visual management (6) Load levelling	(1)Patients leaving with incomplete care (2)Overall time patients spent in the department (3)Numbers of patients attended by the department (4)Average length of stay	(1) Decreased congestion, wasteful delays, and reduplication with improved staff morale, recruitment, and retention of medical and nursing staff.
Pham et al.	2007	Waste reduction	(1)Volume reduction (2)Staff education and reorganization (3)VSM for different disorders (4) Documentation of treatment guidelines (5)Feedback on cost performance (6)Collaboration among purchasers	(1)Costs per episode of several medical subspecialty departments (2) Instances of medical errors or near-misses (3)Physical space usage (4)Worker absenteeism	VMMC increased affordability by maintaining the quality
Balle & Regnier	2007	Waste reduction and zero defects	(1)5S (2)Systematic audit (3)Zero out-of-date practice (4)Supermarket arrangement (5)Daily ward tour (6)Standardization (7)A3 report	(1)Lead times (2)Rate of error incidents per patient (3)Time taken before responding to patient (4)Number of weekly delivery cycle	LT concepts were taught successfully
Kim et al.	2007	Waste reduction and to create flow	(1)Value stream mapping (2)One piece flow (3)Standardization	(1)Number of process steps to begin treatment (2) Number of visits to start therapy (3)Total lead time (4)Process cycle efficiency	Waiting time was reduced and value added activity was improved
Kollberg et al.	2007	Establish flow	(1)Predicting periods of high demands (2)Moving staff from periods with low demand to high-demand periods (3)Information visibility and transparency for everyone	(1)Waiting times and delays (2) Actual and expected times at 8 different points of patient entry and exit (3)Number of times and distance a patient is transported	Designed “the flow model” to measure changes towards LT in health care services by identifying key performance indicators.
Smith et al.	2011	Create value and reduce waste	(1)Voice of the customer (2)Voice of the business (3)Trained clinic staff (4)Checklist to screen records during the weekly team meeting	(1) Lead time (2)Baseline capability (3)Service level and cost (4)Staff turnover	Higher quality care and increased revenue potential was achieved.
Toussaint and Berry	2013	Waste reduction	(1)Respect for front-line workers (2)Visual tracking and flexible regimentation (3)Internal communications and teamwork (4)A3 reports (5)Color coded and numbered equipment supermarket shelving	(1)Inpatient total cost of care (2)Waiting time (3)Call volume (4)Medication errors (5)Operating room turnover time (6) Mean nursing time spent on gathering equipment	Template for implementation of Lean management system

LT Implementation in a Case Hospital

To understand the feasibility of implementing LT in Indian hospitals, a multispecialty case hospital located in southern part of India was chosen and problems associated with various processes were identified. Semi-structured interviews with doctors, nurses, support staff, and patients involved in that process were performed to gather data to understand potential problems in detail. Problems identified were analysed from the lens of seven wastes of lean and suitable lean practices along with implementation procedures were proposed for the case hospital (as shown in table 3).

Easily implementable and affordable solutions with customer focus were given preference by the case hospital to create value to the end patients. Due to space limitations, the details of each and every solution along with waste mapping and LT practices could not be explained. Performance measures capable of measuring the improvements after implementing LT in the case hospital were also proposed. Some of the performance measures adopted in the case hospital to measure the improvements during pre and post implementation of LT were total lead time, average value added time, total waiting time of a patient, average turnaround time for reports, physical space usage, worker absenteeism, walking distances of staff, percentage of cases rescheduled due to late starts and number of reports with errors.

For instance, initially scheduling process for outdoor patient department was requiring the patients to travel to the hospital and check the availability of the doctor before making an appointment. Wastes such as external transportation of patients to hospital for getting appointment, motion of patients within hospital for getting appointment, patients waiting in queues before getting their appointments as well as for meeting the physician which in turn increased the number of patients waiting for service to be delivered (inventory), over processing, and defects occurred when patients appointments were postponed and asked to begin the process from start completely on another day. To overcome these problems and remove the wastes identified, based on LT practices such as process simplification, customer involvement, cycle time and lead time reduction and work in progress (WIP) reduction a solution was proposed and implemented. Solution implemented enhanced patients to fix their appointment either by calling the hospital or using the hospital website for fixing the appointment where they had the option of selecting the timings and doctor of their choice. This solution reduced the wastes significantly as the patient directly moved for consulting the specific physician in the selected time slot on entering the hospital. The performance measures used to assess the improvements after implementing the solution in the scheduling process of outdoor patient department were waiting time at different nodes in the hospital, total lead time from entering and leaving the hospital, walking distance of patients and percentage of cases rescheduled on a single day. Waiting time and lead time reduced from hours to minutes on implementation of the solution proposed. Walking distance of the patients also reduced as they directly moved to the physician without travelling to multiple counters for fixing and finalizing the appointment which in turn was also

found to improve the customer satisfaction. Percentage of cases rescheduled on a single day reduced considerably and were found to be nil in most of the days after implementing the solution.

Another solution, Integrated Pharmaceutical Information System (IHIS) based on lean practices such as electronic data interface, information sharing, supplier involvement and sole sourcing helped pharmacy department to leverage on bulk order special deals provided by the drug suppliers as consumption pattern of each drug was tractable. System also provided patients past purchases on inputting their enrolment number which helped in storing their medication history. System also enabled supplier inventory monitoring by interfacing the information system with suppliers system which in turn reduced the instances of number of medicine stock outs in a month, reduced lead time between order and delivery, number of instances of wrong billing and number of emails transacted for order placement between supplier and pharmacy department. Table 4 provides the comparison of the performance measures pre and post implementation of two sample LT solutions discussed.

Although some of these performance measures are different from those that are proposed in the literature, the authorities in hospital would like to have the proposed measures compatible with their existing measures. Implementation of LT reduced wastes considerably and in turn solved the problems identified. Significant improvements in performance measures post implementation of LT were observed. Thus, this initial research clearly showed the potential of LT in reducing wastes in Indian healthcare system and thereby would help in progressing towards the objective of making it accessible and affordable. As current study is preliminary in nature, case hospital has to be studied in detail over a longer time period to quantify the improvements achieved and detail the issues faced as LT to be successful in an organization should be long term in nature.

Table 3 - List of practices implemented in case hospital.

Practices employed in Case hospital	Lean Practice	Implementation Procedure
Scheduled calibration and checking of equipment's	1) Zero defect principle 2) Safety improvement programs 3) Total preventive maintenance	The equipments were tracked by giving a particular serial number or asset number. Preventive maintenance of the equipment was ensured through a separate checklist against each asset number. Daily maintenance, weekly maintenance, monthly maintenance (calibration & functioning) and half yearly maintenance (servicing equipment by service engineer) were regularly performed.
Capacity Requirement Planning	1) Customer focus by maintaining spare capacity 2) Lead time reduction	Dialysis units were required by the case hospital and number of units of dialysis machines required was found by estimating the number of patients every day. Due to capacity constraints, only 3 patients in place of 4 were provided service/machine in one day. By purchasing 7 new machines with capacity cushion of 12.5%, lead time

		and back logging were reduced as patients were not scheduled for treatment on the next day.
Decision analysis in equipment maintenance	1) Employee participation 2) Suggestion schemes	Biomedical engineers were provided with autonomy to take decisions and provide suggestions based on their past experience with the equipment and process.
Scheduling staff cyclically	1) Production smoothing or load levelling 2) Work load balancing 3) Job rotation	Initially two separate set of employees used to work for day shifts and night shifts but after implementing cyclical scheduling for all the employees, number of night shift a single employee as a whole has to attend for a month significantly reduced.
Statistical process control of biomedical equipment's	1) Statistical process control (SPC) 2) Successive checking 3) Defect prevention	Several biomedical equipment's were subjected to SPC. Especially equipment's which could be life threatening for minute variations in its output were consistently monitored using SPC.
Hospital equipment and accessories inventory control	1) Electronic data interface 2) Supplier involvement	IT-enabled bio-medical stores management system was developed and employed to store and keep a track of work orders, equipment master maintenance, purchase/indents, AMC/Insurance, reports, etc. Suppliers were interfaced with this portal to share the information and leave the onus on the supplier to manage the inventory, servicing and maintenance.
Scheduling for outdoor patient department	1) Process simplification 2) Customer involvement 3) Cycle time and lead time reduction 4) WIP reduction	Patient can fix their appointment either by calling the hospital or using the hospital website where they have the option of selecting the timings and doctor of their choice.
Grievance management system	1) Customer focus and involvement 2) Defect prevention 3) Employee participation 4) Use of problem solving tools	Cause and effect analysis (Ishikawa diagram) was used to reason the problems received through grievance management system from the visitors to the hospital. For example, high waiting time was reported by visitors at pharmacy counters and using the cause and effect analysis, some of the reasons were identified to be lack of skill of pharmacy counter employees, irregular supply of drugs, space unavailability at counters and multiple prescription medicine cross checks in the pharmacy store.
Integrated Pharmaceutical Information System (IHIS)	1) Electronic data interface 2) Information sharing 3) Supplier involvement 4) Sole sourcing and supplier reduction	Pharmacy department through this information system was able to leverage on bulk order special deals provided by the drug suppliers on the medicine with reduced shelf life as consumption pattern of each drug could be tracked. System also enabled supplier inventory monitoring by interfacing the information system with suppliers.

Table 4 - Comparison of the sample performance measures pre and post implementation of LT solutions.

Process	Performance measures	Before	After	Percentage Improvement
Outpatient department scheduling	Average waiting time at different nodes in the hospital	1 hours 20 minutes	30 Minutes	62.5% decrease
	Average total lead time from entering and leaving the hospital	115 minutes	35 minutes	70% decrease
	Average redundant patient walking distance	1770 meter	475 meter	73% decrease
	Average percentage of cases rescheduled on a single day	27 %	3.5%	23.5% decrease
Integrated Pharmaceutical Information System (IHIS)	Average number of medicine stock outs in a month	22	4	82% decrease
	Average lead time between order and delivery	3 days	1 day	67% decrease
	Average number of emails transacted for an order placement	6	Nil	100% reduction
	Number of instances of wrong billing in a month	13	3	77% reduction

CONCLUSION

Documentation of principles, practices and performance measures of LT implemented in hospitals all over the world have been performed through literature review. Current study provided positive outcome after implementing LT in Indian healthcare services and thereby revealed the scope for LT in Indian hospitals. Practices implemented by the case hospital and performance measures adopted by the case organization are also discussed. Inferences made in the current study are based on the research carried out in a single case hospital. Hence generalizability of the outcome is not possible. Based on the literature and experience from implementing LT in a case hospital, a framework for successful implementation of lean in healthcare can be developed in future study which can provide a structured approach for hospitals attempting to implement lean. Outcome of this study is believed to help both academicians and practitioners to understand the feasibility of lean implementation in Indian hospitals and thereby also provides with area of improvements that can be targeted. LT when implemented at the entire hospital, it would not only improve the responsiveness of the hospital to the patients demand but also significantly reduce the cost incurred by the hospitals in delivering the healthcare by removing the non-value adding tasks. Cost benefits harvested by the hospital can be passed on to the patients partially or fully thereby providing a competitive advantage to the hospital of providing quality treatment at low cost in the market. By implementing LT at a large scale in hospitals in its true sense could help in reducing both private and public expenditure on healthcare significantly thereby ensuring affordable, accessible and quality healthcare to all strata of people.

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