

How to Cite:

Sonali, S., Amanjot, Khurana, H. P. S., & Kaur, H. (2022). Forecasting the impact of lean tools and practices on the service quality in a tertiary care hospital: An empirical research study. *International Journal of Health Sciences*, 6(S3), 8883–8895.
<https://doi.org/10.53730/ijhs.v6nS3.8325>

Forecasting the impact of lean tools and practices on the service quality in a tertiary care hospital: An empirical research study

Dr. Seep Sonali*

Assistant Professor, MYAS-GNDU, Department of Sports Sciences and Medicine, Guru Nanak Dev University, Amritsar, India

Dr. Amanjot

Assistant Professor, MYAS-GNDU, Department of Sports Sciences and Medicine, Guru Nanak Dev University, Amritsar, India

Dr. Harinder P. S. Khurana

Chief Training Incharge, Management Mantra, Amritsar

Ms. Harjasleen Kaur

Research Fellow, MYAS-GNDU, Department of Sports Sciences and Medicine, Guru Nanak Dev University, Amritsar, India

Abstract---Purpose – Hospitals always strive to provide quality treatments at a nominal cost to their customers. To achieve this eminence, business improvement methodologies of other divisions such as lean practices are being ingeniously merged. Implementing lean practices in healthcare has always been different from other industries. There are two objectives of this paper, first, to explore the application of lean tools in the service-oriented workplace, and second, to study the contribution of lean culture in improving the service quality in the hospital. Design/methodology/approach – The study was carried out in a tertiary care hospital. The first part of the research was based on a survey that included the collection of the relevant data to investigate the impact of lean tools and techniques on work efficiency and performance. In the second part, a comparative study was conducted to understand the role of lean interventions in improving the service quality in the hospital. The objectives of the research were answered using hypotheses. Findings – The findings elicit that implementation of lean tools in the hospital generates a positive and significant impact on employee work performance and efficiency. Furthermore, the adoption of lean culture paves a way for improved service quality and other significant improvement opportunities in healthcare. Originality/value – Despite the indications that lean is prevalent in healthcare, the researchers regard

its implementation to be pragmatic, and fragmented. In particular, this study shows that lean culture improves service quality.

Keywords---lean management, service quality, standard operating procedures (SOPs), team meetings.

Introduction

Quality health care delivery has always remained a challenge for health care providers in this dynamic and competitive global marketplace. It is in this context that healthcare organizations are increasingly adopting lean practices as an effort to minimize waste and achieve the same core competencies with fewer assets that will eventually lead to consumer satisfaction. After continued success in the manufacturing sector, lean has been adopted by the health care sector as patients are looking for hassle-free, world-class healthcare services from Indian hospitals (Vinodhini, 2018). Lean focuses on green manufacturing, eliminates the non-value-added services at each level, and harnesses the intellectual potential of each staff member. It is a precise evidence-based approach that utilizes a set of tools and strategies to achieve proficiency, accountability and escalates quality along with patient safety in this era of eco-efficiency.

Lean is not a program, a quick fix, a responsibility that can be delegated, nor a set of quality improvement tools. It is a cultural transformation that changes how an organization works. Unlike specific programs, Lean has no finish line. It requires new skills, new habits, and often a new attitude throughout the organization from senior management to front-line service providers (Young, 2014). Thus, lean is a way of thinking and acting; and it applies to all businesses whether manufacturing or service-oriented. To put lean culture into practice, it is necessary to implement certain tools and methodologies that fit into the respective organization's model, such as standard work, team meetings, 5S, visual management, just in time (JIT), or value stream mapping. This paper presents the application of lean practices to a service industry. This research was conducted in a tertiary care hospital situated in Amritsar. The objectives of this study are twofold:

- The first part of the study addresses the impact of the implementation of standard work and team meetings to improve work performance and efficiency respectively.
- The second part explores the contribution of lean culture in improving service quality in the hospital.

This research paper is structured into seven sections. Following the introduction, a brief review of literature on the lean approach and service quality is presented. Then, hypotheses have been developed. Afterward, in the fourth section, the methodology depicting how the study is carried out is mentioned. Subsequently, the analysis and discussion of results are provided, and finally, in the last section, conclusions are delineated.

Literature Review

The origins of lean

From the 1980s, many models of how to run an efficient and effective manufacturing organization were developed. Many of these new models, attractive alternatives that they were, lacked a real logic and toolbox of techniques for managers to begin the transformation process (Rich *et al.*, 2006). The origin of lean concepts lies in the Japanese car industry. During the 1970s in the United States of America, cars were expected to require a lot of maintenance. The Toyota Production System (TPS) changed that by providing reliability on even less expensive models. Manufacturers and academics went to Japan to learn the range of concepts later called lean (Spagnol *et al.*, 2013). The concept of lean thinking was introduced to the western world in lean by the book *"The machine that changed the world"* written by Womack, Jones, and Roos in 1990 (Modi and Thakkar, 2014). They describe Lean production as follows (Ahmed, 2010):

"Lean production is lean because it uses less of everything compared with mass production. Half the human effort in the factory; half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time. Also, it requires keeping far less than half the needed inventory on site, results in many fewer defects, and produces a greater and ever-growing variety of products."

Therefore, lean can be stated as "an integrated multi-dimensional approach encompassing a wide variety of management practices based on the philosophy of eliminating waste through continuous improvement." Lean as philosophy becomes a way of thinking, whereas practices or tools are instruments to action these thoughts (Gupta *et al.*, 2016). Furthermore, implementing lean in any enterprise demands a long-term perspective. The results are not visible overnight.

Lean management

Lean management includes the elimination of operations that do not add value to the company's product or service from the viewpoint of the customer (Cohen, 2018). Lean requires continuous improvement in three dimensions (Bicheno and Holweg, 2016):

- *Waste* reduction
- *Value* enhancement
- *People* involvement

It seeks to identify and eliminate waste (*Muda*) through the use of selected tools. The Toyota approach differs slightly; it aims to highlight areas of waste by eliminating unevenness (*Mura*) and overburden (*Muri*) (Grove *et al.*, 2010). Lean management tools are implemented to elevate productivity through the lowering of expenditure, enhancing quality, lessening flaws, trimming down lead times, and ensuring prompt delivery of products (Mohamad *et al.*, 2016). The core values of Lean management theory include (Simon and Canacari, 2012):

- respect for people (e.g., patients, staff members, managers, physicians),

- continuous improvement (e.g., easier, better, faster, cheaper) and
- human development.

Lean provides a systematic five-step methodology for a lean transformation in an organization (Cohen, 2018; Su *et al.*, 2006):

- First, it identifies what the customer perceives as *value*.
- Second, known as '*Gemba*', the Japanese term for a real place, observers learn to see and understand the multiple areas of delay, inefficiency, and waste. A representational flowchart known as the current-state *value stream map* (CS-VSM) is created.
- Next, the '*flow*' state is visualized in which all the steps in the process follow one another without stopping. A future-state visual stream map (FS-VSM) is created.
- Then, it creates a flow condition in which the product/service advances smoothly and rapidly at the *pull* of the customer.
- Finally, it speeds up the cycle of improvement in pursuit of *perfection*.

Lean approaches help managers recognize and reduce the waste in processes. Wastes are activities that add no value from a customer perspective, including (Simon and Canacari, 2012; Esfandyari and Osman, 2010):

- *Motion*: movement of people that does not add value.
- *Waiting*: idle time created when material, information, people, or equipment is not ready.
- *Correction*: work that contains defects, errors, rework mistakes, or lacks something necessary.
- *Over-processing*: an effort that adds no value from the customer's viewpoint.
- *Over-production*: producing more than the customer needs right now.
- *Transportation*: movement of product that does not add value.
- *Inventory*: more materials, parts, or products on hand than the customer needs.
- *Knowledge*: people doing the work are not confident about the best way to perform tasks.

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Lean in healthcare

In recent years, the term lean health care has emerged, indicating a stronger focus on efficiency and patient satisfaction within the healthcare sector (Dahlggaard *et al.*, 2011). The main scope of lean manufacturing is to eliminate waste and reduce the cycle time to increase the profit and competitiveness by increasing the production and decreasing the cost of the product (Ramakrishnan and Nallusamy, 2017). Lean manufacturing is the production of goods using less of everything compared to traditional mass production, less waste, human effort, manufacturing space, investment in tools, inventory, and engineering time to

develop a new product. Lean production cuts costs & inventories rapidly to free critical cash. (Modi and Thakkar, 2014). Lean Thinking in health care is not just about cost reduction, nor 'efficiency' improvements or staff cuts. It is about improving the safety and quality of healthcare by applying a series of continuous incremental improvements in processes, people, and organizational culture. (Vinodhini, 2018).

Lean has been adopted by health systems worldwide. Large adaptations of the Lean philosophy include the National Health Service in the United Kingdom and the Veterans Health Administration System in the United States. The most often cited instances of system-wide success in the United States are the Virginia Mason Health System in Seattle and ThedaCare in Appleton, Wisconsin. Further instances of success include the ambulatory clinic and emergency, radiology, and laboratory departments (Cohen, 2018). An important aspect that has been discussed in the last decades is the association between lean culture and service quality.

Service quality

There is a continuous rise in consumer needs and expectations concerning the services provided. To deal with the various issues related to service quality in the healthcare system, the management needs to have a considerate insight for the term service quality. The issues can range from service quality measurement, determining shortcomings in service quality to the development of corrective schemes. The quality possessed by the service refers to the extent to which the delivery of service meets the consumer's expectations. Nowadays, service quality has become the key standard to measure the efficiency of the organization and is working as a tool to strengthen the brand image. The organizations are striving hard to withhold the customers by maintaining the quality of service at every level. Better quality of service by the providers often convinces the individuals to make repeated demands. It helps the organization to grow and contributes largely to its revenue and productivity. For the measurement of service quality, five dimensions are very important and these dimensions include (Kansra and Jha, 2016):

- *Empathy* involves the individual attention provided to the customers by firms and their staff members.
- *Tangibility* includes the physical facilities like labs, equipment, infrastructure, and human resources engaged in delivering healthcare services.
- *Assurance* covers the knowledge, expertise, skill of the employees involved in providing the services and their ability to create confidence and trust among patients.
- *Reliability* incorporates the ability to execute the promised services accurately and consistently.
- *Responsiveness* relates to the degree of willingness to facilitate and help the customers by providing quick services to customers.

Hypothesis development

Standardized processes and work performance

Standardization of production processes aimed to obtain more uniform products with increased production and service quality. The best way to begin standardization is to understand how the whole process occurs and, in this case, a systematic representation is required. The Standard Operating Procedure (SOP), describes each critical and sequential step one has to perform in a task to assure its expected result. SOPs are contained in manuals aimed at clarifying doubts and guiding the execution of actions and should be in agreement with the institution's guidelines and standards, be updated whenever necessary, according to scientific precepts that should be followed by all (physicians, nurses, and nursing auxiliaries) in a standardized manner (Guerrero *et al.*, 2008).

Considered a tool for quality management in health services, the SOP is an important technological resource in health practice and should be validated to gain scientific credibility. The objective is to seek excellence in the provision of service by the health staff and to minimize errors and distortions acquired in routine actions (Walter *et al.*, 2016). The benefits of work standardization include (Oliveira *et al.*, 2017):

- *Variability reduction*- The work effort becomes stable and measurable;
- *Cost reduction*- Through waste reduction derived from inefficient work procedures, the system becomes more cost-effective;
- *Quality improvement*- If the same operation were to be executed differently depending on the person, the probability of defects would increase;
- *Worker involvement*- Standard work shifts the blame for errors from the worker to the system. Thus, people tend to start being more honest about improvement opportunities;
- *Continuous improvement*- This tool is essential for continuous improvement, since it facilitates change to improved standards, making it easier, faster, and more efficient overall.

Considering the literature, the relationship between the dependent variable i.e., work performance, and the characteristics of the independent variable i.e., SOPs were tested. Thus, the following hypotheses were developed.

H1. There is a relation between standard operating procedure (SOP) and the work performance improvement of the employees in the hospital.

H1a. There is a relation between the availability of SOPs and the work performance improvement of the employees in the hospital.

H1b. There is a relation between the purpose for which SOPs are used and the work performance of the employees in the hospital.

H1c. There is a relation between the appealing visual representation of SOPs and the work performance of the employees in the hospital.

H1d. There is a relation between the regular updating of SOPs and the work performance of the employees in the hospital.

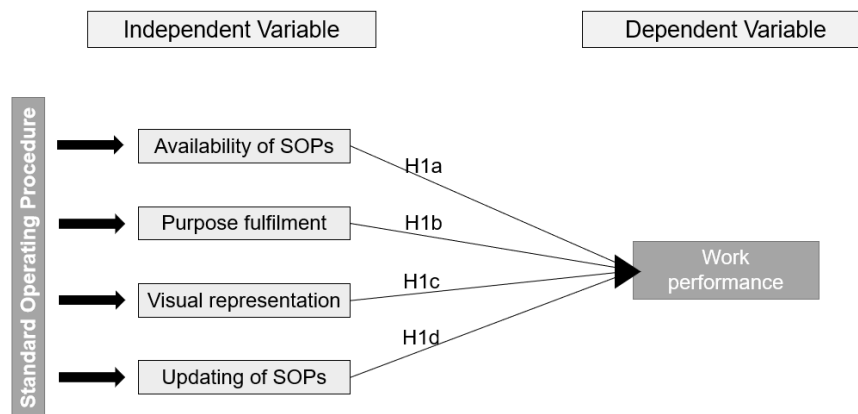


Figure 1. Hypothesis statement 1

Team meetings and work efficiency

In recent years there has been a growing body of workplace communication studies adopting discourse analytic and social pragmatic frameworks. This is reflective of the contemporary workplace moving away from traditional hierarchical structures to more team-oriented work practices, with teamwork and team talk in decision-making gaining increasing relevance. Of particular significance is the focus on meetings that have become routine organizational practice underpinning how intra- and inter-professional collaboration is accomplished in situ (Halvorsen, 2013). According to Stray *et al.*, 2016, meetings are necessary for teamwork to be successful. They provide a venue for information exchange, decision making, coordination, planning, and monitoring progress, each of which is an essential component of the team processes associated with team performance. Empirical studies have found that spending time in a short meeting discussing and solving problems is valuable. DTMs are task-oriented, generally unrecorded, and members gather to focus on a narrow organizational goal. Further, because meeting satisfaction is part of overall job satisfaction, it is important to understand what makes this meeting valuable for team members. Therefore, with regards to the literature, the relationship between the dependent variable work efficiency and the characteristics of the independent variable, team meetings were tested. The following hypotheses were developed.

H2. There is a relation between the team meetings and the work efficiency of the employees in the hospital.

H2a. There is a relation between the frequency of team meetings and the work efficiency of the employees in the hospital.

H2b. There is a relation between the purpose for which team meetings are used and the work efficiency of the employees in the hospital.

H2c. There is a relation between the kind of discussions held in team meetings and the work performance of the employees in the hospital.

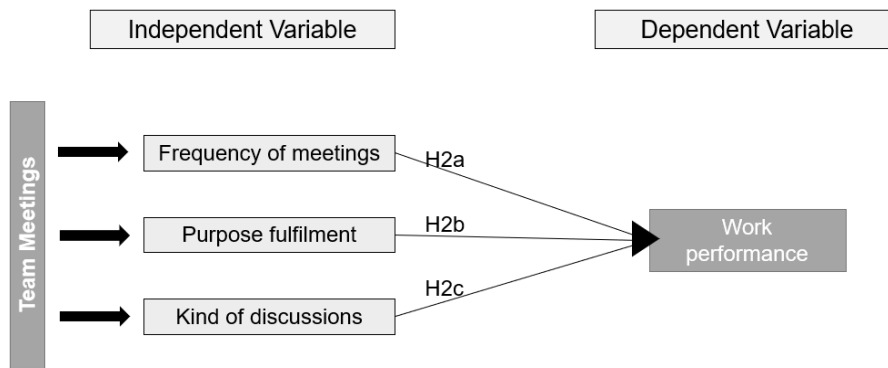


Figure 2. Hypothesis statement 2

Lean culture and service quality

The ultimate goal of lean practice is to achieve organizational efficiency and greater productivity while providing quality services at a lower cost (Hwang *et al.*, 2014). Lean tools are implemented for the benefit of three-dimensional successful outcomes such as for the Patient, Professionals, and Health system improvement (Vinodhini *et al.*, 2018).

- *Patient Outcomes*: patient satisfaction, mortality rate, re-admission rate, etc.
- *Professional Outcomes*: employee satisfaction, time spent with the patient, staff overtime, login to provider time, etc.
- *Health System Improvement Outcomes*: admission time, collection time, turnaround time, triage time, time to see a physician, dispensing time, examination room time, number of patient visits, length of stay, discharge rate, patient journey time, scheduling time, near-miss event rate, turnover time, waiting time, etc. (Lawal *et al.*, 2014).

The third hypothesis examines whether the lean culture in the hospital is associated with improvement in service quality.

H3. There is a relation between lean management and service quality in the hospital.

Methodology

Data collection

For the first part of the study, self-structured questionnaires were randomly distributed to 300 employees like doctors, nurses, technicians, etc. with more than six months of experience working in the in-patient departments of the hospital. The questionnaire was developed based on the research objective and its theoretical framework, with the following script: existence, use, frequency, purpose, and impact of lean improvement tools. For the second part of the study,

questionnaires were distributed to the 30 employees working in the hospital before the implementation of lean culture. The questionnaire stating variables to study the outcomes before and after the lean intervention was prepared.

Statistical measures

The data were analysed in the statistical software SPSS version 26.0. For the first part of the study, through applying the Pearson correlation test, it was investigated whether there existed a significant correlation between the different attributes (statements) from the questionnaire. For the second part of the study, the McNemar test was applied to the data collected to determine if there were differences before and after the lean intervention.

Results

Standardized processes and work performance

Table 1
Relationship of work performance with the standard operating procedure by Pearson correlation

Work Performance	STATISTICAL VALUE	Availability of SOPs	Purpose fulfillment	Visual representation	Updating of SOPs
	r-value	.379**	.551**	.271**	.382**
	p-value	.001	.001	.001	.001
	Mean SD	4.18 ± 1.121	4.40 ± 0.957	3.22 ± 1.210	3.69 ± 1.085

Table 1 reveals that availability, purpose fulfillment, visual representation, and updating of standard operating procedures (SOPs) have a positive relationship with the performance which is highly significant at the 1% level. Thus, it accepts the hypothesis statement *H1*. The positive relationship between these variables indicates that, as availability, purpose fulfillment, appealing visuals, and updating of SOPs increase, work performance also increases.

Team meetings and work efficiency

Table 2
Relationship of work efficiency with team meetings by Pearson correlation

Work Efficiency	STATISTICAL VALUE	Frequency of meetings	Purpose fulfillment	Kind of Discussions
	r-value	.535**	.493**	.436**
	p-value	.001	.001	.001
	Mean SD	4.30 ± 0.917	4.33 ± 0.859	4.37 ± 0.785

Note. ** means highly significant at 1% level

The results of Pearson correlation in Table 2 depict that frequency of meetings, purpose fulfillment, and kind of discussions in meetings have a moderate positive relationship with the improvement in work efficiency. Therefore, with the increase in the frequency of meetings, purpose fulfillment, and the kind of discussions, the work efficiency also increases. The p-values for the correlation in the variables are less than the significance level of 0.05, which indicates that the correlation coefficients are significant. Hence, the hypothesis statement H_2 is accepted.

Lean culture and service quality

Table 3
Test statistics of McNemar test

Test Statistics ^a									
S. No.	Variables	Before		After		N	Chi-Square ^c	Asymp. Sig.	Exact Sig. (2-tailed)
		No	Yes	No	Yes				
1.	SOP implementation	0	13	0	17	30			.000 ^b
2.	Error free and properly recorded documents	0	1	0	29	30	27.034	.000	
3.	Low staff injuries	0	7	0	23	30			.000 ^b
4.	Less confusions and accidents	0	1	0	29	30	27.034	.000	
5.	Timely goal attainment and monitoring	0	6	0	24	30			.000 ^b
6.	Improvement in patient flow	0	9	0	21	30			.000 ^b
7.	Efficient Inter and Intra departmental communication	0	2	0	28	30	26.036	.000	
8.	Reduction in hospital acquired infections	0	5	0	25	30			.000 ^b
9.	Corrective and Preventive Actions	0	4	0	26	30	24.038	.000	
10.	Trainings	0	10	0	20	30			.000 ^b
a. McNemar Test									
b. Binomial distribution used.									
c. Continuity Corrected									

The statistical significance level (i.e., p -value) is less than .05 (i.e., $p < .05$), and therefore the proportion of changes before and after the intervention (lean practices) are significantly different i.e., the results are different after the course of the intervention.

Discussions

The proponents of lean postulate that healthcare can profoundly benefit from lean tools and techniques. Addressing the first part of the study, Pearson correlation

test statistics produce evidence that the Standard Operating Procedures (SOPs) or manual of techniques serves to improve the work performance of the employees in their respective units. The results confirm the hypothesis statement (*H1*) that availability, regular use, updating, and flowcharts along with the pictorial depiction of processes in SOPs significantly ($p\text{-value} < 0.005$) increase the work performance of employees. It is regarded as a tool to develop and sustain disciplined work practices. The results showcase that the standard work manuals are accessible by employees at all times and are used in the majority of the work. Moreover, the employees are also of the view that the use of SOPs is helpful to learn the functioning of various types of equipment at the time of induction training. For better understanding and the added use of SOPs, the algorithms illustrating the stepwise procedure are displayed in the Inpatient departments, thus increasing the retention of processes thereby reducing risks.

The findings of *H2* also lend support to the prior literature depicting a positive and significant relationship ($p\text{-value} < 0.005$) of team meetings in increasing the work efficiency of the employees working in the in-patient processes of the hospital. The data analyzed in the Pearson correlation test portrays that regular team meetings are useful in increasing work efficiency. The team meetings are significantly helpful in task assignment and defining daily goals. Besides, the employees shared their perspective that information regarding patient safety issues, findings of various audits, corrective and preventive measures taken, previous incidents reported with positive or negative outcomes and any new improvement initiatives taken, etc are discussed in the team meetings. These meetings keep them updated with whatever is going in the unit, in improving relations within the team, confusions are easily cleared and the goals are attained trouble-free.

The findings of *H3* are in line with the literature and suggest that hospitals with lean implementation can significantly ($p\text{-value} < 0.005$) improve service quality. The proportion of changes before and after the intervention are significantly different and depict that there exists an association between lean management and improvement of service quality in the hospital. The findings highlight that the adherence to standard work practices has increased and the documentation processes have become error-free. The results also suggest that Lean can yield benefits to both employees and patients not only by decreasing workplace injuries but also by improving service quality through improved patient flow and reducing hospital-acquired infections. The respondents of the study have reported efficient intra- and inter-departmental communication, timely attainment of goals, and increased corrective and preventive actions plans. Along with this, the lean intervention has also led to putting employees through regular training. The statistically significant outcomes of lean intervention also demonstrate that the hospital staff has valued the lean culture and is profoundly engaged in the implementation efforts. The results imply that the lean techniques if implemented properly can bring remarkable tangible and intangible outcomes in hospitals. According to what is said above, the approach of lean management indeed serves to be an important factor for enhancing service quality.

Conclusion

This paper has presented the implementation and impact of lean practices on service quality in a tertiary care hospital. The key findings set forth the improvements seen in work performance and efficiency on applying the concept of standard operating procedures and team meetings respectively. Based on the research findings, one of the major conclusions devised is that the adoption of lean culture in the healthcare industry is a significant trigger to improve service quality.

References

- Ahmed, R.A.H.S. (2010), "Roadmap for continuous quality improvement and sustainability: a case study in Egyptian service sector organisation", *International Journal of Productivity and Quality Management*, Vol. 6 No. 3, pp. 318-331.
- Bicheno, J. and Holweg, M. (2016), *The lean toolbox: A handbook for lean transformation* (Vol. 5), Buckingham: PICSIE books.
- Cohen, R.I. (2018), "Lean methodology in health care", *Chest*, Vol. 154 No. 6, pp. 1448-1454.
- Dahlgaard, J.J., Pettersen, J. and Dahlgaard-Park, S.M. (2011), "Quality and lean health care: A system for assessing and improving the health of healthcare organisations", *Total Quality Management & Business Excellence*, Vol. 22 No. 6, pp. 673-689.
- Esfandiyari, A. and Osman, M.R. (2010), "Success and failure issues to lead lean manufacturing implementation" in *4th International Management Conference*, Vol. 4 No. 1, pp. 134-143.
- Grove, A.L., Meredith, J.O., Macintyre, M., Angelis, J. and Neailey, K. (2010), "Lean implementation in primary care health visiting services in National Health Service UK", *Quality and Safety in Health Care*, Vol. 19 No. 5, pp. e43-e43.
- Guerrero, G.P., Beccaria, L.M. and Trevizan, M.A. (2008), "Standard operating procedure: use in nursing care in hospital services", *Revista latino-americana de enfermagem*, Vol. 16 No. 6, pp. 966-972.
- Gupta, S., Sharma, M. and Sunder M., V. (2016), "Lean services: a systematic review", *International Journal of Productivity and Performance Management*, Vol. 65 No. 8, pp. 1025-1056.
- Halvorsen, K. (2013), "Team decision making in the workplace: A systematic review of discourse analytic studies", *Journal of Applied Linguistics and Professional Practice*, Vol. 1 No. 1, pp. 273-296.
- Hwang, P., Hwang, D. and Hong, P. (2014), "Lean practices for quality results: a case illustration", *International Journal of Health Care Quality Assurance*, Vol. 27 No. 8, pp. 729-741.
- Kansra, P. and Jha, A.K. (2016), "Measuring service quality in Indian hospitals: an analysis of SERVQUAL model", *International Journal of Services and Operations Management*, Vol. 24 No. 1, pp. 1-17.
- Lawal, A.K., Rotter, T., Kinsman, L., Sari, N., Harrison, L., Jeffery, C., Kutz, M., Khan, M.F. and Flynn, R. (2014), "Lean management in health care: definition, concepts, methodology and effects reported (systematic review protocol)", *Systematic reviews*, Vol. 3 No. 1, pp. 1-6.

- Modi, D.B. and Thakkar, H. (2014), "Lean thinking: reduction of waste, lead time, cost through lean manufacturing tools and technique", *International journal of emerging technology and advanced engineering*, Vol. 4 No. 3, pp. 339-334.
- Mohamad, E., Ibrahim, M.A., Shibghatullah, A.S., Rahman, M.A.A., Sulaiman, M.A., Rahman, A.A.A., Abdullah, S. and Salleh, M.R. (2016), "A simulation-based approach for lean manufacturing tools implementation: a review", *ARPN Journal of Engineering and Applied Sciences*, Vol. 11 No. 5, pp. 3400-3406.
- Oliveira, J., Sá, J.C. and Fernandes, A. (2017), "Continuous improvement through "Lean Tools": An application in a mechanical company", *Procedia Manufacturing*, Vol. 13, pp. 1082-1089.
- Ramakrishnan, V. and Nallusamy, S. (2017), "Implementation of total productive maintenance lean tool to reduce lead time-A case study", *International Journal of Mechanical Engineering and Technology (IJMET)*, Vol. 8 No. 12, pp. 295-306.
- Rich, N., Bateman, N., Esain, A., Massey, L. and Samuel, D. (2006), *Lean evolution: lessons from the workplace*, Cambridge University Press.
- Simon, R.W. and Canacari, E.G. (2012), "A practical guide to applying lean tools and management principles to health care improvement projects", *AORN journal*, Vol. 95 No. 1, pp. 85-103.
- Spagnol, G.S., Min, L.L. and Newbold, D. (2013), "Lean principles in Healthcare: an overview of challenges and improvements", *IFAC Proceedings Volumes*, Vol. 46 No. 24, pp. 229-234.
- Stray, V., Sjøberg, D.I. and Dybå, T. (2016), "The daily stand-up meeting: A grounded theory study", *Journal of Systems and Software*, Vol. 114, pp. 101-124.
- Su, C.T., Chiang, T.L. and Chang, C.M. (2006), "Improving service quality by capitalising on an integrated Lean Six Sigma methodology", *International Journal of Six Sigma and Competitive Advantage*, Vol. 2 No. 1, pp. 1-22.
- Vinodhini, A., Seethalakshmi, R. and Sowdamini, T. (2018), "Analyzing the role of lean management in health care: A systematic literature review", *International Journal of Mechanical Engineering and Technology*, Vol. 9 No. 7, pp. 303-312.
- Walter, R.D.R., Gehlen, M.H., Ilha, S., Zamberlan, C., Freitas, H.M.B.D. and Pereira, F.W. (2016), "Standard operating procedure in the hospital context: the nurses' perception", *Revista de Pesquisa: Cuidado é Fundamental Online*, Vol. 8 No. 4, pp. 5095-5100.
- Young, F.Y. (2014), "The use of 5S in healthcare services: a literature review", *International Journal of Business and Social Science*, Vol. 5 No. 10, pp. 240-248.