



Lean Management: Review of Lean Consciousness for the Clinical Laboratory

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ABSTRACT

Lean management is a work philosophy of continuous improvement to achieve a smooth work flow by minimizing all kinds of waste including time, cost and manpower. The concept of lean management started as early as 1980's and was soon adopted by production industry. However, incorporation of this concept in healthcare has been very gradual and hesitant, though lean health care has immense potential to improve operational performance.

A clinical laboratory, which is essential in practice of evidence-based medicine, can be efficiently managed using lean management concept. Only a few publications in English literature have studied the effect of implementation of lean management in a clinical laboratory. There are certain challenges that a health care manager is likely to face in the implementation of lean management in clinical laboratory especially in developing nations. The present review discusses the implementation of lean management in a clinical laboratory with identification of various steps which require lean thinking.

Keywords: Lean Management, Clinical Laboratory, Healthcare

Introduction

Lean management is an approach of continuous improvement to achieve smooth work flow by minimizing element of waste and incorporating a flexibility to change.

^[1] In lean management, all kind of wastages are considered including time, cost and man power. This can be considered as a work philosophy which is used in management process for running on the best track in the best way and to serve customers exactly according to their needs.^[2]

A study conducted in Massachusetts Institute of Technology (MIT) created the concept of lean in the 1980s.^[3] Thereafter, its application started in various industries. Gradually lean concept was incorporated in healthcare system as well which came to be known as "lean healthcare". Lean healthcare is based on concepts of lean management applied to health systems for improvement of health care services.^[4]

Now-a-days, clinical laboratory is a vital part of healthcare services in the era of evidence-based medicine. An incorrect diagnosis increases medical visits, number of tests, and also increases health service cost.^[5] Hence began the demand of quality testing, and creeping of lean consciousness in the management of clinical laboratory.

The objective of this review article is to introduce the current as well as future laboratory managers to the concept of lean management with a brief review of literature.

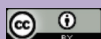
Discussion

History: Journey from production industry to healthcare industry

The term lean was coined by Jon Krafcif, who was the member of MIT International Motor Vehicle Program research team.^[6] The concept of lean came from the approach used by the Toyota, Japan. The Japanese companies have contributed significantly in quality management tools including lean methodology. The works done by Deming and Juran led to the modern-day concept of lean and six sigma methodology.^[7]

Its application has been explored by different authors in different working environments demonstrating an improved customer satisfaction and improvement in delivery of services. The tools of lean management including Value Stream Mapping (VSM), 5S and Kaizen generated a view to focus on waste elimination leading to improved customer satisfaction.^[8]

In healthcare, the implementation of lean management in hospitals has been described in a study in the year 2013, where the aim of lean management was to do work in a smooth and improved way.^[9] A study of nine hospitals in India showed that world class healthcare can be provided at ultralow cost with implementation of management tools



including lean management.^[10] Various methodologies of lean management can be applied in different areas of a hospital setup like patient flow, operation theater and surgery to improve patient experience as a final goal.^[8]

Processes which create wastes

Various processes which create waste are the improvement targets of lean thinking. These processes can be classified as following:^[11]

Overproduction: Excess production or before time production resulting in excess inventory.

Delay: Unusual delay in one step results in idle manpower and machinery at the next step and also results in long delivery time.

Excessive Transport: Too much movement of materials or manpower results in wastage of time and money.

Inadequate Processes: Unnecessary complicated methodology as compared to effective simple methods are wasteful.

Unnecessary Inventory: More than required inventory bears extra cost.

Unnecessary Movement: Disorganised working environment with unnecessary movement is not only wasteful but can be hazardous.

Defective Products: Defective products due to one or more reason results in unnecessary repeated production and customer dissatisfaction.

Principles of lean management

The lean management is based on six principles^[12] which are as follows:

- 1. Value:** The “value” of a product or service is defined from the customers’ perspective. A value is something that a customer is paying for. The objective of lean management is to identify the steps or processes which add value to final product (value adding) or does not add value to the final product (nonvalue adding). A third type of activity is non-value adding but necessary for the product or service (necessary non-value adding)
- 2. Value stream:** It is the sequence of multiple steps of the entire process, adding values to the final product or services. The objective here is to eliminate the steps which do not add value to the product or services.
- 3. Flow:** It is the continuous flow of various value adding steps. This principle works to eliminate the

fragmentation of the entire process. Eliminating batch processing is one such approach.

- 4. Pull production:** This is a production process where the customer’s demand is the inherent trigger (pull) for the production. In this principle, unnecessary inventory is to be eliminated.
- 5. Perfection and Continuous improvement:** This principle states that nothing is 100% perfect and there is always a scope for improvement. Hence, continuous monitoring of the process is required to identify the areas for improvement.
- 6. Respect for people:** This is probably one of the most important principles of lean management. Employees are encouraged to identify the problems themselves, do root cause analysis to recognize the underlying factors leading to the problems, and then perform suitable corrective and/ or preventive action. When error happens, the focus should be on the process and not on the person involved.

What is the need of lean management in healthcare?

In the present scenario where a hospital set up faces an intense competition to sustain, there is a felt need of achieving a higher level of quality work and subsequently to achieve high patient satisfaction.^[8] Hospitals are facing problems in healthcare management due to lack of mechanisms to capture and analyze real-time performance in both the clinical and laboratory services.^[13] There is a paucity of healthcare staff in certain critical areas of the hospitals causing overwork, tiredness and stress in the employees resulting in more mistakes, poor quality and poor relationship with patients.^[8] Improved quality in healthcare and patient satisfaction could be achieved by reducing the workload on employees and identifying the sources of waste that can be eliminated, i.e. lean management.

Various studies conducted worldwide concluded that numerous challenges in healthcare system lead to improper work flow. Studies estimated that inefficient practices occurring within the hospital management incurs approximately 13-20% of additional hospital cost.^[8]

Goals achieved by lean management in health care

Lean management helps in improving operational performance like reduction in turnaround time (TAT), savings in the cost of tests and enhancement in quality of the results. Furthermore, this kind of management helps in reducing the number of visits to hospitals via reducing the misidentification of samples, avoiding improper/

insufficient volume of sample collection and sample transport issues.^[14]

This management tool can also help in reducing the variations in analytical or operational performance hence reducing the test errors and testing faults. There is also a decrease in instrument contamination with consequent reduction in sterilization time. Lean management also helps in rapid introduction or implementations of new tests. Moreover, the improvements in various phases of laboratory testing lead to an enhancement in the safety of staff and patients and helps in building up employee morale.^[14]

Implementing lean management in a clinical laboratory

Lean management thinking and concept can be easily implemented in the clinical laboratory management using VSM, work place organization and standardization. Other tools include Kaizen Blitz (Sudden change for good), Cell Layout, Flow Map value and Pokka-yoke (Fool proofing) which can also be used. The VSM can be done on the basis of 5 principles of lean management.^[15]

A clinical laboratory is a complex organization comprising of various sections. It deals with multistep processes, having high potential of existence of different types of waste, many of which may be obscured. Hence there is a scope of improvement by implementation of lean management. Laboratory processes can be classified as pre-analytical, analytical and post-analytical. Laboratory process mapping and suggested guidelines for lean management are tabulated in Table 1.

Workplace organization is a process of organizing workplace so as to remove the clutter and streamlining the place. Its steps are as follows which are known as 3+2S.^[16]

1. **Sort:** In this step, the unnecessary items are identified and moved to a holding area.
2. **Set in order:** The useful or needed items are rearranged in proper order.
3. **Shine:** In this step the workplace is regularly inspected and cleaned.
4. **Standardized:** It is the step where proper rules are laid down so that the 3S described above are implemented.
5. **Sustained:** In this step these 5S are continued by staff training, set of rules and proper communication.

Existing Literature of Lean Management in a Clinical Laboratory

In 2016, Tamer C et al^[17] conducted a study on lean six sigma methodologies and found that it improves clinical

laboratory efficiency and reduced turnaround times. They reported that in the reception area, 25-30% of all samples were erroneously labeled due to low quality of barcode and less trained workers. They replaced the faulty barcodes with new one and retrained their staff. After 3 months, the incorrectly labeled barcodes values had dropped to 30 per day which reduced the wasted time by significant amount leading to a substantial reduction in TAT.

The lean management helps organizations to improve their performance for competing well with other organization by decreasing cost and increasing the demand. Furthermore, lean management helped in reducing the TAT and increasing the efficiency.^[14]

Karine B et al^[18] conducted a study on lean healthcare as a tool for improvement. They found “wastes” that increased the process time leading to increased waiting time at the reception. Using lean management as an improvement plan, the authors reported reduction or elimination of waste in processes and increasing customer satisfaction, mainly by reducing the waiting time, which is extremely important when considering healthcare delivery.

Similarly, Bohdan W Oppenheim^[12] conducted a study on lean enablers for clinical laboratories and found that lean management could be a powerful tool for increasing the productivity, quality of work and increasing the staff morale in clinical laboratories as it is in other healthcare setups.

Challenges in implementation of Lean Management in a Laboratory

The main challenge in implementation of lean management is the lack of awareness of health care managers about this concept of management. Hence, publications and research on lean management in healthcare will help in this regard. The lack of awareness fuels various myths associated with the lean management among healthcare managers, as discussed by Bohdan W Oppenheim^[12] It needs to be stressed that lean management does not mean people will have to work faster or harder. Lean management also does not imply that cost reduction will result in compromise in quality, nor does it mean that organization will lay off their staff. The healthcare managers need to be made aware that “lean” is not with respect to staff or quality but rather pertains to wastage. In addition to being unaware, healthcare workers have resistance to adopt this concept due to the inherent human nature of resisting change. Change management strategies with adequate communication with the staff would help to overcome this resistance.

Table 1: Value stream mapping and suggested guidelines for lean management for a clinical laboratory.

Phases of Laboratory process	Steps	Scope of improvement
Pre analytical phase	Reception	<ul style="list-style-type: none"> • Enough staff to attend the patients resulting in place in order • Display of details at the reception • Prevention of over burdening of staff • Use of ergonomic conditions • All the printer, fax, paper, telephone etc available at the same work station • Optimization of increased work load at peak hours • Maintenance of manual register (if any) should be in legible handwriting • Technical knowledge of how to use Laboratory information system • Specific instructions/information for specialized test properly communicated to testing team
	Collection	<ul style="list-style-type: none"> • Drawing of all the blood samples in one time in the wards should be staggered as much as possible • Training the phlebotomist so that repeat pricks are minimized, adequate amount of sample in correct vial is drawn • Correctly identifying the patient forms and the tests requested • Proper labelling of vial and proper dispatch of sample
	Transport	<ul style="list-style-type: none"> • Avoid the long walks and multiple hands off • Lack of standardized protocol for handover of samples • Inappropriate knowledge of transport • Identify the choke points and check points • Avoid overloading in transport system • Maintaining proper conditions during transport
	Triage	<ul style="list-style-type: none"> • Right sample to reach at the right testing place in right time
Analytical phase		<ul style="list-style-type: none"> • One person one machine • Five-six feet radius of working • Avoid unorganized work bench • Avoid time delay in looking for things in a cluttered work place. • Labelling of all reagents/documents • Visual representation of reagent and kits indicating the amount which is left • Proper quality control measures in place • Straight line walking • Biomedical waste safety • Automation as far as possible • Standard operating procedures • Avoid compartmentalization of workstation • Clubbing of similar tasks • Creating framework for obtaining ideas and suggestions from all concerned staff • Avoid the time delay in sample processing beyond the stipulated time like waiting of the centrifuge to fill or waiting to completely load the machine • Adequate inventory maintenance • Eliminate hidden inventory and hoarding of supply • Strategically placing of analysers for better utilization and reduction in the number of analysers • Use of check lists as management tool • Avoid operational distractions
Post analytical phase	Delivery	<ul style="list-style-type: none"> • Delivery of correct result to correct patient/clinical team and within stipulated time frame
	Post delivery	<ul style="list-style-type: none"> • Solving the queries of physician will results in lesser number of repeat tests

In our scenario of being a developing nation, there is an increasing population with change in diseases pattern. Along with a persistence of infectious diseases, an increase in non-communicable and metabolic diseases is being witnessed. In such a scenario, there may be some difficulties in implementation of the concept of lean management in a clinical laboratory due to changes in the spectrum of laboratory tests demanded by the treating physicians. Also, the shortage of work force in public sector hospitals may hinder the application of lean concept in such a laboratory.

Automation and Lean management

Now a days, gradually most of the laboratory processes are being automated. Automated sample transport & acquisition system, automated laboratory analyzers, automated reflex testing, automated acquisition of results by integrating machines and laboratory information system, automated quality control systems and automated human resource processes are few examples of process automation in a clinical laboratory. Process automation not only improve precision but also reduces cost of operation and increases safety. Process automation result in elimination of waste that is non-value adding steps. However, there are certain pitfalls of automation, as has been published that there are instances of over-investment in automation and digitization. [19] Bortolli T et al [20] emphasized that automation of poorly stream line process may result in automation of errors and waste. They suggested “lean first, then automate.”

Conclusion

A clinical laboratory has various sections dealing with multistep processes and hence there is a scope of improvement by implementation of lean management. However, following lean management philosophy is not free of challenges especially in a scenario of a developing nation. Hence, healthcare managers are required to undergo training in lean management to understand the concept fully and find ways to overcome the various challenges faced in the process of its implementation.

References

- Anvari, A, Zulkifli, N, Yusuff, RM. A dynamic modeling to measure lean performance within lean attributes. *The International Journal of Advanced Manufacturing Technology*. 2012;66:5-8.
- Santos EF, Lima CAC. DMAICR in an ergonomic risks analysis. *Work* 2012;41:1632–1638.
- Womack JP, Jones DT, Roos D. *A máquina que mudou o mundo*, 3th ed. Rio de Janeiro: Campus, 1992.
- Graban, M. *Lean Hospitals - Improving Quality, Patient Safety, and Employee Satisfaction*. Nova Iorque: Taylor & Francis Group. 2009.
- Ismail AAA, Paul LW, Julian HB et al. Wrong biochemistry results: two cases reports and observational study in 5310 patients on potentially misleading thyroid-stimulating hormone and gonadotropin immunoassay results. *Clin. Chem* 2002;48:2023–2029.
- Womack James P, Daniel T Jones, Daniel Roos, *The Machine That Changed The World: The Story Of Lean Production*. New York: Harper Perennial 1991.
- Zidel T. A Lean Toolbox - Using Lean principles and techniques in healthcare. *Journal of Healthcare Quality*, 2006;28(1);W1-7.
- Yaduvanshi D, Sharma A, Gupta D. Lean Thinking: An Empirical Study for Performance evaluation in Hospital Operations. *J of Health Management* 2018;19:203-213.
- Burgess N, Radnor Z. Evaluating Lean in healthcare. *International Journal of Health Care Quality Assurance*. 2013;26:220-235.
- Govindarajan V, Ramamurti R. *Delivering World-Class Health Care, Affordably*. Harvard Business Review: Harvard Business Publishing, Nov 2013
- Shingo SA. *Study of the Toyota Production System from an Industrial Engineering Viewpoint*. Norwalk: Productivity Press.1981.
- Oppenheim BW. *LeanEnablersforClinicalLaboratories*. Research in Medical & Engineering Sciences. 2017;2:4.
- Gottfredson M, Aspinall K. Innovation versus complexity: What is too much of a good thing? *Harvard Business Review*: Harvard Business Publishing, 2005;83(11):62-71, 164.
- Warade J. Lean management in clinical laboratory. *Clinical laboratory*. Weblog. [Online]. Available from: <https://clinlabworld.blogspot.com/2014/07/lean-management-in-clinical-laboratory.html> [Accessed 25-Sep-2020]
- Arnheiter E, Maleyeff J. The integration of lean management and six sigma. *Total Qual. Manag.* 2005;17(1):5–18.
- Stankovic KA. Developing a lean consciousness for the clinical laboratory. *Journal of Medical Biochemistry*, 2008;27(3): 354-359. doi:10.2478/v10011-008-0015-2
- Inal TC, Ozturk OG, Kibar F, Cetiner S, Matyar S, Daglioglu G, Yaman A. Lean six sigma methodologies improve clinical laboratory efficiency and reduce turnaround times. *J Clin Lab Anal*. 2018 Jan;32(1):e22180. doi: 10.1002/jcla.22180. Epub 2017 Feb 15.
- Oliveira K, Santos E, Veraldo L. Lean Healthcare as a Tool for Improvement: A Case Study in a Clinical Laboratory. *Adv in human factors and ergonomics in healthcare* 2017;482:129-140.

19. Bowen DE, Youngdahl WE. "Lean" service: in defense of a production-line approach. *International Journal of Service Industry Management* 1998;9(3):207--225
20. Bortolotti T, Romano P, Nicoletti B. (2010) Lean First, Then Automate: An Integrated Model for Process Improvement in Pure Service-Providing Companies. In: Vallespir B., Alix T. (eds) *Advances in Production Management Systems. New Challenges, New Approaches. APMS 2009. IFIP Advances in Information and Communication Technology*. Springer: Berlin, Heidelberg. (2010) https://doi.org/10.1007/978-3-642-16358-6_72

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