

Barriers and Enablers of Lean Tools in Medical Laboratory Industry: A Case of Namibia

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Abstract

Turnaround time covers activities involving ordering, collection, transportation, preparation, analysis, interpretation, and provision of medical test results to clinicians and patients. Considered as the most important key performance indicator in the medical laboratory industry, turnaround time is influenced by various forms of lean wastes, which are, transportation, inventory, motion, waiting, over production, over processing, and defects. Elimination of these wastes will improve the operational efficiency and cost-effectiveness of the medical laboratory industry. Given the widespread awareness of what lean can do in the healthcare industry, it worthwhile investigating the factors behind the adoption of non-adoption of lean in the medical laboratory industry. This paper investigates the barriers to and enablers of lean adoption and implementation in the context of medical laboratories in Namibia. Findings from this research indicate that management support plays an important role in enabling lean adoption. On the other hand, lack of support from management is the strongest inhibiting barrier to the successful adoption of lean.

Keywords

Barriers, enablers, turnaround time, medical laboratory, lean tools, lean adoption, Namibia

1. Introduction

Turnaround time refers to time between ordering a laboratory test and reporting the test results (Alem, 2013; Deyet al. 2013; Biswajit et al., 2013). In line with this, Hawkins (2007) explains turnaround time in terms of nine steps, namely, ordering, collection, identification, transportation, preparation, analysis, reporting, interpreting, and provision of results to clinicians and patients. Fast turnaround time is crucial to medical laboratories (Poksinska,

2010). In fact turnaround time has been considered as the most important laboratory key performance indicator by most clinicians and laboratories (Hawkins, 2007). Not surprisingly, Moyo et al. (2015) showed that 91% of laboratory results have been utilized by clinicians in planning patient management, for example, ruling out diseases, monitoring therapy and hospital discharge and admission. Therefore, improving turnaround time in the medical industry is imperative.

Though increased technological innovations have been reported to be useful in the medical laboratory industry, most laboratories continue to receive complaints in regards to slow turnaround time. Customer demands are rising, expenditures are increasing, and healthcare staff is in short supply. Patient waiting times tend to be too long, and healthcare continue to face challenges while seeking to provide better patient care with less staff and limited financial resources (Rosmulder, 2011). Turnaround time continues to be the major cause of customer complaints within the industry (Hawkins, 2007). Long turnaround time is often associated with stock shortages, shared specimen, increased workload, shortage of skilled staff, instrument breakdown, test complexity, lack of standard operating procedures, and inadequate space (Alem, 2013; NIP, 2014; Stankovic, 2008; White et al., 2015; Rutledge, Xu, & Simpson, 2010).

The Namibia Institute of Pathology (NIP) reported that short turnaround time enables the laboratory to reduce cost, to increase efficiency, and to promote customer satisfaction (NIP, 2014). Furthermore, to improve turnaround time, NIP reported that it is crucial to reduce various forms of lean wastes. Lean wastes are classified as transportation, inventory, motion, waiting, over production, over processing, and defects (Womack & Jones, 2003). As such, assessment of turnaround time in relation to barriers and enablers of lean is essential in order to develop effective lean transformation strategies for medical laboratories. The current study focuses on barriers and enablers of adoption of lean tools in the Namibian medical laboratory industry. In this development, the following are the specific objectives for the study:

1. To investigate barriers and enablers of lean tools in the medical laboratory industry;
2. To assess the influence of the barriers and enablers of lean tools in the Namibian medical laboratory industry; and,
3. To derive strategies for lean implementation in the medical laboratory industry.

This study is expected to benefit private and public medical laboratories, clinicians, patients and the healthcare sector at large. Efficient turnaround time can prevent the spread of infectious disease among community members. Patients will receive their laboratory test results and treatment in a timely manner, resulting in customer satisfaction and improved client retention.

The remainder of the paper is structured as follows: The next section presents the related literature. This is followed by research methodology, results and discussions are then presented, managerial implications, and conclusions.

2. Related Literature

2.1 Lean Healthcare

Lean can be defined as a systematic approach to reducing the time between customer request and service delivery through identification and elimination of wastes (Coons, 2007). Lean has been applied to the healthcare industry since the 90s and continues to grow across the industry (Stankovic, 2008). The application of lean is based on five basic principles of lean, outlined as follows (Amirahmadi et al. 2007; Rosmulder, 2011): (i) define value from the perspective of the end user, (ii) identify the entire value stream and eliminate waste, (iii) make the value-creating steps occur in tight sequence so the product will flow smoothly toward the customer, (iv) as flow is introduced, let customers pull value from the next upstream activity, focusing on shortening the lead time, and (v) pursue perfection, as value is specified, value stream identified, wasted steps removed, flow and pull introduced, begin the process again and continue until a state of perfection is reached. Figure 1 illustrates the five lean principles.

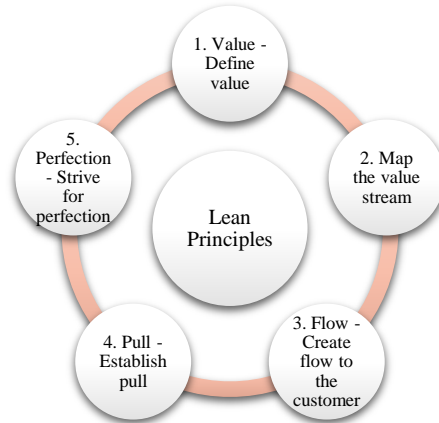


Figure 1. The five lean principles

Careful application of lean in medical laboratories can deliver benefits in terms of cost-efficient testing and quality results by eliminating waste, while maintaining client satisfaction (Amirahmadi, Dalbello, Gronseth, & McCarthy, 2007; Sandle, 2014). Furthermore, lean can create more output with less effort, reduce non-value adding activities, reduce cycle time, and increase customer order accuracy (Mallick et al., 2012). Learning from the seven types of lean wastes, specific descriptions of these wastes in the healthcare contexts are presented in Table 2 (Mutingi et al., 2015).

Table 2. Defining lean healthcare wastes (Mutingi et al., 2015)

	Original Waste	Corresponding Healthcare Waste
1.	Transportation	Staff walking to the other end of a ward to pick up notes.
2.	Inventory	Excess stock in storerooms that is not being used, patients waiting to be discharged. Waiting lists.
3.	Motion	Unnecessary staff movement looking for paperwork, e.g. drug sheets not put back in the correct place, syringes and needles at opposite ends of the room.
4.	Waiting (Delay)	Waiting for patient theatre staff results, prescriptions and medicines. Waiting for doctors to discharge patients.
5.	Over-production	Requesting unnecessary tests from pathology Keeping investigation slots 'just in case'
6.	Over-processing	Duplication of information asking for patient data several times. Repeated clerking of patients
7.	Defects/Errors	Re-admission due to failed discharge and adverse drug reactions. Repeating tests due to initial incorrect information

To date, there are a number of lean tools that are applicable to the healthcare sector. These include, (i) value stream mapping, a component of lean which can identify, map, document and review the entire processes, (ii) Kaizen, a philosophy that focuses upon continuous improvement of processes, (iii) standardization, a way of documenting procedures that capture best practices adopted as standards, and (iv) root cause analysis, a problem resolving methodology that focuses on resolving the underlying problem rather than quick fixes, and (v) key performance indicator, the use of metrics designed to track and encourage progress towards critical goals of the organization.

2.2 Barriers and Enablers of Lean Principles

A number of barriers and enablers of lean adoption are found in the literature (Drotz, 2014; Mallick et al., 2012). In 2006, Kim et al. [10] claimed that hospitalists can use lean principles to deliver high-quality and efficient care to patients, subject to the underlying cultural and barriers. As listed in Table 2, seven major barriers and eight major enablers of lean adoption were identified from the existing literature.

Table 2. Description of barriers and enablers of lean adoption

Barriers	Enablers
1. Staffs resistance to change	1. Top management involvement,
2. Leadership failures	2. Employee empowerment
3. Weak link between improvement and strategy	3. Flow orientation
4. Improper planning	4. Ability to learn and accept changes
5. Lack of training	5. Proper planning
6. Lack of democratic talk	6. Quality workshops organized regularly
7. Inadequate attention to customers	7. Open talk about all wastes
	8. Internal and external customer satisfaction

3. Research Methodology

This section describes the research approach followed in this study. A descriptive, cross-sectional, mixed study approach was used since the main aim was to assess the sample of a population at one specific point in time without making inferences, so as to identify areas for further research. A combination of both qualitative and quantitative research methods were applied at different phases of research. Qualitative methods were used to obtain opinions and insights into the problem. Conversely quantitative methods were used to quantify the problem by generating numerical data that can be transformed into useable statistics.

The study was conducted in 72 medical laboratory services in Namibia, involving medical laboratory employees from private and public laboratories in a period of one month. Both probability and non-probability (purposive) sampling techniques were used in selecting participants. Probability sampling was used to select non-management participants, while non-probability sampling was used to select participants in managerial positions, who were able to provide valuable data. Questionnaires were also given to other non-technical employees so as to generalize the results across the entire organizations.

The questionnaire comprised of rating scale questions for capturing respondent knowledge about lean tools and the associated enablers and barriers of their adoption in the Namibian medical laboratory industry. The Likert type scale was used, containing close-ended questions, with extra space for respondent opinions and suggestions. An online questionnaire was emailed to participants, and data were recorded anonymously. Data analysis was as based on an ordinal Likert type scale, for example, a five-point scale consisting of 1-no influence, 2-little influence, 3-some influence, 4-strong influence, 5-very strong influence, which is one of the most convenient ways of analyzing data. The data was recorded anonymously and archived properly to ensure confidentiality.

The next section presents the results, discussions and managerial implications pertaining to the research questions and objectives.

4. Results and Discussions

A large percentage of respondents, 40 out of 72 (56 %), were from the public medical laboratories. The rest (44 %) were from the private medical laboratories. This is expected since there are more public than private medical laboratories in Namibia. The influence of each of the barriers and enablers are presented.

4.1 Enablers of Lean Principles

The main aim of this investigation was to identify the factors or drivers which make the application of lean possible and easier. These include top management involvement, proper planning, adequate training, customer satisfaction, democratic talk about waste, and ability to accept change.

Table 3. Enablers of lean adopting in medical laboratory industry

Rank	Enabler	Mean Score
1	Adequate training	4.49
2	Proper planning	4.47
3	Top management involvement	4.43
4	Customer satisfaction	4.35
5	Democratic talk about waste	4.14
6	Ability to accept change	3.74

As indicated by the analysis in Table 3, adequate training has the strongest influence on lean adoption in medical laboratory, with a mean score (or response) of 4.49. Proper planning and involvement closely follows adequate planning, along with top management involvement. The rest of the enablers were customer satisfaction, democratic talk about wastes and ability to accept change, as shown in the table. Interestingly, the mean score for all the enablers in the top five range were above 4, which indicates that the top five enablers had a strong influence on the adoption of lean. Overall, top management involvement is crucial in proper planning and making plans for adequate training which play a crucial role in the rest of the enabling factors. These results are supported by past research findings (Mallick et al., 2012; Poksinska, 2010; Joosten et al., 2009).

4.2 Barriers of Lean Principles Application

This investigation was aimed at identifying factors or challenges that inhibit can hinder or inhibit the adoption of lean in the medical laboratory industry. The factors identified were support from the management, financial constraints, staff resistant to change, lack of conceptual knowledge on lean principles, and absence of lean culture in the laboratory.

Table 4. Barriers to adoption of lean in medical laboratory industry

Rank	Barrier	Mean Score
1	Lack of support from the management	4.32
2	Financial constraints	4.28
3	Staff resistant to change	4.18
4	Lack of conceptual knowledge	3.90
5	Absence of lean culture in the laboratory	3.88

Table 4 presents a summary of the results in terms of mean response rate. From this analysis, it can be seen that that lack of support from the management has the highest inhibitive influence on the adoption of lean in medical laboratories, with a mean score of 4.32. This agrees well with the conclusion obtained above, that top management involvement is the most crucial factor in lean implementation. Following the lack of management support, financial constraints and staff resistance to change have a significant influence. However, lack of conceptual knowledge and absence of lean culture in the laboratory have moderate influence on inhibiting the implementation of lean in the medical laboratory industry. These findings are similar to what was observed in past studies by Drotz (2014); Mallick et al. (2012).

4.3 Managerial Implications

This research provides important managerial implications. Deriving from this study, the following approaches are considered to essential for lean transformation and application, particularly from the context of the Namibian medical laboratory industry:

1. Identify the key performance indicators which are below the target, along with the existing wastes;
2. Implement improvement initiatives based on the affected indicators and communicated to the relevant personnel;
3. All staff involved should be trained adequately;
4. Identify the most appropriate lean tools and apply them according in order to eliminate wastes;
5. If little or no improvement, revise and restart the process repeatedly until the wastes are eliminated;
6. If wastes are eliminated, monitor the process often to ensure that the wastes do not reappear; and,
7. Sustain the process and strive for perfection by continually removing the wastes as they appear.

The suggested strategies are slightly in agreement with Poksinska (2010) and Venugopal (2013). Poksinska (2010) argued that there is no single approach to adoption of lean. However, this study provided an insight into lean implementation, through which the medical laboratory industry can strive to improve turnaround by eliminating waste or non-value adding steps in their processes.

5. Conclusions

This study investigated the enablers and barriers of lean in the medical laboratories, with a case study of the Namibian medical laboratory industry. Findings from the study indicated that management support plays a crucial role in the successful adoption of lean tools. On the other hand, lack of support from management is a cause for concern as it poses the strongest inhibition to the successful adoption of lean.

Lean is a useful tool for eliminating wastes or non-value adding steps in the medical laboratory processes. These wastes include transportation, defects, over-production, over-processing, inventory, motion and waiting. These can be eliminated by applying the rightful lean tools, resulting in improved efficiency, reduced wastes, while improving quality of patient care, cost-effectiveness and job satisfaction. In summary, this research recommends the following:

1. Medical laboratory personnel should be able to learn and accept culture change. This will enhance the lean implementation;
2. Medical laboratory staff should be well trained for best practices;
3. The medical laboratory industry should communicate lean tools to all the laboratory staff in order to encourage a lean culture in the industry; and,
4. Knowledge about how lean implementation should be shared throughout the Namibian medical laboratory industry to enhance effective application of lean tools for customer satisfaction.

Further research on the impact of lean implementation could be necessary to determine the effectiveness of lean on the efficiency and effectiveness of lean tools on the medical laboratory industry.

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References

- Alem, G. (2013). Reducing turnaround time for CD4 laboratory test results in Wukro Hospital. pp. 1-29. Retrieved from <http://hdl.handle.net/123456789/5253>
- Amirahmadi, F., Dalbello, A., Gronseth, D., & McCarthy, J. (2007, August). Mayo Clinic. Retrieved from Mayo Medical Laboratories web site: www.leadingedgegroup.com > uploads
- Biswajit, D., Jyotsna, N. B., & Montosh, C. (2013). Laboratory turnaround time. *International Journal of Health Sciences and Research*, 3(5), 82-84.
- Coons, A. J. (2007). Beginning the lean improvement journey in the clinical laboratory. Retrieved from <https://www.iienet2.org/.../Beginning%20the%20Lean%20Improvement>
- Dey, B., Bharti, J. N., & Chakraborty, M. (2013). Laboratory Turnaround Time. *International Journal of Health Sciences and Research*, 3(5), 1-4.
- Drotz, E. (2014, September 5). Lean in the public sector. Possibilities and limitation, pp. 1-62. Retrieved from www.liu.diva-portal.org
- Hawkins, R. C. (2007). Laboratory turnaround time. *The Clinical Biochemistry Reviews*, 28(4), 179-194.
- Joosten, T., Bongers, I., & Janssen, R. (2009). Applications of lean thinking in Health care: Issues and observations. *International Journal For Quality in Health Care*, 21(5), 341-347. doi:10.1093/intqhc/mzp036
- Kim, C.S., Spahlinger, D.A., Kin, J.M., Billi, J.E. (2006). Lean health care: what can hospitals learn from a world-class automaker? *Journal of Hospital Medicine*, 1(3), 191-9
- Mallick, Z., Ahmad, S., & Bisht, L. S. (2012). Barriers and enablers in implementation of lean six sigma in Indian manufacturing industries. *International Journal of advanced Research in Management*, 3(1), 11-19. Retrieved from www.iaeme.com/ijarm.html
- Moyo, K., Porter, C., Chilima, B., Mwenda, R., Kabue, M., Zungu, L., & Sarr, A. (2015, November 18). Use of laboratory test results in patients management by clinicians in Malawi. *African Journal Laboratory Medicine*, 4(1), 277-283. doi:10.4102/ajlm.v4i1.277
- Mutingi, M., Monageng, R., & Mbohwa, C. (2015). Lean healthcare implementation in Southern Africa: A SWOT analysis. *Proceedings of the World Congress on Engineering*, 2, pp. 1-4. London. Retrieved from www.iaeng.org
- NIP. (2014). Namibia Institute of Pathology Annual report. Windhoek. Retrieved from www.nip.com.na/wp.../NIP-2014-annual-report-lores_20141028pdf
- Poksinska, B. (2010). The current state of lean implementation in health care: Literature review. *Quality Management in Health Care*, 20(2), 319-329. doi:10.1097/QMH.0b013e3181fa07bb
- Rosmulder, R. W. (2011). Improving healthcare delivery with lean thinking: Action research in an emergency department. Utrecht: Wohrmann Print service. doi:10.3990/1.9789036532587

- Rutledge, J., Xu, M., & Simpson, J. (2010). Application of the Toyota Production System improves core laboratory operation. *American Journal of Clinical Pathology*, 24-31.
- Sandle, T. (2014). The lean laboratory and its application for the review of environmental monitoring samples. *Journal of Intitute of Validation Technology*, 20(2), 1-5.
- Stankovic, K. A. (2008). Developing a lean consciousness for the clinical laboratory. *Journal of Medical Biochemistry*, 27(3), 354-359. doi:10.2478/v10011-008-0015-2
- Venugopal, G. (2013). Lean strategy implementation methodology. Retrieved from www.slideshare.net
- White, A. B., Baron, M. J., Dighe, S. A., Camargo, A. C., & Brown, F. D. (2015). Applying lean methodologies reduce ED laboratory turnaround times. *The American Journal of Emergency Medicine*, 33(11), 1572-1576. doi:10.1016/j.ajem.2015.06.13
- Womack, J. P., & Jones, D. T. (2003). *Lean thinking: Banish waste and create wealth in your corporation*. New York: Free Press.

Biography

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Charles Mbohwa is an established Researcher and Professor at the University of Johannesburg. He has a DEng from Tokyo Metropolitan Institute of Technology, masters in operations management and manufacturing systems from the University of Nottingham and a BSc (honors) in Mechanical Engineering from the University of Zimbabwe. He has been a British Council Scholar, Japan Foundation Fellow, a Heiwa Nakajima Fellow, a Kubota Foundation Fellow and a Fulbright Fellow. His research interests are in operations management, engineering management, energy systems and sustainability assessment. He has published a book, several book chapters and more than 150 articles.