

Impact of Lean in the Inventory Process of a Clinical Laboratory

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Abstract — *The inventory process of clinical laboratories was evaluated to detect common problems, waste and identify areas of improvement. The objective of this project was to assess the impact of lean in health care environment. Medical Technologist participated in a survey were data gathering of collective problems and waste in the process of inventory control was obtained. Participants responded that the most common problems were the expiration of unopened reagents and out of stock. Medical Technologists selected transportation as the number one waste followed by waste of waiting and motion. The lack of organization was the main driver for waste in the inventory process. As a way to address the deficiencies, eliminate waste and improve quality a 5S lean tool was suggested to aid in the inventory process. A lean design project can be implement in a clinical laboratory to determine the impact of lean methodology in a health care environment.*

Key Terms — *5S, Clinical Laboratory, Inventory, Lean.*

PROBLEM STATEMENT

The focus of this project is to evaluated the inventory process of a clinical laboratory to identify areas of improvement and common problems. The objective of this research is to assess how the application of lean in a clinical laboratory inventory promotes waste reduction while improving turnaround time and quality of service.

Research Description

During this research, clinical laboratory inventory process will be evaluated to identify areas of waste and improvement. Lean tools will be applied to the clinical laboratory inventory process with the purpose of improve process by removing waste and reducing time.

Research Contribution

This research will help to understand the inventory process in a clinical laboratory and how lean tools can help to improve the quality of service by reducing wastes and increasing performances of excellence. Applying Lean -at a small scale- in the clinical laboratory inventory will provide data of the impact of lean in a health care environment. This information can be used by other health care departments as reference to improve service and quality.

LITERATURE REVIEW

Lean application consists of methodologies that share one goal, creating a problem-solving structure by removing waste and promoting efficiency in a process. Lean has been applied in business, manufacturing and health care environments for the benefits that produce and the opportunity of improvement that provides. Clinical laboratories have applied lean concept in small and large scale to promote efficiency and high quality.

Clinical Laboratories are well recognized by the accustomed need for quality assurance and quality control [1]. In a clinical laboratory quality control is essential to guaranty precise and accurate results. For that reason, as part of a daily routine quality control are process on analyzers to safeguard patient against mechanical errors or assay performance, as well periodically quality assurance is conduct to ensure excellence performance [1]. Excellent QA/QC programs guarantee the accurate reporting of results that are vital for clinical decision regarding diagnostic and treatment of patients [1]. Despite the fact that clinical laboratories are recognize by the effort in quality, there is an existence deficiency in laboratory management.

Deficiencies in the management of a laboratory can affect; quality of assay performance, increase of cost, unsatisfied employees and negative impact on customer service. In an attempt to address the inefficiencies, the increasing cost of material and in order to provide value, laboratories are expanding the quality assurance programs to include improvement initiatives that pursue the enhance of efficiency [1]. Lean thinking is an initiative that can assist to reduce waste while improving efficiency in a health care environment. Lean thinking defines the value of a process and divides process steps in value-added and non-value-added tasks [2].

A Lean Lab Design can be created as a way to address the deficiencies of laboratory management, reduce waste and improve efficiency. The application of lean in a clinical laboratory can improve workflow, turnaround times (TAT's), quality and employment engagement [3]. The entire staff has to be involved in the process to succeed, from medical technicians to lab director [3]. Identifying value and waste in the process will help to select the appropriated lean tools to improve the process. Lean tools like pull system (the use of Kanban cards) rather than a push system would facilitate the flow of value through the value stream [1]. Lean tools as 5S principals contribute to generate and support order while promoting a standardized value-based process resulting in an improve patient care [4].

The development of a lean design can be tried at first in a small scale, for example in the inventory process of the laboratory or a department to evaluate the impact. If the results are positive it can be applied in a higher level. Lean methodology has been applied in at small scale in Microbiology Lab department were a Lean Design was created to reduce testing turnaround times. As a result, better turnaround times, engage employees, improvement in workflow and patient satisfaction where among the benefits of lean implementation in the Microbiology Lab [3]. Lean initiatives at a macro scale have also provide positive effects in the laboratory and patient care and safety [4]. An implementation of lean in a hospital laboratory in

Nebraska, USA was conducted, were quality care and patient safety was improved [4]. Identification of waste and inefficiency help to develop a new lab design options for workflow to ensure expensive equipment's was only move once allowing medical technologist to keep working and reduce the impact in patient care [4]. The new lab design included the inventory process, were Kanban card lean tool was applied. Improving the inventory process helped reduce inventory levels and cost, while essentially reducing the time spent by the medical technologist ordering supplies [4].

The pursuit of quality, efficiency and continues improvement is the goal of any clinical laboratory. Provide accurate result for patients benefit while reducing waste and mechanical errors makes lean methodology the best choice. Staff must be accountable to achieve success during the process [4]. Lean implementation can create a positive impact on small to large scale in a clinical laboratory.

METHODOLOGY

This research purpose was to evaluate the process of inventory in clinical laboratories to identify common problems that can be improved using lean tools. The inventory process varies in each clinical laboratory depending on the size of the laboratory, departments that owns and volume of patients that receive.

A survey was conducted to understand the inventory process in a clinical laboratory. The survey helped to identify collective problems and waste in the process of inventory control. The survey was administrated to Medical Technologist of different clinical laboratories were information of the inventory process, location of reagents and materials, waste identification and possible options to improve the laboratory inventory was gathered.

Understanding the laboratory inventory flow, collecting the information from the people that use and manage materials, identifying waste in the process and acknowledge the safety protocol for storage of materials lead us to select the right tools to improve the process. When common waste

identification was completed, a lean tool was selected.

RESULTS

Data Collection and Survey Participants

Research survey was administered only to Medical Technologist working in a health care environment. The survey helped to gather information of the inventory process and identify common problems. The survey was sent to over 40 Medical Technologist, and a 77% of responses was obtained.

The majority, 58.06%, of the Medical Technologists that participated on the survey worked in a Hospital environment. Other participants worked in Reference Laboratories 12.90%, Urgent Care Clinics 9.68% and Private - Outpatient only-Laboratories 9.68%. Two participants responded that they work for Pathology Laboratories and one in the State Laboratory, these three responses were not included on the percentage for this first question.

Survey Results

Only 58.06% of the participants were not involve in the inventory process of their laboratories. The other 41.94% perform inventory, they claim that the inventory process takes them less than one hour, two hours or more (up to 12 hours) to complete the process. We asked the participants if they considered the inventory process of their laboratory to be efficient, a 41.38% of the Medical Technologists responded that it was a good process and 6.90% that it was a poor process (figure 1.)

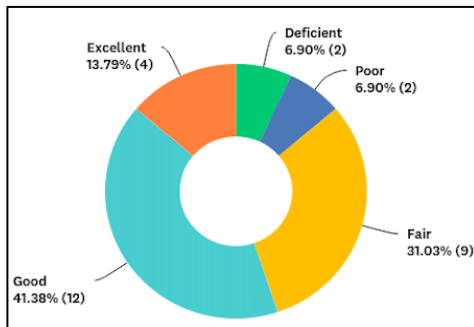


Figure 1
Efficiency of the Inventory Process of the Clinical Laboratory According to the Survey Participants

The majority of the Medical Technologist responded, that the organization of materials in their laboratories was somewhat helpful 35.48%, while 19.35% said it was extremely helpful (figure 2). In order to get more information about the inventory process we asked which were the most common problems on the process. The participants responded that the most common problem when dealing with inventory was the expiration of unopened reagents 61.29%, follow by out of stock 54.84% as shown in figure 3. Wrong quantity or order and over-tock were the third common problem with a 22.58%. In this question, Medical Technologist had the option to add any other problems they consider were common when working with inventory. A 19.35% of other problems included standing order need to be cancelled for some low usage of reagents; inability to find supplies, due to no regular storage; some reagents stored outside the lab, and wrong lots.

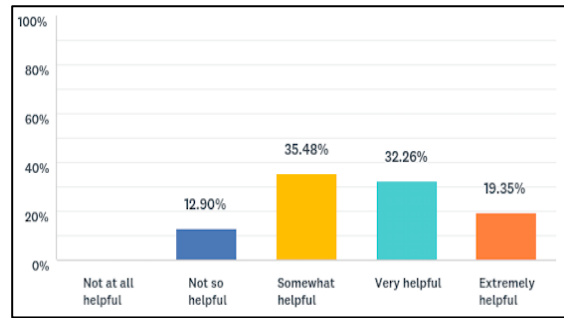


Figure 2
Classification of Helpfulness of the Location and Storage of Material in the Clinical Laboratory

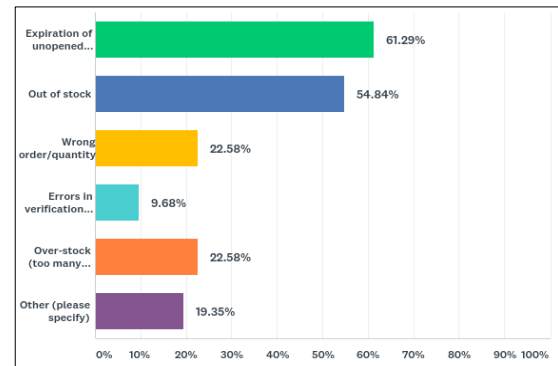


Figure 3
Common Problems in the Inventory Process of a Clinical Laboratory

The participants were asked to provide a brief explanation of the methods used to perform the

inventory. Medical Technologist provided a variety of responses that were summarized in table 1, which included manual techniques to perform the inventory as well as computerized methods. Some of the laboratories performed the inventory process monthly or weekly, while few of them executed daily. In several of the laboratories the inventory process was conducted by Supervisors, Lead Tech or Medical Technologist. In other cases, there was external personnel in charge of the inventory process.

Table 1
Methods Applied to Perform Inventory in Clinical Laboratories

Methods utilized to perform inventory in clinical laboratories according to survey responses
Inventory Computer System
Excel Worksheet
Manually count each reagent and material
By quantity. If reagents quantity is low, a new order is created.

Recommendations for possible improvements that Medical Technologist thought would help the inventory process was other of the question from the survey. Table 2 summarizes the options given by the Medical Technologist. For this question, 25 responses were collected and 6 participants skipped the question. Some participants provide more than one idea to improve the process. While others provided ideas that are not on the laboratory control. Others did not provide any idea since they believe the process is good and does not need improvements. Organization was the major response with a frequency of 9 responses. The second idea was implement a new method to perform inventory with a frequency of 4 responses. The implementation of a barcode system or having designated personnel to be in charge of the laboratory inventory were also ideas provided by the survey participants. Other simple changes to improve the process was to modify the frequency with which the inventory is conducted and adjust the quantity of the orders to avoid common problems.

Table 2
Possible Improvements for the Inventory Process of a Clinical Laboratory

Improvement for the inventory process of a clinical laboratory	
Ideas of improvement	Frequency
Organization	9
New method to perform inventory	4
Barcode system	3
Frequency of performing inventory	2
Quantity order	2
Personnel in charge of the inventory process	3

Medical Technologist were questioned about their knowledge on Lean Methodology, which 54.84% responded yes and 45.16% answered no. To collect information about possible waste in the process they were asked to select – on their better understanding- possible waste that the inventory process of their laboratory presents (figure 4). 28 responses were obtained and 3 participants skipped the question. Transportation was the number one waste according to the Medical Technologists with a 42.86%. Waiting was the second waste with 39.29%. Motion and Non-Utilized Talent were the third major waste in the process with a 35.71%.

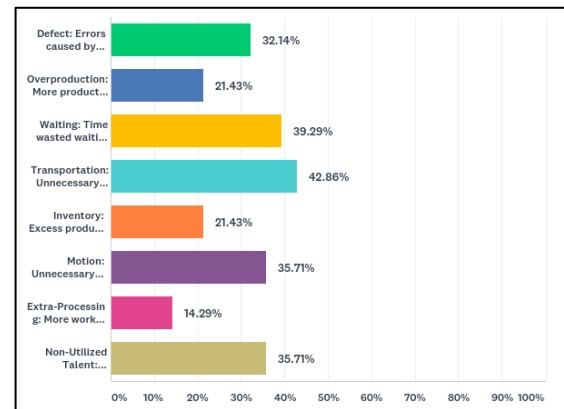


Figure 4
Types of Waste in the Inventory Process of a Clinical Laboratory

The last item of the survey asked the participants if they believe improvements in the laboratory should only be discussed between management for example Managers, Supervisor,

Lead Tech, etc. The majority of the Medical Technologist responded strongly disagree with 41.94% and disagree 25.81%. A 19.35% strongly agree with the fact that improvements should be decided only with the support of management and a 12.90% also agree.

DISCUSSION

A considerable completion rate of the survey was achieved. Reactions from medical technologists that work in different types of laboratories was possible to collect. More than half of the medical technologists that participated in the survey work in clinical laboratories of a hospital environment-58.06%. Input of medical technologists from Reference Laboratories, Urgent Care Unit, Private Labs and Pathology Laboratories were also collected but it was smaller. Analyzing the feedbacks of each participant, regarding the inventory process efficiency, we noticed that the majority of the medical technologists from hospital laboratories considered fair and good the efficiency of the process. Whereas, medical technologists from reference laboratories answered that the efficiency of inventory process in their lab was good or excellent. The participation of reference lab technologists was smaller compared with the hospital medical technologists; therefore, we cannot assume that efficiency in reference lab sector is more developed than hospital labs. Nevertheless, we can sustain that according to results there is area for improvement in the inventory process of a clinical laboratory where lean methodology can be implemented.

According to the medical technologist there are four major problems; 1) expiration of unopened materials/reagents, 2) out of stock, 3) wrong order/quantity, and 4) over stock. We identify that the root of these common problems was poor organization. The methods employed to perform the inventory created a lot of waste. Three major wastes were identified by the Medical Technologist: transportations, waiting, and motion. Transportation waste could be produced in the movement of material

from a place to another, since some of the participants explained that materials are localized outside of the laboratory. Waiting could be the time required to find the materials to be able to process the specimen or even waiting for borrowed materials from another lab when they run out of materials or out of stock. Motion which is the unnecessary movement of people it was also a waste according to participant, this could be seen in a manual method of doing inventory where the medical technologist has to be walking around back and forward to perform the inventory rather than having everything organized by areas.

Medical technologists suggested possible improvements they thought could help to create a more efficient process. As listed in table 2, organization was the number one suggestion followed by implementation of a new method to perform inventory. Using a barcode system for the inventory process was other of the possible ideas to improve the process. Lean methodology has different tools than can be applied to improve a process and eliminate waste. The selection of lean tools would depend of the types of waste presented in the process and what the organization wants to improve. Analyzing the data collected through the survey we detected lack of organization in the process. This could be the principal cause of the common problems on the inventory control. A lean tool that can be used to improve the inventory process could be a five S methodology (5S).

A 5S methodology will help to create and sustain order in the inventory process and as a result eliminate waste, reduce turnaround times and improve quality of service. For this reason, 5S methodology is the perfect tool for a lean design model. The 5S methodology describes the five steps of a workplace organization process, which are: sort, set in order, shine, standardize and sustain. Safety can also be included in the 5S methodology, since we are working in a laboratory environment where chemicals and biohazard materials are implicated. In order to create a lean design model applying 6S (sort, set in order, shine, standardize and safety) for the inventory control the storage and localization of

materials needs to be rearrange in a lean approach were transportation and motion waste can be eliminated. The method applied to performed the inventory can be modified applying lean methods to help improve the process.

The last question of the survey asked the participants if they believe improvements in the laboratory should only be discussed between management only and the majority responded that they disagree. Although management makes the decisions, the voice of the employee has to be heard. The engagement and cooperation of all staff from Technicians to Supervisors is extremely important for the success of a lean implementation.

CONCLUSION

Research Conclusion

Lean tools application in a health care environment can be beneficial for patient care, since helps to increase quality of service and to reduce turnaround time. Lean can be implemented at a small scale in the clinical laboratory inventory process to reduce common problems and reduce common wastes. A lean design model can be created to improve the efficiency of the inventory process of a clinical laboratory taking in consideration the laboratory needed. A before and after implementation of lean 5S (or 6S) tool can be evaluated to determine the impact of lean in patient care. Staff compromise and cooperation is important for the success of the lean implementation.

Research Contributions

Conducting this research help to the understanding of the inventory process of a clinical laboratory. Identification of common problems affecting the efficiency of the process was achieved. Identification of areas of improvement and common waste in the process help to determine were lean tools can be functional to create an efficient process.

Future Research

A lean design project can be implemented in a clinical laboratory to evaluate the before and after

results and determine the impact of lean methodology at a small scale in a health care environment.

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