

# BEGINNING THE LEAN IMPROVEMENT JOURNEY IN THE CLINICAL LABORATORY

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## Abstract

Lean is an extremely powerful tool in identifying and eliminating waste. The roots of Lean methods have been applied to various industries for more than 100 years. In the late 1990s, Lean was introduced into healthcare. Since then, many hospitals have adopted Lean as the key method for implementing significant process improvements to drive quality, cost, safety, and delivery of care. This article highlights some key concepts of Lean and the elements of beginning a Lean journey within the clinical laboratory. It explores Lean tools that can be implemented within the healthcare setting, highlighting case study examples.

## Introduction

Since the late 1990s, Lean has been applied to the healthcare setting and has continued to grow across the industry. Lean is a methodology of eliminating waste by targeting the processes surrounding patient care, allowing clinicians to re-evaluate their process in the patient's eyes. Lean can be defined as:

*A systematic approach to shorten the time between customer (patient, physician, nurse, other) request and service delivery by identifying and eliminating sources of waste (non-value-added activities).*

Simply put, Lean is focused on the elimination of waste, or non-value-added activities, from the process. Non-value-added activities can be defined as those activities the customer is not willing to pay for (i.e., it

does not affect the service or outcome). These activities typically account for 75-95% of the the total time needed to provide a service – the lead time (Figure 1).

Healthcare, as well as other industries, has strict regulations that monitor and

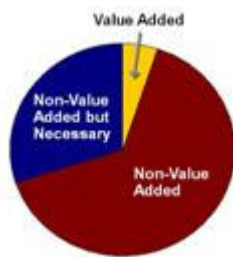


Figure 1

protect patients. Many of these regulations can cause processes to be redundant and non-value-added; however, they must be performed to satisfy regulatory bodies. These activities fall into a third category – non-value-added, but necessary. These activities should not be excluded when driving improvement, but further ways to improve should be explored while adhering to regulations.

There are eight types of non-value-added activities or waste.

**Defects :** Work that contains errors, rework, mistakes, or lacks something necessary

**Overproduction:** Making more, earlier, and/or faster than is required by the next process

**Waiting:** Idle time created when material, information, people, or equipment are not ready

**Not utilizing employees knowledge, skills, and abilities:** The waste of not leveraging peoples' full talents and capabilities

**Transportation:** Movement of patients and materials that adds no value

**Inventory:** Any supply in excess of what is required

**Motion:** Movement of people that does not add value to the product or service

**Extra Processing:** Additional effort that adds no value to the product or service from the customers' viewpoint

Lean is an extremely powerful tool in identifying and eliminating these eight wastes. However, it is critical to understand which Lean tools to implement and when. It is often difficult to implement and sustain improvement if a "cookie cutter" approach is used to apply Lean throughout the organization, which is why some organizations will claim, "Lean doesn't work for us," and dissolve any Lean efforts.

Taking a deeper look at how Lean can be described, in 1988 Taichi Ohno (known as the father of the Toyota Production System) stated:

All we are doing is looking at the time line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing the non-valued-added wastes.

From this statement, we can assume that every organization has a goal to reduce the lead time or length

of stay. Every process has waste – the key lies in seeing it!

## Beginning a Lean Lab Effort

Starting the Lean journey in any department can be difficult. It is critical to have alignment and clearly state the need for improvement from the beginning. There are five key steps that should be taken when starting the journey towards a Lean improvement.

1. Develop a burning platform for change
2. See the waste
3. Develop the lab's specific plan for improvement
4. Implement changes
5. Measure, monitor, and sustain

These steps can be applied whether the journey begins in the ED, OR, or lab. This article will guide through the approach, highlighting examples within the clinical lab.

## Develop a Burning Platform for Change

It is essential that all members of the team, support areas (e.g., facilities, IT), and Senior Leadership are aligned. Defining the scope of the improvement and setting a burning platform for change is the first step.

When defining the need for change, look at it in terms of how the customer is being impacted. The customer might be the patient, family, clinician, or the hospital. Some case study examples of a burning platform for change might be:

- 30% of test results are not verified for physician rounds
- Emergency department LWOBS has increased from 1% to 4.5% in the ED over the past six months
- The average LOS in med/surg has increase 25% in the past 12 months
- The hospital has lost \$3.5 million in revenue due to missing charges over the past year
- Increased return of medications to inpatient pharmacy is over 15%, costing nearly \$500,000 per year

These statements are just a few examples of the issues that hospitals face today. It is essential to clearly define the need and then discover the detail behind the problem statement. Supporting data will be needed to support any improvement within a given department. It is critical that baseline measures are established to monitor

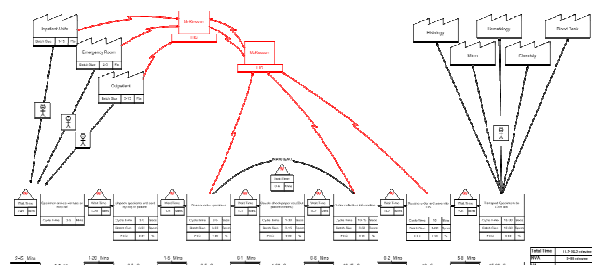
success. This will be the foundation to measure success as key opportunities for improvement are determined.

## Case Study Example

The clinical laboratory has seen an increase in volume over the past six months of 15%. As volume increased, the average turnaround time has increased to an average of 60 minutes across the top eight tests. In addition, the percent of tests verified for morning rounds is 65%.

## See the Waste

Now that the need for improvement has been defined, next is to understand where to target the improvements. Many improvements fail because “cherry picking” occurs, which occurs when the team determines what problems are causing the issue without investigating it first. This can be the downfall of any Lean improvement. A tool that can be used to avoid “cherry picking” is value stream mapping. Value stream mapping is a process by which all activities are mapped, both value-added and non-value-added, that are required to perform a service (Figure 2).



improved process that streamlines patient care.

**Figure 3**

Value stream maps are a very powerful tool to guiding improvements. Key benefits of value stream mapping include:

- 
- Provides a common language for talking about healthcare processes
- Shows the linkage between the information flow and the patient flow
- Ties together Lean concepts and techniques
- Helps make decisions about the flow apparent for further discussion

Value stream maps are a working document that will guide not only the first improvement, but ongoing continuous improvement efforts (Figure 3).

## Develop the Specific Plan for Improvement

Next, the team will define the key opportunities for improvement, which will outline the work plan needed to achieve the desired goals. The improvement opportunities will need to be prioritized by evaluating several aspects of each opportunity. These criteria could include impact, ease, or cost – or anything that will allow the team to objectively determine the best opportunities to implement.

With key improvements identified, the team will need to outline the timing for implementation. A typical approach may include the value stream map (already completed), training, and multiple rapid improvement events followed with sustainment. Rapid improvement events are events that produce drastic improvement results over a one to five-day period.

### Case Study Example

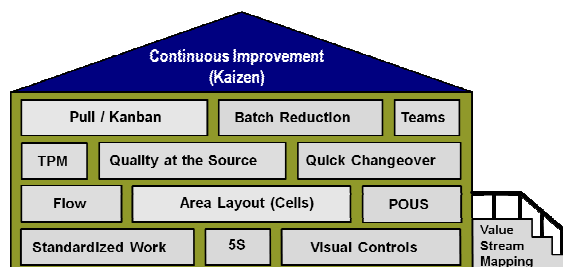
There are many approaches to driving Lean within an organization. A common approach might include:

- Lean training
- Value stream analysis (VSA)
- Implementation (including rapid improvement events)
- Sustainment

In this case, the team determined that 5S was the first improvement opportunity to implement. As discussed in the next section, 5S is widely considered as the foundation for all other Lean improvements.

## Implement the Changes

Within the “House of Lean” there are multiple tools that could be implemented. Figure 5, represents some of core tools that could be implemented. It can be difficult at times to know where to start; however, the value stream map can shed light on which tools to implement.



**Figure 5**

To help understand which tools to implement, the chart below provides some guidance on when to use various Lean tools. It outlines some of the typical opportunities that exist in clinical labs today and the corresponding Lean tool(s) that could help drive improvement.

Opportunity	Lean Tool
Large amount of in process specimen	Batch Size Reduction, Teams
Redundant Work	Root cause analysis
Multiple Handling	Standard work methods
Inconsistency in tech or phlebotomist process	Standard work methods
Re-labeling or Insufficient sample volume	Quality at the Source
Not understanding current conditions or status	Visual Controls
Excessive travel / walking	Flow, Point of Use Storage, Area Layout
Excessive clutter and visual noise	5S Implementation

To further breakdown several key Lean tools, the following tools will be discussed in more detail.

- Workplace Organization (5S)
- Batch Size Reduction
- Standard Work

### Workplace Organization (5S)

Workplace Organization (5S) is a method for organizing and standardizing the location of materials, information, and equipment to optimize flow and to help understand when something is out of place or missing. It helps to identify and remove what is not needed from the workplace to achieve a given task. This allows management and staff to quickly determine when

something is out of place or if a problem exists. Workplace Organization can be broken into five steps (thus, 5S):

1. **Sort** - Sort through all items in a given area, placing a red tag / sticker on all unneeded items and moving them to a temporary holding area.
2. **Set in Order** - Identify the best location for remaining items, relocate out of place items, set inventory limits, and install temporary location indicators.
3. **Shine** - Clean everything, inside and out. Continue to inspect items by cleaning them and to prevent dirt, grime, and contamination from occurring.
4. **Standardize** - Create the rules for maintaining and controlling the first three S's and use visual controls.
5. **Sustain** - Ensure adherence to the 5S standards through communication, training, and self-discipline.

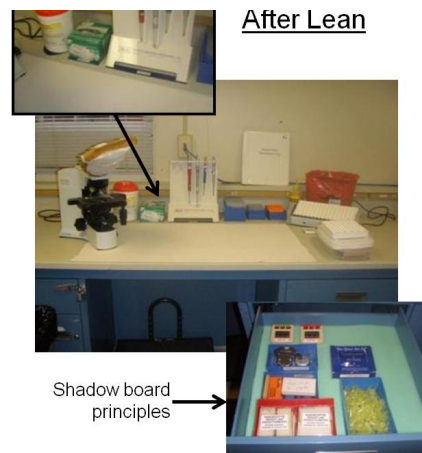
Workplace Organization is often a great starting point for many laboratories. Over the years, the instinct to hold on to things "just in case," has allowed departments to build up endless clutter. 5S allows the team to re-evaluate every item and determine what is truly needed to perform a given task at a work bench or area. 5S can be seen as the foundation for all other Lean activities. Without 5S, it could be difficult to achieve maximum results.

### Case Study Example

Oftentimes, many people believed that areas of the laboratory were not disorganized; however, if items were taken from the work area, not everyone would realize it. It might be apparent to the tech working the bench, but it may not be discovered until they are in the middle of a test. Implementing 5S principles helped ensure that all needed items were where they should be kept. Below is an example of a before and after shot of a Lueko Reduction Counting workstation.



**Figure 6. Before Lean.** The drawers are not organized and workstation is not neatly arranged.

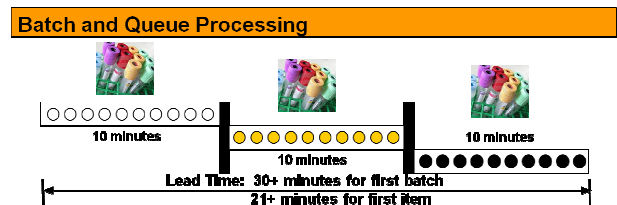


**Figure 7. After Lean.** All items are clearly labeled and the drawer contains foam cut-out to quickly identify what is missing.

As 5S is implemented, it is important to remember to stay flexible. Although 5S determines what items should remain, it does not mean the items can't be moved during daily operation. There must be flexibility for the tech to become comfortable as he or she works. At the end of the shift, items should be returned to the proper location to maintain standardization and sustainment (especially among the different shifts).

### Batch Size Reduction

Evaluating and minimizing the batch size of various processes can yield substantial results. Large batch sizes lead to the potential for greater quality errors and increased lead time. By reducing batch sizes throughout the process, it can provide better agility to respond to customer demand. In addition, large batch sizes can result in downstream constraints in the process. By reducing batch sizes, it allows the product or service to move on to the next process in less time, ultimately being completed faster. For example, a batch size of ten going through three process steps (each taking one minute), it would take 30 minutes to complete the batch and 21 minutes for the first item to be processed (Figure 8).



**Figure 8**

However, if the batch size was reduced by 50%, it would take 15 minutes to process the batch and 11 minutes for the first item. (Figure 9)

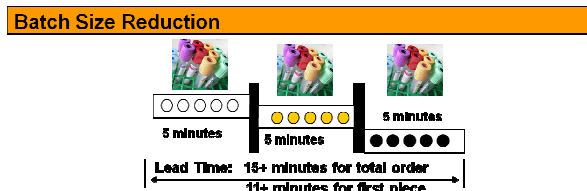


Figure 9

Although it still would take 30 minutes to process all ten items, the first five would have already moved on to the next process or to the customer. This results in a 48% improvement in turnaround time.

By moving to single-piece flow or a reduced batch size throughout the process, constraints can be minimized by level-loading process steps with optimal batch sizes, work-in-process can be drastically reduced or eliminated, and turnaround time can be greatly improved.

### Case Study Example

Clinical lab accessioning can be the most critical step in getting results to physicians, and ultimately, the patient. Accessioning truly sets the pace in which the lab processes specimens. In many labs, large batch sizes are used to draw specimens as well as receive specimens. As an example, one laboratory receives specimens with an average batch size of 30. These specimens must be time stamped, received into the LIS, centrifuged if needed, re-labeled, and staged for the analyzer. The average lead time to perform this work takes 20 minutes and is handled by three different staff (Figure 10).

#### Process Steps:

1. Open bag, timestamp, and stage for receipt
2. Centrifuge (If needed) and receive into LIS
3. Match specimen with label, Label and stage for analysis

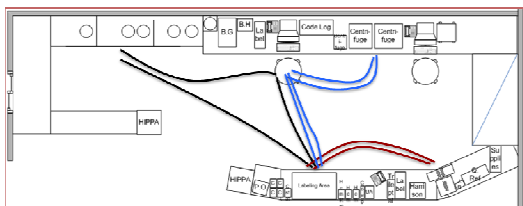


Figure 10

Evaluating the constraints and process workflow, it was determined that reducing the batch size to eight specimens and having each staff member process their

own batch could yield tremendous improvement in both time and capacity. This improvement resulted in an improvement of capacity per hour from 90 to 144 specimens. As a next step, new centrifuges were purchased reducing the centrifugation from ten minutes to five minutes. This increased the total capacity per hour to 288 specimens (Figure 11).

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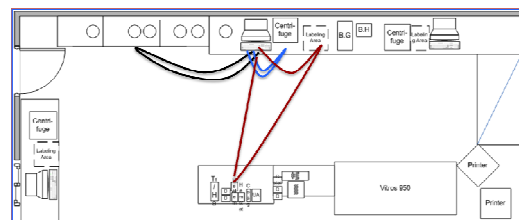


Figure 11

In summary, by implementing batch size reduction, improved process workflow, and an improved centrifugation time, the capacity per hour was improved from 90 to 288 specimens – a 220% improvement.

### Standard Work




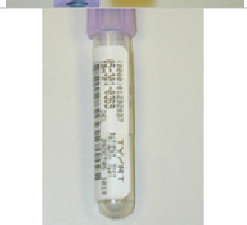
Implementing standardization of the new method is the basis for sustaining all continuous improvement activities. Many times procedures exist for nearly all work performed, but are written for regulatory bodies or lawyers instead of the employees. Standard Work differs in that the procedures or work instructions are written to further define and document the best practices determined by the staff. Standard Work needs to include multiple methods of education to ensure awareness and understanding by the staff. Different methods to consider might be incorporating pictures of certain activities performed along with text or including process flow diagrams that provide a summary of the keys steps. Employees need quick methods to help them determine that they are performing their work in the most efficient manner possible. To strengthen this standardization of new processes, consider posting the process flow diagrams in various parts of the department. Having standard work in place and incorporating various methods of education will further maintain your ability to sustain the results.

### Case Study Example

Many laboratories struggle to maintain quality labeling practices. Laboratory specimen labeling became a big issue when labels needed to be positioned in a certain fashion in order for the automated equipment and



analyzers to read the barcode properly. When specimen labels were not positioned correctly, it led to rework and costly errors. By using Standard Work principles (Figure 12) and incorporating pictures, the error of interpretation by staff when training new hires or additional staff was drastically reduced.

		Ensure that the name and medical record number of the LIS label is still visible.
2.		If the LIS label is placed on the tube so that a "flag" protrudes off of the specimen,
		fold the "flag" down to the tube and place the LIS label lengthwise over the flag, allowing the patient's last name and medical record number on the LIS label to be seen. (This is also true for all other 3cc tubes.)
3.		The LIS label should be smooth and not wrinkled. This is extremely important for the barcode area of the label. This barcode area is what the analyzers read in the automated running of the specimen.

**Figure 12**

### Measure, Monitor, and Sustain: The Keys to Success

The journey through implementation can be very difficult at times, so it is critical to set goals and drive to achieve them.

However, some people like change and others do not. Across nearly every industry, the breakdown of individuals' acceptance of change can be broken down to:

- 20% like change
- 60% are not sure of change
- 20% do not like change

A key aspect of driving the improvement is to include staff from the 20% that does not like change. The purpose behind this is those that are on the fence may look up to staff that do not like change. Converting those that do not like change into believers will quickly

win the support of the staff. This shift in culture will allow an organization to navigate obstacles and will help achieve any goals set forth.

To keep all staff involved and communicate the success to other departments, the use of a metrics tracking center will be greatly beneficial. The tracking center might contain elements such as:

- Current state value stream map
- Future state value stream map
- Implementation plan
- Key performance measures
- Communications

This will allow employees involved in the process to have all the information in one place and track the success of the project. In addition, this will allow the department and team members to continue tracking the success until goals are achieved.

Typical results that can be achieved during Lean engagements within the lab can include:

- 25-50% improvement in turnaround time
- 20-50% improvement in tests verified for morning rounds
- 10-35% improvement in productivity measure
- 5-15% improvement in staff and patient satisfaction

Driving Lean improvements within any department can seem challenging, but with the right tools, approach, and support, it can result in drastic improvements to patient care.

### Biographical Sketch

Jason Coons is the Program Manager for Healthcare Solutions at TechSolve. Jason has implemented multiple Lean improvements within the clinical lab as well as many other departments in the hospital. Jason holds a Bachelor's of Science degree in Industrial Engineering. He holds Green Belt and Black Belt certifications in Six Sigma as well as Lean Healthcare Certification from the University Of Tennessee.