Use of Lean Six Sigma Tools for the Design of a Core Laboratory

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Abstract

The Core Laboratory within the Department of Laboratory Services at Stanford Hospital & Clinics was experiencing inconsistent turnaround time (TAT) to key service departments. It was widely believed that space layout and a lack of fully automated instrumentation systems were major contributing factors.

Process mapping of the Specimen Processing areas revealed that eleven different processes were being used by three different processing stations which led to operational difficulties in meeting TAT.

The operational review also revealed three distinct design issues that contributed substantially to TAT issues.

The Core Lab Design Team has developed a new operational plan based on reducing the number of processes and a new space plan that incorporates the optimal use of automated systems with a design goal of achieving an absolute TAT of 30 minutes.

Introduction

The entire Department of Laboratory Services at Stanford Hospital & Clinics (SHC) retained Chi Solutions, Inc., to develop space plans for laboratory facilities to meet growth projections for the next 20 years.

The planning process included the extensive use of Lean Six Sigma analysis tools to improve operational efficiency through process change and efficient space planning.

The Core Laboratory was experiencing erratic turnaround time to key service departments, such as the Emergency Department, which was verified by measuring turnaround times over a 30-day period.

It was widely believed that the current space layout of the entire Core Laboratory and Specimen Processing, in particular, and a lack of space for fully automated instrumentation systems were major contributing factors.

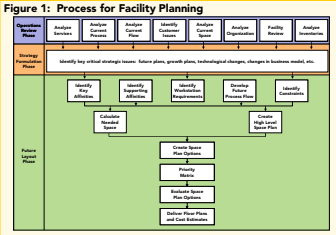
A comprehensive, Lean Six Sigma-based operational review was performed that included the development of complete process maps for all testing areas in the Core Laboratory.

A zero-based approach was applied to develop space plans based on the design of individual sub-blocks for the entire laboratory. The sub-blocks were then arranged strategically to provide efficient workflow.

Materials and Methods

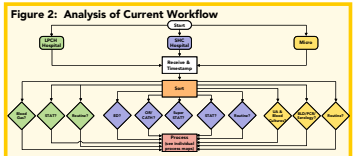
- A thorough Lean Six Sigma-based process was applied to develop high-level space plans for the Core Laboratory (Figure 1). The design process included active participation by a Core Lab Design Team composed of Medical Directors, Technical Directors, and Laboratory Supervisors.

Figure 1: Process for Facility Planning



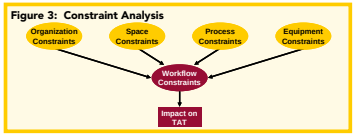
- A detailed operational review was performed that included the development of complete process maps from specimen receipt through result reporting for all testing areas in the Core Laboratory (Figure 2).

Figure 2: Analysis of Current Workflow



- A constraint analysis was performed that included a physical review of the current space plan and specimen flow through the Core Laboratory (Figure 3).

Figure 3: Constraint Analysis



- A TAT analysis was performed that included key metrics for a 30-day period for the Emergency Department (Figure 4).

Figure 4: Analysis of ED TAT Performance

Metric	Average (Min)	Standard Deviation
Collect to Verify	63.7	34.3
Collect to Receive	26.5	19.5
Receive to Verify	36.5	26.5
Receive to Bench	13.9	16.9
Bench to Result	15.0	18.5
Result to Verify	8.3	16.4

Summary:
- It takes an average of 64 minutes to process a specimen from the ED.
- Once the specimen has been received, it takes an average of 14 minutes to arrive at a workstation bench and 23 minutes for a result to be tested and released.
- It takes an average of eight minutes to verify a result after completion of testing.
- There are large deviations in each of the main process steps.

Note: N = 6778. Statistics exclude outliers of >200 minutes.

- A facility space layout analysis of the entire Core Laboratory (Figure 5) and of the Specimen Processing (Figure 6) areas was performed to identify physical or equipment constraints.

Figure 5: Current Space Layout of Core Laboratory

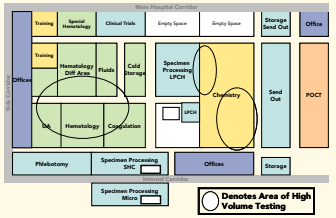
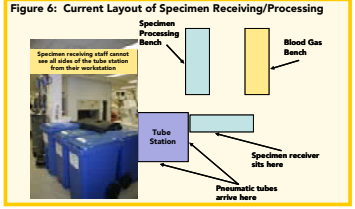


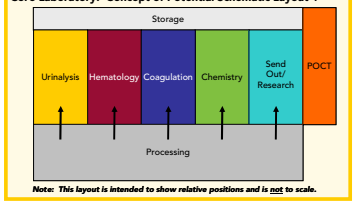
Figure 6: Current Layout of Specimen Receiving/Processing



Results

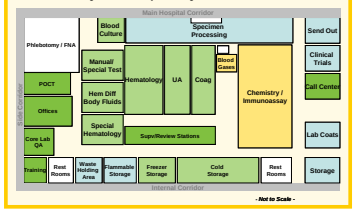
- Specimen Processing is physically organized into multiple receiving areas for specimens (two manual drop-off and three tube locations).
- Eleven different processing priorities are used, each with different handling steps.
- The physical location of the tube stations is not conducive to smooth workflow.
- High volume testing activities are performed in physically-limited spaces.
- Once the specimen has been received in the laboratory, the TAT averages 36 minutes.
- There is a delay in delivering specimens to the testing areas after receipt.
- There is a delay in release (i.e., verification) of results following testing.
- There is limited use of automation and auto-verification.
- TAT improvement efforts led to "ad hoc" initiatives that likely impeded improvement of overall workflow.
- A Core Lab Design Team facilitated by Chi consultants was developed to address these issues as part of the laboratory design project. Their charter was to develop an efficient design supporting lean-based process flow. The key results of their efforts were based on the following:
  - **Simplify Processing** - Eliminate multiple categories and resorting.
  - **Space Layout** - Physically reorganize the space so that workflow can be optimized.
  - **Automate** - Install automated equipment with use of auto-verification.

Core Laboratory: Concept of Potential Schematic Layout 1



Note: This layout is intended to show relative positions and is not to scale.

Core Laboratory: Future Space Layout



Conclusion

- Improvement actions prior to the study period resulted in the development of numerous processes to prioritize specimens to improve TAT for specific customers. However, this approach likely resulted in unintended consequences that actually increased TAT because they were not applied to develop a strategic solution.
- A Specimen Processing study group was developed during the design phase, and they have reduced the number of processing priorities from eleven to two.
- The Core Laboratory had several major issues impacting TAT including equipment, space, and design constraints.
- The Core Lab Design Team has developed a lean-based, future state schematic plan to simplify the physical plan of the Core Laboratory, improve patient access, improve workflow, and allow the installation of automation. The laboratory has been designed to achieve an absolute TAT of 30 minutes for all RRL tests. The high-level plan has been approved by senior management, and full schematic plans are now being developed.
- The use of Lean Six Sigma process improvement techniques can be successfully applied to the design of an entire laboratory if a comprehensive approach to meet strategic needs is used.

Team Members

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