ARUP Specimen Processing Lean Case Study
INTRODUCTION

The Lean method of improvement achieves process optimization through incremental change, with each subsequent activity building on the value gained from previous wins. While this approach offers proven sustainability, the continually changing context of the healthcare environment may occasionally require a more disruptive change model. Episodic transformational change can be a successful strategy when used in conjunction with continuous, incremental change.

In August 2009, with a primary goal of improving workflow and accuracy and a secondary goal of more efficiently utilizing existing space, ARUP Specimen Processing embarked on an experimental and transformational journey using the tools and methods of Lean manufacturing.

By March 2010, the shop floor, work stations, and team structure were completely reconfigured.

ARUP SPECIMEN PROCESSING CASE STUDY

Various studies of laboratory error have estimated that 60 to 80 percent of laboratory errors happen in the pre-analytical phase of testing. These errors occur in patient identification or preparation; in the selection of container, collection device, or collection technique; and in specimen receiving, ordering, preparation, or transport and storage.

The value stream represented by these steps begins when the physician orders a diagnostic or monitoring assay and ends when the reported result produces a patient-care outcome. Functioning primarily in the context of a reference laboratory, ARUP’s Specimen Processing group enters this value stream after the sample has been collected, prepared for transport, and sent to ARUP.

Steps include 1) receiving shipments, 2) processing specimens and orders, and 3) delivering specimens and aliquots. Omissions, violations, deficits, and delays in any of these three steps tend to follow the sample throughout the testing process; thus, optimization of these steps is an ongoing quality strategy for ARUP.

Root-cause analysis reveals that process failures are associated with high turnover, entry-level employees, input variability, task complexity, and goal conflicts.

MEASURES OF PERFORMANCE

Indicators of process performance are measured and evaluated in three dimensions: time (from shipping box receipt to completed processing); quality (lost, compromised, and mislabeled samples or order errors); and cost (per billing unit).

Historically, the goal of quality assurance has been to prevent error-prone behaviors, encourage productive behaviors, and enhance workplace efficiency. The primary methods (i.e., training, awareness, incentives, audits, process modifications, and work aids) for achieving these goals have been incremental and steady; however, more complex and/or costly initiatives (i.e., predictive hiring, automation, electronic transmission of data, and software enhancements) have been used as well.
Over time, these interventions have carried the Specimen Processing group through double-digit growth while guarding against quality degradation.

**STAGE ONE**

ARUP formed a team that included management staff, line-level supervisors, and selected members of the workforce from both Specimen Processing and Exception Handling. Daily stand-up meetings were held to review progress, solve problems, and promote teamwork.

The initial stage reduced the number of times shipping boxes, transport bags, and specimen containers were “touched.” Reduced touches would eliminate hand-off error, improve efficiency, and increase productivity.

To this end, the team created extensive flow charts of the three main tasks involved in specimen receipt: two manifesting tasks (performed by couriers and workflow coordinators) and the main processing task (performed by processors).

- Courier manifesting represented 14 touches and was the initial processing step.
- Workflow manifesting represented 9 touches.
- Specimen Processing, the final task, required 11 touches.

**BEFORE**

![Before flow charts](image)

**AFTER**

By focusing on eliminating waste in all aspects of the process, the team was able to reduce the number of touches from 34 to 16. With the new processes, shipping boxes are delivered directly to processors, and the steps from the three processes are consolidated.

Additionally, the total number of steps was reduced from 54 to 31, further decreasing the complexity of the entire process.
The second stage concentrated on the design of the shop floor. The existing layout placed processors in rows. Staff worked in back-to-back stations, with each station afforded access to the automated delivery track (purple line). After the initial courier manifesting task was complete, workflow coordinators, stationed at the end of each row, managed the flow of incoming work and distributed work to processors. Specimens were unbundled from the shipping boxes and rebundled for distribution to the processors. An inspection step for all paper orders was performed away from the work area by order editors.

Inadequate order information and sub-optimal specimens were “excepted”—sequestered and sent to a separate department for handling and resolution. Handling for non-standard samples and orders was delayed, regardless of the complexity of the non-conformity. For instance, orders for testing on 24-hour urine collections without total volume were handled in the same way as orders accompanied by samples that were inappropriate for the test ordered.

While the configuration of the shop floor was adequate to meet expectations for quality and timeliness, the team considered that a different configuration could deliver improved quality and efficiency.

The area was redesigned using the principles of cellular design. The automated track now runs along the outside edges of each four-station cell. The cells are dubbed PODs and include four processors per POD; the PODs are supported by:
• A processing lead to provide immediate support for questions and error recovery.

• An immediate quality check by order editors to detect and correct errors with timely feedback provided to the person making the error.

• Exception handling experts for resolving simple submission errors and omissions, many of which can be resolved without client contact.

The new configuration provides better access to processing expertise for new workers and supports a whole-team approach to box processing. Enhanced, timely error recovery and training opportunities remove the sting from unintentional error and improve morale. Training time is shortened and overall adaptability to submission variation is boosted. With Exception Handling staff at the workstation, uncomplicated submission issues are detected and resolved before the sample moves into the testing laboratory. Accordingly, the quality of work is continuously improving. Over time, the team saw a marked decrease in the number of lost and mislabeled samples.

STAGE THREE

The final stage of the transformation involved the workstation itself. To optimize the space reconfiguration, the team addressed the design of the work stations. Using the principles of 5S (Sort, Straighten, Shine, Standardize, Sustain), the team consolidated storage and staging space and reduced the footprint for each work station by 21 percent (from 5 feet to just less than 3 feet).

Standardization of the units created a better design for storage of shared materials and equipment. Focusing on point-of-use design for workstations also improved ergonomics and reduced strain. With ready access to materials and information, processing staff saw efficiency and efficacy gains.

In combination, cellular design and standardized workstations increased the number of workstations that the existing shop floor could accommodate. With the previous configuration, maximum capacity was 116 seats; the new space can accommodate 171 seats.
RESULTS

In addition to better use of existing space, the team projected potential improvement in four areas: increased efficiency, reduced turnaround time, higher quality, and improved morale. Time period was measured for 18 months prior to the POD project and for 14 months after completion. The following chart shows measurable gains.

<table>
<thead>
<tr>
<th>Before POD Configuration</th>
<th>After POD Configuration</th>
<th>Change</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production units</td>
<td>Increased 49%</td>
<td></td>
<td>Three-month moving average</td>
</tr>
<tr>
<td>Efficiency: number of &quot;touches&quot;</td>
<td>34 16 Reduced 53%</td>
<td></td>
<td>Eliminated wasteful redundancy; reduced opportunity for error.</td>
</tr>
<tr>
<td>Efficiency: distance traveled</td>
<td>4,000 feet 700 feet Reduced x6</td>
<td></td>
<td>Improved cycle time for specimen delivery to holding bins (hand-delivered specimens only).</td>
</tr>
<tr>
<td>Turnaround time: time from box arrival to box open</td>
<td>Reduced 52%</td>
<td></td>
<td>Reduced opportunity for compromised specimens awaiting processing; better turnaround time for assays.</td>
</tr>
<tr>
<td>Turnaround time: resolution of issues before samples arrive in testing sections</td>
<td>30/month 3,000/month Increased x100</td>
<td></td>
<td>Reduced workload for Exception Handling employees; improved turnaround time for minor submission issues.</td>
</tr>
<tr>
<td>Turnaround time: time from processor to editor</td>
<td>Reduced 75%</td>
<td></td>
<td>Shortened time from error to detection; less chance of error affecting patient care. Immediate feedback for errors means more effective training.</td>
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<tr>
<td>Quality: lost samples</td>
<td>5.58 Sigma 5.71 Sigma Reduced by average 45%</td>
<td></td>
<td>Specimen Processing achieved Six Sigma performance for lost samples for the first time during one of the months post-implementation.</td>
</tr>
<tr>
<td>Quality: mislabeled samples (combined total for those detected and corrected internally and those detected by external entities)</td>
<td>5.02 Sigma 5.16 Sigma Reduced by average 16%</td>
<td></td>
<td>Immediate auditing of manual orders enhanced the speed of detection and correction. The result was an improvement in the ratio of internal to external errors, consequently reducing the number of labeling errors with the potential for affecting patient care.</td>
</tr>
<tr>
<td>Space utilization: shop floor capacity</td>
<td>116 seats 171 seats Increased 47%</td>
<td></td>
<td>Able to postpone major construction (to accommodate growth projections) by two to three years.</td>
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</table>
SUMMARY

The POD changes are one step in an unending effort to create the conditions from which quality naturally emerges. The configuration of the PODs, the workforce composition, and the level of support are continually tuned and improved in the quest for optimal performance.

While the multiple factors influencing the performance of the Specimen Processing area are fundamentally the same over time, fluctuations in workload, workforce availability, and process drift require continual adjustments to the way work is done and require adaptation on the part of management and staff.

Specimen Processing management recognizes that a protracted string of “fixes” have the potential to fracture the value stream, eventually necessitating a more radical re-engineering effort to realign and harmonize the departmental value streams. While incremental change is less risky, with forethought and planning, adding transformational change to the mix can be a strategic win.

REFERENCES


CONTRIBUTORS

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