

Lean lab in action

Question: Can eliminating institutionalized inefficiencies in the lab result in better TATs and enhanced lab performance? **Answer:** Read on!

By Joseph Campos, PhD

In 2009, our microbiology lab at the Children's National Medical Center (CNMC) was searching for solutions to some core inefficiencies, namely staffing and lab layout. CNMC is the only exclusive provider of pediatric care in the metropolitan Washington, DC, area. The hospital cares for more than 360,000 patients each year who come from throughout the region, nation and world. Through our existing vendor relationship with bioMérieux, we learned of its Lean Lab Design offering. They have partnered with Guidon Performance Solutions to create a service that applies Lean Six Sigma principles to the microbiology lab. It involves an observational audit of existing lab processes and provides the customer with a roadmap outlining improvements to reduce waste and improve efficiency, while simultaneously increasing the quality of results and reducing errors. We opted to work with bioMérieux/Guidon, with most of the program implementation taking place during 2010. Two years after starting down this road, the improvements in workflow, turnaround times (TATs), and patient outcomes have been dramatic.

The "Kaizen" approach to institutionalized improvement

The approach employed to address CNMC's microbiology lab inefficiencies relied heavily on involving the entire staff, from medical laboratory technicians all the way up to the lab director. This is called the "Kaizen" approach—the word is a transliteration of a Japanese word meaning "change for the better"—which defines a philosophy of continual improvement and constant change to heighten the "core values" of any task. This approach has been used in many industries (perhaps most famously by Toyota) including manufacturing, engineering, banking, government, process engineering—as well as specimen processing in a microbiology lab. The cornerstone of Kaizen is that this ongoing effort involves everyone who touches the process, from the most junior staffers through senior management. In the lab, it applies to laboratorians, lab managers, pathologists, and clinical groups, as well as hospital management.

Getting the most out of existing resources

Prior to the Lean laboratory assessment, our microbiology laboratory was staffed with 11 full-time employees. We did not have money in the budget for additional hiring. We had almost all of our staff working from 7:30 a.m. to 4 p.m. We scheduled one person to process new specimens during the evening shift, but processed CSF specimens only during the night shift, which is when a significant percentage of our workload would arrive.

As a result, the day shift began each morning with an accumulation of new specimens and positive blood cultures from the previous night shift that needed processing. Before our Lean changes, the staff faced the prospect of completing 16 hours of

specimen processing and 24 hours of culture plate reading within an 8-hour work day. The workload pressure had a negative effect on morale, since this staffing model entailed a great deal of overtime and needless financial strain on the lab.

Spreading the workload, improving morale and TATs

Implementing the Lean program meant, in part, distributing our workload over a 24-hour period. This change by itself relieved pressure, markedly reduced overtime, and also greatly improved employee morale.

To achieve this, four of our medical technologists were assigned to work the evening and night shifts. Our laboratory then was able to process new specimens and examine culture plates throughout the 24-hour workday instead of compressing most of this critical work into a single work shift. Now employees no longer dread coming into the lab every morning to be faced with a mountain of accumulated work. Clinicians obtain their test results more quickly since laboratorians are available to work up and report positive cultures even in the middle of the night.

Workload and staff redistribution was just one aspect of our Lean process. A benefit of the change in our staffing was the enabling of the transfer of automated molecular testing from our day-shift-only Molecular Diagnostics Laboratory to the Microbiology Laboratory. This testing is now performed upon specimen arrival rather than as part of a scheduled batch, significantly improving TAT.

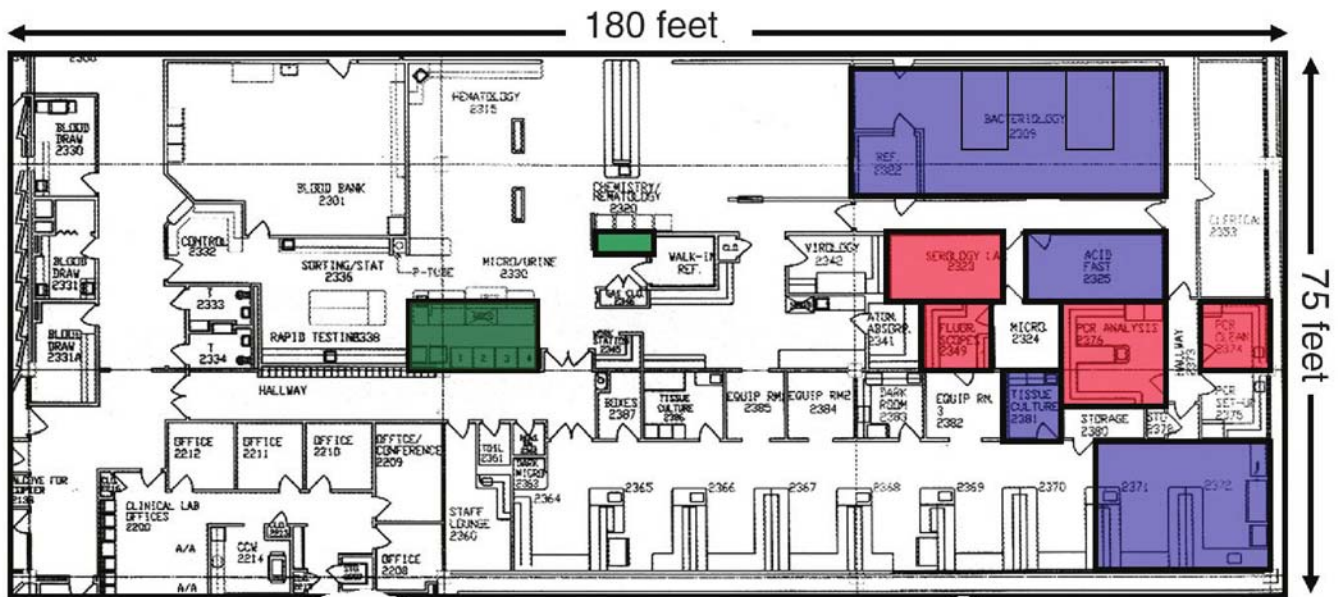
In the pre-Lean laboratory, all culture plate reading occurred during the day shift. If growth was insufficient to permit culture work-up, the culture media were placed back into the incubator for another 24 hours. Now, our cultures are examined for the first time after 16 hours of incubation, regardless of the time of day. If growth is insufficient for culture work-up, the culture media are re-incubated for four hours and checked again. Usually, 16 hours of incubation is sufficient to obtain adequate growth for inoculation of identification and antimicrobial susceptibility tests. In our pre-Lean laboratory, inoculation of identification and susceptibility tests from uncomplicated cultures often occurred more than 24 hours after specimen receipt. Now it happens in as little as 16 hours and almost always in less than 24 hours.

Lab redesign focused on improving core lab values

It was clear from the Lean assessment that we needed to redesign our physical lab space. It was critical for us to create a Microbiology Incoming "work cell," or a work area dedicated to the process of receiving and processing new specimens.

Prior to the redesign, our laboratory's Incoming area was part of a core laboratory thoroughfare that saw frequent walk-throughs in an area where our laboratory scientists needed to be very focused. To address this, we moved our Incoming area into

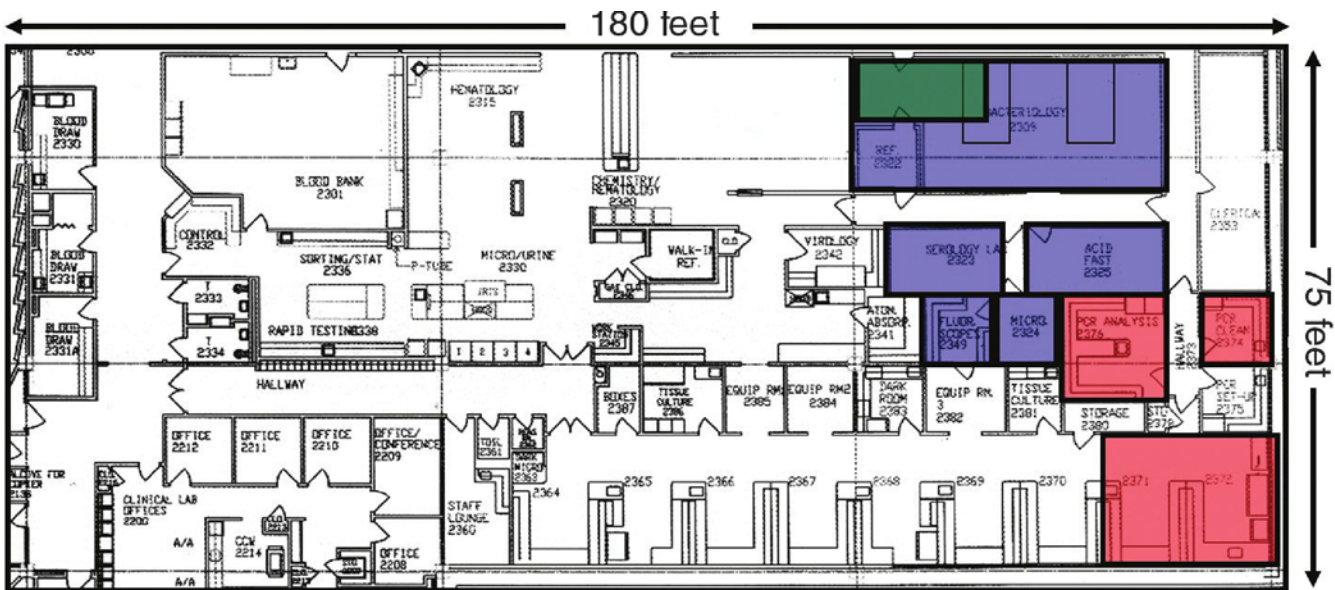
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- Microbiology
- Molecular Diagnostics
- Microbiology Incoming

Microbiology Total 2000 sq ft

Molecular Diagnostics Total 600 sq ft



- Microbiology
- Molecular Diagnostics
- Microbiology Incoming

Microbiology Total 1550 sq ft

Molecular Diagnostics Total 825 sq ft

Figure 1: Pre-Lean (top) and post-Lean (below) lab layout at CNMC

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the main Microbiology Laboratory, where pass-through traffic is minimal. Further, Microbiology Incoming is now much closer to our media storage cold room and our incubators, resulting in much less nonproductive walking (**Figure 1, page 27**).

Additional unexpected “good” consequences

An unanticipated benefit of distributing our workload over a 24-hour workday was the consolidation of some of our work stations. Whereas pre-Lean we needed four concurrent culture plate reading work benches to complete each day’s work during an eight-hour shift, post-Lean we learned we needed only two. Put another way, with our staffing distributed over three work shifts, we needed less overall bench space. When we converted our classic virology testing to molecular testing, we no longer needed two tissue culture hoods and a tissue culture incubator, freeing up valuable floor space. Even more floor space became available when we instituted twice-weekly culture media shipments instead of once-weekly, enabling us to move refrigerated supplies from floor-standing refrigerators (which we no longer needed) to empty shelves in our cold room.

Some of the newly created floor space was used to house a newly acquired automated plate streaking system. This equipment not only relieves our lab scientists from the chore of manually streaking growth media, but yields cultures with more isolated colonies. This in turn reduces the number of instances in which 24-hour subcultures are required to obtain pure cultures for iden-

tification and antimicrobial susceptibility tests. The result of this is less expenditure on culture media, reduced use of technologist time, and shorter turnaround times for positive culture results.

As **Figure 1** shows, the Molecular Diagnostics Laboratory occupied many non-adjointing spaces in the Department of Laboratory Medicine prior to the Lean redesign. That is because the need for that laboratory was not envisioned when the hospital was built in the early 1970s, and thus it was subsequently squeezed into available “nooks and crannies.” Today the Molecular Diagnostics Laboratory is the fastest growing section of the Department and the “core value” quotient of its testing is very high. As a byproduct of the Microbiology Lean project, the Molecular Diagnostics Laboratory was given an additional 200 square feet, permitting it now to occupy a contiguous corner of the general laboratory with room for additional growth.

Day	Pre-Lean Average TAT	POST-Lean Average TAT
Monday	4.1 days	3.2 days
Tuesday	3.8 days	2.7 days
Wednesday	3.7 days	2.9 days

Table 1. Days of the week: pre- and post-Lean positive culture TATs

Better turnaround times elevating the lab’s role

The primary driver of our desire to implement the Lean lab program was our goal to reduce testing TATs. Since implementing the program, we have seen a significant improvement in TATs for positive cultures from all specimen types: blood, stool, urine and

Critical Care Department	Pre-Lean Average TAT	Post-Lean Average TAT
ICU	3.5 days	2.7 days
ED	3.2 days	2.8 days
NICU	2.7 days	2.6 days
Pediatric ICU	2.9 days	2.3 days

Table 2. Critical care TAT improvements by department

Bacteria	Pre-Lean Average TAT	Post-Lean Average TAT
<i>Streptococcus pneumonia</i>	3.5 days	2.4 days
<i>Escherichia coli</i>	3.5 days	3.3 days
<i>Enterobacter cloacae</i>	3.75 days	2.8 days
<i>Klebsiella pneumonia</i>	4.0 days	3.3 days
<i>Pseudomonas aeruginosa</i>	3.1 days	3.0 days
MRSA	3.3 days	3.0 days
<i>Staphylococcal septicemia</i>	3.8 days	3.6 days

Table 3. TAT improvements from positive blood cultures to antibiotic susceptibility report to physicians by bacteria

Shift	Pre-Lean	Post-Lean
Night Shift	2.8 days	2.4 days
Evening Shift	3.2 days	2.8 days
Day Shift	NA	NA

Table 4. TATs pre- and post-Lean by shift

others. We've gained, on average, a complete day in our positive culture TATs post-Lean (Table 1). This is most profound early in the work week. Since our Lean staffing changes were limited by available personnel to weekdays, we've seen no improvement in TAT on specimens received on Saturdays, and a slight improve-

ment for those received on Sundays.

Shorter TATs mean getting results to physicians more quickly. Our physicians are pleased because they're getting needed information much more promptly and are able to deliver pathogen-specific patient care sooner. Pre-Lean, physicians had to rely upon empiric management for longer periods of time.

Table 2 shows the improved TATs for positive cultures collected from patients in our critical care units and in our Emergency Department. Table 3 shows the shorter TATs from specimen collection to antimicrobial susceptibility reporting for our most frequent blood culture isolates. Table 4 reveals the improved TATs stratified by specimen collection work shift.

In just two years after implementation of the Lean program, the CNMC microbiology lab has achieved significant improvements in efficiency. The early results are a streamlined staffing and workflow system and a lab designed to maximize both personnel and equipment. Because the Lean system is based on the philosophy of constant improvement, I'm confident that we will continue to see and adopt new ideas and processes that will guide our lab for years to come. As our lab grows, the Lean program will be essential to managing our resources to ensure that specimens and cultures are processed as quickly as possible in order to meet the increasing demand for testing. □

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