

# Using LEAN and Automation to Create the 24-Hour Hospital Microbiology Lab

Joseph M. Campos, PhD, D(ABMM), F(AAM)

Director Microbiology Laboratory, Molecular Diagnostics Laboratory and  
Laboratory Informatics  
Children's National Medical Center  
Washington, DC



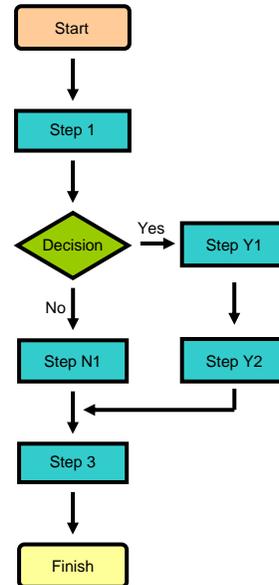
## Objectives

*At the conclusion of this lecture, participants will be able to:*

- Explain how **LEAN** principles apply to the clinical microbiology lab.
- Using the Children's National Medical Center "pre-**LEAN**" Clinical Microbiology Lab as an example, describe the current state of many such labs today.
- Identify opportunities for improving the efficiency of clinical microbiology labs.
- Assess the impact of **LEAN** measures on the Clinical Microbiology Lab's efficiency and consider how your laboratory might be similarly impacted.

## Healthcare and LEAN

- **LEAN** principles may be applied to processes that can be mapped as a series of discrete steps
- Healthcare in general, and laboratory testing in particular, are especially amenable to **LEAN** improvement
  - Some of the estimated \$850 billion per year of waste in the U.S. healthcare system can be attributed to hospital laboratories
  - A **LEAN** overhaul of the hospital laboratory involves carefully analyzing each step in its processes, eliminating wasteful activity and inactivity, and developing revised processes in which each step adds value



## Laboratory Testing and LEAN

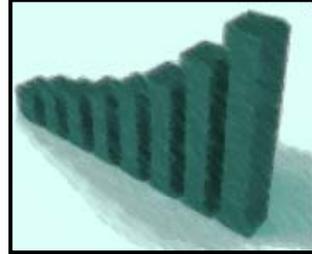
- The main objective of a **LEAN** laboratory reorganization is to deliver the highest quality test results possible, at the lowest cost, within the shortest time, while improving physician, patient, and employee satisfaction
- The deliverables of a successful **LEAN** laboratory reorganization include:
  - Improved operational performance
  - More standardized processes
  - Fewer errors
  - Lower test costs
  - Better employee morale
  - Enhanced patient management

Quality



## Five LEAN Concepts that Apply to Laboratory Testing

- **Value:** Seek to increase the clinical value of testing from the physician and patient perspectives
- **Value Stream:** Analyze the steps of each testing process and eliminate wasteful activity and inactivity
- **Flow:** Make each testing process proceed as evenly as possible
- **Pull:** Maintain a “just-in-time” inventory of supplies
- **Continuous Improvement:** Strive for perfection by constantly reviewing the steps of each testing process

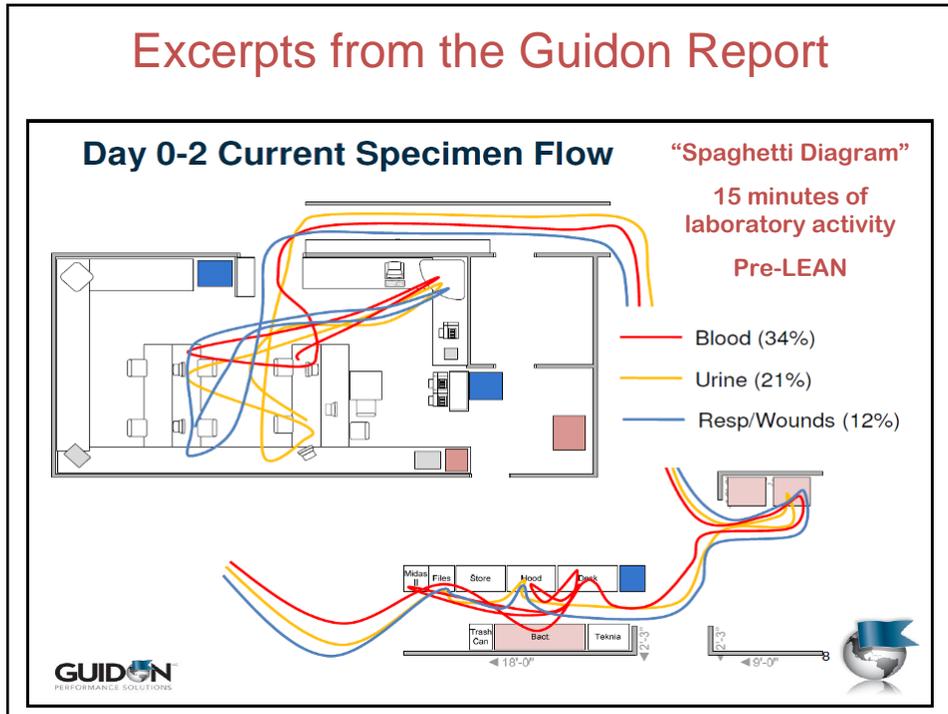


## The LEAN Process in the Microbiology Lab at Children’s National Medical Center

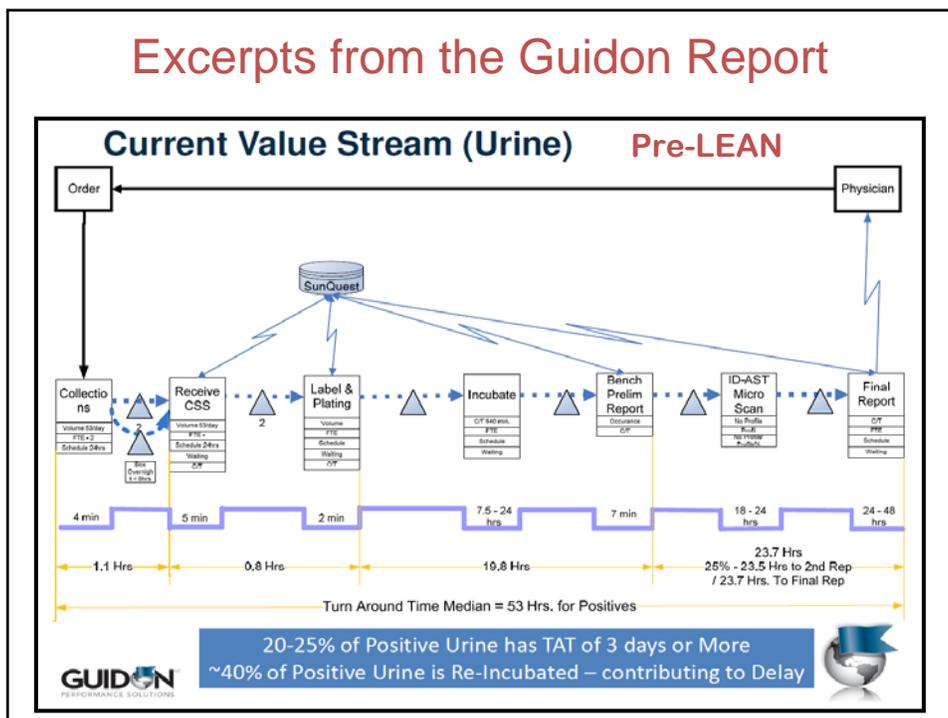
- Microbiology Lab workload and staffing data were submitted to Guidon Performance Solutions (Mesa, AZ) prior to their on-site visit
- A 3.5 day lab evaluation was conducted by experts from Guidon and bioMerieux
- The focus was on the blood and urine culture value streams, our two busiest streams
- Limiting parameters
  - No new laboratory space was available
  - No additional staffing was available
  - Costs of lab layout changes had to be minimal



## Excerpts from the Guidon Report

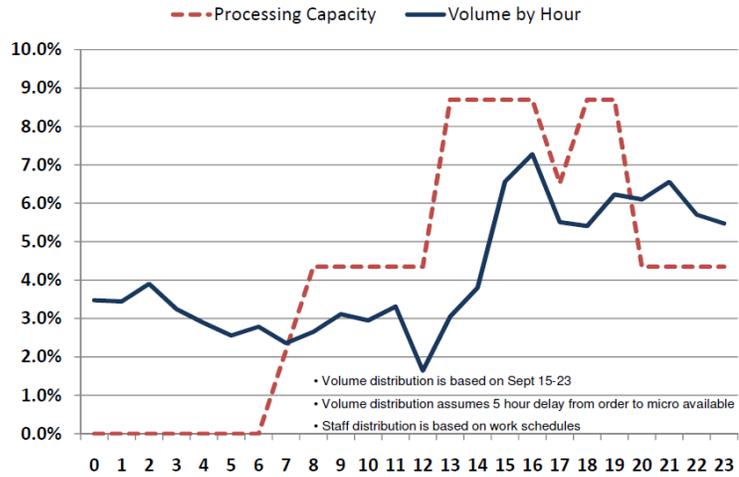


## Excerpts from the Guidon Report



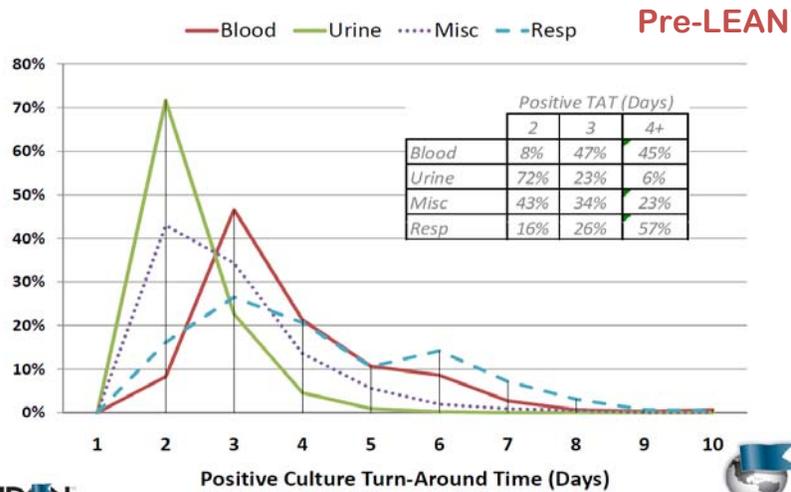
## Excerpts from the Guidon Report

### Hourly Volume and Specimen Processing Staff Capacity Distribution Pre-LEAN



## Excerpts from the Guidon Report

### Positive Culture Turn Around Time Pre-LEAN



## Major LEAN Recommendation

- Move staff from the Day to the Evening and Night shifts to enable 24-hour specimen processing and culture reading
  - ~25% of our specimens were waiting 1-10 hours for processing
  - Cultures that became positive during the late day, evening or night shifts were waiting 1-20 hours for the initiation of workups
  - The Joint Commission required round-the-clock specimen and positive blood culture processing capability during our 2011 survey



## Microbiology Laboratory Staffing

Pre-LEAN	Post-LEAN
MC Incoming Day shift	MC Incoming Day shift
MC Incoming Evening shift	MC Incoming Evening shift
Blood Culture Bench	MC Incoming Night shift
Urine/Stool Culture Bench	New Cultures Bench Day shift
Respiratory Culture Bench	New/Old Cultures Bench Evening shift
Miscellaneous Culture Bench	New/Old Cultures Bench Night shift
Mycology/Parasitology Bench	Old Cultures Bench Day shift
Virology Bench 1	Mycology/Parasitology/QC Bench
Virology Bench 2	Serology + "Water Spider"
Serology + Help for Busy Bench	Coverage for Day-Off Techs
Coverage for Day-Off Techs	Coverage for Day-Off Techs

## New Culture Reading Schedule

Culture Inoculation Time	Culture Reading Time
0001-0200	1601-1800
0201-0400	1801-2000
0401-0600	2001-2200
0601-0800	2201-2400
0801-1000	0001-0200
1001-1200	0201-0400
1201-1400	0401-0600
1401-1600	0601-0800
1601-1800	0801-1000
1801-2000	1001-1200
2001-2200	1201-1400
2201-2400	1401-1600

## Microbiology Testing – Pre-LEAN Approach

<b>Day Zero</b>	0000 – 1600 New specimens are examined microscopically and inoculated to culture media	1600 – 2400 New specimens are examined microscopically and inoculated to culture media
<b>Day One</b>	0800 – 1600 Culture media are examined for growth and identification/antimicrobial susceptibility tests are set up	0800 – 1600 Culture media are reincubated to allow more time for organisms to grow
<b>Day Two</b>	0800 – 1600 Identification/antimicrobial susceptibility test results are reviewed and released to the physician	0800 – 1600 Culture media are examined for growth and identification/antimicrobial susceptibility tests are set up
<b>Day Three</b>		0800 – 1600 Identification/antimicrobial susceptibility test results are reviewed and released to the physician

## Microbiology Testing – Post-LEAN Approach

<b>Day Zero</b>	0000 – 2400 New specimens are examined microscopically and inoculated to culture media
<b>16 Hours Later</b>	0000 – 2400 Culture media are examined for growth and identification/antimicrobial susceptibility tests are set up
<b>18-24 Hours Later</b>	0000 – 2400 Identification/antimicrobial susceptibility test results are reviewed and released to the physician

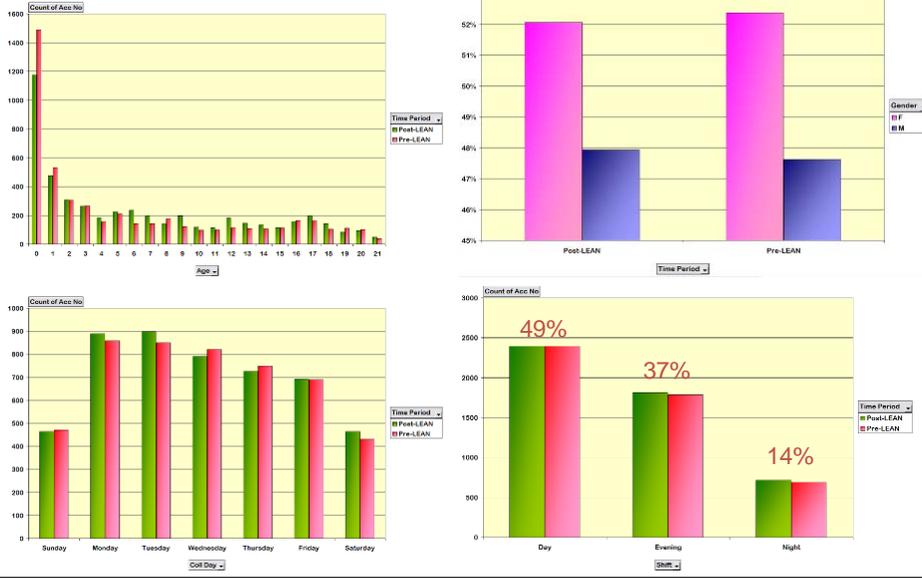
## Pre-LEAN versus Post-LEAN Microbiology Testing

- In the pre-LEAN scenario, positive culture workups began when the lab staff was ready – organisms waited for the next day shift to arrive
- In the post-LEAN scenario, positive culture workups begin when the organisms are ready – staff are always available
- In the pre-LEAN scenario, final results of uncomplicated positive cultures were released in 40-64 hours
- In the post-LEAN scenario, final results of uncomplicated positive cultures are released in 34-40 hours



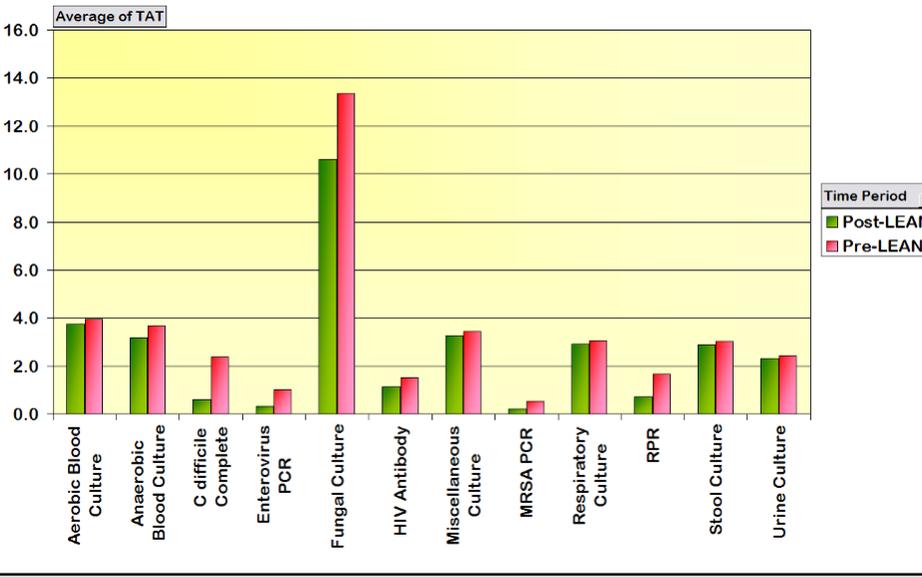
# Impact of LEAN on Turnaround Time

Six Month Period Post-LEAN versus the Same Six Month Period Pre-LEAN



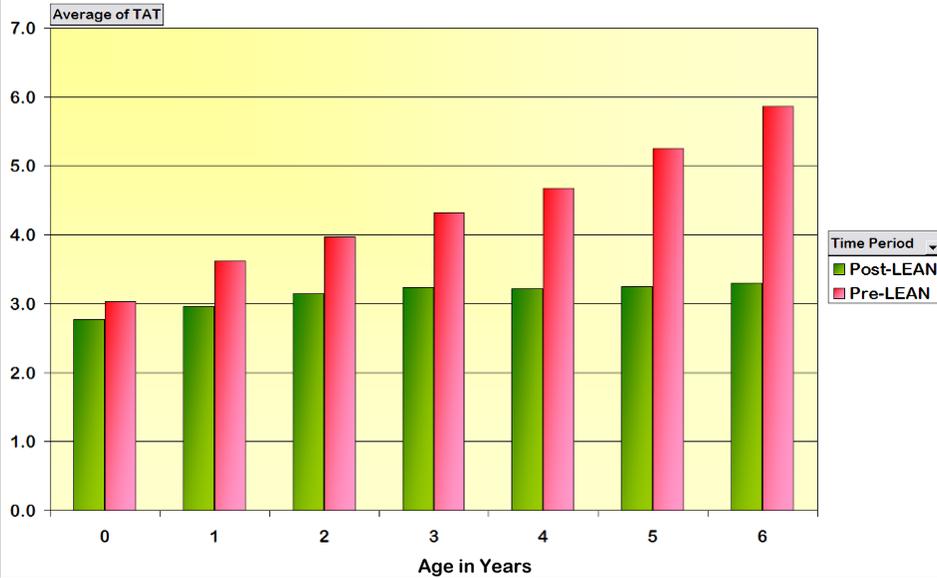
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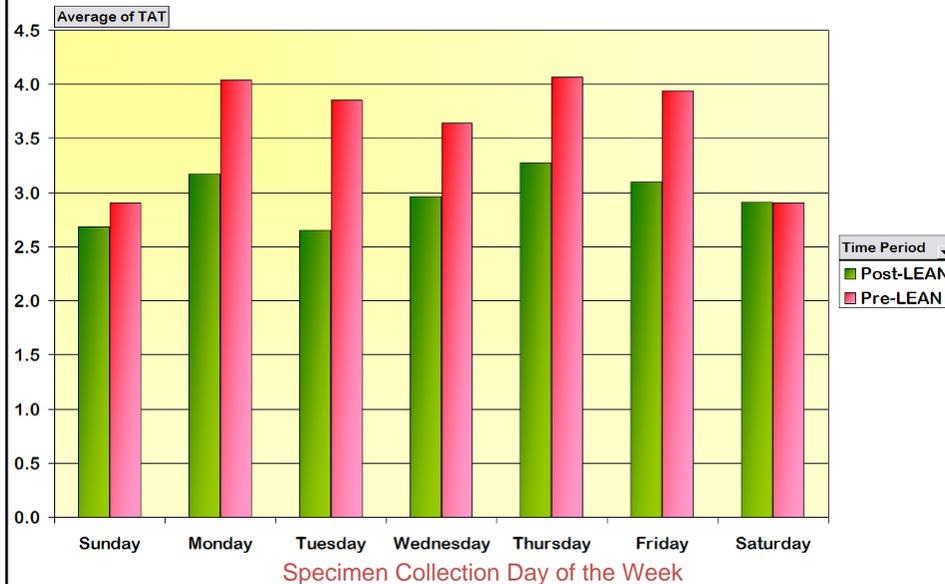
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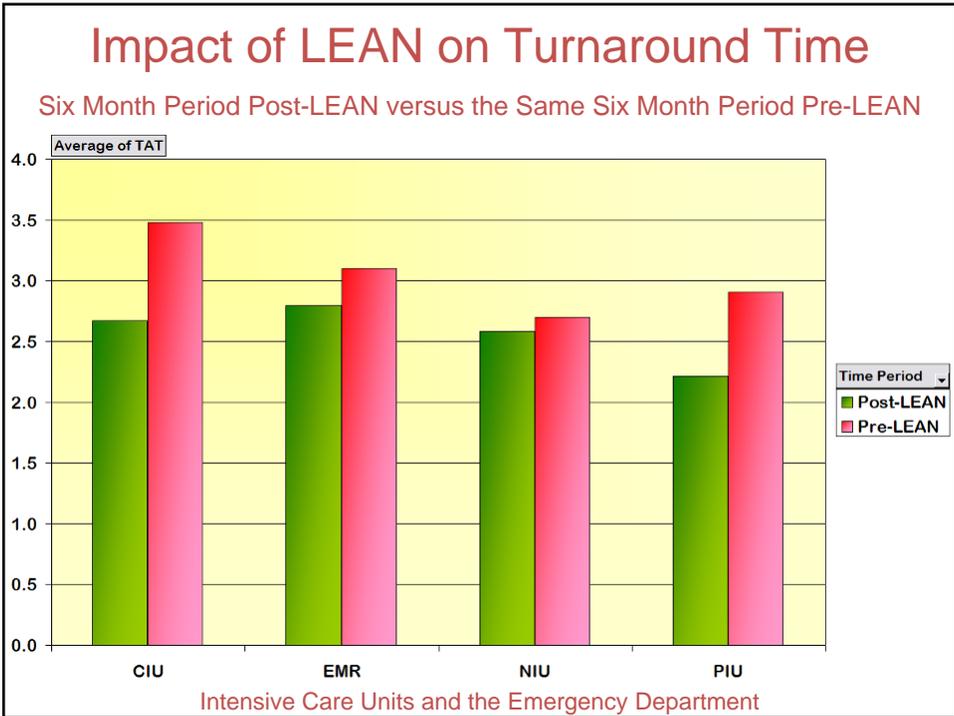
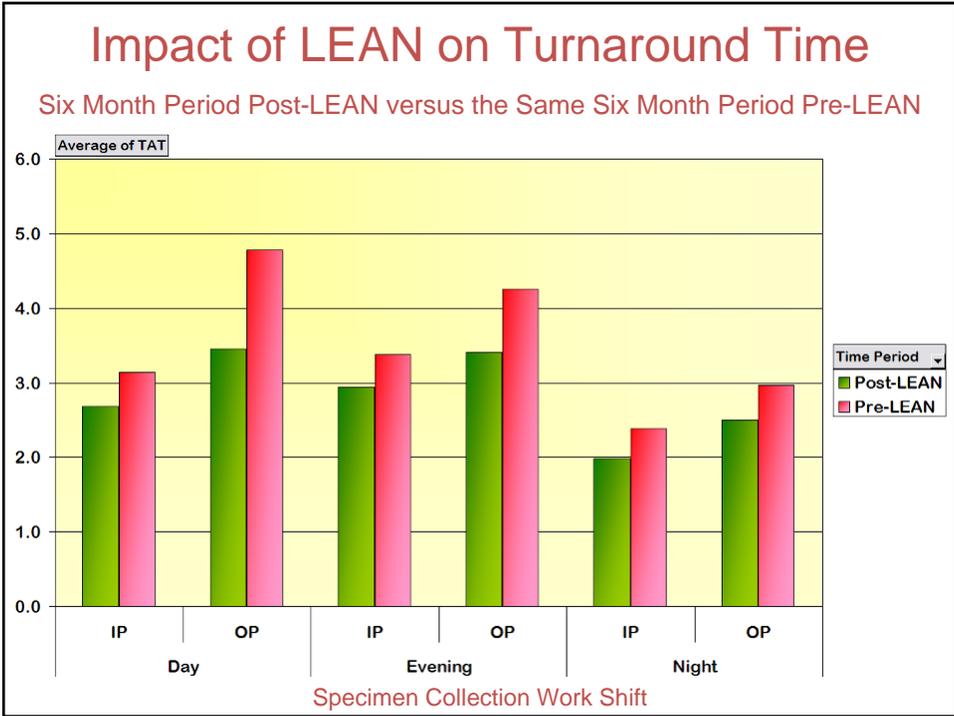
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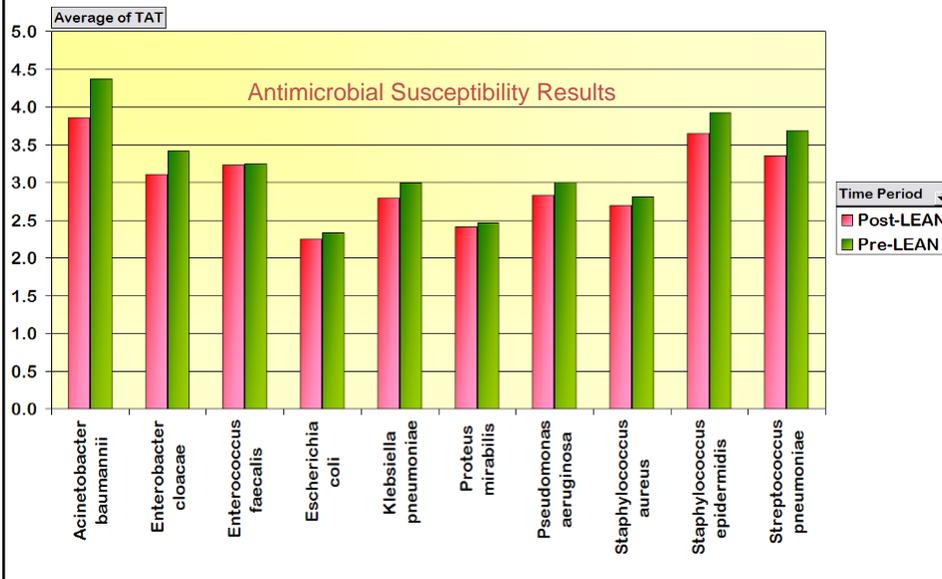
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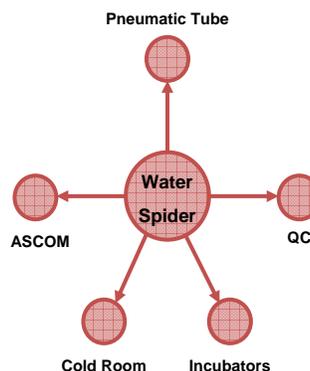
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## Further Recommendations

- Reorganize the floor plan, including creation of a Microbiology Incoming cell to reduce the amount of “spaghetti” and increase the available technologist time
- Add the “Water Spider” concept to the Microbiology Lab
  - Transport specimens from the pneumatic tube to the Incoming bench
  - Supply media and reagents to the Incoming and Plate Reading benches
  - Complete “start-up” tasks (e.g. temperature monitoring, preventive maintenance, general QC)
  - Transport cultures to and from the incubators
  - Answer telephone calls (wireless ASCOM phone)



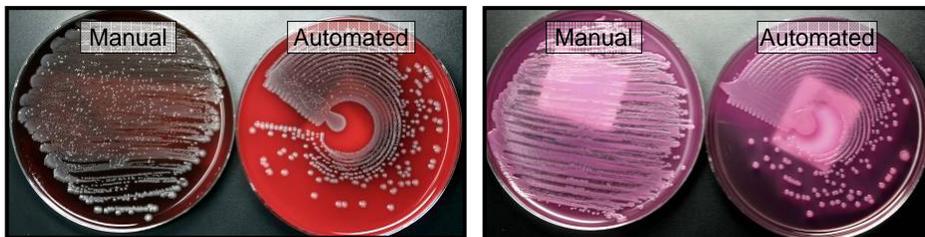


## Other LEAN Microbiology Recommendations

- Creation of “work cells” to minimize unnecessary movement and motion
- Add additional automation to the Microbiology Laboratory
  - Plate streaking
  - Gram staining
  - ID/AST
  - Data management
- More frequent deliveries of culture media and reagents to lessen storage space requirements and deterioration of labile materials
- Use of information technology to standardize culture workups, reducing inefficiency and mistakes



## Automated Culture Plate Inoculation



- The goal of microbiology cultures is to furnish well-isolated colonies for additional testing
- The urine culture photos above illustrate how much better a job the automated culture plate inoculator does than a human
- In this example, identification and antimicrobial susceptibility results would be available at least 18 hours sooner from the culture plates inoculated with the automated instrument

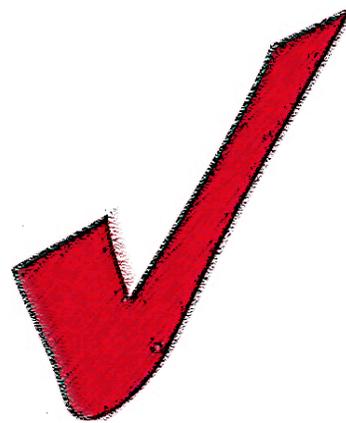
## Summary (1)

- We need to creatively reevaluate our practice of clinical microbiology
- Because of new technology and a shrinking workforce, labs must implement operational changes that promote more efficient work practices
- We need to leverage automation to standardize testing, reduce turnaround times, eliminate errors, and lower costs
- Relatively few labs have gone down this road so far – it's time for all of us to get moving!



## Summary (2)

- The **LEAN**-based reorganization of our Microbiology Lab eliminated a great deal of wasted activity and inactivity
- The changes were made without increasing lab space or lab staff
- The clinical utility of test results was improved because they are now less prone to human error and are now available on a more timely basis
- The morale of the staff is higher than ever, as evidenced by the following question asked at a recent lab meeting: “Why didn’t we do this a long time ago?”



**Mission  
Accomplished!**