22nd ECCMID London, United Kingdom 31 March – 3 April 2012
ESCMID EUROPEAN SOCIETY OF CLINICAL MICROBIOLOGY AND INFECTIOUS DISEASES

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Evaluation of Automation and Lean Methodologies on the urine workflow in a Microbiology laboratory

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Urinalysis remains one of the three major in vitro diagnostic screening tests after serum chemistry profiles and complete blood counts (Carlson DA, Statland BE et al. 1988). When it comes to improving efficiency, the greatest benefits often come from revamping high-volume manual processes. Traditional, manual urine screening methods are time-consuming, outmoded and inefficient. They are open to significant errors that negatively impact patient care and drive up costs. Inaccurate microscopy results may also lead to unnecessary cultures and a subsequent cost. Estimates have shown that 25 percent of urine cultures are unnecessary, which not only waste resources, but delays other results

A "top to bottom" assessment of urinalysis testing, that is, pre-analytical, analytical, and post-analytical work processes and outcomes were evaluated and addressed, using Lean Six Sigma methods and automation.

Methods

A baseline measure of turnaround time (TAT) defined as time of booking in to time of released report, and staff productivity was established. This was compared to TAT performance and staff productivity after implementing Lean process modifications, included the creation of a urine work cell, automation for the analytical and post-analytical stages.

The following five LEAN principles were applied to the urine work-flow:

- Value Stream: The steps of the urine process were defined and wasteful activities and inactivity eliminated.
- Flow: Each process step was made to flow as consistently as possible. This was achieved by automating the manual microscopy (Sedimax® A. Menarini), utilizing an automated plate streaker (The InoqulA® from Kiestra) and an automated identification and sensitivity reader (VITEK 2® Biomerieux)
- Pull: Maintain a "just-in-time" inventory of supplies
- Value: Increase the value of testing from the physician/patient perspective. Reducing turnaround times
- Continuous Improvement: Strive for perfection by constantly reviewing the steps of the testing processes. Lean is not a destination; it's a journey

Results:

To "lean" out the urine workflow value stream mapping was utilized. This enabled us to identify waste (Table 1) in the system and reduce the number of process steps, reduce variability and the potential for errors

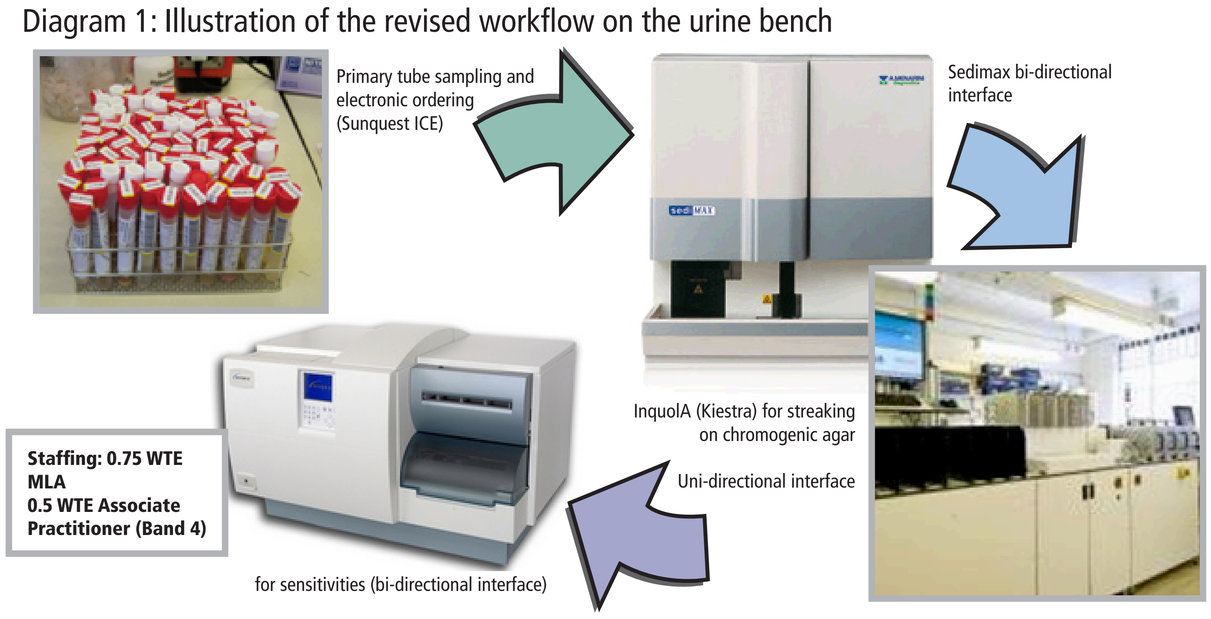
Table 1: Types of waste (muda) identified using value stream mapping

Types of Waste	Definition	Waste identified in the urine work-flow
Waiting	Idle time created	• BMS or instrument to become available • Batch working • Waiting on sensitivity results • Waiting on demographics to be entered • Things just don't happen when they should
Transportation/ material movement	Movement of material or information that does not add value	• Samples travelling throughout the lab to be processed and tested. Solution create a work cell • Walking to the cold room to obtain media • Taking forms to another person to be 'booked in'
Over-processing	Efforts that create no value	• Culturing all urines • Excess paperwork • Manual data entry • Unnecessary testing due to an overly sensitive instrument • Redundant approvals
Motions/ movement	Movement of people that does not add value	• Extra keystrokes or clicks on the keyboard • Inputting lab numbers • Handling paperwork • BMS or AP leaves area to find supplies • Manual microscopies, streaking and sensitivities • Decanting urine into a compatible urine tube for the analyser
Defects	Work that contains errors or rework (Do it right first time)	• Data entry error • Manual microscopies • Manual interpretation of sensitivities • Poor streaking • Transcriptional errors
Mis-utilization of skills	Grade of staff needed	• Utilization of a BMS when an AP is appropriate.
Re-prioritization	Starting one task, being interrupted and changing to another task before the first task is complete	• Unexpected equipment failure • Trouble shooting • Answering queries about urine microscopy results

Table 2: staffing levels

State of Play	Medical lab assistants	Associate practitioner	Biomedical Scientists	Cost (midpoint of scale)
Prior to Lean Six Sigma & Automation	2 WTE	0	1.25 WTE	£66140.00
Post Lean Six Sigma & Automation	0.75 WTE	0.6 WTE	0	£23 474.50
Staff savings				£42 665.50

Diagram 1: Illustration of the revised workflow on the urine bench



Every manual task (e.g. administrative tasks (booking forms in), plate streaking, manual microscopy, inputting results onto the LIMS, walking between instruments and shuttling specimens around) while essential to the lab is not value added. Upon analysis, it is often simpler to improve efficiencies in theses activities and to reduce turn around time. Urine specimens were processes in the order they were received by creating a standardized production line akin in principle to any industrial production line. The more standardized the process, the better and more consistent the product's quality and turnaround time.

Fig 1: Turnaround times pre and post Lean and automation

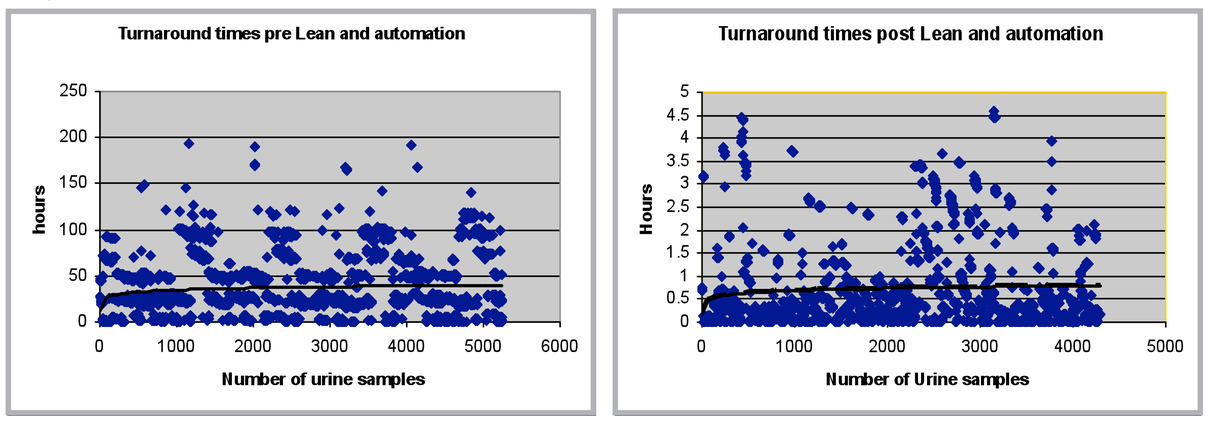


Fig 2: Post Lean and automation

State of Play	Average TAT
Prior to Lean Six Sigma & Automation	36.77 hrs
Post Lean Six Sigma & Automation	0.72 hrs

Increased productivity and labour savings: The average time required for a technician to process a urine specimen was reduced by 50 percent, from 150 seconds to 75 seconds. This was predominately due to elimination of non-value steps in the process. The faster and more predictable turnaround reduced the number of inquiries regarding specimen status. Overall staffing mix on the urine bench changed substantially as demonstrated in Table 2. This enabled the redeployment of more skilled staff, improving overall lab performance.

Conclusion:

Implementation of Lean Six Sigma methodologies in the urine work flow of a microbiology lab resulted in significant improvements in both productivity and TAT. There was also a 5000% overall reduction in urinalysis turnaround time, more accurate results, and an enhanced ability in the lab to meet demand. Implementation of automation and Lean demonstrated synergy between the two. Lean improved the processes while automation standardized the processes. Lean eliminated the waste while automation automated the processes that helped reduce the waste. Ultimately the two significantly helped improve patient care pathways.

This microbiology management success story demonstrates that a holistic approach is needed. The most innovative laboratories no longer approach problems individually; instead they view the work flow in a comprehensive manner, with the goal of implementing a systemic improvement that fixes many problems at once, while simultaneously establishing a basis for continuous improvement.

A.MENARINI diagnostics

Reference:

Carlson DA, Statland BE. Automated urinalysis. Clin Lab Med. 1988;8(3):449-461.