Combining Lean with Automation and Maldi-TOF in Microbiology: How We Cut TAT, Boosted Staff Productivity, Reduced Costs and Helped Improve Patient Care

Lab Quality Confab

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Evanston Hospital, Evanston, IL
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Objectives:

- Understand the rationale for introducing total lab automation into the Microbiology Department
- Understand how unique technologies are improving performance in Microbiology
- How does automation affect the clinical, operational and economic performance of Microbiology
- Determine the changes necessary to successfully implement total lab automation in Microbiology
Our Mission – to preserve and improve human life
About NorthShore University HealthSystem

• Headquartered in Evanston, Illinois
• Comprehensive, fully integrated healthcare delivery system serving the Chicago region
• Four Hospitals: Evanston, Glenbrook, Highland Park and Skokie
  – Total of ~800 beds
• Employs about 10,000 people
• Approximately 2,400 affiliated physicians with nearly 900 belonging to the NorthShore Medical Group, a multispecialty group practice with 100+ office locations.
About NSUHS

• Principal teaching affiliate for the University of Chicago Pritzker School of Medicine

• Leading clinical programs:
  – Kellogg Cancer Center
  – NorthShore Neurological Institute
  – NorthShore Orthopaedic Institute
  – NorthShore Cardiovascular Institute
  – High-Risk Maternity

• NorthShore Research Institute
  – Focuses on clinical and translational research
  – Leadership in clinical trials and medical informatics
Microbiology at NSUHS

- Centralized at Evanston Hospital
- Full-service Microbiology
- Performs ~300,000 billable tests/year
- First Kiestra TLA in the U.S.!
Why Automate Now???

• Aging Workforce
  – At decision time NSUHS Micro had 30 FTEs w/9.1 who were >= 60YO
    That is 30% of our staff!

• Knowing we would like to pursue automation:
  – Starting 2013 as staff left we weren’t given permission to fill most vacancies.
  – From 9/2013 to present we reduced staffing by 6.0 FTEs through attrition

• Current Staffing
  – 20 Full-time (1.0 – 0.8)
  – 2 Part-time (0.5)
  – 7 Resource
Why Automate Now???

<table>
<thead>
<tr>
<th>Date vacated</th>
<th>FTE</th>
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<tbody>
<tr>
<td>Sept 2013</td>
<td>-1.0</td>
</tr>
<tr>
<td>Jan 2014</td>
<td>-0.2</td>
</tr>
<tr>
<td>June 2014</td>
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</tr>
<tr>
<td>Oct 2014</td>
<td>-1.0</td>
</tr>
<tr>
<td>Dec 2014</td>
<td>-1.0</td>
</tr>
<tr>
<td>Dec 2014</td>
<td>-0.8</td>
</tr>
<tr>
<td>Mar 2015</td>
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</tr>
<tr>
<td>August 2015</td>
<td>-0.8</td>
</tr>
<tr>
<td>August 2015</td>
<td>-0.3</td>
</tr>
<tr>
<td>August 2015</td>
<td>-1.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>-8.1</td>
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</table>

<table>
<thead>
<tr>
<th>Original FTE</th>
<th>FTE increase</th>
<th>New FTE</th>
<th>Effective Date</th>
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<tr>
<td>0.5</td>
<td>0.3</td>
<td>0.8</td>
<td>Dec 2014</td>
</tr>
<tr>
<td>0.5</td>
<td>0.3</td>
<td>0.8</td>
<td>Apr 2015</td>
</tr>
<tr>
<td>0.5</td>
<td>0.3</td>
<td>0.8</td>
<td>Apr 2015</td>
</tr>
<tr>
<td>0.3</td>
<td>0.2</td>
<td>0.5</td>
<td>Apr 2015</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1.0</td>
<td>2.1</td>
<td>Jul 2015</td>
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</table>

Net Decrease in FTEs = 6.0
Why Automate Now???

• Fewer MLS programs
• Fewer skilled Microbiologists
• TLA is the perfect companion to MALDI-TOF to further decrease TAT and increase productivity
NorthShore Impetus to Automate

It was a Perfect Storm!
NorthShore Impetus to Automate

• New Department Chairperson in 2012
• Lab due for a complete renovation
  – Capital $$$$ available
• Support from Hospital Administration
• TLA would allow for increased volume without the need for more space or personnel
Decisions, decisions …

- First look at Kiestra in early 2011
  - Fact finding
- Presentations by the two major players late 1\textsuperscript{st} quarter/early 2\textsuperscript{nd} quarter of 2013
- Decision made by looking at throughput, flexibility, plans for future modules, reputation in marketplace
  - Ability to streak five plates at the same time
  - Rolling bead technology provides superior isolation of colonies
  - Can hold up to 24 different types of plated media
NorthShore Microbiology before TLA
NS Micro Ready for TLA
Finally – A new Lab!
New Lab
New Lab
NS TLA Timeline

- System delivered late July 2014
- Installation/vendor testing and validation August 2014
- Key User and staff training September & October 2014
- Clinical validation of TLA with urine specimens November 2014
- Go-live with urines December 15, 2014
NS TLA Timeline

- Stool cultures added May 2015
- MDRO screens added June 2015
- GBS screens added August 2015
- Throat, genital, wound, and positive blood cultures added September 2015
- InoquILA+ installed February 2016
  - Remaining Bacteriology specimen types requiring semi-automated processing added.
February 2016 – BacT is Totally Automated!
Improving Performance in Microbiology

• New Technologies
  – MALDI-TOF
    » Improved TAT for organism identification
    » Decreased reagent costs
    » Decreased QC in age of IQCP
  – Plug-and-Play PCR assays
    » Organism ID/resistance mechanisms direct from positive blood cultures
    » Toxigenic C. difficile
    » MRSA screening
    » Respiratory viruses
  – TLA
    » Automated plating
    » “Smart” incubators: Plates remain incubated instead of sitting on the counter until the technologist is ready to read them
    » HD imaging of cultures: Can visualize all plates from a culture on one screen at the same time
Improving Performance and Quality in Microbiology

• TLA + MALDI-TOF
  – TAT for cultures is decreased
    » More robust culture growth earlier because incubators aren’t opened and closed
    » First images for urine cultures taken at 10 hours
    » First images for throat cultures taken at 12 hours
    » First images for wound and sputum cultures taken at 15 hours
    » First images for stool cultures taken at 16 hours
    » First images for genital cultures taken at 18 hours
    » MALDI-TOF for ID – minutes versus hours/days for final ID
    » Better/consistent streaking = better isolation of colonies = decreased TAT for ID/Sens and fewer subcultures
Improving Performance and Quality in Microbiology

- NorthShore data (2012-2016) submitted for publication
Plate Images

*Strep pyogenes* in urine culture

*Enterococcus faecalis* in urine culture
Plate Images

Lactose- & Non-lactose-fermenters in urine culture
Plate Images

*Staph aureus* in a wound culture
Necessities for Successful Implementation

• Physical resources – Do we have enough space?
• Human resources
  – A strong and committed Key User Group
  – Validation of system
  – Training
  – Leadership dedicated to change management
• IT
  – Commitment from both Hospital and LIS teams
• Service
  – On-site and phone support from vendor
Necessities for Successful Implementation
Necessities for Successful Implementation

- Ensure that your specimen collection devices are compatible with your TLA before implementation.
Outcomes of Automation

- Easier to apply LEAN concepts
  - All workstations are configured the same
  - Protocols for culture reading and workup carried out uniformly
- Decreased TAT
- Improving antibiotic stewardship (MALDI & Verigene assays)
- Error reduction due to barcoding
- Reduced costs
  - Employee expense decreased 2.8% in FY14 ($69,655); 4.3% in FY15 ($103,046) and 0.4% in FY16 ($9,371)
    » NSUHS has given merit raises in each of these years with an average increase of 3%
  - Implementation of MALDI-TOF saved $65,500 in reagent cost
## Outcomes of Automation

### Reagent Savings due to MALDI-TOF

<table>
<thead>
<tr>
<th></th>
<th>FY 13</th>
<th>FY 14</th>
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</thead>
<tbody>
<tr>
<td>Reagent Cost</td>
<td>$126,200</td>
<td>$37,900</td>
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<tr>
<td>MALDI Reagent Cost</td>
<td></td>
<td>$22,800</td>
</tr>
<tr>
<td><strong>Total Reagent Savings</strong></td>
<td></td>
<td><strong>$65,500</strong></td>
</tr>
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Outcomes of Automation

• Increased Productivity
  – Our data presented as a poster at Microbe 2016
    » Analyzed # of tests and FTEs pre- and post-TLA
    » 3.2% increase in tests with a 9.4% decrease in FTEs
    » Tests/FTE increased 14%

• Continue to work with the BD Kiestra Lean Optimization Team to gain further efficiencies
Lessons Learned – What we did well

• Chose our Key User Group wisely
• Kept to our implementation timeline and added one specimen type at a time
• Keep lines of communication open – if a process isn’t working as expected be open to suggestions for change
• Made change management a priority
• Did a thorough validation of first specimen source, then less rigorous for additional types
Lessons Learned – What we could have done better

- Ensure that your swab specimens are ESwabs prior to implementation
- All technologists trained to read cultures from all specimen sources
- Don’t “Go Live” during the holidays
Thank you!

The Hard-working and Dedicated Team at NSUHS Microbiology
Team Microbiology!
Questions?
Contact Information

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