Automation Process Improving Microbiological Laboratory Efficiency

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Background
- In May 2015, UMC Lubbock implemented the Becton Dickinson (BD) Kiestra Total Laboratory Automation (TLA) system which automates sample setup, incubation and reading.
- Automation minimizes hands-on steps, increasing efficiency, productivity and quality, thereby allowing rapid identification of pathogens.
- Standard Operation Procedures (SOP) and other changes were instituted to optimize the impact, including changing to a 24-hour reporting system.
- Turnaround time (TAT) was defined as the time from laboratory login of specimen to the time of earliest definitive positive results reported.

Methods
- After approval from the Quality Improvement Review Board, a retrospective analysis of electronically captured microbiological data in Becton Dickinson (BD) Clinical Insights Research Database was performed to compare:
  - Pre-installation period (January-December 2013) to
  - Post-installation period (January-December 2016)
- Specimens classified as blood, urine, respiratory, wound, intraabdominal, stool and other
- Only positive mono-microbial and negative culture results were included.
- Ten common and clinically relevant bacteria were evaluated:
  - Enterococcus faecalis
  - Enterococcus faecium
  - Escherichia coli
  - Klebsiella pneumoniae
  - Proteus mirabilis
  - Pseudomonas aeruginosa
  - Staphylococcus aureus
  - Streptococcus agalactiae
  - Streptococcus pneumoniae
  - Streptococcus pyogenes
- Reporting times divided into four separate six hour shifts
- Statistical analysis was performed with SAS software version 9.4
- For categorical variables, a χ² test was performed
- For continuous variables, a log-transformed t-test was performed
- A p-value of <0.05 was considered statistically significant

Results
- Changes to SOP and use of Smart Incubators on TLA allowed for a more even distribution of reporting times (Figure 1).
- Analysis revealed a statistically significant faster TAT for positive bacterial pathogen ID for all sources (Table 1, Fig. 2a-d).
- Negative result TAT was also statistically significantly shortened in 2016 for all sources except for respiratory and other.

Conclusions
- This study demonstrates that a combination of workflow improvements and TLA facilitates microbiological laboratory efficiency with shorter definitive organism identification TAT for all sources, as well as shorter TAT for negative results for most sources.
- The Smart Incubators on the TLA allow for more consistent growth of organisms leading to faster results.
- Earlier availability of these results should play a role in the use of targeted antibiotic therapy, leading to improved clinical decision making and enhanced patient care.

Future Directions
- Further studies are needed to evaluate if the earlier availability of positive culture results translates into timely, appropriate adjustments to antibiotic therapy and improved antimicrobial stewardship.
- Evaluations are also needed to see if earlier negative culture results leads to decreased use of unnecessary antibiotics and possibly decreased patient length of stay.

Acknowledgements
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References
- Irene K. Dusch, MT(ASCP)SM. Transforming the microbiology laboratory to address the Triple Aim in healthcare. Medical Laboratory Observer, April 2017
- Patrick R. Murray, PhD. Laboratory automation: efficiency and turnaround times. MICROBIOLOGY AUSTRALIA 2014 (Feb. 3, 2014)

![Figure 1. Organism identification reporting time distribution](image1)

![Figure 2a. Blood](image2a)
![Figure 2b. Urine](image2b)
![Figure 2c. Respiratory](image2c)
![Figure 2d. Wound](image2d)

Table 1. Statistics for definitive positive bacterial pathogen identification TAT (in hours)

<table>
<thead>
<tr>
<th>Specimen source</th>
<th>Year</th>
<th># of specimen</th>
<th>Mean</th>
<th>Median</th>
<th>P-value (log t-test)</th>
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<tbody>
<tr>
<td>Blood</td>
<td>2013</td>
<td>759</td>
<td>70.6</td>
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<td></td>
<td>2016</td>
<td>882</td>
<td>51.2</td>
<td>46.6</td>
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<td>Urine</td>
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<td>2,282</td>
<td>47.3</td>
<td>43.6</td>
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<td>Wound</td>
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<td>60.2</td>
<td>58.6</td>
<td>&lt;0.0001</td>
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<td>2016</td>
<td>869</td>
<td>39.6</td>
<td>32.8</td>
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<tr>
<td>Respiratory</td>
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<td>67</td>
<td>65.3</td>
<td>&lt;0.0001</td>
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<tr>
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<td>2016</td>
<td>369</td>
<td>47.7</td>
<td>43.9</td>
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<tr>
<td>Intraabdominal</td>
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<td>69.9</td>
<td>64.3</td>
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<td>57.8</td>
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<tr>
<td>Other</td>
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<td>75.1</td>
<td>64.5</td>
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<td>52.6</td>
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<td>Stool</td>
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<td>40.1</td>
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<td>Overall</td>
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