Setting up first-line drug susceptibility testing (DST) directly from a positive Mycobacteria Growth Indicator Tube (MGIT): the catalyst for a structured workflow in the Tuberculosis (TB) Laboratory

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ABSTRACT

Objective: To reduce the turnaround time (TAT) and meet CDC TB Elimination Healthy People 2020 goals for identification and drug susceptibility testing of Mycobacterium tuberculosis complex (MTBC) through progressive workflow improvements and scheduled testing.

Study Design: DCLS sought to improve timelines in DST by evaluating the laboratory practice of initiating first-line DST from a Middlebrook 7H9 culture. The lab designed an alternate laboratory workflow, for which DST was initiated from positive MGITs within 5 days of positivity on the MGIT 960. In addition, Accuprobe MTBC identifications and DSTs were performed twice a week to identify new MTBC cases and promptly initiate susceptibility testing. Lab personnel created a job aid to exhibit the new workflow schedule and quickly identify MGITs that required re-seeding to meet the required 5 day set-up time. A visual board was created to track new MTBC cases and the testing performed in real-time. The board also provided a feedback mechanism to display the monthly DST TAT and track the improvements over time.

Results: Since implementation of the new workflow in February 2018, the lab reduced the average TAT for identification of MTBC by 6.6 days (23.6 days in 2017, 17.0 days in 2018) and the average DST TAT for 2017 by 11.6 days (25.6 days in 2017, 14.8 days in 2018). The lab has increased the percentage of cases identified as MTBC within 21 days of received date by 8% (65.2% in 2017, 73.4% in 2018), exceeding the CDC target goal of 75%. The lab has also increased the percentage of cases with DST reported within 17 days of identification by 4% (29.8% in 2017, 33.3% in 2018), exceeding the CDC target goal of 65%.

Conclusions: Data generated by the DCLS TB Laboratory demonstrates the positive impact of a defined schedule and modified workflow on timelines for diagnostic reporting of MTBC and DST results. Workflow organization and a feedback mechanism added value to the study and encouraged laboratory scientists to adhere to the new structured workflow.

INTRODUCTION and BACKGROUND

- The TB laboratory, as part of the Microbial Reference Group at DCLS, performs testing on clinical specimens and reference cultures for the identification of mycobacteria and DST of MTBC. In 2018, the DCLS TB lab received approximately 3,325 clinical specimens and 475 reference isolates.
- As the Commonwealth of Virginia’s MTBC library repository, the DCLS TB laboratory performs identification and DST of all Virginia primary MTBC isolates (first confirmed culture from each TB patient) and routes all isolates to the National Tuberculosis Molecular Surveillance Center in Michigan for genotyping.
- The TB lab at DCLS is a grantee of the Tuberculosis Elimination and Laboratory Cooperative Agreement, funded by the CDC in collaboration with APHL, for the primary purpose of facilitating improvements in TB laboratory performance. The agreement includes performance targets that DCLS uses to assess TAT for identification and susceptibility testing of MTBC. These performance targets were used as the criteria for this study.

METHODS

Clinical specimens are decontaminated/concentrated and inoculated into a MGIT, Lowenstein Jensen (LJ), and glass slide for fluorescent microscopy. Positive acid fast bacilli (AFB) growth in culture is tested by the Accuprobe MTBC for identification and DST is performed using the MGIT 960 system for first line drugs (streptomycin, isoniazid, rifampin, ethambutol, and pyrazinamide). The following graphic represents the previous workflow and new workflow from the time of growth of AFB (confirmed by Kinyoun stain) to setting up the DST. The new workflow reduced the time from growth to probe testing by implementing Accuprobe DNA Probe testing on all new index positive MGITs that required DST. DST report results are confirmed by a separate subculture step by setting up DST directly from the positive MGIT within 5 days of positivity.

RESULTS

Performance Target Benchmark Performance Target

<table>
<thead>
<tr>
<th>MTBC</th>
<th>Target</th>
<th>2017 Average (range)</th>
<th>2018 Average (range)</th>
<th>Change in TAT (average days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification of MTBC from received date</td>
<td>&gt; 74%</td>
<td>65.2% (45/69)</td>
<td>80.3% (13/66)</td>
<td>-6.6</td>
</tr>
<tr>
<td>Days from identification of MTBC to DST report</td>
<td>&gt; 69%</td>
<td>29.0% (20/69)</td>
<td>80.3% (13/66)</td>
<td>-1.0</td>
</tr>
</tbody>
</table>

CONCLUSION

- Data generated by the DCLS TB Laboratory demonstrates the positive impact of a defined schedule and integrating new workflow efficiencies on timelines for diagnostic reporting of MTBC and DST results.
- Strategic communication of workflow updates and the visual board feedback mechanism added value to the study and encouraged laboratory scientists to adhere to the new structured workflow.
- The TB laboratory achieved a reduction in the TAT of identification and DST results of MTBC, resulting in exceeding the TB Cooperative Agreement performance indicators for 2018, and ultimately contributing to a more timely patient diagnosis and treatment.
- Limitations that resulted in individual specimens not meeting the performance targets for DST results included identification errors, failure of the organism to grow during DST, cultures mixed with non-mycobacterial bacteria, and rare laboratory errors or delays.

ACKNOWLEDGEMENTS

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