Implementation of a Rapid Molecular Meningitis Panel

Kevin M. McNabb, Ph.D. 1, 2, Kevin Briggs, M.S. 1, and Christopher McKinney M.D. 1, 2

1 Department of Pathology and Area Laboratory Services, 2 Wilmington Pathology Associates, New Hanover Regional Medical Center, Wilmington, NC 28401

Background

Infection of the meninges (meningitis) or of the brain (encephalitis) is rare, but potentially fatal disease where symptoms can appear suddenly and escalate quickly to brain damage, hearing and/or speech loss, blindness, and death. Rapid initial diagnosis and treatment is critical, particularly for bacterial infections. Viral meningitis is more common, but typically mild and non-fatal. The ability to provide a more comprehensive diagnostic laboratory test with faster turnaround time (TAT) could potentially improve outcomes by directing more specific therapy in patients with meningitis or encephalitis (ME) and prevent unnecessary prophylactic treatment for patients without disease. In addition, faster, in-house, test could allow better management of patients with suspected ME and perhaps rule out unneeded therapy, and eliminate adverse reactions associated with unnecessary therapy.

Project Goal and Implementation Plan

To add a molecular test to detect viral, bacterial, and yeast pathogens that cause ME in lieu of sending this testing to a reference laboratory. This will reduce time from specimen receipt to result to less than 3 hours. We required both positive and negative results to be immediately called to providers. Testing was discussed before implementation with EDIER staff and Pediatric staff members but they would know this test would take priority and that all results would be called immediately. Our goal was for patients to be treated faster if therapy was needed and not to treat patients who did not have infection. These results could also help determine if patients needed to be admitted or could be safely discharged. Admission would depend on clinical assessment but the molecular test results, if provided quickly, could provide valuable information in the overall assessment of the patient.

Improvement Process

Our team chose a rapid molecular test that detects 14 of the most common pathogens responsible for community acquired ME which includes viruses, bacteria and yeast. (Table 1)

While this test will not detect all organisms that cause ME, it detects over 85% of the organisms that cause ME in the United States. This test allowed for better workflow since preparation, amplification, detection, and analysis is in one automated system with a run time of approximately 1 hour, with only 2 minutes of hands-on time. We collected the TAT on all cases since implementation to collect a year of data. We worked with clinical staff regarding implementation, with focus on Pediatrics and EDIER. Our laboratory performed the test 24 hours per day, 365 days per year with results called as soon as testing was completed. Both positive and negative results were called to allow for better patient management.

The team used a combination of PDSA methodology and other tools such as spaghetti diagrams to remove process waste between the receiving and reporting milestones. Physical steps were reduced from 46 steps to 18 steps on average after careful consideration was given to selection of the appropriate location of the system. Although recent staff satisfaction results are pending, it is perceived that workflow improvements will indicate a higher level of engagement.

Results and Outcomes

Testing started in June 2016 and data was collected until end of May 2017 and 223 tests completed with an average time from receipt of specimen to final result of 2 hours and 8 minutes. This was well below our goal of 3 hours. A chart review of all tested patients showed 67 patients had been deferred from admission when ME was ruled out with a negative test result and appropriate clinical assessment. (See Figure 1)

Out of the 67 patients deferred, 17 were positive for viral meningitis (7 Enterovirus, 7 Human parvovirus B19, 1 Human herpesvirus 6, and 2 herpes simplex virus 2). These infections were considered mild and self limiting and thus did not require admission. The remaining 50 were all negative for pathogens and thus ME was ruled out. (Table 2)

Pathogens Detected by Methodology

A summary of the cost for this new testing compared to similar send out testing is seen in the Table 3 below. The total cost for this testing in the first year of operation was $63,000.00. By comparison, if we shipped out testing for full viral panels (not as inclusive as our panel) and also performed bacterial antigen testing in house, the cost would be $127,566.00, which is $30,566.00 more than in house testing. The savings in the first year is reduced by the initial instrumentation cost. In subsequent years the savings per year is estimated to be $78,956.00. Labor was not considered since the labor to set up and complete the newer molecular panel is similar to the labor associated with shipping to a reference laboratory. Culture costs were also not included since fungal and bacterial cultures were also ordered on most patients, before and after testing.

Costing Summary Table

Table 3: Cost of testing comparison of ship out testing laboratory panels.

Conclusion

Rapid molecular testing of CSF specimens in patients with suspected ME resulted in faster and more accurate diagnosis and more appropriate therapy. The results have reduced the use of unnecessary antibiotics, antifungals, and antivirals in patients who do not have infection ME while allowing faster and more specific therapy in those with positive results.

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