PERSPECTIVE

A comparison of the clinical and microbiological effects of syndromic pneumonia molecular testing in intensive care units

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ABSTRACT

Pneumonia is one of the most prevalent diagnoses in the intensive care unit, with high fatality rates and substantial healthcare expenditures. Antimicrobial therapy may be targeted using microbiological diagnostics, which has been shown to enhance patient outcomes. Due to the time necessary to produce results, standard sputum culture has limitations. To quickly detect infections, Bio Fire offers a syndromic panel of multiplex PCR. This research looked at ICU admission, antibiotic treatment, and consequences for patients. The study looked at the admission information of radiologically confirmed pneumonia patients admitted to Hull Hospitals' ICUs between August 1 and December 31, 2018, before and after Bio Fire testing was implemented.

In the 2018 and 2019 study periods, 139 and 120 patients, respectively, had radiologically diagnosed pneumonia and sputum samples sent to the laboratory. Between the cohorts as a whole, there was no statistical difference in the length of ITU admission or the duration of mechanical ventilation. In hospital and ventilator-acquired pneumonias, however, sub-group analysis demonstrated a 5.6-day reduction in duration of stay. Following the introduction of Bio Fire, the time to change antibiotics was reduced by 1.81 days (p=0.001). Furthermore, utilizing Bio Fire, we discovered differences that allowed us to identify additional infections in 23 patients not observed on normal culture. Rapid molecular diagnoses enable for more timely antimicrobial medication adjustments as well as infection control precautions. In pneumonia patients who require ICU admission, syndromic PCR-based diagnostics has the potential to improve patient outcomes.

Key Words: *Molecular Testing; Pneumonia; Antibiotics*

INTRODUCTION

Pneumonia is a prevalent diagnosis in Intensive Care Unit (ICU) patients, and it has a high fatality rate. Pneumonia can be the primary reason for critical care admission, but it can also be a consequence of the hospital stay. For targeted therapy of pneumonia, a microbiological diagnosis is essential (British Thoracic Society). The gold standard in microbiological testing, sputum culture, has its limits. It might take several days from the time the material is collected to the time the findings are available. Variable sensitivity and specificity for identifying specific bacteria, as well as low sensitivity in individuals who have received antibiotics, are some of the other drawbacks. In the field of microbiological diagnostics, molecular testing has risen to the fore. Several studies have demonstrated that it is superior to normal culture in terms of detecting infections. PCR testing can also reveal whether or not genes linked to antibiotic resistance are present. The Bio Fire Film Array Pneumonia Panel (BFPP) uses syndromic PCR to detect pathogens in respiratory samples. The pneumonia panel uses sputum samples to screen for 27 pathogens at the same time, including bacteria and viruses. In February 2019, BFPP was introduced to Hull University Teaching Hospitals (HUTH).

All pneumonia patients hospitalized in Intensive Care Units (ICUs) who had sputum samples taken throughout two time periods were included in this observational research. The Bio Fire Film Array Pneumonia Panel (BFPP) is used in this study to assess a variety of outcomes in an intensive care scenario. In VAP and HAP patients, the use of BFPP resulted in a shorter time between antibiotic changes, a higher detection rate of bacteria and viruses, and a non-significant reduction in ITU stay. There were no significant changes in any clinical outcomes. In the BFPP group, we identified a substantial decrease in time to change antibiotics of 1.81 days (p= 0.001). It takes between 24 hours and 48 hours to detect infections using standard culture methods, and another 12 hours-36 hours to perform susceptibility testing. The ability to quickly detect both bacteria and viruses that causes pneumonia might lead to early antibiotic medication refinement. Improved patient outcomes and a reduction in antibiotic resistance are two possible benefits of early antibiotic optimization. In ICU patients with ventilator-associated pneumonia or ventilated hospital-acquired pneumonia, Peiffer-Smadja observed that using multiplex PCR resulted in the early introduction of efficacious antibiotics in 21% of patients and de-escalation in 39%. Monard conducted a retrospective multicenter investigation in which respiratory samples from 159 pneumonia patients were collected and evaluated using quick multiplex PCR and

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traditional microbiological techniques at the same time. In 77 percent of pneumonia cases, the authors advised changing the empirical therapy. De-escalation was used in 40% of instances, escalation was used in 35% of cases, and indeterminate was used in 16% of cases. These earlier findings would be bolstered by our observation that clarithromycin usage has declined. In comparison to culture, BFPP testing allows for the detection of more bacteria and viruses. Bacteria not seen in sputum culture were often discovered. Rapid molecular testing appears to be more sensitive than culture-based approaches, according to mounting data. Cremet looked examined how the Bio Fire arrays may be used to diagnose HAP in ICU patients. When compared to normal tests, the Bio Fire Film Array resulted in the detection of more bacteria in 39.5 percent of Bronchoalveolar lavages and 37.8 percent of endotracheal aspirates. The usage of BFPP is not without its restrictions. Fungal species are not detectable, and the panel now contains 27 pathogens (18 bacteria, 9 viruses) and 7 antibiotic resistance genes. To avoid missing medication for pneumonia caused by a pathogen not covered in the panel, medical practitioners must comprehend the panel's spectrum. Because the BFPP isn't comprehensive, it can't yet replace traditional microbiological culture. Our findings show that the BFPP might be a valuable tool for detecting bacteria and viruses that aren't detectable by culture. The current study contains several flaws. For starters, the results are less generalizable due to the limited sample size, single-center design, and retrospective methodology. Second, the study was done in the autumn and early winter, thus our findings cannot be extrapolated outside of this time range, and it was undertaken before the COVID-19 epidemic. Third, because the inclusion criteria were broad and covered all major kinds of pneumonia (i.e., HAP, VAP, CAP, and aspiration pneumonia), it is uncertain which types of pneumonia would benefit the most from BFPP testing due to the diverse research group. The limited number of patients in each pneumonia subgroup makes it challenging to evaluate the results. Finally, the study's observational methodology makes it vulnerable to selection bias. A randomized control study would provide a more conclusive comparison of BFPP usage with conventional therapy alone, and this should be a focus of future research.

CONCLUSION

In conclusion, our findings suggest that while using the rapid Bio Fire Film Array pneumonia panel in an adult ICU population did not result in a shorter stay, it did result in a shorter time to change antibiotics, a higher rate of detection for bacteria and viruses, and a possible reduction in the length of time spent in the ITU in VAP and HAP patients. Antibiotic treatment that can be fine-tuned sooner may lead to a reduction in antimicrobial resistance.