Impact of a Rapid Diagnostic Assay for the Detection of Bacterial and Viral Agents on Antimicrobial use in Critically Ill Patients with Pneumonia

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Background

- Prompt initiation of effective antimicrobial therapy improves clinical outcomes of patients with pneumonia[1]
  - Mortality increases by 8% for each hour of inappropriate therapy in patients with septic shock[2]
- Broad-spectrum antimicrobials are initiated empirically, with the anticipation of de-escalating once microbiology data become available
- Culture remains the gold standard for bacterial identification
  - Turnaround can be up to 72 hours. Which prolongs duration of empiric broad-spectrum antibiotics, increasing the risk of adverse events.
- Rapid diagnostic tests significantly shorten the time to pathogen identification
  - When combined with an antimicrobial stewardship intervention, they have been shown to decrease mortality in patients with bloodstream infections[3]
- The BioFire® FilmArray® Pneumonia Panel (BFPP) is a syndromic multiplex PCR assay able to identify 26 targets and 8 antimicrobial resistance genes in 75 minutes
- The assay is validated for sputum, bronchoalveolar lavage (BAL), mini-BAL, and endotracheal aspirates (ETA)
- Recent evidence has shown that early de-escalation is possible in up to 70% of cases when BFPP is utilized[4]
- Data on the actual impact of the BFPP on clinical and antimicrobial stewardship outcomes are lacking

Table 1. Targets Identified by BFPP

Bacteria		Viruses
Semi-quantitative (1+, 2+)	Qualitative (detected/not detected)	
Acinetobacter calcoaceticus *Acinetobacter baumannii* *Enterobacter cloacae* *Escherichia coli* *Haemophilus influenzae* *Klebsiella aerogenes* *Klebsiella oxytoca* *Klebsiella pneumoniae* *Moraxella catarrhalis* *Proteus* spp. *Pseudomonas aeruginosa* *Serratia marcescens* *Staphylococcus aureus* *Streptococcus agalactiae* *Streptococcus pneumoniae* *Streptococcus pyogenes*	*Chlamydia pneumoniae* *Legionella pneumophila* *Mycoplasma pneumoniae* **Resistance genes** KPC NDM IMP VIM OXA-48 CTX-M mecA/mecC, MREJd	Adenovirus Coronavirus Human metapneumovirus Rhinovirus/enterovirus Influenza A and B Parainfluenza virus Respiratory syncytial virus

Methods

Design

Retrospective, single-center, pre-post study

- Pre-implementation: Dec 1, 2018-Feb 28, 2019
- Post-implementation: Dec 1, 2021-Feb 28, 2022

Inclusion Criteria

- Admitted to an intensive care unit
- Confirmed, or strong clinical suspicion for bacterial pneumonia
- Respiratory culture obtained from BAL, mini-BAL, or ETAs

Exclusion Criteria

- Active febrile neutropenia
- Known or suspected fungal or mycobacterial pneumonia
- Died within 48 hours of BFPP
- Cystic fibrosis or bronchiectasis

Figure 1. BFPP Workflow

Baseline Characteristics

Variable		Pre (n = 80)	Post (n = 83)	P-value
Age, y, mean ± SD		57±15	57±17	0.8
APACHE II Score, median [IQR]		21 [16-26]	19 [13-27]	0.08
Male, no. (%)		47 (59)	48 (58)	0.1
Specimen Type, no. (%)	BAL	21 (26)	5 (6)	<0.01
	Mini-BAL	32 (40)	38 (45)	0.7
	ETA	27 (34)	40 (48)	0.04
Pneumonia Type, no. (%)	CAP	27 (34)	21 (25)	<0.01
	HAP	47 (59)	23 (28)	<0.01
	VAP	6 (7)	40 (47)	<0.01
Immunocompromised. no. (%)		12 (15)	8 (10)	0.4
COPD. no. (%)		25 (33)	17 (20)	<0.01

Outcomes

Primary Outcome

- Time from respiratory culture collection to receipt of optimal antimicrobial therapy (TTOT)

Secondary Outcomes

- Time from respiratory culture collection to receipt effective antimicrobial therapy (TTET)
- Duration of therapy (DOT) for antipseudomonal and anti-MRSA agents from respiratory culture collection

Results

Outcome (median, IQR)	Pre (n = 80)	Post (n = 83)	P-value
TTOT, hours	38 [15-44]	21 [8-45]	<0.001
TTET, hours	5.7 [0.8-28]	4.9 [2.7-7]	0.106
Anti-MRSA DOT, days	1.9 [0.9-3.2]	0.9 [0.6-2.7]	<0.001
Anti-pseudomonal DOT, days	4.4 [2.1-6.8]	2.1 [0.9-6.1]	<0.001

Conclusion

- Implementation of a rapid multiplex PCR panel along with ICU pharmacist intervention significantly reduced the time to optimal therapy in critically ill patients with pneumonia.

References

1. Chest. 1999 Feb;115(2):462-74.
2. Crit Care Med. 2006 Jun;34(6):1589-96.
3. Clin Infect Dis. Jan 1 2017;64(1):15-23.
4. J Clin Microbiol. Jun 24 2020;58(7)