Evaluation of Accelerate Pheno™ System in a Clinical Setting: Comparison of Identification and Antibiotic Susceptibility Test Results of 224 Prospective Positive Blood Cultures to Standard Laboratory Methods at Detroit Medical Center

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INTRODUCTION

Bloodstream infections (BSI) cause more than one million hospitalizations, 258,000 deaths and $24 billion in hospital costs annually. Rapid organism identification (ID) and antimicrobial susceptibility testing (AST) can guide early appropriate antimicrobial therapy and improve patient outcomes. The Accelerate Pheno™ system identifies common pathogens and provides MICs for multiple antibiotics directly from positive blood cultures in 7 hours. We aimed to evaluate the performance (accuracy) and time to organism ID and AST results of the Accelerate Pheno™ system compared to standard laboratory methods using positive blood cultures collected prospectively from unique patients with suspected BSI.

METHODS

Residual positive blood bottles were tested on the Accelerate Pheno™ system within 8 hours of positivity using pre-FDA cleared software (1.0) and CLSI 2016 breakpoints. ID sensitivity and specificity and AST essential (EA) and/or categorical agreement (CA) were calculated and compared to our current clinical laboratory methods. The standard methods at the Detroit Medical Center (DMC) consist of a combination of phenotypic, biochemical method and/or MALDI-ToF techniques for organism ID combined with AST via the BD Phoenix™ Automated Microbiology System. Time to organism ID was also compared to the Verigene® System.

RESULTS

Based on 224 unique prospective positive blood cultures tested, the Accelerate Pheno™ system, pre-discrepancy testing, showed an overall sensitivity of 93.8% and specificity of 99.7% for pathogen ID compared to our standard methods. For AST, the Accelerate Pheno™ system showed an overall EA and CA of 96.3% and 94.8%, respectively. Results from organisms/antibiotics not included in the final FDA-cleared version were not included in performance analysis. The average time to ID and AST was about 39 hours faster with the Accelerate Pheno™ system than with standard methods (Table 4).

CONCLUSION

Rapid ID and AST of bloodstream pathogens allows for rapid transition to targeted therapy which could reduce mortality and unnecessary broad-spectrum antimicrobial exposure. These data showed the ability of the Accelerate Pheno™ system to provide accurate ID in less than 90 minutes, and most importantly, reliable AST results in less than 7 hours from the detection of a positive blood culture; thus decreasing the time to AST results by nearly 2 days compared to standard methods.

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Table 1: *Identification Performance (n=206 runs)**

Organism	Sensitivity		Specificity	
Gram-Positive				
Coagulase-negative *Staphylococcus* spp.	28/31	90.3%	167/169	98.8%
Enterococcus faecalis	10/11	90.9%	195/195	100%
Enterococcus faecium	5/5	100%	198/200	99%
Staphylococcus aureus	47/48	97.9%	152/153	99.3%
Staphylococcus lugdunensis	0/1	0%	203/203	100%
Streptococcus spp.	18/19	94.7%	187/187	100%
Gram-Negative				
Acinetobacter baumannii	0/0	N/A	206/206	100%
Citrobacter spp.	1/1	100%	204/205	99.5%
Enterobacter spp.	6/8	75%	197/197	100%
Escherichia coli	34/34	100%	172/172	100%
Klebsiella spp.	16/18	88.9%	187/187	100%
Proteus spp.	7/7	100%	199/199	100%
Pseudomonas aeruginosa	4/5	80%	201/201	100%
Serratia marcescens	1/1	100%	205/205	100%
Yeast				
Candida albicans	1/1	100%	203/203	100%
Candida glabrata	3/3	100%	199/203	98%
Overall	**181/193**	**93.8%**	**3075/3085**	**99.7%**

*Monomicrobial Meta Call PPV: 97.3%

Table 2: *Resistance Phenotype Performance*

Combination	Count	CA	VME	ME
Cefoxitin & *S. aureus*	42	42/42 (100%)	0/26 (0%)	0/16 (0%)
Cefoxitin & CNS	10	8/10 (80%)	1/7 (14.3%)	1/3 (33.3%)
Cefoxitin & *S. lugdunensis*	0	0/0 (N/A)	0/0 (N/A)	0/0 (N/A)
MLSb & CNS	10	8/10 (80%)	1/6 (16.7%)	1/4 (25%)
MLSb & *S. lugdunensis*	0	0/0 N/A	0/0 (N/A)	0/0 (N/A

Table 3: *Antimicrobial Susceptibility Testing (AST) Performance*

Antibiotic	Count	Essential Agreement	Categorical Agreement
Gram-Positive[1,2]			
Ampicillin	11	90.9%	90.8%
Ceftaroline	0	N/A	N/A
Daptomycin	64	90.6%	98.4%
Doxycycline	0	N/A	N/A
Erythromycin	54	94.4%	94.4%
Linezolid	65	95.4%	98.5%
Trimethoprim-Sulfamethoxazole	44	100%	100%
Vancomycin	65	96.9%	98.5%
Gram-Negative[1,3]			
Amikacin	64	98.4%	98.4%
Ampicillin-Sulbactam	49	93.9%	75.5%
Aztreonam	64	93.8%	96.9%
Cefazolin	46	95.7%	76.1%
Cefepime	64	96.9%	96.9%
Ceftazidime	64	90.6%	89.1%
Ceftriaxone	61	98.4%	98.4%
Ciprofloxacin	63	100%	96.8%
Colistin	0	N/A	N/A
Ertapenem	60	100%	100%
Gentamicin	64	98.4%	96.9%
Meropenem	59	98.3%	98.3%
Minocycline	0	N/A	N/A
Piperacillin-Tazobactam	62	95.2%	91.9%
Tobramycin	64	98.4%	93.8%
Overall	**1087**	**96.3%**	**94.8%**

[1]Results based on CLSI 2016 breakpoints
[2]3 major errors / 244 S results - 0 very major errors / 5 R results
[3]1 major error / 655 S results - 5 very major errors / 59 R results

Table 4: *Comparison of Time to ID and AST*

	Average Time to ID	Average Time to AST
Accelerate Pheno™ System	1.4 h	6.7 h
Verigene System	2.0 - 2.5 h	N/A
MALDI-TOF	33.9 h	N/A
Standard Methods ID / BD Phoenix Automated Microbiology System	40.3 h	45.5 h

Figure 1: *Categorical Time Difference to ID Results for Culture vs. Accelerate Pheno™ System*

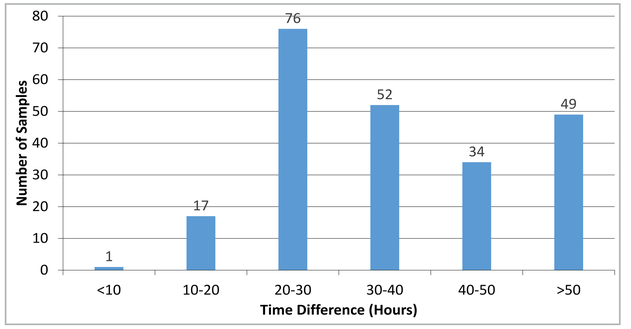
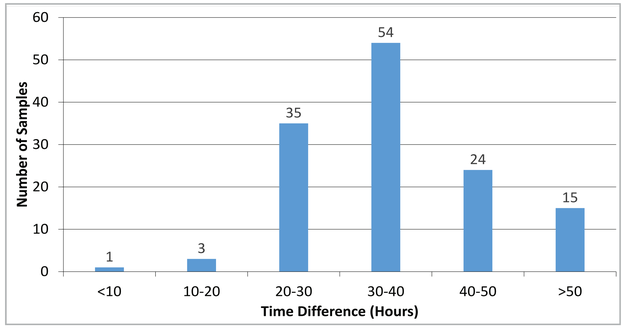


Figure 2: *Categorical Time Difference to AST Results for Culture vs. Accelerate Pheno™ System*



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