Evaluation of a Rapid Blood Culture Assay for Phenotypic Antimicrobial Susceptibility Testing of Gram-negative Bacteria on Antimicrobial Use in Children

Thao Truong1, Irvin Ibarra Flores1, Kanokporn Mongkolrattanothai2,3, Jennifer Dien Bard1,3

Pathology & Laboratory Medicine at Children's Hospital Los Angeles1; Department of Pediatrics, Division of Infectious Diseases, Children's Hospital Los Angeles2; Keck School of Medicine at the University of Southern California3

Introduction

- Rapid identification and antimicrobial susceptibility testing (AST) from positive blood cultures can decrease the time to optimal therapy and reduce the use of broad-spectrum agents.
- The Accelerate Pheno Blood Culture panel (Pheno) provides AST of select on-panel Gram-negative organisms directly from positive blood cultures.
- We sought to determine the performance and the clinical impact of Pheno at our pediatric hospital compared to the BD Phoenix AST system (reference).

Methods

- We conducted chart review on a total of 100 cases tested by conventional AST directly from positive blood culture cell pellet during the period of May 2018 - April 2019 and a total of 97 cases tested by Pheno during May 2019 - March 2021. A total of 183 patients were tested.
- Pheno results in the test group were compared to the BD Phoenix AST system in the reference group.
- Duration of therapy, time to optimal therapy, and length of stay were calculated.

Results

Table 1. Demographics and clinical outcomes

	Pre-implementation	Post-implementation	p value
Demographics	(n = 90)	(n = 93)	
Median age	6.4	2.3	0.16
Female	40 (44.4)	40 (43.0)	0.88
Immunocompetent	6 (6.7)	17 (18.3)	0.02
Chart review	(n = 100)	(n = 97)	
Mean length of stay	17.0 days	14.0 days	
30 day mortality	4 (4.0)	7 (7.2)	0.37
CVAD line removal	28 (28.0)	22 (22.7)	0.42
Community-onset	56 (56.0)	63 (64.9)	0.24
Hospital-onset	44 (44.0)	34 (35.1)	0.19
Antimicrobial duration	(n = 100)	(n = 97)	
Meropenem	47.7 hours	25.2 hours	<0.01

Figure 1. Median time to AST and optimization of therapy from time of receipt in laboratory

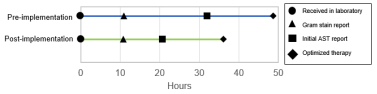
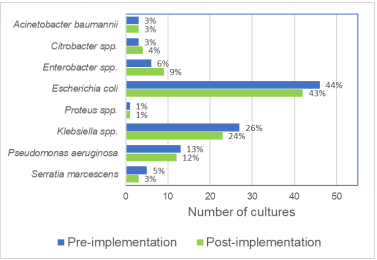


Figure 2. Organisms identified in blood cultures



Results

Figure 3. Category of antimicrobial change after susceptibility testing results

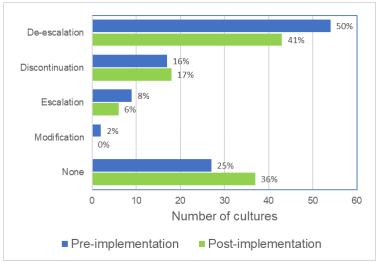


Table 2. Antimicrobial susceptibility agreement between Pheno and reference method

Antibiotic	Minor errors (%)	Major errors (%)	Very major errors (%)
Amikacin	0	0	0
Ampicillin-sulbactam	20.7	1.7	1.7
Aztreonam	2.6	0	0
Cefazolin	16.1	5.4	0
Cefepime	6.8	0	0
Ceftazidime	16.1	2.3	0
Ceftriaxone	0	1.3	0
Ciprofloxacin	3.4	0	0
Ertapenem	1.4	0	0
Gentamicin	4.6	2.3	0
Meropenem	4.6	0	0
Minocycline	0	0	0
Piperacillin-tazobactam	14.9	0	0
Tobramycin	4.6	0	0
Total	**7.56**	**0.94**	**0.10**

Results

Differences in categorical agreement

- 72 minor errors
  - Overcalling
    - 26.4% (R) when reference was (I)
    - 61.1% (I) when reference was (S)
  - Undercalling
    - 5.6% (I) when reference was (R)
    - 6.9% (S) when reference was (I)
- 9 major errors
  - 1 ampicillin-sulbactam, 3 cefazolin, 2 ceftazidime, 1 ceftriaxone, 2 gentamicin
- 1 very major error (ampicillin-sulbactam in Klebsiella pneumoniae)
- 9 of 12 ampicillin-sulbactam minor errors were due to overcalling resistance in *Escherichia coli* when the reference method was intermediate

Conclusions

- Pheno had accurate performance compared to the reference method. The majority of the minor errors were due to overcalling intermediate resistance when the reference was susceptible.
- The median time to initial AST report and optimal therapy decreased significantly after Pheno implementation.
- There was no significant impact on clinical outcomes such as 30-day mortality or central venous access device removal.
- There were significantly more immunocompetent patients in the post-implementation group, potentially impacting these results.
- The median duration on broad-spectrum meropenem decreased by 22.5 hours after Pheno implementation (P<0.01).