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Evaluation of a Rapid Antimicrobial Susceptibility Testing System From Positive Blood Cultures For Accuracy And Potential Clinical Impact

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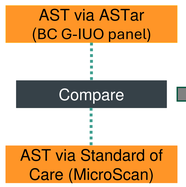
Introduction

Bloodstream infections remain a significant global contributor to morbidity and mortality. Reducing the time to appropriate antimicrobial therapy is critical for enhancing patient outcomes and healthcare quality. Rapid advancements in diagnostic technologies continue to increase the accuracy, the turnaround time, and clinical utility of laboratory results. Performing antimicrobial susceptibility testing (AST) directly from positive blood culture (PBC) bottles enables earlier antimicrobial intervention, which may improve clinical outcomes by decreasing mortality, hospital stay duration, adverse drug events, and the emergence of antimicrobial resistance. The Q-linea ASTar System can perform phenotypic AST directly from a PBC bottle. Here, we evaluated the AST accuracy and potential clinical utility and outcomes driven by the AST results from the ASTar system.

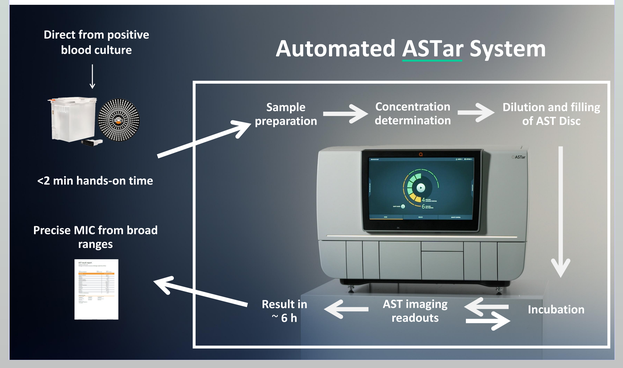
Methods

- Seventy-five PBCs (57 prospective, 18 spiked) were evaluated.
- AST results (using the Microscan Walkaway) generated from standard of care (SoC) PBC overnight subculture were compared to AST results generated from the Q-linea ASTar system.



Assessment:

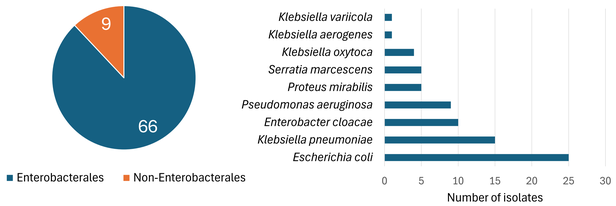
- Performance comparison (essential and categorical agreement, error rates)
- Time to actionable results (time from PBC to availability of AST report)
- Hypothetical clinical decisions: treatment adjustment type (retrospective clinical chart review)



Results

A: Distribution of Organisms Tested

A majority of the PBC bottles harbored Enterobacterales (88%, n=66) with the others being non-Enterobacterales, namely *P. aeruginosa* (12%, n=9). Resistant organisms harboring *blaCTX-M* (17%, n=13) and *blaKPC* (1%, n=1) were also tested.



C: Potential Therapeutic Impacts

The ASTar system can decrease the time-to-phenotypic AST after initial positive Gram-stain result by 38.8 hours compared to the standard of care workflow (10.3 hrs vs 49.1 hrs, p<0.00001).

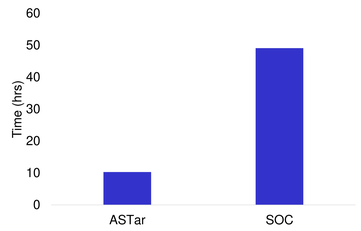
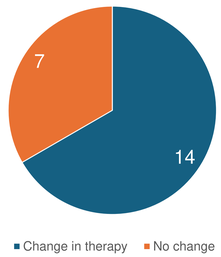


Chart reviews performed (n=21, 28%) suggested that results from the ASTar would have therapy adjusted in 66% of the patients



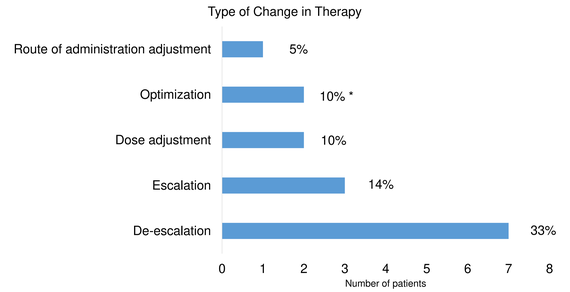
B: Comparison of AST from SoC sub-culture versus the ASTar

**No discrepancy adjudication has been completed.

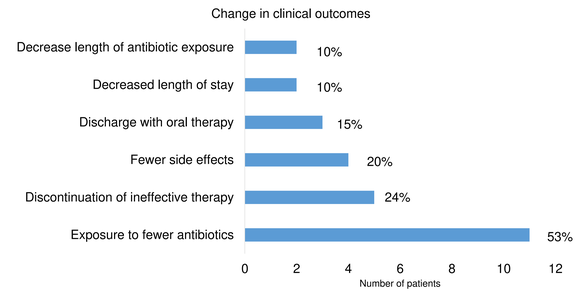
- The ASTar yielded an essential agreement of 95.5% and categorical agreement of 91.8%.
  - Organisms with agreement of <90% included *S. marcescens, K. variicola,* and *K. aerogenes*.
- There were 2.6% major errors and 6.7% very major errors.
  - Very major errors (n>1) were seen with aztreonam, ceftazidime, and ceftriaxone.
  - Major errors (n>1) were seen with cefazolin, cefoxitin, cefuroxime, and trimethoprim-sulfamethoxazole.
- ASTar results from drug-resistant organisms (1 *blaKPC* and 13 *blaCTX-M*) were 100% concordant.

Organism	Essential Agreement (%)	Categorical Agreement (%)	Very Major Error (%)	Major Error (%)
E. coli (n=25)	98.4%	93.9%	0.9%	1.4%
K. pneumoniae (n=15)	95.9%	91.5%	3.7%	3.4%
E. cloacae (n=10)	95.7%	89.4%	8.3%	4.6%
P. aeruginosa (n=9)	96.0%	99.0%	0.0%	0.0%
S. marcescens (n=5)	84.5%	85.7%	100.0%	0.0%
P. mirabilis(n=5)	93.5%	92.5%	10.0%	3.6%
K. oxytoca (n=4)	94.4%	91.5%	0.0%	0.0%
K. variicola (n=1)	83.3%	61.1%	0.0%	11.8%
K. aerogenes (n=1)	81.3%	81.3%	0.0%	18.8%

Antimicrobial	Essential Agreement (%)	Categorical Agreement (%)	Very Major Error (%)	Major Error (%)
Grand Total	95.6% (1346/1409)	91.8%(1292/1407)	6.7% (16/240)	2.6% (29/1131)
Amikacin	98.6% (70/71)	98.6% (70/71)	100% (1/1)	0% (0/70)
Ampicillin	100% (28/28)	100% (28/28)	0% (0/15)	0% (0/13)
Ampicillin-sulbactam	93.9% (46/49)	71.4% (35/49)	0% (0/13)	3.6% (1/28)
Aztreonam	94.6% (70/74)	94.4% (68/72)	15% (3/20)	0% (0/52)
Cefazolin	89.8% (44/49)	75.5% (37/49)	0% (0/20)	19.2% (5/26)
Cefepime	96.0% (71/74)	95.9% (71/74)	0% (0/17)	1.8% (1/56)
Cefotaxime	100% (18/18)	100% (18/18)	0% (0/10)	0% (0/8)
Cefoxitin	98.0% (48/49)	55.1% (27/49)	0% (0/1)	8.9% (4/45)
Ceftazidime	90.5% (67/74)	93.2% (69/74)	17.6% (3/17)	1.8% (1/55)
Ceftazidime-avibactam	98.3% (57/58)	100% (58/58)	0% (0/0)	0% (0/58)
Ceftolozane-tazobactam	98.2% (55/56)	98.2% (55/56)	100% (1/1)	0% (0/55)
Ceftriaxone	89.1% (57/64)	90.6% (58/64)	22.7% (5/22)	2.4% (1/42)
Cefuroxime	90% (54/60)	81.7% (49/60)	0% (0/19)	21.0% (8/38)
Ciprofloxacin	94.6% (70/74)	90.5% (67/74)	4.8% (1/21)	2.0% (1/49)
Ertapenem	98.5% (64/65)	98.4% (64/65)	0% (0/1)	0% (0/63)
Gentamicin	95.8% (68/71)	97.2% (69/71)	0% (0/8)	1.6% (1/63)
Levofloxacin	97.3% (72/74)	90.6% (67/74)	0% (0/16)	1.8% (1/55)
Meropenem	98.6% (73/74)	98.6% (73/74)	0% (0/1)	1.4% (1/73)
Meropenem-vaborbactam	98.3% (58/59)	96.6% (57/59)	0% (0/0)	0% (0/58)
Piperacillin-tazobactam	91.7% (67/73)	89.0% (65/73)	0% (0/5)	1.6% (1/63)
Tigecycline	96.7% (57/59)	96.6% (57/59)	100% (1/1)	0% (0/57)
Tobramycin	98.6% (70/71)	95.8% (68/71)	0% (0/10)	1.7% (1/60)
Trimethoprim-sulfamethoxazole	95.4% (62/65)	95.4% (62/65)	4.8% (1/21)	4.5% (2/44)



*Optimization includes target source optimization and optimizing therapy against ampC-producing organism



Conclusions

- The Q-linea ASTar generated reliable phenotypic AST results from PBC bottles.
- AST profiles generated from drug-resistant organisms were correctly identified by the ASTar.
- At our institution, rapid phenotypic AST platforms may potentially lead to therapeutic changes for patients with Gram-negative bacteremia.
- Implementation of technologies performing rapid AST like the ASTar may accelerate AST results by >24 hours.
- Technologies accelerating AST results combined with hospital antimicrobial stewardship efforts continue to show promise in improving patient outcomes.
- Discrepancy resolution and chart reviews are ongoing.

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Acknowledgments

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