Performance of a System for Direct Rapid Antimicrobial Susceptibility Testing from Blood Culture

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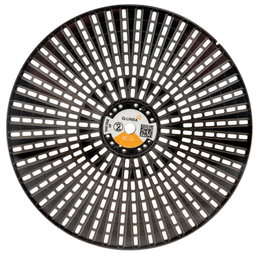
Introduction

Bloodstream infections (BSIs) are a major cause of mortality. Longer time to effective antibiotic therapy is associated with lower survival rates. Timely antimicrobial susceptibility testing (AST) is critical to improve outcomes in BSIs and sepsis (1,2). However, traditional AST methods require overnight culturing, delaying results by several days. The rise of antibiotic resistance further complicates treatment. While broad-spectrum antibiotics offer initial coverage, their overuse risks selecting for resistant strains. Rapid phenotypic AST systems may shorten the time to AST results, guiding targeted therapy, minimizing resistance, and improving patient outcomes (3).

Q-linea ASTar is a rapid antimicrobial susceptibility testing (AST) system that provides MIC results and susceptible/intermediate/resistant interpretation from positive blood cultures within 7 hours (h), compared to days using Standard of Care (SoC) methods (4). This study evaluated the technical performance of the Q-linea ASTar.

Methods

- Q-linea ASTar BC G- compared to Microscan WalkAway 96 NM56
- Results were analyzed using FDA 2021 breakpoints
- Inclusion criteria:
  - Positive blood cultures obtained as part of standard of care platforms
  - Gram stain: Gram-negative rods
  - FilmArray BCID2: Enterobacterales, *Pseudomonas aeruginosa*
  - *Haemophilus influenzae* and *Acinetobacter baumannii* are also on-panel for ASTar but not recovered as part of this study
- 73 patient blood cultures enrolled
  - 6 excluded post analysis due to polymicrobial (3) or failed ASTar (3)
- 16 contrived blood cultures using clinical isolates
- Discrepant analysis for select isolates performed by 3rd party broth microdilution in triplicate
  - 24 data points across 9 isolates



Results

Table 1. Performance of Q-linea ASTar BC G-. Results were compared to Microscan Walkaway NM56 panel. Results were analyzed using Investigational Use Only (IUO) reporting as well as FDA In Vitro Diagnostic (IVD) cleared reporting. The FDA IVD reporting has limitations for certain antibiotic/bacterial species combinations including no reporting or reporting with a comment stating that a second method should be use to confirm the result prior to reporting. All results with such limitations were removed from analysis. Very major error (VME); major error (ME); minor error (mE); categorical agreement (CA)

	IUO								FDA IVD							
	Enterobacterales															
Antimicrobial Agent	**N**	**S**	**I**	**R**	**CA**	**VME**	**ME**	**mE**	**N**	**S**	**I**	**R**	**CA**	**VME**	**ME**	**mE**
Amikacin	**72**	72	0	0	**100%**	0	0	0	**37**	37	0	0	**100%**	0	0	0
Ampicillin	**39**	22	0	17	**100%**	0	0	0	**39**	22	0	17	**100%**	0	0	0
Ampicillin/ Sulbactam	**59**	40	10	9	**75%**	0	2 (5%)	13 (22%)	**59**	40	10	9	**75%**	0	2 (5%)	13 (22%)
Aztreonam	**72**	56	2	14	**97%**	0	0	2 (3%)	**71**	56	2	13	**97%**	0	0	2 (3%)
Cefazolin	**59**	37	3	17	**56%**	0	5 (14%)	21 (36%)	**20**	12	0	8	**55%**	0	1 (8%)	8 (40%)
Cefepime	**72**	57	4	11	**96%**	0	0	3 (4%)	**62**	48	4	10	**95%**	0	0	3 (5%)
Cefotaxime	**72**	54	0	18	**100%**	0	0	0	*Perform an alternative method prior to reporting*							
Ceftazidime	**72**	57	0	15	**97%**	0	0	2 (3%)	**35**	28	0	7	**94%**	0	0	2 (6%)
Ceftazidime-avibactam	**65**	64	0	1	**100%**	0	0	0	**15**	15	0	0	**100%**	0	0	0
Ceftolozane-tazobactam	**62**	59	0	3	**97%**	0	0	2 (3%)	*Perform an alternative method prior to reporting*							
Ceftriaxone	**72**	55	1	16	**100%**	0	0	0	*Not reported / Perform an alternative method prior to reporting*							
Ciprofloxacin	**72**	52	3	17	**94%**	0	0	3 (4%)	**71**	52	3	16	**96%**	0	0	3 (4%)
Ertapenem	**72**	69	0	3	**100%**	0	0	0	*Perform an alternative method prior to reporting*							
Gentamicin	**72**	65	2	5	**99%**	0	0	1 (1%)	**30**	29	1	0	**100%**	0	0	0
Levofloxacin	**72**	56	2	14	**93%**	0	0	5 (69%)	**72**	56	2	14	**93%**	0	0	5 (7%)
Meropenem	**72**	69	1	2	**99%**	1 (50%)	0	0	**44**	42	0	2	**98%**	1 (50%)	0	0
Meropenem-vaborbactam	**69**	69	0	0	**100%**	0	0	0	**69**	69	0	0	**100%**	0	0	0
Piperacillin-tazobactam	**72**	65	3	4	**94%**	0	0	4 (6%)	**53**	49	1	3	**100%**	0	0	0
Tigecycline	**67**	67	0	0	**100%**	0	0	0	**67**	67	0	0	**100%**	0	0	0
Tobramycin	**72**	63	4	5	**94%**	0	1 (2%)	3 (4%)	**66**	57	4	5	**94%**	0	1 (2%)	3 (5%)
Trimethoprim-sulfamethoxazole	**72**	55	0	17	**99%**	0	1 (2%)	0	**57**	48	0	9	**98%**	0	1 (2%)	0
Total	**1428**	**1203**	**35**	**188**	**95%**	**1 (0.5%)**	**9 (0.7%)**	**59 (0.4%)**	**867**	**727**	**27**	**113**	**95%**	**1 (0.9%)**	**5 (0.7%)**	**39 (4.5%)**
Pseudomonas aeruginosa																
Antimicrobial Agent	**N**	**S**	**I**	**R**	**CA**	**VME**	**ME**	**mE**	**N**	**S**	**I**	**R**	**CA**	**VME**	**ME**	**mE**
Amikacin	**9**	9	0	0	**100%**	0	0	0	**9**	9	0	0	100%	0	0	0
Aztreonam	**11**	5	1	5	**72%**	0	0	3 (27%)	*Perform an alternative method prior to reporting*							
Cefepime	**11**	6	2	3	**82%**	0	0	2 (18%)	**11**	6	2	3	82%	0	0	2 (18%)
Ceftazidime	**11**	6	0	5	**100%**	0	0	0	*Perform an alternative method prior to reporting*							
Ceftazidime-avibactam	**11**	10	0	1	**100%**	0	0	0	**11**	10	0	1	100%	0	0	0
Ceftolozane-tazobactam	**11**	11	0	0	**91%**	0	0	1 (9%)	*Perform an alternative method prior to reporting*							
Ciprofloxacin	**11**	7	2	2	**72%**	0	0	3 (27%)	**11**	7	2	2	72%	0	0	3 (27%)
Levofloxacin	**11**	5	3	3	**72%**	0	0	3 (27%)	**11**	5	3	3	72%	0	0	3 (27%)
Meropenem	**11**	6	0	5	**100%**	0	0	0	**11**	6	0	5	100%	0	0	0
Piperacillin-tazobactam	**11**	6	1	4	**82%**	0	0	2 (18%)	*Not reported*							
Tobramycin	**11**	11	0	0	**100%**	0	0	0	*Perform an alternative method prior to reporting*							
Total	**121**	**82**	**9**	**28**	**88%**	**0**	**0**	**14 (12%)**	**64**	**43**	**7**	**14**	**88%**	**0**	**0**	**8 (13%)**
All isolates																
Total	**1547**	**1285**	**44**	**216**	**95%**	**1 (0.5%)**	**9 (0.7%)**	**73 (4.7%)**	**931**	**770**	**34**	**127**	**94%**	**1 (0.8%)**	**5 (0.6%)**	**47 (5%)**

Antibiotic	Organism	BMD	M	Q	Error vs M	Error vs BMD
Ampicillin/sulbactam	*E. coli*	S	S	I	mE	mE
	K. pneumoniae	S	S	R	ME	ME
	K. pneumoniae	R	I	R	mE	No error
Aztreonam	*K. pneumoniae*	R	I	R	mE	No error
Cefazolin	*P. mirabilis*	I	S	R	ME	mE
Cefepime	*K. pneumoniae*	SDD	SDD	R	mE	mE
	K. pneumoniae	SDD	SDD	R	mE	mE
Ceftazidime/avibactam	*P. aeruginosa*	R	S	R	ME	No error
	P. aeruginosa	R	S	R	ME	No error
Ceftriaxone	*P. mirabilis*	S	R	S	VME	No error
Ciprofloxacin	*K. pneumoniae*	I	S	R	ME	mE
	K. pneumoniae	R	I	R	mE	No error
	P. aeruginosa	S	S	I	mE	mE
Gentamicin	*P. aeruginosa*	S	I	S	mE	No error
Levofloxacin	*E. coli*	I	I	R	mE	mE
	K. pneumoniae	S	S	I	mE	mE
	K. pneumoniae	I	S	I	mE	No error
	P. aeruginosa	I	I	R	mE	mE
Meropenem	*C. freundii*	R	R	S	VME	VME
Piperacillin/tazobactam	*K. pneumoniae*	I	S	R	ME	mE
	P. aeruginosa	R	R	I	mE	mE
Tobramycin	*E. coli*	S	S	R	ME	ME
Trimethoprim-sulfamethoxazole	*P. mirabilis*	S	S	R	ME	ME
	K. pneumoniae	S	R	S	VME	No error

Table 2. Discrepancy analysis was performed on select isolates by a reference laboratory. The Q-linea ASTar (Q) result was compared to Microscan (M) and reference method broth microdilution (BMD) performed in triplicate. 15/24 (62.5%) errors resolved in favor of Microscan.

Results

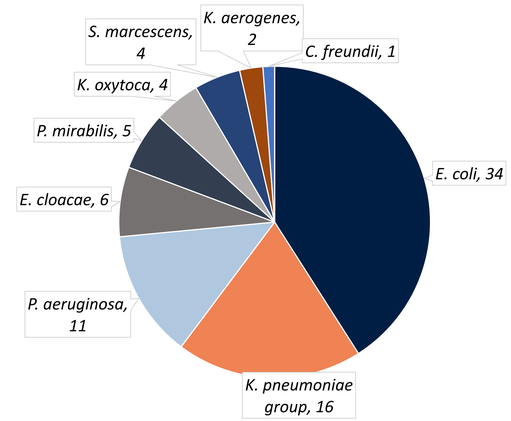


Figure 1. Isolates included in the study.

Discussion

- Overall categorical agreement between Q-linea ASTar and the comparator was 95%, with <1% VME and ME using IUO reporting
- Several antibiotics did not reach >90% CA
  - Enterobacterales: ampicillin/sulbactam, cefazolin
  - *P. aeruginosa*: aztreonam, cefepime
- Application of FDA cleared reporting did not significantly affect performance but did limit reportable results.

References

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3. Bassetti M, Kanj SS, Kiratisin P, et al. Early appropriate diagnostics and treatment of MDR Gram-negative infections. JAC Antimicrob Resist. 2022;4(5):dlac089.
4. Göransson et al. Performance of a System for Rapid Phenotypic Antimicrobial Susceptibility Testing of Gram-Negative Bacteria Directly from Positive Blood Culture Bottles. J Clin Microbiol. 2023 Mar 23;61(3):e0152522.
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Acknowledgments

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