Performance of the Qvella FAST™ Prep System in the Analysis of Positive Blood Cultures

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Introduction

- Sepsis is a life-threatening dysregulated systemic inflammatory response to a bloodstream infection
- Studies show that earlier initiation of antibiotics leads to lower mortality, and current clinical guidelines recommend empiric antibiotics within 3 hours[1-4]
- Identification and susceptibility testing can take 48-72 hours with standard of care (SoC) culturing methods
- The Qvella FAST™ Prep System (Qvella) can potentially reduce this time by 18-24 hours by producing a Liquid Colony™ (LC) when blood cultures are flagged positive

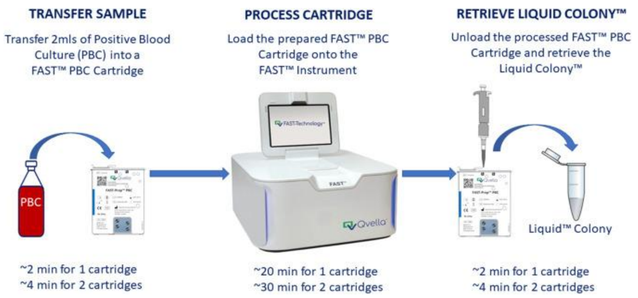
Aims and Objectives

- To assess the performance of the Qvella in the analysis of positive blood cultures by comparing the accuracy of microbial species identification and antimicrobial resistance detection to the standard of care.

Methods

- Positive blood cultures were retrospectively run on the Qvella to produce an LC in <1 hour
- The LC was then used for identification (ID) on MALDI-TOF and used as inoculum for antibiotic susceptibility testing (AST)
- ID and AST results were then compared between the LC and standard of care

Qvella FAST™ Prep System[5]



Results

- MALDI-TOF results from the LC agreed with the SoC at the genus or species level in 69% (62/90) of samples (Table 1)
- In 31% (28/90) of samples, no ID was obtained from the LC (Table 1)
- Overall essential agreement (EA) and categorical agreement (CA) for AST was 97.9% and 94.9% for Gram (-) species, respectively (Table 2)
- Very Major Error (VME) rate was 1.1%, Major Error (ME) rate was 2.2%, and Minor Error (miE) rate was 3.0% for Gram (-) species (Table 2)
- Overall EA and CA for AST was 96.1% and 95.8% for Gram (+) species, respectively (Table 3)
- VME rate was 9.3%, ME rate was 1.5%, and miE rate was 1.6% for Gram (+) species (Table 3)

Table 1, MALDI-TOF ID Results for LC

Species	Correct Genus & species	Correct Genus	Wrong Genus	No ID	Total
Abiotrophia defectiva	0	0	0	1	1
C. albicans	0	0	0	2	2
C. freundii	3	0	0	0	3
C. koseri	1	0	0	0	1
Coagulase negative staph	0	14	0	10	24
E. cloacae	3	0	0	0	3
E. coli	11	0	0	1	12
E. faecalis	4	0	0	0	4
K. pneumoniae	3	1	0	1	5
M. morganii	1	0	0	0	1
P. aeruginosa	10	0	0	5	15
P. mirabilis	2	0	0	0	2
P. stutzeri	1	0	0	0	1
Pasteurella multocida	0	0	0	1	1
S. agalactiae	1	0	0	0	1
S. anginosus	0	0	0	1	1
S. aureus	3	0	0	2	5
S. lutiensis	1	0	0	0	1
S. marcescens	3	0	0	2	5
S. sanguinis	0	0	0	2	2
Totals	47	15	0	28	90

Table 1. For Coagulase negative staph, many of these were not identified to the species level

Table 2, Gram (-) Species AST Results

Antibiotic	EA	CA	VME	ME	miE
Ampicillin/sulbactam	100.0%	88.5%	0.0%	0.0%	10.7%
Amikacin	100.0%	97.9%	0.0%	0.0%	2.0%
Ampicillin	100.0%	100.0%	0.0%	0.0%	0.0%
Amoxicillin/K Clavulanate	100.0%	95.8%	0.0%	0.0%	3.8%
Azithromycin	97.9%	93.6%	0.0%	5.9%	2.1%
Ceftolozane/Tazobactam	97.6%	95.1%	0.0%	2.9%	2.3%
Ceftriaxone	96.9%	90.6%	0.0%	0.0%	9.1%
Ceftazidime	97.8%	95.7%	0.0%	0.0%	4.3%
Cefotaxime	96.9%	90.6%	0.0%	3.8%	6.1%
Cefoxitin	100.0%	96.2%	0.0%	0.0%	3.6%
Cefazolin	100.0%	87.5%	0.0%	0.0%	11.5%
Ciprofloxacin	95.7%	95.7%	0.0%	7.1%	0.0%
Cefepime	95.7%	89.4%	0.0%	5.9%	6.1%
Cefuroxime	100.0%	96.2%	0.0%	0.0%	3.6%
Ceftazidime/Avibactam	100.0%	97.5%	14.3%	0.0%	0.0%
Ertapenem	100.0%	97.0%	0.0%	0.0%	2.9%
Nitrofurantoin	100.0%	N/A	N/A	N/A	N/A
Gentamicin	97.9%	91.5%	0.0%	2.9%	6.1%
Imipenem	97.4%	97.4%	6.7%	0.0%	0.0%
Levofloxacin	93.8%	93.8%	0.0%	9.4%	0.0%
Meropenem	95.8%	95.8%	7.1%	0.0%	2.0%
Meropenem/vaborbactam	96.6%	96.6%	0.0%	0.0%	3.3%
Minocycline	100.0%	97.0%	0.0%	0.0%	2.9%
Moxifloxacin	97.0%	97.0%	0.0%	3.4%	0.0%
Piperacillin/Tazobactam	97.9%	97.9%	0.0%	2.9%	0.0%
Trimethoprim/sulfamethoxazole	97.1%	97.1%	0.0%	4.5%	0.0%
Tetracycline	96.8%	90.9%	0.0%	4.8%	5.7%
Tigecycline	100.0%	100.0%	---	0.0%	0.0%
Tobramycin	97.9%	95.7%	0.0%	2.7%	2.0%
Total	97.9%	94.9%	1.1%	2.2%	3.0%

Table 2. EA: essential agreement. CA: categorical agreement. VME: very major error. ME: major error. miE: minor error. Interpretive results are not available for nitrofurantoin. VME for Tigecycline could not be calculated due to a lack of resistant isolates.

Table 3, Gram (+) Species AST Results

Antibiotic	EA	CA	VME	ME	miE
Ampicillin	100.0%	100.0%	---	0.0%	0.0%
Chloramphenicol	100.0%	93.8%	---	0.0%	6.3%
Clindamycin	100.0%	100.0%	0.0%	0.0%	0.0%
Cefoxitin screen	100.0%	100.0%	N/A	N/A	N/A
Ciprofloxacin	100.0%	100.0%	0.0%	0.0%	0.0%
Ceftaroline	100.0%	100.0%	---	0.0%	0.0%
Daptomycin	87.5%	100.0%	---	0.0%	0.0%
Erythromycin	100.0%	100.0%	0.0%	0.0%	0.0%
Gentamicin	91.7%	100.0%	0.0%	0.0%	0.0%
Gentamicin Synergy Screen	100.0%	100.0%	---	0.0%	0.0%
Inducible Clindamycin	100.0%	100.0%	N/A	N/A	N/A
Levofloxacin	100.0%	93.8%	0.0%	0.0%	6.3%
Linezolid	93.8%	100.0%	---	0.0%	0.0%
Moxifloxacin	91.7%	75.0%	50.0%	0.0%	16.7%
Oxacillin	91.7%	91.7%	20.0%	0.0%	0.0%
Penicillin	100.0%	100.0%	---	0.0%	0.0%
Rifampin	92.9%	93.8%	0.0%	7.1%	0.0%
Streptomycin Synergy Screen	100.0%	100.0%	---	0.0%	0.0%
Synercid	91.7%	91.7%	---	9.1%	0.0%
Trimethoprim/ sulfamethoxazole	100.0%	91.7%	33.3%	0.0%	0.0%
Tetracycline	93.8%	93.8%	33.3%	0.0%	0.0%
Tigecycline	100.0%	100.0%	---	0.0%	0.0%
Vancomycin	93.8%	93.8%	0.0%	6.7%	0.0%
Total	96.1%	95.8%	9.3%	1.5%	1.6%

Table 3. EA: essential agreement. CA: categorical agreement. VME: very major error. ME: major error. miE: minor error. Error rates are not applicable for Inducible Clindamycin and Cefoxitin Screen. VME could not be calculated for several drugs due to a lack of resistant isolates.

Conclusions

- Gap in ID accuracy was largely due to significant number of failed runs with the LC
- When an ID result was achieved with the LC on MALDI-TOF, results were highly accurate
- In many cases, samples required several MALDI-TOF runs to generate a result
- CA for specific drugs was below our acceptable threshold (≥90%), which could be addressed with more targeted testing
- Very Major rates above our acceptable threshold (≤3%) was likely due to a small number of resistant isolates being tested
- The Qvella LC represents a promising technology for reducing times to species ID and AST patterns from blood cultures
- More work is needed to address the high failure rate of ID on MALDI-TOF

References

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