Rapid Blood Culture Identification: A Lower Cost Per Panel Might Equal a Higher Cost for the Laboratory

Background

After decades of incremental technological advances in the clinical microbiology laboratory, the development of rapid blood culture identification (BCID) has set the stage for significant strides in improving patient care. This includes the laboratory's ability to directly impact the quality measures that were recently established within the healthcare community, including reducing infection and readmission rates, improving antibiotic stewardship, the quality of care and patient experience[1]. With a technology that allows for comprehensive rapid results, that were previously difficult to provide using traditional microbiological test methods, microbiology laboratories are able to more effectively and directly impact quality-based initiatives in the hospital.

As the market for rapid blood culture identification expands, so does the pressure to improve patient outcomes and manage costs. Microbiology laboratories are faced with selecting the appropriate molecular assay for their institution and building the business case to justify the incremental costs that can sometimes accompany a technology transition or upgrade. Without a full assessment of the laboratory and overall hospital costs that could be incurred or avoided, the decision of assay selection might be based solely on the cost per test. It is necessary to consider all aspects of assay design and performance when considering adopting a new technology or test.

The following overview can assist the laboratory in selecting a rapid molecular test for BCID by quantifying the factors that can affect laboratory costs. Additionally, this overview will demonstrate how the ePlex® Blood Culture Identification Panels can improve laboratory and hospital costs, and help improve patient care.

Considerations for Assay Selection

Laboratories making the decision to consider any new technology must first determine whether the benefit of that technology outweighs the cost. Most often, positive patient outcomes are the benefits that are evaluated against the costs. This white paper will focus on 3 key benefits of the ePlex BCID Panels that provide cost savings as compared to other rapid BCID assays: (1) panel inclusivity, (2) inclusion of contamination rule-out targets and (3) rare but significant organisms

INCLUSIVITY

The ePlex BCID Panels include a broad range of targets that are not found on other commercially available panels. Additionally, most of the organisms that are included on the ePlex BCID Panels are identified to the species level. With the genus and species of the causative organism provided within hours of positivity, in many cases, the technologist no longer needs to perform an organism identification from colony growth post-incubation, where verification of colony morphology may be sufficient. This feature makes the ePlex BCID Panels uniquely positioned to eliminate laboratory costs associated with traditional methods of identification, like spot biochemical tests. Other competitor methods can result in the same testing costs as conventional identification methods in addition to the cost of the panel itself.

To elaborate, other rapid blood culture identification panels may not provide a level of identification that is sufficient enough to guide treatment of pathogenic organisms; Or they may not offer any identification at all. The ePlex BCID panels were designed to offer the appropriate level of identification needed for the treatment of

pathogens as well as for de-escalation of therapy in the presence of blood culture contaminants. Without this broad inclusivity, the laboratory does not see significant reductions in workload or costs associated with traditional methods of identification. And even worse, an assay that does not provide any identification results is a cost increase for the laboratory without yielding any benefit to the patient or to the hospital.

In addition to the costs incurred by the laboratory, traditional methods of identification can take an average of 24 – 72 hours from the time the blood culture bottle flags positive. In the case of fastidious organisms like facultative anaerobes, an identification can take up to 5 days after bottle positivity. This could result in the patient being exposed to unnecessary or inappropriate antibiotics for a prolonged amount of time; and inappropriate antimicrobial use can carry a heavy financial burden for the hospital and a substantial hardship for the patient[2,5].

To illustrate the added costs of identification, a theoretical case study can be found in Tables 1a and b. Included in this are examples of a typical workflow that the microbiology laboratory might follow for conventional organism identification as well as a demonstration of how that workflow might be improved by ePlex vs a competitor BCID Panel. The ePlex BCID Panels can reduce laboratory costs with higher inclusivity when compared to other rapid blood culture identification systems.

CONTAMINATION RULE-OUT

Reducing blood culture contamination has historically been a focus in the hospital. Blood culture contamination during specimen collection is especially problematic for the laboratory due to the unnecessary expenses incurred for the work-up of an insignificant organism. Furthermore, some of the most common organisms responsible for this type of contamination have characteristics that make them difficult to culture and even harder to identify.

For this reason, the ePlex BCID Panels were designed to provide the laboratory with accurate, rapid identification of potential contaminants without additional laboratory expenses and resources. Having several of the most common contamination targets on the ePlex BCID Panels significantly reduces laboratory costs by providing an identification without the need for the traditional methods commonly used in the laboratory.

The contamination rule-out targets on the ePlex BCID Panels also allow for de-escalation of unnecessary antibiotics which frequently results in a reduction in length of stay for the patient[3]. Other panels that lack the ability to identify skin contaminants force the laboratory to continue to budget for conventional identification methods in addition to the cost of the new assay.

A theoretical case study related to contamination targets can be found in Tables 2a and b., demonstrating how a microbiology laboratory might identify a contaminant recovered from a positive blood culture. This hypothetical, but common laboratory scenario, provides insight as to how the ePlex BCID Panels can reduce laboratory costs with contamination rule-out targets as compared to other rapid blood culture identification systems that lack these targets.

UNCOMMON BUT SIGNIFICANT ORGANISMS

ePlex BCID Panels can also save the laboratory in costs related to the identification of uncommon organisms that are frequently associated with high mortality rates. Identification of these pathogens can be time consuming and costly for the lab, as well as detrimental for the hospital and for the outcome of the patient.

Even the most highly trained clinical microbiologist is challenged when encountering uncommon organisms and typically must perform several tests to aid them in a definitive identification. The ePlex BCID Panels were designed to eliminate this additional testing to reduce the workload for the lab. Other panels that do not include these less common organisms force the clinical microbiologist to perform additional testing regardless of the fact that new technology is now available to them.

Moreover, many of these uncommon organisms are significant pathogens and any delay in optimal treatment can significantly impact the patient[4]. Inclusivity of critical pathogens makes the ePlex BCID Panels better equipped to reduce costs in the laboratory and improve the likelihood of a positive patient outcome.

A theoretical case study can be found in Tables 3a and b, illustrating the additional costs associated with the identification of an uncommon organism. Due to the testing that a laboratory would need to perform if using a rapid identification test that is not as inclusive as the ePlex BCID Panels. With the ePlex BCID Panels the laboratory can reduce costs by eliminating the need to identify uncommon but significant blood pathogens with traditional methodologies.

Table 1a: Case Study #1: *Bacteroides fragilis* recovered from 2 sets of blood culture bottles from a patient admitted to the ICU.

		ePlex BCID-GN Panel	Other Molecular Multiplex Panels	Time since Blood Culture Positivity
Gram Stain Result		Gram-Negative Bacilli		<30 minutes
BCID Panel Result		*Bacteroides fragilis* detected **(Result Reported)**	Negative/None Detected	<2 hours
Culture Day 1	Laboratory Testing	Visual confirmation of growth	Repeat Gram stain & re-incubate culture plates	18-24 hours
	Result Reported	**Final Report:** *Bacteroides fragilis*	Growth too young to interpret; Refer to Gram stain result	
Culture Day 2	Laboratory Testing		Automated identification, re-isolate & re-incubate	36-48 hours
	Result Reported		Possible anaerobic gram-negative bacilli	
Culture Day 3	Result Reported		**Final Report:** *Bacteroides fragilis*	54-72 hours

Costs incurred for additional testing needed for a single blood culture positive for *Bacteroides fragilis* when using competitor panels for rapid blood culture identification:

Table 1b:

Additional Testing Performed	Cost Per Test	Tech Time Per Test (hours)	Average hourly rate[c]	Cost of tech time (per test)	Overall Cost to Lab (per culture)
Additional Incubation	N/A	0.5	$30.49	$15.25	**$52.29**
Automated ID[a] (Vitek, MicroScan, etc.)	$13.34	0.2		$6.10	
ANA jar/bag[b]	$11.50	0.2		$6.10	

a. Retrieved from: https://procure.ohio.gov/PriceList/800014pricelist.pdf (Sept. 2018)
b. Retrieved from: https://www.fishersci.com/shop/products/bd-bio-bag-environmental-chambers-6/p-44440 (Sept. 2018)
c. Garcia, et. al., (2018) Am J Clin Path; 00:1-24.

As demonstrated by the tables above, ePlex is the only rapid blood culture identification system that detects and identifies anaerobic bacteria. This provides a cost savings for the laboratory of around $52.29 per culture - as additional testing is no longer needed for organism identification. In addition to the cost savings for the laboratory, the physician can optimize therapy less than two hours after bottle positivity. Other molecular panels do not offer this cost and time savings to the laboratory nor do they impact the outcome of the patient beyond that of traditional culture and identification methods.

*ePlex BCID Panels are CE-IVD. Not available for sale in the US.

Table 2a: Case Study #2: *Corynebacterium* species recovered from 1 bottle only in blood cultures collected from a patient admitted from the emergency department

		ePlex BCID-GN Panel	Other Molecular Multiplex Panels	Time since Blood Culture Positivity
Gram Stain Result		Gram-Positive Bacilli		<30 minutes
BCID Panel Result		*Corynebacterium* detected **(Result Reported)**	Negative/None Detected	<2 hours
Culture Day 1	Laboratory Testing	Visual confirmation of growth	Repeat Gram stain & re-incubate culture plates	18-24 hours
	Result Reported	**Final Report:** *Corynebacterium* species	Growth too young to interpret; Refer to Gram stain result	
Culture Day 2	Laboratory Testing		Automated identification, re-isolate & re-incubate	36-48 hours
	Result Reported		Gram-positive diphtheroid-like bacilli, identification to follow	
Culture Day 3	Result Reported		**Final Report:** *Corynebacterium* species	54-72 hours

Costs incurred for additional testing needed for a single blood culture positive for *Corynebacterium* species when using competitor panels for rapid blood culture identification:

Table 2b:

Additional Testing Performed	Cost Per Test	Tech Time Per Test (hours)	Average hourly rate[b]	Cost of tech time (per test)	Overall Cost to Lab (per culture)
Additional Incubation	N/A	0.5	$30.49	$15.25	**$34.69**
Automated ID[a] (Vitek, MicroScan, etc.)	$13.34	0.2		$6.10	

a. Retrieved from: https://procure.ohio.gov/PriceList/800014pricelist.pdf (Sept. 2018)
b. Garcia, et. al., (2018) Am J Clin Path; 00:1-24.

The ePlex BCID Panels provide the added benefit of contamination rule-out targets. These targets are not included or are limited on competitor panels. Removing the need for unnecessary identification of non-pathogenic organisms can save the laboratory an average of $34.69 per culture. Additionally, detecting contaminants early can reduce the use of unnecessary antibiotics and decrease hospital length of stay which can also reduce the adverse effects of and costs associated with empiric antimicrobial therapy[2].

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Table 3a: Case Study #3: *Salmonella* species recovered from all blood culture bottles collected from an infant in the NICU

		ePlex BCID-GN Panel	Other Molecular Multiplex Panels	Time since Blood Culture Positivity
Gram Stain Result		Gram-Negative Bacilli		<30 minutes
BCID Panel Result		*Salmonella* detected **(Result Reported)**	*Enterobacteriaceae* detected	<2 hours
Culture Day 1	Laboratory Testing	Visual confirmation of growth	Indole, oxidase, automated identification	18-24 hours
	Result Reported	**Final Report:** *Salmonella* species	Non-lactose fermenting gram-negative bacilli	
Culture Day 2	Laboratory Testing		Re-isolate to differential media and re-incubate for confirmation of ID	36-48 hours
	Result Reported		Possible *Salmonella* species	
Culture Day 3	Result Reported		**Final Report:** *Salmonella* species	54-72 hours

Costs incurred for additional testing needed for a single blood culture positive for *Salmonella* species when using competitor panels for rapid blood culture identification:

Table 3b:

Additional Testing Performed	Cost Per Test	Tech Time Per Test (hours)	Average hourly rate[e]	Cost of tech time (per test)	Overall Cost to Lab (per culture)
Indole[a]	$2.00	0.1	$30.49	$3.05	**$49.45**
Oxidase[b]	$1.93	0.1		$3.05	
Automated ID[c] (Vitek, MicroScan, etc.)	$9.66	0.2		$6.10	
Additional Incubation	N/A	0.5		$15.25	
Differential Media[d]	$5.36	0.1		$3.05	

a. Retrieved from: https://www.fishersci.com/shop/products/bd-reagent-stain-droppers/b4361187 (Sept. 2018)
b. Retrieved from: https://www.fishersci.com/shop/products/bd-reagent-stain-droppers-3/1491016 (Sept. 2018)
c. Retrieved from: https://procure.ohio.gov/PriceList/800014pricelist.pdf (Sept. 2018)
d. Retrieved from: https://www.fishersci.com/shop/products/thermo-scientific-remel-xld-agar-xylose-lysine-desoxycholate-monoplate---%20%20%2010-pk/r01980 (Sept. 2018)
e. Garcia, et. al., (2018) Am J Clin Path; 00:1-24.

Identification of uncommon but critical pathogens found in blood culture specimens can be costly for the laboratory. The ePlex BCID solutions can aid the laboratory in reducing both time and cost when testing for these significant pathogens. In the case study above, competitor methods could result in an average cost of $49.45 per patient in addition to the cost of the molecular test itself. This contributes to the efforts of the hospital in providing quality care to the patient while keeping laboratory costs down. Additionally, providing an organism identification can eliminate several critical days in patient diagnosis as compared to both traditional culture methods and other molecular rapid BCID panels, improving overall hospital costs, stewardship efforts and patient outcomes.

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Conclusion:

For laboratories looking to improve both patient care and antimicrobial stewardship initiatives while minimizing costs, the ePlex BCID Panels are the only choice. With their ability to eliminate some of the traditional testing that is required for identifying microorganisms, the ePlex BCID panels can save time, money, and can impact patient care – which cannot be measured monetarily. The ability to rule out blood culture contamination at the time of positivity and the inclusivity of species-level bacterial targets as well as uncommon pathogens can provide the microbiology lab with a solution that will achieve all of the goals set forth for not only the laboratory, but for the hospital and the patient.

References:

1. https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/QualityMeasures/index.html
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3. Box, M. et. al., (2016), Pharmacotherapy, 35 (3): 269-276
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5. Wenzler, E., et. al., (2016), Antibiotics, 5(1), 6

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