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Clinical Evaluation of a Rapid Multiplex Polymerase Chain Reaction Blood Culture Identification Panel

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Abstract

Background: Prompt initiation of appropriate antimicrobial therapy of septicemia is associated with improved patient outcomes. Identification and susceptibility testing using conventional methods requires 24 to 72 h. The FilmArray (Biofire) blood culture identification panel (BCID) is a completely automated, high-order multiplex, nested PCR designed to identify 19 bacteria, 5 *Candida* spp. and 4 antibiotic resistance genes (*mecA, vanA/B*, and KPC) within 1 h directly from positive blood culture bottles. **Methods:** We evaluated the performance of the BCID with 213 consecutive positive blood cultures collected from 178 adult patients. The BCID panel results were available within 2 h of blood culture positivity. The accuracy and time to identification with the BCID panel was compared with the results obtained with conventional MicroScan (Siemens Healthcare) Gram-negative, and Gram-positive combination identification and susceptibility test panels performed on subcultures from positive blood cultures. **Results:** Overall there were 189 monomicrobial positive cultures included in the analysis. BCID provided the correct genus and species for 44 (69%), correct family (*Enterobacteriaceae*) for 7 (11%) and no identification for 13 (20%) (12 not in panel) gram-negative rods. BCID provided the correct genus and species in 48 (47%), correct genus (*Enterococcus* or *Streptococcus* spp.) in 33 (33%) and no identification in 20 (20%) (19 not in panel) gram-positive organisms. BCID provided the correct identification for 23 (96%) of 24 *Candida* spp. There were 27 cultures in which *mecA* was detected by both BCID and conventional methods and 2 in which *mecA* was detected by BCID alone. *VanA/B* was detected in 8 cultures by both methods and 1 in which *vanA/B* was detected by BCID alone. Only one culture contained the KPC gene and it was detected by both methods. Mean times from blood culture receipt to identification by BCID and conventional methods were 27 h and 50 h, respectively. There was agreement between BCID and conventional methods for identification in 14 (58%) of 24 polymicrobic cultures. Conventional methods failed to identify 1 organism in 4 and BCID failed to identify ≥1 organism in 7 (5 not in panel) polymicrobic cultures. **Conclusions:** The BCID panel provided rapid, reliable, and clinically actionable results in 82.3% of our positive blood cultures.

Background

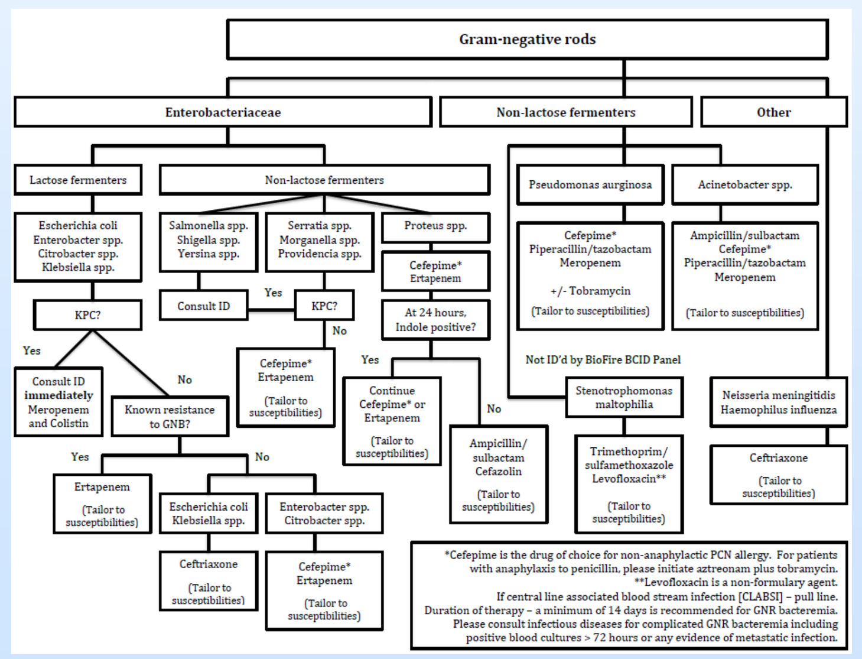
Prompt initiation of appropriate antimicrobial therapy of septicemia is associated with improved patient outcomes. Identification and susceptibility testing using conventional methods requires 24 to 72 h. The FilmArray (Biofire) blood culture identification panel (BCID) is a completely automated, high-order multiplex, nested PCR designed to identify 19 bacteria, 5 *Candida* spp. and 4 antibiotic resistance genes (*mecA, vanA/B*, and KPC) within 1 h directly from positive blood culture bottles (1, 2).

Methods

We evaluated the performance of the BCID with 213 consecutive positive blood cultures (bioMérieux standard aerobic and anaerobic bottles) collected from 178 adult patients. The BCID panel results were available within 2 h of blood culture positivity around the clock. BCID panel results were called to clinicians with the Gram stain results. A link to pathogen-specific treatment algorithms developed by our Antimicrobial Stewardship program was available to all clinicians in the electronic medical record. See example below. In addition, BCID results were used by an infectious disease pharmacist to assess appropriateness of therapy and recommend changes if needed.

The accuracy and time to identification with the BCID panel was compared with the results obtained with conventional MicroScan (Siemens Healthcare) Gram-negative, and Gram-positive combination identification and susceptibility test panels performed on subcultures from positive blood cultures. The only other rapid identification and susceptibility test methods deployed at the time were direct tube coagulase and subcultures to MRSA chromogenic medium for gram positive cocci in clusters. The comparator methods for *Candida* spp. included *C. albicans* screen, rapid trehalose assimilation and RapID Yeast Plus tests (Remel) and morphology on corn meal agar as appropriate.

Gram Negative Rod Treatment Algorithm



Results

Identification	CM+/BCID+	CM+/BCID-	CM-/BCID+
Gram negative			
E. coli	19	0	0
K. pneumoniae	11	0	0
P. aeruginosa	7	0	0
E. cloacae	4	1	0
P. mirabilis	3	0	0
A. baumannii	2	0	0
C. freundii	1	0	0
C. koseri	1	0	0
E. gergoviae	1	0	0
H. influenzae	1	0	0
S. typhimurium	1	0	0
Subtotal	51	1	0

Identification	CM+/BCID+	CM+/BCID-	CM-/BCID+
Gram positive			
S. aureus	26	0	0
Enterococcus spp.	18	0	0
Coagulase-negative staphylococci	12	0	0
Alpha-hemolytic streptococci	6	0	0
S. pneumoniae	5	0	0
S. pyogenes	3	0	0
S. agalactiae	2	0	0
Microaerophilic streptococci (A/C/I)	2	1	0
Streptococcus, Group G	2	0	0
S. mitis	2	0	0
S. bovis	1	0	0
S. salivarius	1	0	0
S. lugdunensis	1	0	0
Subtotal	81	1	0

Identification	CM+/BCID+	CM+/BCID-	CM-/BCID+
Yeast			
C. albicans	17	0	0
C. glabrata	5	1	0
C. parapsilosis	1	0	0
Subtotal	23	1	0

Identification	CM+/BCID-
Gram positive not in BCID panel	
Micrococcus spp.	8
Aerococcus spp.	3
Bacillus spp.	3
Granulicatella sp.	1
Corynebacterium sp.	1
Clostridium sp.	1
Weissella confusa	1
Lactobacillus sp.	1
Subtotal	19

Identification	CM+/BCID-
Gram negative not in BCID panel	
Acinetobacter lwoffii	3
Alcaligenes sp.	1
Burkholderia cepacia	2
Stenotrophomonas maltophilia	1
Fusobacterium nucleatum	1
Morganella morganii	1
Moraxella catharralis	1
Neisseria spp.	2
Subtotal	12

Resistance Gene	CM+/BCID+	CM+/BCID-	CM-/BCID+	CM-/BCID-
mecA	27	0	2 (CNS)	13
vanA/vanB	8	0	1	9
KPC	1	0	0	49

Key to Tables

CM, Conventional methods; Red, Only genus or family level identification provided by BCID

Polymicrobial Cultures		
	Detected by:	
Identification	CM	BCID
VRE, *P. aeruginosa*	1, 1	1, 1
Enterococcus, AHS, NHS, *P. aeruginosa*	0, 1, 1, 1	1, 1, 1, 1
MRSA, *Bacillus* sp., *E. coli*, *H. influenzae*, *Corynebacterium* sp., AHS	1, 1, 1, 0, 1,1	1, X, 1, 1, X, 1
Enterococcus, E. coli	1, 1	1, 1
C. glabrata, CNS	1, 1	1, 1
Abiotrophia sp., AHS	1, 1	X, 0
AHS, NHS	1, 1	1, 1
K. pneumoniae, P. aeruginosa	1, 0	1, 1
C. albicans, C. glabrata	1, 1	1, 1
VRE, MRSA, *P. aeruginosa, C. glabrata, C. albicans*, AHS	1, 1, 1, 1, 1	1, 1, 1, 1, 1
P. mirabilis, Lactobacillus sp.	1, 1	1, X
K. pneumoniae, S. marcescens	1, 1	1, 1
Enterococcus, *S. pneumoniae*	1, 0	1, 1
B. fragilis, Peptostreptococcus sp.	1, 1	X, X
A. lwoffii, Corynebacterium sp.	1, 1	X, X
C. parapsilosis, CNS	1, 1	1, 1
NHS, AHS	1, 1	1, 1
Enterococcus, CNS, *C. glabrata*	1, 1, 1	1, 1, 1
Enterococcus, *E. gergoviae*	1, 1	1, 1
K. pneumoniae, *P. mirabilis, S. marcescens*	1, 1, 1	1, 1, 1
CNS, *Enterococcus*	1, 1	1, 0
Enterococcus, *Corynebacterium* sp.	1, 1	1, X
MRSA, *E. coli, P. mirabilis*	1, 1, 1	1, 1, 1
MSSA, *S. pneumoniae*	1, 1	1, 1
Subtotal	24	
Key: 1, detected; 0, not detected; and X, not in BCID panel		

Results Summary

Overall there were 189 monomicrobial positive cultures included in the analysis. BCID provided the correct genus and species for 44 (69%), correct family (*Enterobacteriaceae*) for 7 (11%) and no identification for 13 (20%) (12 not in panel) gram-negative rods. BCID provided the correct genus and species in 48 (47%), correct genus (*Enterococcus* or *Streptococcus* spp.) in 33 (33%) and no identification in 20 (20%) (19 not in panel) gram-positive organisms. BCID provided the correct identification for 23 (96%) of 24 *Candida* spp. There were 27 cultures in which *mecA* was detected by both BCID and conventional methods and 2 in which *mecA* was detected by BCID alone. *VanA/B* was detected in 8 cultures by both methods and 1 in which *vanA/B* was detected by BCID alone. Only one culture contained the KPC gene and it was detected by both methods. Mean times from blood culture receipt to identification by BCID and conventional methods were 27 h and 50 h, respectively. There was agreement between BCID and conventional methods for identification in 14 (58%) of 24 polymicrobic cultures. Conventional methods failed to identify 1 organism in 4 and BCID failed to identify ≥1 organism in 7 (5 not in panel) polymicrobic cultures.

Conclusions

The BCID panel provided rapid, reliable, and clinically actionable results in 82.3% of our positive blood cultures. The ease of use, speed, and comprehensive coverage of pathogens and inclusion of key antibiotic resistance genes offer great opportunities for laboratories to provide information that will positively impact patient care.

References

1. Blaschke AJ et al. 2012. Rapid identification of pathogens from positive blood cultures by multiplex polymerase chain reaction using the FilmArray system. Diag. Microbiol. Inf. Dis. 74:349-355.
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