

BioFire FilmArray Blood Culture PCR Interpretation Guide

BACKGROUND

The FilmArray blood culture identification panel (BCID) tests for a comprehensive list of 24 pathogens and 3 antibiotic resistance genes associated with bloodstream infections (**Table 1, Table 4**). This test uses a PCR-based approach to amplify DNA targets directly from positive blood cultures. Once a blood bottle is flagged as positive, the BCID can be performed by the micro staff. This allows organism identification to be available in the EMR is just a few hours, compared to traditional methods which take a few days.

MICROBIOLOGY PROCESS

When a blood culture bottle is positive, microbiology will perform a gram stain on each positive bottle. BCID will be run on the first bottle that comes up positive per set and then only on bottles with gram stains that are different. For gram negatives and yeast, microbiology will call the floor nurse initially with gram stain results and a second time with BCID results. For gram positives, microbiology will call the floor nurse once with both the gram stain and BCID results. Both results will be entered in the electronic medical record by the microbiology technician. Microbiology will continue their workup including plating to solid media and running the specimen on the Vitek II to obtain final identification and susceptibilities.

INTERPRETATION

Use **Table 2** to escalate or de-escalate antibiotics as appropriate based on BCID results. Note that BCID does NOT provide susceptibilities. Consider other sites of infection the patient may also have when choosing an appropriate antibiotic. **Table 3** provides additional recommendations on the resistance genes that may be detected.

Table 1: List of Pathogens Detected

Gram Positive Bacteria	Gram Negative Bacteria	Yeast	Resistance Genes
<i>Enterococcus*</i>	<i>Acinetobacter baumannii</i>	<i>Candida albicans</i>	mecA
<i>Listeria monocytogenes</i>	<i>Haemophilus influenzae</i>	<i>Candida glabrata</i>	vanA/B
<i>Staphylococcus*</i>	<i>Neisseria meningitidis</i>	<i>Candida krusei</i>	KPC
<i>Staphylococcus aureus</i>	<i>Pseudomonas aeruginosa</i>	<i>Candida parapsilosis</i>	
<i>Streptococcus*</i>	<i>Enterobacteriaceae*</i>	<i>Candida tropicalis</i>	
<i>Streptococcus agalactiae</i>	<i>Enterobacter cloacae</i> complex		
<i>Streptococcus pneumoniae</i>	<i>Escherichia coli</i>		
<i>Streptococcus pyogenes</i>	<i>Klebsiella oxytoca</i>		
	<i>Klebsiella pneumoniae</i>		
	<i>Proteus</i>		
	<i>Serratia marcescens</i>		

*See Table 4 for further genus breakdown

Table 2: Interpretation of Pathogen and Recommended Therapy

Pathogen Detected	Preferred Therapy	Comments
Gram Positive Organisms		
Enterococcus van A/B not detected van A/B detected (i.e. VRE)	Vancomycin Daptomycin	VRE: recommend ID consult
<i>Listeria monocytogenes</i>	Ampicillin	
<i>Staphylococcus</i> (not <i>aureus</i>) 1 of 2 bottles 2 of 2 bottles or > 1 set mecA not detected mecA detected	Probable contaminant Oxacillin Vancomycin	Consider withholding treatment unless critically ill Cefazolin is alternative to oxacillin
<i>Staphylococcus aureus</i> mecA not detected mecA detected (i.e. MRSA)	Oxacillin Vancomycin	ID consult required Cefazolin is alternative to oxacillin
<i>Streptococcus</i>	Ceftriaxone	
<i>Streptococcus agalactiae</i>	Penicillin OR ampicillin	Use ceftazidime if age < 2 months or NICU Use vancomycin if severe b-lactam allergy
<i>Streptococcus pneumoniae</i>	Ceftriaxone	If source is CNS, add vancomycin until susceptibilities known
<i>Streptococcus pyogenes</i>	Penicillin	
Gram Negative Organisms		
<i>Acinetobacter baumannii</i>	Ceftazidime	Consider adding aminoglycoside if critically ill
<i>Haemophilus influenzae</i>	Ceftriaxone	Use ceftazidime if age < 2 months or NICU
<i>Neisseria meningitidis</i>	Ceftriaxone	Use ceftazidime if age < 2 months or NICU
<i>Pseudomonas aeruginosa</i>	Ceftazidime OR cefepime	Consider addition of amikacin if critically ill
<i>Enterobacteriaceae</i>	Cefepime	
<i>Enterobacter cloacae</i> complex	Cefepime	Consider ertapenem if critically ill
<i>Escherichia coli</i>	Ceftriaxone	Consider ertapenem if history of ESBL
<i>Klebsiella oxytoca</i>	Ceftriaxone	
<i>Klebsiella pneumoniae</i>	Ceftriaxone	
<i>Proteus spp.</i>	Ceftriaxone	
<i>Serratia marcescens</i>	Cefepime	
ANY GNR KPC detected		Recommend ID consult
Yeast		
<i>Candida albicans</i>	Fluconazole	Recommend ID consult
<i>Candida glabrata</i>	Micafungin	Recommend ID consult
<i>Candida krusei</i>	Micafungin	Recommend ID consult
<i>Candida parapsilosis</i>	Fluconazole	Recommend ID consult
<i>Candida tropicalis</i>	Fluconazole	Recommend ID consult

Table 3: Interpretation of Resistance Genes

Resistance Gene	Interpretation	Example	Treatment
mecA	Methicillin resistance	<i>S. aureus</i> , mecA detected = MRSA	Vancomycin
vanA/B	Vancomycin resistance	<i>Enterococcus</i> species, vanA detected = VRE	Daptomycin
KPC	Carbapenem resistance	<i>K. pneumoniae</i> , KPC detected = CRE	Consult ID

Table 4: List of Pathogens for *Enterococcus*, *Staphylococcus*, *Streptococcus*, *Enterobacteriaceae*

Items marked as (reduced sensitivity) refer to the sensitivity of the PCR to detect the specific organism, not susceptibility results.

Genus	Pathogens Detected	Pathogens Not Detected
<i>Enterococcus</i>	<i>E. faecalis</i> <i>E. faecium</i> <i>E. avium</i> <i>E. casseliflavus</i> <i>E. durans</i> <i>E. gallinarum</i> <i>E. hirae</i> <i>E. dispar</i> (reduced sensitivity) <i>E. saccharolyticus</i> (reduced sensitivity)	<i>E. raffinosus</i>
<i>Staphylococcus</i> (unique assay for <i>S. aureus</i>)	<i>S. caprae</i> <i>S. cohnii</i> <i>S. epidermidis</i> <i>S. haemolyticus</i> <i>S. hominis</i> <i>S. lugdunensis</i> <i>S. xylosus</i> <i>S. capitis</i> (reduced sensitivity) <i>S. pasteurii</i> (reduced sensitivity) <i>S. saprophyticus</i> (reduced sensitivity) <i>S. simulans</i> (reduced sensitivity) <i>S. warneri</i> (reduced sensitivity)	<i>S. auricularis</i> <i>S. carnosus</i> <i>S. lentus</i> <i>S. pettenkoferi</i> <i>S. pseudointermedius</i> <i>S. schleiferi</i> <i>S. sciuri</i>
<i>Streptococcus</i> (unique assay for <i>S. agalactiae</i> , <i>S. pneumoniae</i> , <i>S. pyogenes</i>)	<i>S. anginosus</i> <i>S. bovis</i> <i>S. constellatus</i> <i>S. dysgalactiae</i> <i>S. equinus</i> <i>S. gallolyticus</i> <i>S. gordonii</i> <i>S. intermedius</i> <i>S. mitis</i> <i>S. mutans</i> <i>S. oralis</i> <i>S. parasanguinis</i> <i>S. pseudopneumoniae</i>	

	<i>S. salivarius</i> <i>S. sanguinis</i>	
Enterobacteriaceae (unique assay for <i>E. cloacae</i> complex, <i>E. coli</i> , <i>K. oxytoca</i> , <i>K. pneumoniae</i> , <i>Proteus</i> , <i>S. marcescens</i>)	<i>Cedeceae</i> spp. <i>Citrobacter</i> spp. <i>Cronobacter</i> spp. <i>Enterobacter</i> spp. <i>Escherichia</i> spp. <i>Klebsiella</i> spp. <i>Kluyvera</i> spp. <i>Leclercia adecarboxylata</i> <i>Proteus</i> spp. <i>Raoultella</i> spp. <i>Salmonella</i> spp. <i>Shigella</i> spp. <i>Serratia ficaria</i> <i>Serratia entomophila</i> <i>Yokenella regensbergi</i> <i>Edwardsiella</i> spp. (reduced sensitivity) <i>Enterobacter gergoviae</i> (reduced sensitivity) <i>Hafnia alvei</i> (reduced sensitivity) <i>Pantoea</i> spp. (reduced sensitivity) <i>Salmonella bongori</i> (reduced sensitivity) <i>Serratia fonticola</i> (reduced sensitivity) <i>Serratia odorifera</i> (reduced sensitivity) <i>Serratia rubidaeeae</i> (reduced sensitivity)	<i>Morganella morganii</i> <i>Providencia</i> spp. <i>Rahnella</i> spp. <i>Serratia liquefaciens</i> <i>Serratia plymuthica</i> <i>Tatumella ptyseos</i> <i>Yersinia enterocolitica</i>

Common skin contaminants other than CONS (diphtheroids, *Micrococcus*, *Bacillus* spp.) and anaerobes are **not detected by BCID.

References

- FilmArray® Blood Culture Identification (BCID) Panel Instruction Booklet. 2015.
- HSHS St. John’s Hospital Cumulative Antimicrobial Susceptibility Report. 2016.