**Guide to Interpretation of BioFire FilmArray Blood Culture Identification (BCID) Panel**

**Antimicrobial Stewardship Program, VA Greater Los Angeles Healthcare System**

**February 2017**

**Introduction:**

The microbiology laboratory is implementing the BioFire FilmArray Blood Culture Identification (BCID) system in order to provide preliminary identification of bloodstream pathogens within an hour of blood cultures turning positive. It is important to note that this system only provides preliminary identification of the organism present and whether or not any of three resistance genes are present; ***it does NOT provide antimicrobial susceptibility NOR does it capture all mechanisms of antimicrobial resistance.*** Antimicrobial resistance testing is still performed via standard methodology and can take up to 96 hours to be completed. Certain infections are frequently polymicrobial in nature and the isolation of a single pathogen from the blood culture, while allowing narrowing of therapy, should not result in over-narrowing. Some specific examples of this would include complicated intra-abdominal infections and diabetic foot infections. These infections often involve anaerobes and therapy active against these should generally be included until definitive cultures of the site of infection have returned.

**Table 1: Organism species and antibiotic resistance reported by BioFire FilmArray BCID panel:**

|  |  |
| --- | --- |
| **Gram+  Bacteria** | **Gram–  Bacteria** |
| *Enterococcus*  *Listeria monocytogenes*  *Staphylococcus*  *Staphylococcus aureus*  *Streptococcus*  *Streptococcus agalactiae*  *Streptococcus pyogenes*  *Streptococcus pneumoniae* | *Acinetobacter baumannii*  *Haemophilus influenzae*  *Neisseria meningitidis*  *Pseudomonas aeruginosa*  *Enterobacteriaceae*  *Enterobacter cloacae* complex  *Escherichia coli*  *Klebsiella oxytoca*  *Klebsiella pneumoniae*  *Proteus*  *Serratia marcescens* |
| **Yeast** | **Antibiotic Resistance** |
| *Candida albicans*  *Candida glabrata*  *Candida krusei*  *Candida parapsilosis*  *Candida tropicalis* | *mecA* - methicillin resistance  *vanA/B* - vancomycin resistance  KPC - carbapenem resistance – note that there are other, less common mechanisms of carbapenem resistance |

Based on the combination of species identification and presence of antibiotic resistance genes identified above, the GLA Infectious Diseases Section recommends the following empiric therapy (Table 2).

Please note that organisms are listed in alphabetic order, with the exception of all of the *Enterobacteriaceae,* which are listed together. The bacterial family of *Enterobacteriaceae* consists of *E. coli, Klebsiella*, *Enterobacter, Proteus, Serratia* and other related Gram-negative bacteria that can be a part of gut flora. While the BCID panel contains specific primers for *E. coli, E. cloacae, K. oxytoca, K. pneumoniae, Proteus,* and *S. marcesens,* the less-specific *Enterobacteriaceae* probe is designed to detect less common species within the family. The antibiotic recommendation is the same whether a specific species probe is positive or just the nonspecific *Enterobacteriaceae* probe.

Similarly, The *Staphylococcus* genus PCR detects many, but not all species of staphylococci including *S. aureus*, *S. epidermidis*, *S. hominis* and others. When *S. aureus* is present, the *Staphylococcus* genus and *S. aureus* species will both be identified, but when a coagulase-negative staphylcooccus such as *S. epidermidis* is present, only the *Staphylococcus* genus will be identified.

Recommendations for some species are dependent on whether certain resistance genes are present:

* The presence of *mecA* determines if staphylococci are resistant to oxacillin and therapy should be adjusted to account for these results.
* The presence of *vanA/B* indicates resistance to vancomycin. The GLA Infectious Diseases section recommends empiric therapy with daptomycin for infections when *vanA or vanB (vanA/B) positive results are obtained*
* The presence of KPC resistance to all carbapenems. The GLA Infectious Diseases section recommends empiric therapy with ceftazidime/avibactam PLUS amikacin for infections. Note that there are other, less common mechanisms of carbapenem resistance which include the New Delhi Metallo-beta-lactamase and OXA-48-like carbapenemases.

At the end of Table 2 are suggestions for empiric therapy when the standard blood culture is positive yet the species-specific BCID assays are negative, based on whether or not a Gram-positive bacterium, Gram-negative bacterium, yeast, or mold is identified (according to antibiotic resistance detected where relevant).

PLEASE NOTE that this chart should NOT replace clinical judgment, and the Infectious Diseases Consult Service (UCLA virtual pager 89321) is available for further assistance in interpretation. Therapy should be modified when final susceptibility results are available.

**Table 2: Suggested antimicrobial therapy (pending susceptibilities) for organisms identified**

|  |  |  |
| --- | --- | --- |
| **Organism Identification by BCID**  *(with relevant antibiotic resistance gene results)* | **Suggested therapy pending susceptibilities**  *(assuming normal renal function)* | **Comments** |
| ***Acinetobacter baumannii*** | Meropenem 500mg IV q6h PLUS amikacin (pharmacy to dose) | Consult ID |
| ***Candida albicans*** | Micafungin 100mg IV q24h if critically ill or recent azole exposure; otherwise fluconazole 800mg IV x1, then 400mg IV q24h | Consult ID |
| ***Candida glabrata*** | Micafungin 100mg IV q24h | Consult ID |
| ***Candida krusei*** | Micafungin 100mg IV q24h | Consult ID |
| ***Candida parapsilosis*** | Fluconazole 800mg IV x1, then 400mg IV q24h | Consult ID |
| ***Candida tropicalis*** | Fluconazole 800mg IV x1, then 400mg IV q24h | Consult ID |
| ***Enterobacteriaceae* AND/OR**  ***Eschericia coli*, *Enterobacter cloacae* complex, *Klebsiella oxytoca, Klebsiella pneumoniae, Proteus, Serratia marcesens***  ***KPC* NEGATIVE** | Ertapenem 1gm IV q24h (consider adding amikacin if critically ill or history of infection with carbapenem-resistant organisms) | Consider ID Consult |
| ***Enterobacteriaceae* AND/OR**  ***Eschericia coli*, *Enterobacter cloacae* complex, *Klebsiella oxytoca, Klebsiella pneumoniae, Proteus, Serratia marcesens***  ***KPC* POSITIVE** | Ceftazidime-avibactam PLUS amikacin (pharmacy to dose) | Mandatory ID consult |
| ***Enterococcus:***  *vanA/B* NEGATIVE  *vanA/B* POSITIVE | Vancomycin IV (trough 15-20)  Daptomycin 8-10 mg/kg IV q24h | Consult ID  Consult ID |
| ***Haemophilus influenzae*** | Ceftriaxone 2gm IV q24h |  |
| ***Listeria monocytogenes*** | Ampicillin 2gm IV q4h | Consult ID |
| ***Neisseria meningiditis*** | Ceftriaxone 2gm IV q12h | Consult ID |
| ***Pseudomonas aeruginosa*** | Piperacillin-tazobactam 4.5gm q8h (extended infusion) PLUS amikacin (pharmacy to dose) | Consult ID |
| ***Staphylococcus* genus AND POSITIVE *S. aureus* species result**  *mecA* NEGATIVE  *mecA* POSITIVE  *vanA/B* POSITIVE (rare) | Oxacillin 2gm IV q4h  Vancomycin IV (trough 15-20)  Daptomycin 8-10mg/kg IV q24h | MSSA (mandatory ID consult)  MRSA (mandatory ID consult)  VRSA (mandatory ID consult) |
| ***Staphylococcus* genus and NEGATIVE *S. aureus* species result**  *mecA* NEGATIVE  *mecA* POSITIVE  *vanA/B* POSITIVE (rare) | SEE COMMENTS🡪  Oxacillin 2gm IV q4h  Vancomycin IV (trough 15-20)  Daptomycin 8-10mg/kg IV q24h | Result suggests coagulase-negative staphylococcus (may be contaminant, especially if isolated from only one of multiple blood culture bottles) |
| ***Streptococcus agalactiae\**** | Penicillin 3 million units IV q4h | Consult ID (especially in setting of suspected endocarditis or diabetic foot infection) |
| ***Streptococcus pneumoniae\**** | Ceftriaxone 2gm IV q24h  -add vancomycin IV (trough 15-20 mg/dL) if CNS infection suspected |  |
| ***Streptococcus pyogenes\**** | Penicillin 3 million units IV q4h  -add clindamycin 900mg IV q8h if necrotizing fasciitis is suspected) |  |
| ***Streptococcus* genus and all *Streptococcus agalactiae/pneumoniae/***  ***pyogenes* species results NEGATIVE** | Ceftriaxone 2gm IV q24h |  |
| **Positive blood culture growth but NO species detected by BCID** *(with relevant antibiotic BCID resistance gene results)* | **Suggested therapy pending susceptibilities**  *(assuming normal renal function)* | **Comments** |
| **Gram-positive bacterium in culture, no species ID by BCID**  *vanA/B* NEGATIVE  *vanA/B* POSITIVE | Vancomycin IV (trough 15-20)  Daptomycin 8-10mg/kg IV q24h | Consult ID  Consult ID |
| **Gram-negative bacterium in culture, no species ID by BCID**  KPC NEGATIVE  KPC POSITIVE | Meropenem PLUS IV sulfamethoxazole-trimethoprim  Ceftazidime-avibactam PLUS amikacin (pharmacy to dose) | Consult ID  Mandatory ID consult |
| **Yeast in culture, no species ID by BCID** | Voriconazole 6mg/kg IV q12h x2 doses, then 4mg/kg IV q12h | Consult ID |
| **Mold in culture, no species ID by BCID** | Liposomal amphotericin B 5mg/kg IV q24h | Consult ID |

\*The *Enterobacteriaceae* family assay and the *Streptococcus* genus assays may be negative in the setting of a specific species being positive; this does not mean that the species assay is incorrect (just that the assay is designed to pick up less common species). Furthermore, not all species are detected by the genus-specific assays for *Enterococcus, Staphylococcus, Streptococcus,* and the family specific assay for *Enterobacteriaceae.* Pathogens detected and not detected with each assay are tabulated below:

**Table 3: Pathogens detected and not detected by genus/family-specific assays**

|  |  |  |
| --- | --- | --- |
| **Genus-Specific Assay** | **Pathogens Detected** | **Pathogens NOT Detected** |
| *Enterococcus* genus | *E. faecium, E. faecalis, E. avium, E. casseliflavus, E. durans, E. gallinarium*  *E. hirae, E. dispar* (reduced sensitivity)*, E. saccharolyticus* (reduced sensitivity) | *E. raffinosus* |
| *Staphylococcus* genus | *S. aureus, S. caprae, S. cohnii, S. epidermidis, S. haemolyticus, S. hominis, S. lugdunensis, S. xylosus*  Detected but with reduced sensitivity: *S. capitis, S. pasteuri , S. saprophyticus, S. simulans, S. warneri* | *S. auricularis, S. carnosus, S. lentus, S. pettenkoferi, S. pseudointermedius, S. schleiferi, S. sciuri* |
| *Streptococcus* genus | *S. anginosus, S. bovis, S. constellatus, S. dysgalactiae, S. equinis, S. gallolyticus, S. gordonii, S. intermedius, S. mitis, S. mutans, S. oralis, S. parasanguinis, S. pseudopneumoniae, S. salivarius, S. sanguinis* |  |
| *Enterobacteriaceae* genus | *Cedaceae* spp., *Citrobacter* spp., *Cronobacter* spp., *Enterobacter* spp., *Escherichia* spp., *Klebsiella* spp., *Kluyvera* spp., *Leclercia adecarboxylata*, *Proteus* spp., *Raoutella* spp., *Salmonella* spp., *Shigella* spp., *Serratia marcescens*, *Serratia ficaria*, *Serratia entomophilia*, *Yokenella regensbergei*  Detected but with reduced sensitivity: *Edwardsiella* spp., *Enterobacter gergoviae*, *Hafnia alvei,* *Pantoea* spp.,  *Salmonella bongori* spp., *Serratia fonticola, Serratia odorifera*, *Serratia rubidaeae* | *Morganella morganii, Providencia* spp.*, Rahnella* spp.*, Serratia liquefaciens, Serratia plymuthica, Tatumella ptyseos, Yersinia enterocolitica* |