Rapid Blood Pathogen Identification Panel

What is it?

The Methodist Microbiology Laboratory has introduced an FDA approved test called the Bloodstream Infection Test (performed by the Verigene® Gram-Positive or Gram-Negative Nucleic Acid Test). This is a qualitative, multiplexed *in vitro* diagnostic test which identifies genus, species and genetic antimicrobial resistance determinants for a broad panel of gram-positive *or* gram-negative bacteria (listed in **Table 1**) directly from positive blood culture bottles, allowing rapid identification of pathogens and earlier transition to most appropriate therapy. Information on which species are detected by the genus specific only assays can be found in **Table 4**.

Table 1: List of Pathogens Detected

Gram-positive bacteria	Gram-negative bacteria	Resistance Gene
Staphylococcus genus	*Escherichia coli*	mecA = methicillin (nafcillin) resistance
Staphylococcus aureus	*Klebsiella pneumoniae*	vanA = vancomycin resistance
Staphylococcus epidermidis	*Klebsiella oxytoca*	vanB = vancomycin resistance
Staphylococcus lugdunensis	*Pseudomonas aeruginosa*	CTX-M= ESBL
Streptococcus genus	*Serratia marcescens*	IMP = carbapenemase
Streptococcus anginosus Group	*Acinetobacter* genus	KPC = carbapenemase
Streptococcus agalactiae	*Citrobacter* genus	NDM = carbapenemase
Streptococcus pneumoniae	*Enterobacter* genus	OXA = carbapenemase
Streptococcus pyogenes	*Proteus* genus	VIM = carbapenemase
Enterococcus faecalis		
Enterococcus faecium		
Listeria genus		

How does it work?

When a blood culture bottle is identified as positive by the automated instrument, a microbiology technologist will perform a Gram stain on blood from the bottle. If the Gram stain shows a Gram-positive organism, the Gram-Positive Nucleic Acid Test will be performed and if the Gram stain shows a Gram-negative organism, the Gram-Negative Nucleic Acid Test will be performed. The results of the Bloodstream Infection Test will typically be available in Cerner within 3 hours of notification of a positive blood culture.

A list of recommended therapeutic decisions and treatment choices based on the Verigene® data are outlined in **Table 2 and Table 3**. These recommendations are based on an analysis of the Methodist Hospital antibiogram – please refer to the antibiogram for the most current susceptibility data from our lab.

Why is it helpful?

Previous studies have shown that rapid pathogen identification can result in earlier time to active therapy, earlier time to most appropriate therapy, shorter hospital stay, and improved clinical outcomes. The utility and cost-effectiveness of such testing is dependent on clinicians reacting to the data in real time. **It is strongly recommended that the Verigene results be utilized for therapy decisions at the time they are available.**

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. An example of this would be a complicated intra-abdominal infection. This infection often involves anaerobes and therapy active against these should generally be included until definitive cultures of the site of infection have returned.

Final susceptibilities will be available in 24-72 hours and should always be reviewed to determine if therapy adjustments need to be made.

Table 2: Gram Positive Pathogen Detected and Recommended Therapy Adult Dosing

*For all gram positive bacteremia - If endocarditis is concern, consult ID for consideration of gentamicin

Pathogen Detected	Preferred Therapy	Comments
Staphylococcus* genus** with negative *S. aureus* PCR**, *including S. epidermidis and ***excluding S. lugdunensis*** Blood Culture result:		
1 of 2 BCX positive	Consider withholding or discontinuing therapy as likely contaminant	In severely ill patients, consider starting/continuing therapy until more definitive results return.
2 of 2 BCX positive mecA negative	Nafcillin 2g q4h or 12g q24h	Cefazolin 2g q8h is an alternative
mecA positive	Vancomycin 15 mg/kg q12h	Pharmacokinetic dosing per pharmacy
Staphylococcus lugdunensis	Nafcillin 2g q4h or 12g q24h	*S. lugdunensis* is a virulent coagulase-negative staphylococcus that behaves like *S. aureus* and should be presumed to be pathogenic.

Staphylococcus aureus mecA negative = MSSA	Nafcillin 2g q4h or 12g q24h	Cefazolin 2g q8h is an alternative
mecA positive = MRSA	Vancomycin 15 mg/kg IV q12h	Pharmacokinetic dosing per pharmacy
***Streptococcus* genus** <u>Blood Culture result:</u> 1 of 2 BCX positive	Consider withholding or discontinuing therapy as likely contaminant	In severely ill patients consider starting/continuing therapy until more definitive results return.
2 of 2 BCX positive	Ceftriaxone 2g q24h	
***Streptococcus anginosus* Group**	Penicillin G 3-4 million units q4h or ceftriaxone 2g IV q24 h	Sub-group of *viridans group streptococci* with a propensity for abscess formation.
***Streptococcus agalactiae* (Group B Strep)**	Penicillin G 3-4 million units q4h or ampicillin 2g q4h or cefazolin 2g q8h	β-hemolytic strep are routinely susceptible to penicillin
Streptococcus pneumoniae <u>Source of Infection:</u> Uncomplicated pneumonia	Ceftriaxone 2g q 24h	Levofloxacin 750mg Q24h is an alternative
CNS infection	Ceftriaxone 2 g q 12h **<u>AND</u>** vancomycin 15 mg/kg q 12h	Continue vancomycin until susceptibilities return
***Streptococcus pyogenes* (Group A Strep)**	Penicillin G 3-4 million units q 4h or ampicillin 2g q4h or cefazolin 2g Q8h	β-hemolytic strep are routinely susceptible to penicillin
Enterococcus faecalis or ***Enterococcus faecium*** van A/B negative	Ampicillin 2g IV q 4h	Alternate: Vancomycin 15 mg/kg IV q 12h
van A/B positive = VRE	Linezolid 600 mg q 12h or daptomycin 8 mg/kg IV q 24h	
***Listeria* genus**	Nafcillin 2g Q4h or 12g q24h	TMP/SMX in patients with severe beta-lactam allergy

Table 3: Gram Negative Pathogen Detected and Recommended Therapy

*For all gram negative bacteremia - increase ceftriaxone to 2g Q12h for CNS indication; increase meropenem to 2g Q8h for CNS indication

Pathogen Detected	Preferred Therapy	Comments
Escherichia coli	Community onset: Ceftriaxone 2g q24h Nosocomial onset: Piperacillin/tazobactam 4.5 g q8h	
Klebsiella pneumoniae	Community onset: Ceftriaxone 2g q24h Nosocomial onset: Piperacillin/tazobactam 4.5 g q8h	
Klebsiella oxytoca	Community onset: Cefepime 1g q6h Nosocomial onset: Ertapenem 1g q24h	
Pseudomonas aeruginosa	Piperacillin/tazobactam 4.5g q8h OR cefepime 2g q8h	Consider addition of tobramycin in severely ill patients while awaiting susceptibility testing
Serratia marcescens	Ceftriaxone 2g q24h OR Cefepime 2g q8h	
***Acinetobacter* genus**	Meropenem 1g q8h	No beta-lactam with >90% susceptibility Consider addition of amikacin in severely ill or non-responding
***Citrobacter* genus**	Ceftriaxone 2g q24h Or piperacillin/tazobactam 4.5g q8h	
***Enterobacter* genus**	Cefepime 2g q8h Or meropenem 1g q8h	
***Proteus* genus**	Ceftriaxone 2g q24h	
CTX-M gene	**Consult ID** Meropenem 1g q8h	Marker for extended spectrum beta-lactamase (ESBL)
IMP, KPC, NDM, OXA or VIM genes	**Consult ID** Ceftazidime/avibactam (nonformulary) + Colistin +/- tigecycline	Marker for carbapenem resistant *Enterobacteriaceae* (CRE)

Table 4: Pathogens Detected by Genus Specific Assays

Genus Specific Assay	Pathogens Detected	Pathogens That May Not Be Detected
Staphylococcus genus	*S. arlettae* *S. aureus* *S. auricularis* *S. capitis* *S. caprae* *S. chromogenes* *S. cohnii* *S. epidermidis* *S. haemolyticus* *S. hominis* *S. intermedius* *S. lugdunensis* *S. muscae* *S. pasteuri* *S. saccharolyticus* *S. saprophyticus* *S. schleferi* *S. sciuri* *S. simulans* *S. warneri* *S. xylosus*	*S. carnosus* *S. condimentii* *S. delphini* *S. equorum* *S. felis* *S. hyicus* *S. gallinarum* *S. kloosii* *S. lentus* *S. lutrae* *S. nepalensis* *S. pettenkoferi* *S. piscifermentans* *S. flueretii* *S. pseudointerdium* *S. simiae* *S. succinus*
Streptococcus genus	*S. agalactiae* *S. anginosus* *S. bovis* *S. constellatus* *S. dysgalactiae* *S. dysgalactiae* subsp. *equismilis* *S. equi* *S. equinus* *S. gallolyricus* *S. gallolyticus pasteurianus* *S. gordonii* *S. infantarius* subsp. *coli* *S. infantarius* subsp. *infantarius* *S. infantis* *S. intermedius* *S. mitus* *S. mitis/oralis*	*S. acidominimus* *S. canis* *S. criceti* *S. downei* *S. ferus* *S. ictaluri* *S. iniae* *S. lactarius* *S. lutetiensis* *S. macacae* *S. macedonius* *S. parauberis* *S. pasteurianus* *S. pluranimalium* *S. porcinus* *S. pseudopneumoniae* *S. pseudoporcinus* *S. ratti* *S. suis*

	S. parasanguinis *S. peroris* *S. pneumoniae* *S. pyogenes* *S. salivarius* *S. sanguinis* *S. thoraltensis*	*S. urinalis* *S. cristatus* *S. australis* *S. sinesis* *S. orisratti* *S. oligofermentans* *S. massiliensis* *S. sobrinus* *S. vestibularis* *S. thermophiles* *S. alactolyticus* *S. uberis* *S. equismilis*
Listeria genus	*L. innocua* *L. ivanovii* *L. monocytogenes* *L. seeligeri* *L. welshimeri*	*L. marthii* *L. grayi*
Acinetobacter genus	*A. baumanii* *A. baylyi* *A. bereziniae* *A. calcoaceticus* *A. guillouiae* *A. haemolyticus* *A. johnsonii* *A. junii* *A. lwoffi* *A. radioresistens* *A. schindleri* *A. ursingii*	*A. tartarogenes*
Enterobacter genus	*E. aerogenes* *E. amnigenus* *E. asburiae* *E. cancerogenus* *E. cloacae* *E. hormaechei* *E. ludwigii* *E. nimipressuralis/E. orzae*	*E. gergoviae* *E. kobei* *E. pyrinus*
Proteus genus	*P. hauseri* *P. mirabilis* *P. myxofaciens* *P. penneri* *P. vulgaris*	