Clinical Impact of Rapid Molecular Diagnosis of Bloodstream Infections at an Academic Medical Center in New York City

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BACKGROUND

In patients with bacteremia, rapid multiplex polymerase chain reaction (rmPCR) tests may improve antimicrobial prescribing and reduce length of stay and mortality when paired with antimicrobial stewardship (AS) interventions.

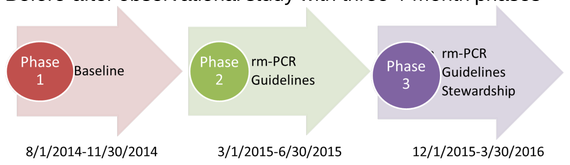
The clinical value of rmPCR in the absence of AS interventions is poorly understood.

STUDY OBJECTIVE

To evaluate the clinical impact of rmPCR blood culture identification with and without an AS intervention, as compared with traditional microbiological methods for organism identification, on antimicrobial utilization and clinical outcomes.

METHODS

Before-after observational study with three 4-month phases



rm-PCR

- FilmArray® Blood Culture ID (Biofire) gram-negative panel
- Verigene® Blood Culture gram-positive panel (Luminex)
- Detects 20 bacterial species and mecA, vanA/B, KPC genes

Guidelines

- Treatment guidelines for rmPCR results based on the hospital antibiogram, published on hospital intranet

Stewardship

- ID physician or pharmacist reviewed rmPCR results and made recommendations to primary care team as appropriate
- Reviews performed 1-2 times per day, 7 days per week

Included

- Adult inpatients with 1st bacteremic episode per phase

Excluded:

- Age <18 years
- Outpatient or discharged from Emergency Department
- Polymicrobial bloodstream infection

Primary outcomes

- Time to optimal antimicrobial therapy* (table)
- Time to effective antimicrobial therapy

Secondary outcomes

- Aggregate days of antimicrobial therapy per patient, hospital length of stay, *Clostridium difficile* infection, in-hospital mortality

RESULTS

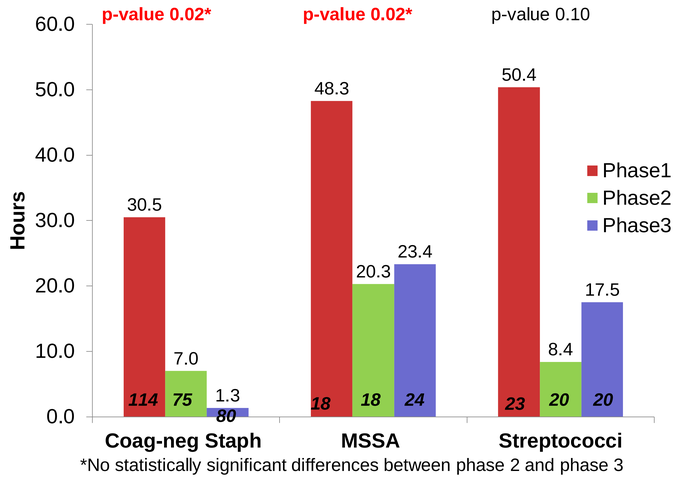
Clinical Characteristics of Bacteremia Episodes

Characteristic	Phase 1 (n=396)	Phase 2 (n=293)	Phase 3 (n=339)
Age (median)	67	67	67
Female	45.2%	46.4%	45.7%
Primary service[1]			
Medicine	72.8%	80.8%	87.2%
Surgery	12.9%	9.9%	7.4%
Neurology/Neurosurgery	7.9%	4.1%	3.3%
Other	6.4%	5.0%	2.1%
Source of Bacteremia			
Contaminant	31.8%	28.1%	27.4%
Genitourinary	16.9%	19.5%	20.1%
Unknown or not documented	18.0%	15.4%	15.4%
Gastrointestinal/Intra-abdominal	10.6%	11.0%	11.8%
Vascular catheter	9.8%	8.9%	9.4%
Skin/soft tissue	4.8%	6.2%	3.5%
Pulmonary	4.0%	4.1%	7.1%
Endocarditis	3.0%	2.1%	2.7%
Bone/joint	0.5%	1.7%	2.4%
Other	0.5%	2.4%	0.3%
Antibiotic allergy			
Penicillin class	12.1%	18.1%	13.9%
Other antibiotic allergy	3.8%	3.1%	4.4%
Infectious diseases consultation, %	51.3%	50.2%	46.6%
Pitt bacteremia score (mean)	2.24	2.13	2.05
Charlson Comorbidity Index (mean)	2.60	2.85	2.84
Immunosuppression[1]	31.1%	36.5%	39.8%
Community onset, %	65.4%	63.8%	69.6%

[1]Denotes statistically significant differences between 3 groups by Chi square test

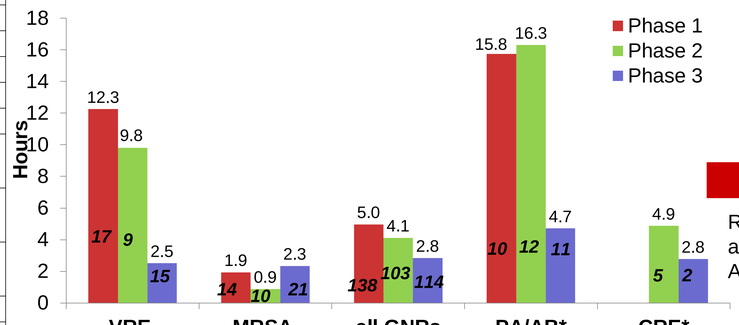
Organism	*Time to Optimal Therapy Definition
Coagulase-negative Staphylococci	Time to discontinuation of vancomycin (contaminants)
MSSA	Time to initiation of oxacillin or cefazolin
Streptococci	Time to initiation of ceftriaxone or penicillin

Median time to optimal therapy for gram-positive bacteremia



*No statistically significant differences between phase 2 and phase 3

Mean time to effective therapy for VRE, MRSA and GNR bacteremia



All comparisons not statistically significant by Kruskal-Wallis or Wilcoxon-Rank sum tests

*PA/AB=*Pseudomonas aeruginosa* and *Acinetobacter baumannii*

+CRE=Carbapenem-resistant Enterobacteriaceae

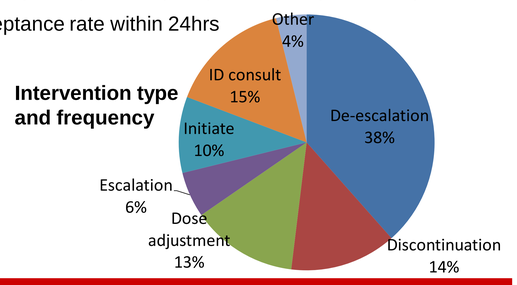
Comparison of Clinical Outcomes

Outcome	Phase 1 (n=396)	Phase 2 (n=293)	Phase 3 (n=339)	P-value
Days of antimicrobial therapy (per patient)	8.92	8.77	9.11	0.82
Hospital length of stay, median days	12.4	11.3	12.5	0.87
Clostridium difficile infection	3.5%	2.0%	3.2%	0.52
In-hospital mortality[1]	21.9%	22.3%	20.7%	0.92

[1]Excludes contaminants

STEWARDSHIP INTERVENTION RESULTS

- 10% (42/442) patients reviewed required intervention
- MSSA (24%), Streptococci (29%), VSE (10%) most frequent
- 70% acceptance rate within 24hrs



CONCLUSIONS

RmPCR significantly improved the time to optimal therapy in MSSA and coagulase-negative staphylococcal bacteremia even **without** an AS intervention

- Decreased time to optimal therapy for streptococcal bacteremia without AS, but not statistically significant
- Decreased time to effective therapy for VRE, *Pseudomonas*, *Acinetobacter* and CRE bacteremia with AS, but not statistically significant

There was no statistically significant impact on clinical outcomes such as LOS, mortality.

Identification of additional resistance determinants (i.e. CTX-M) and more frequent or "real-time" alerting mechanism for AS interventions would likely be required to improve clinical outcomes.

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