Impact of BioFire® FilmArray® Blood Culture Identification Panels on Time to Optimal Antimicrobial Therapy

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Background

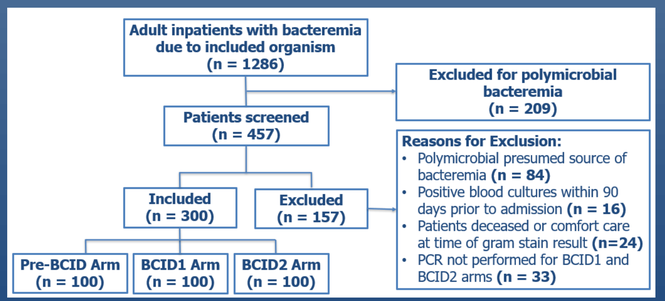
- Bloodstream infections are associated with significant morbidity, mortality, and costs
- Timely initiation of effective treatment is required for optimal outcomes
- Conventional microbiological techniques may require 72 hours for organism identification; however, rapid blood culture identification (BCID) polymerase chain reaction (PCR) panels have expedited this process
- At Atlantic Health System, the Biofire® FilmArray® was implemented June 2020 (BCID1), with subsequent upgrade to BCID2 March 2021
- Notable features of the BCID2 panel include species identification of *Enterococcus* and the addition of the CTX-M target
- The objective of this study is to assess time to optimal therapy with and without the BCID platforms for select organisms

Methods

- **Retrospective chart review** at two community-teaching hospitals in New Jersey
- **Study Arms:**
  - Pre-BCID: May 2019 – February 2020
  - BCID1: June 2020 – February 2021
  - BCID2: March 2021 – December 2021
- **Inclusion Criteria:** Hospitalized patients ≥ 18 years old who have positive blood cultures for *Enterococcus faecalis*, *E. faecium*, *Proteus* spp, *Escherichia coli*, or non-*aerogenes Klebsiella* spp. in pre-BCID vs. BCID1 vs. BCID2 time periods
- **Exclusion Criteria**: Patients with polymicrobial or presumed polymicrobial source of bacteremia, recent positive blood cultures, PCR not performed in BCID arms, or who were deceased/comfort care at time of Gram stain
- **Statistics:** Continuous data analyzed using the student t-test and Wilcoxon rank sum test; nominal data analyzed using the chi-squared and Fisher's exact tests
- **Primary Endpoint (Pre-BCID vs. BCID1/Pre-BCID vs. BCID2)**:
  - Time to optimal therapy (TTOT) – time from blood culture collection to start of pathogen-specific regimen as defined by local guidelines
- **Secondary Endpoints (Pre-BCID vs. BCID1/Pre-BCID vs. BCID2)**:
  - Time to effective therapy – time from blood culture collection to initiation of antimicrobial therapy to which the organism was found to be susceptible
  - Duration of vancomycin therapy
  - Therapy modification 24 hours after Gram stain result
  - Carbapenem use within 24 hours after Gram stain results for Gram-negative bacteremia
  - Length of stay
  - 30-day readmission
  - Recurrence or reinfection within 30 days of discharge
  - All-cause 30-day mortality

Results

Figure 1. Study Enrollment



Results

Table 1. Patient Characteristics

	Pre-BCID (n=100)	BCID1 (n=100)	BCID2 (n=100)
Age, years [median (range)]	75 (22 – 95)	74 (28 – 94)	67 (21 – 102)
Female	53	53	56
Pitt bacteremia score [median (range)]	1 (0 – 8)	1 (0 – 10)	1 (0 – 8)
ICU admission at time of Gram stain	9	13	11
Infectious diseases consult within 24 hours of Gram stain	76	84	81
Organisms			
E. faecalis	13	7	13
E. faecium	2	2	3
E. coli	66	69	60
K. oxytoca	0	1	1
K. pneumoniae	15	16	14
Proteus spp.	4	5	9
Source of bacteremia			
Respiratory tract	8	2	4
Endocarditis	2	2	2
Catheter associated	5	3	4
Urinary tract	65	69	60
Intraabdominal	18	23	26
Skin and soft tissue	2	1	4
Resistance mechanisms			
ESBL (CTX-M)	13	10	11
CRE (KPC)	0	1	1
VRE (VanA/B)	2	1	3

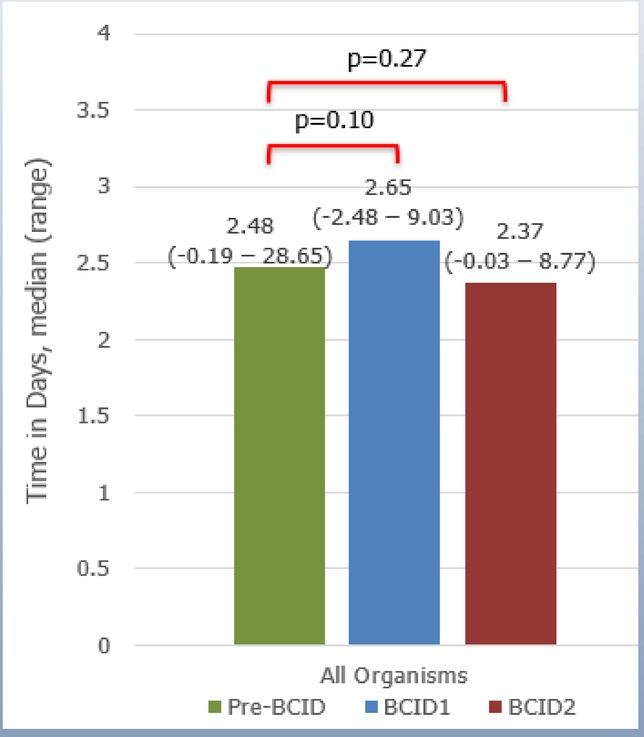
Data expressed as percentages unless otherwise specified
p>0.05 relative to pre-BCID, unless bolded
ESBL: Extended-spectrum beta-lactamases, **CRE**: Carbapenem-resistant *Enterobacterales*, **VRE**: Vancomycin-resistant *Enterococcus*

Table 2. Secondary Endpoints

Endpoint	Pre-BCID (n=100)	BCID1 (n=100)	BCID2 (n=100)
Time to optimal therapy, days	2.48 (-0.19 – 28.65)	2.65 (-2.48 – 9.03)	2.37 (-0.03 – 8.77)
Gram-negative	1.85 (-0.19 – 28.65); n=85	**2.62 (-2.48 – 9.03); n=91**	2.23 (-0.03 – 7.85); n=84
Gram-positive	3.69 (1.17 – 6.99); n=15	2.93 (0.80 – 8.59); n=9	2.84 (0.82 – 8.77); n=16
Time to effective therapy, days	0.02 (-0.19 – 6.99)	0.05 (-2.48 – 6.06)	0.03 (-0.99 – 3.44)
Gram-negative	0.02 (-0.19 – 3.47); n=85	0.04 (-2.48 – 2.98); n=91	0.02 (-0.99 – 2.06); n=84
Gram-positive	0.01 (-0.12 – 6.99); n=15	0.84 (0.03 – 6.06); n=9	**0.18 (-0.72 – 3.44); n=16**
Duration of vancomycin, days	0 (0 – 28.59)	0 (0 – 2.65)	0.08 (0 – 4.78)
Gram-negative	0 (0 – 28.59); n=85	0 (0 – 2.65); n=91	0.07 (0 – 4.78); n=84
Gram-positive	2.46 (0 – 8.60); n=15	0.80 (0 – 2.64); n=9	**0.84 (0 – 2.86); n=16**
Therapy modification 24 hours after Gram stain result, %	23	30	**44**
Carbapenem use within 24 hours after Gram stain results for Gram-negative bacteremia, n/N (%)			
Non-ESBL	8/72 (11%)	18/81 (22%)	6/72 (8%)
ESBL	7/13 (54%)	2/10 (20%)	**11/12 (92%)**
Length of stay, days	7 (3 – 134)	7 (3 – 34)	7 (3 – 42)
30-day readmission, %	13	12	20
Recurrence or reinfection within 30 days of discharge, %	1	0	1
All-cause 30-day mortality, %	5	4	10

Data expressed as median (range), unless otherwise specified
p>0.05 relative to pre-BCID, unless bolded

Figure 2. Primary Endpoint (TTOT)



Discussion/Conclusion

- There was no difference in time to optimal therapy with either the BCID1 or BICD2 panel
- In the BCID2 arm, the following findings were significant:
  - Reduction in the duration of vancomycin use
  - More therapy changes within 24 hours of Gram stain result
  - More appropriate carbapenem use within 24 hours of Gram stain result for gram-negative organisms
- Barriers to benefit
  - Implementation at the emergence of COVID-19 pandemic limited prioritization of education efforts
  - Lack of formal real-time antimicrobial stewardship team involvement
- Study Limitations:
  - Retrospective design
  - Generalizability
    - Local definitions of optimal antimicrobial therapy
    - Organism/source distribution (*E. coli* from urinary source was predominant)
- Future Directions
  - Consideration of real-time antimicrobial stewardship team involvement

References

1. Nagel JL, et al. *J Clin Microbiol*. 2014;52(8):2849-54.
2. Messacar K, et al. *J Pediatr Infect Dis*. 2017;6(3):267-74.
3. Graff KE, et al. *Microbiol Spectr*. 2021;9(1):e0042921-e0042921

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