2018

Impact of rapid identification of gram negative blood cultures in a community hospital system

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Impact of Rapid Identification of Gram Negative Blood Cultures in a Community Hospital System

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The speaker has no actual or potential conflict of interest in relation to this presentation

Blood Culture Identification (BCID)

- Rapid polymerase chain reaction (PCR)
- Technology identifies select pathogens and resistance genes
- Multiple versions of this technology are utilized across the country
- Results within 1-3 hours of testing
- Important tool for antimicrobial stewardship (AMS) teams

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Ward C, Stocker K, Begum J, Wade P. *Eur J Clin Microbiol Infect Dis*. 2015.

Rapid PCR BCID at Parkview

- Gram negative pathogens identified:
  - *Escherichia coli*
  - *Klebsiella pneumoniae*
  - *Pseudomonas aeruginosa*
  - *Enterobacter cloacae* complex
  - *Enterobacteriaceae*
  - *Proteus spp.*
  - *Acinetobacter spp.*
  - *Haemophilus influenzae*
  - *Neisseria meningitides*
  - *Serratia marcescens*
- Gram negative resistance gene identified:
  - *Klebsiella pneumoniae* carbapenemase (KPC) gene
- Does not provide susceptibilities or MIC values

MIC = minimum inhibitory concentration

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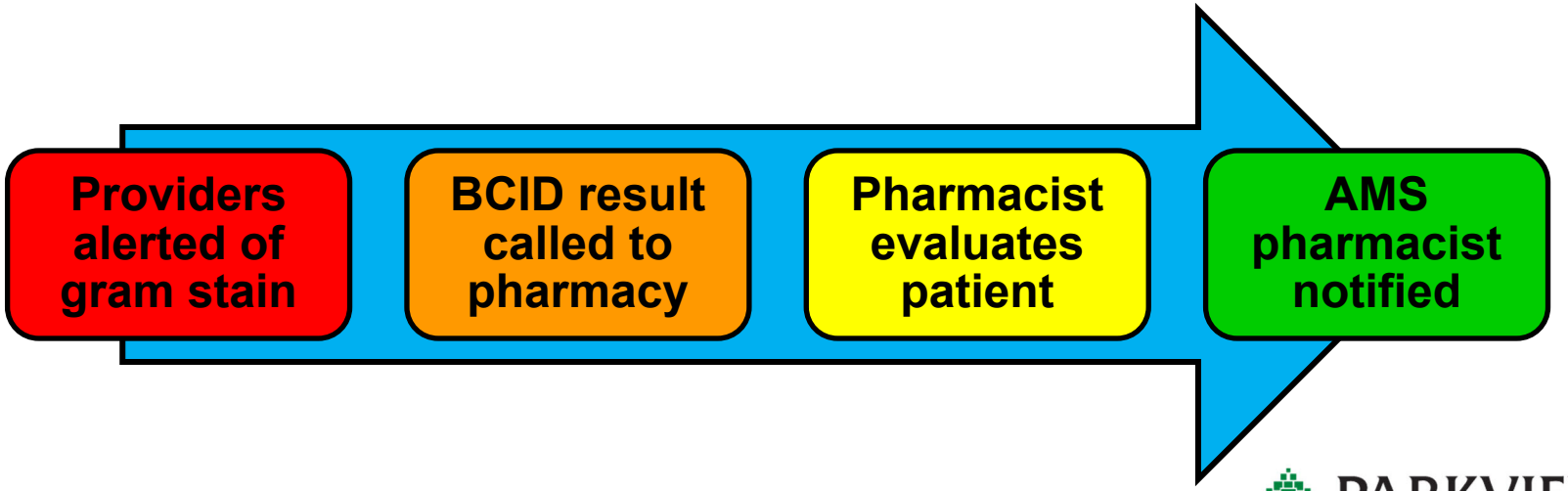
Blood Culture Identification Panel. Biofire website: http://www.biofiredx.com/products/the-filmarray-panels/.

Rapid PCR BCID at Parkview

- Integrated at Parkview Health in November 2015
- Providers are alerted of gram stain results while awaiting PCR
- Pharmacy notified 24/7 of all rapid PCR BCID results for adequate coverage and recommend if needed
- Results then sent to AMS pharmacists to evaluate for de-escalation (Monday–Friday, day shift)



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Assessment Question #1

Which of the following best describes the capabilities of rapid PCR blood culture identification technology for gram negative bacteremia?

A. Identifies all gram negative species

B. Recognizes select antimicrobial resistance genes

C. Identifies antimicrobial susceptibility and MIC values

D. Replaces the need for traditional blood cultures

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McVane SH, Nolte FS.

- Conducted at an academic hospital in 2015
- Gram positive and gram negative bloodstream infections
- Control, AMS, and rapid PCR BCID plus AMS
- 364 subjects
- Results
  - Improved time to first de-escalation
  - No statistical difference in cost, length of stay, or mortality

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McVane SH, Nolte FS. *Journal of Clinical Microbiology*. 2016.

Box MJ, et al.

- Conducted at a community-based hospital system in 2014
- Gram positive bloodstream infections only
- Control vs. rapid PCR BCID, both utilized AMS
- 167 subjects
- Results
  - Improved time to targeted therapy
  - Decrease in median length of stay
  - Decrease in median total direct variable costs

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Box MJ, et al. *Pharmacotherapy*. 2015.

Assessment Question #2

Hospitals that utilize rapid PCR blood culture testing in conjunction with antimicrobial stewardship programs can:

A. Increase time to de-escalation of antibiotic therapy
B. Decrease overall mortality
C. Increase overall cost for the patient
D. Improve time to targeted therapy

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Impact of Rapid Identification of Gram Negative Blood Cultures in a Community Hospital System

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Parkview Health

- 2 hospitals located in Allen County, Indiana
  - Parkview Regional Medical Center
  - Parkview Randallia
- 5 community hospitals in the surrounding counties

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Study Purpose

- **To evaluate the impact of rapid PCR BCID on the de-escalation of antibiotic therapy in patients with gram negative bacteremia in multiple community hospitals**
- Limited gram negative literature
- Previous resident conducted a study evaluating impact of rapid PCR BCID on coagulase negative *Staphylococcus*

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Design

- Retrospective chart review
- Approved by Institutional Review Board

Control Group
- Traditional blood cultures only

Rapid PCR BCID introduced

Study Group
- Rapid PCR BCID

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Inclusion Criteria

- ≥ 18 years old
- Positive blood culture with gram negative bacteria
- Admission to Parkview Health hospital

- Note: If there were multiple gram negative bacteremia admissions, only the first admission was evaluated

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Exclusion Criteria

- Hospice
- Polymicrobial bacteremia
- Immunocompromised
  - Neutropenic
  - Transplant patients
  - Immunosuppressants
- Not receiving gram negative coverage at time blood culture result
- Immunosuppressants
  - Monoclonal antibodies
  - Chemotherapy
  - Chronic steroids

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Outcomes

- **Primary Outcomes**
  - Difference in time to first de-escalation
    - *Removal of a single agent or reduction in the spectrum of activity*
  - Difference in time to targeted therapy
    - *De-escalation to antibiotic with the narrowest spectrum of activity appropriate for the pathogen*

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Outcomes

- **Secondary Outcomes**
  - Incidence of first de-escalation
  - Incidence of gram-positive removal
  - Incidence of targeted therapy
  - Difference in time to removal of gram-positive coverage
  - Intensive care unit length of stay
  - Hospital length of stay
  - Survival
  - Percent de-escalation recommended by pharmacy

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Statistical Analysis

- $\alpha = 0.05$
- **Primary outcomes**
  - Mann-Whitney U Test
- **Secondary outcomes and baseline characteristics**
  - Chi square
  - Student's t test

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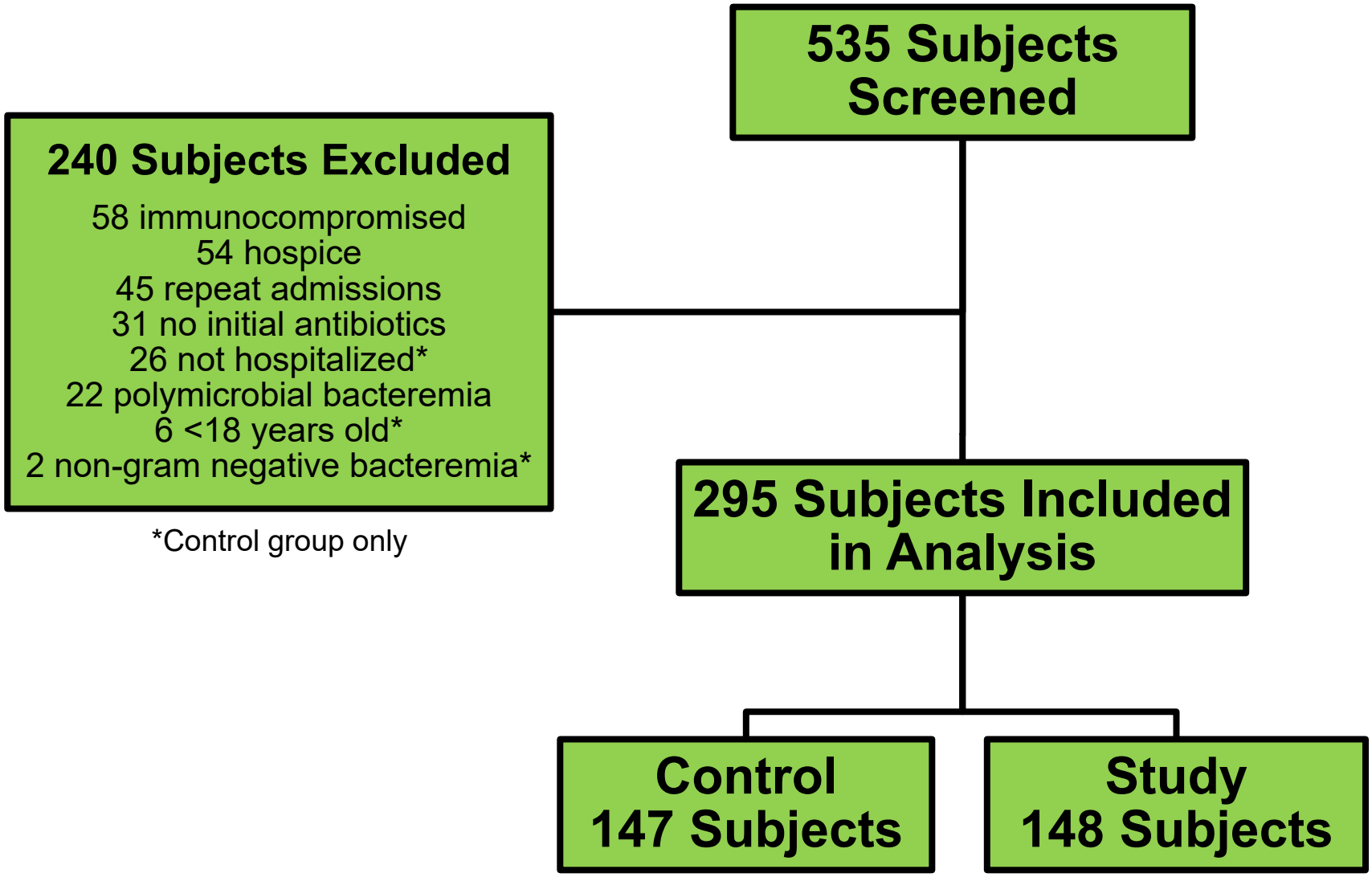
Subjects


535 Subjects Screened
240 Subjects Excluded
58 immunocompromised
54 hospice
45 repeat admissions
31 no initial antibiotics
26 not hospitalized*
22 polymicrobial bacteremia
6 <18 years old*
2 non-gram negative bacteremia*
*Control group only
295 Subjects Included in Analysis
Control 147 Subjects
Study 148 Subjects

Baseline Characteristics

	Control Group (*n* = 147)	Study Group (*n* = 148)	*P*-value
Age, mean (SD)	66.7 (17)	67.3 (16.7)	0.72
Sex, male, *n* (%)	56 (37.8)	60 (40.8)	0.60
Weight, kg, median (IQR)	80.4 (67.6, 95.3)	83 (68.9, 105.8)	0.10
Antibiotic Allergy, *n* (%)	46 (31)	50 (34)	0.59
Hospital Location, *n* (%)			0.86
Allen County	121 (81.8)	119 (81)	--
Non-Allen County	26 (18.2)	29 (19)	--

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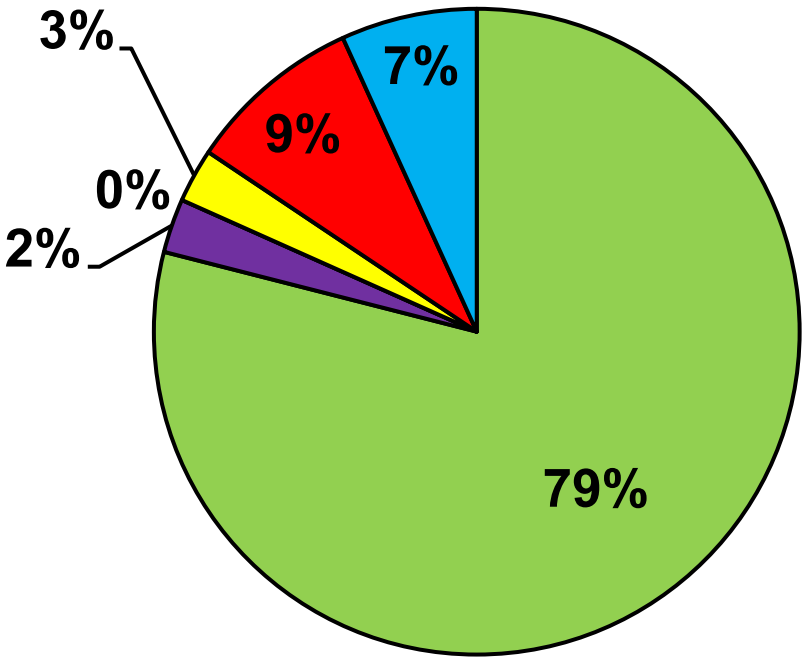
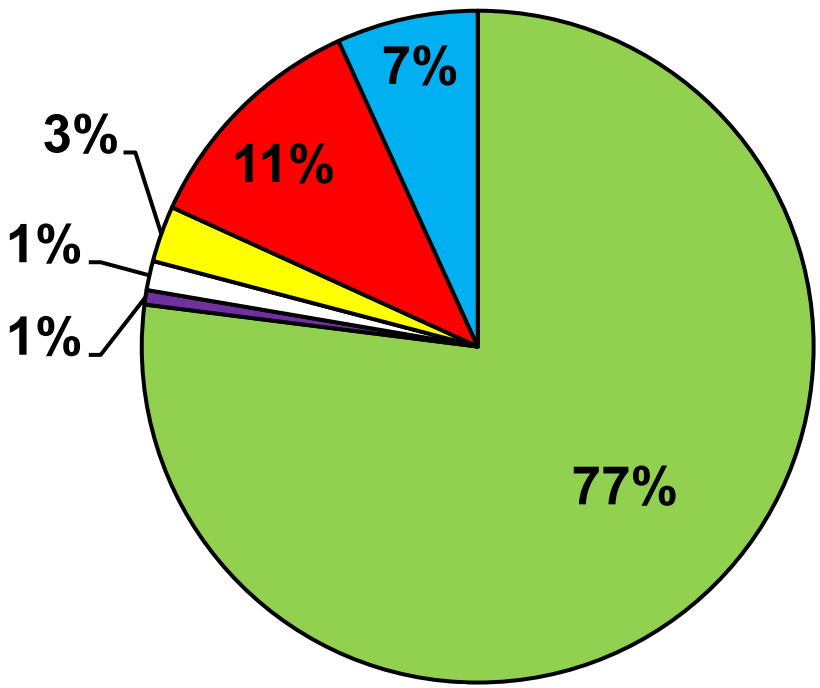
Baseline Characteristics

Control Group Source of Infection



Study Group Source of Infection



Urine | IV Catheter | Skin
Respiratory | Other | Unidentified

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Baseline Characteristics

Bacteria Identified	Control Group (*n* = 147)	Study Group (*n* = 148)
Escherichia coli	95 (64.6)	101 (68.2)
Klebsiella pneumoniae	25 (17)	22 (14.9)
Proteus spp.	13 (8.8)	5 (3.4)
Pseudomonas aeruginosa	8 (5.4)	6 (4)
Enterobacter cloacae	3 (2)	10 (6.8)
Serratia marcescens	3 (2)	3 (2)
Haemophilus influenzae	0 (0)	1 (0.7)

Reported *n*, percent

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Primary Outcomes

	Control Group *n*=102	Study Group *n*=119	Difference	*P*-value
Time to First De-escalation, days, median (IQR)	1.63 (0.51, 2.47)	1.58 (0.73, 2.46)	0.04 (0.96 hr)	0.92

	Control Group *n*=95	Study Group *n*=115	Difference	*P*-value
Time to Targeted Therapy, days, median (IQR)	2.60 (1.95, 3.76)	2.65 (1.84, 3.89)	0.05 (1.2 hr)	0.68

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Secondary Outcomes

	Control Group	Study Group	*P*-value
Incidence of First De-escalation, *n* (%)	102 (69.4)	119 (80.4)	0.03
Incidence of Gram-Positive Removal, *n* (%)	47 (32)	55 (37.2)	0.35
Incidence of Targeted Therapy, *n* (%)	95 (64.6)	115 (77.7)	0.42
Time to Gram-Positive Removal, days (hr), median	1.2 (28.8)	0.92 (22.1)	0.13

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Secondary Outcomes

	Control Group	Study Group	*P*-value
ICU Length of Stay, median (IQR)	3.19 (2.1, 5.1)	3.15 (1.6, 4.3)	0.93
Hospital Length of Stay, median (IQR)	4.94 (3.2, 7.8)	4.99 (3.4, 7)	0.90
Survival, *n* (%)	143 (97.3)	146 (98.6)	0.45
Pharmacist Intervention, *n* (%)	19 (13.3)	79 (52.7)	<0.001

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Conclusions

- Rapid PCR technology did not have a significant effect on time to first de-escalation or time to targeted therapy
  - 52 total subjects were already receiving targeted therapy, 33 in the control group and 19 in the study group
- Rapid PCR technology resulted in a clinically significant decrease in time to removal of gram positive coverage
- Rapid PCR implementation increased opportunities for pharmacist recommendations

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Discussion

- Primary etiology of gram-negative bacteremia was UTI, where presentation may have influenced empiric therapy
- Gram-negative rapid PCR BCID has limited resistance identification, which can restrict the ability to de-escalate
- The current protocol encourages appropriate initial coverage and not de-escalation of therapy
- AMS pharmacist coverage was limited to 40 hours/week

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Limitations

- Retrospective chart review
- Did not account for the other benefit of rapid PCR BCID – addition of initial coverage
- Study stopped in the Spring of 2017 and physicians may be getting more comfortable with the technology

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Future Direction

- Education of practitioners on:
  - The benefits of rapid PCR BCID technology
  - Regional *E. coli* susceptibility profile
- Make local antibiogram more easily accessible with an electronic version
- Publication

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