

# Validation of Local Risk Factors for Antibiotic-resistant Pathogens in Community-acquired Pneumonia at an Urban Community-based Medical Center

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## Introduction

The 2019 ATS/IDSA community-acquired pneumonia (CAP) guidelines recommend abandoning the definition of healthcare-associated pneumonia (HCAP) and to base the need for methicillin-resistant *Staphylococcus aureus* (MRSA) and/or broad-spectrum gram-negative (*Pseudomonas aeruginosa*) coverage on local epidemiology and risk factors.<sup>1</sup>

Jamaica Hospital Medical Center represents a unique population of ethnically diverse and immigrant patients. The hospital is located in a low socioeconomic area and serves multiple nursing homes and both a national and international airport.

## Objectives

**Primary:** to determine prevalent risk factors for infection with MRSA and/or clinically significant multidrug-resistant gram-negative organisms (including *P. aeruginosa* and extended-spectrum beta-lactamase-producing [ESBL] organisms) within an urban community-based medical center in Jamaica, NY

**Secondary:** to validate the drug resistance in pneumonia (DRIP) score in this patient population

## Methods

Retrospective study evaluating adults admitted from August 1, 2018 to December 31, 2019 with a diagnosis of CAP, including aspiration pneumonia.

All patients with a drug-resistant pathogen (DRP) that met inclusion criteria were selected; the next consecutively admitted patient with a non-resistant culture that met study criteria was included as a matched control.

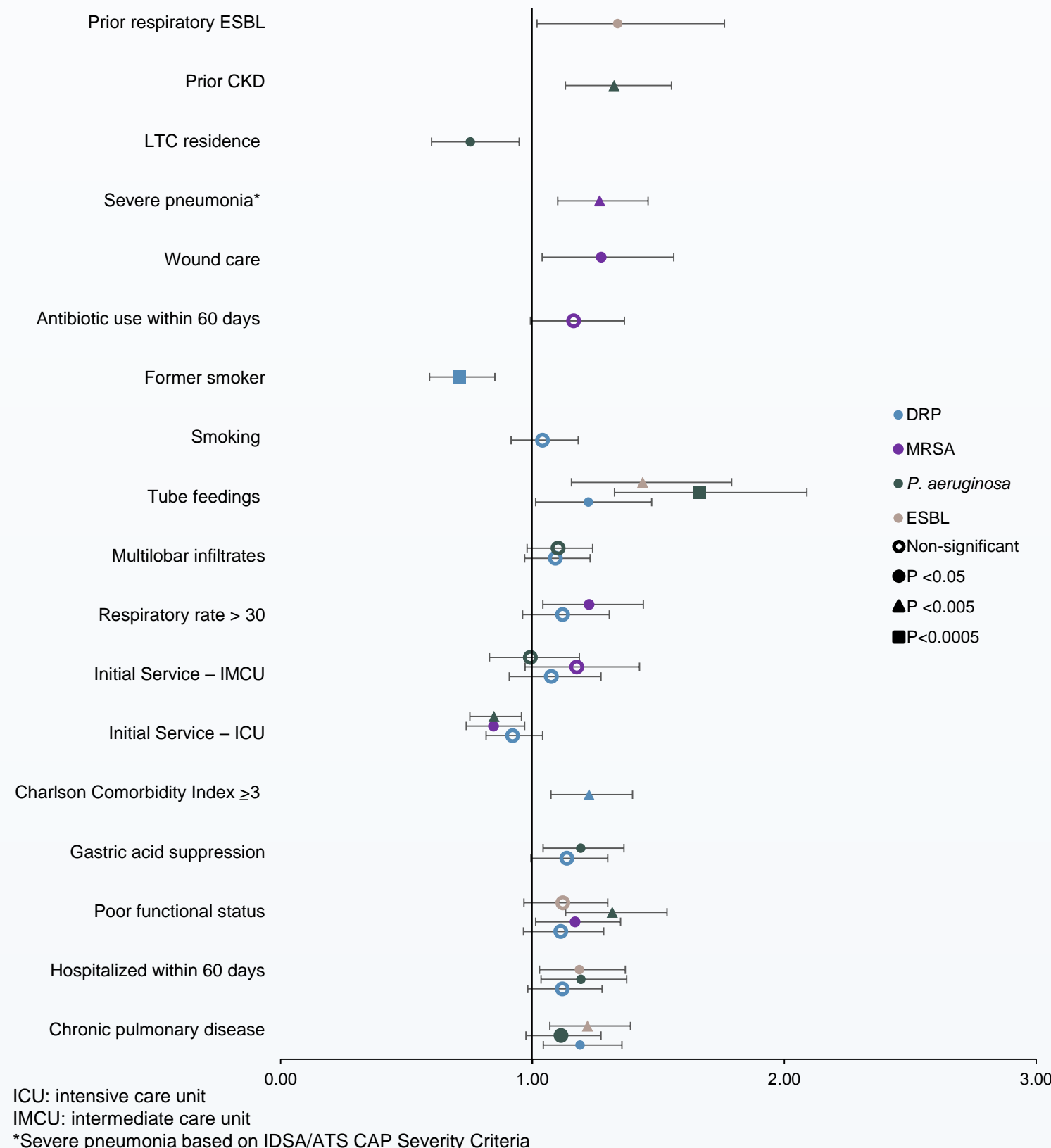
Table 1: Baseline Characteristics

| Characteristic                                   | DRP (n = 114) | Control (n = 113) | P values        |
|--|---------------|-------------------|-----------------|
| Age, years (mean, SD)                            | 67.9 (13)     | 63.5 (16)         | <b>0.03</b>     |
| Male (n/%)                                       | 70 (61.4%)    | 76 (67%)          | 0.43            |
| Race   |               |                   | <b>0.002</b>    |
| Asian or Asian Indian                            | 24 (21.1%)    | 9 (7.9%)          |                 |
| Black or African American                        | 42 (36.8%)    | 37 (32.7%)        |                 |
| White  | 34 (29.8%)    | 32 (28.3%)        |                 |
| Other*   | 13 (11.4%)    | 32 (28.3%)        |                 |
| Unknown  | 1 (0.9)       | 3 (2.7%)          |                 |
| Hispanic Ethnicity                               | 24 (21.1%)    | 15 (13.3%)        |                 |
| Long term care (LTC) residence                   | 45 (39.5%)    | 10 (8.8%)         | <b>&lt;.001</b> |
| LTC residence – ventilator unit                  | 32/45 (71.1%) | 1/10 (10%)        | <b>&lt;.001</b> |
| LTC residence – non-ventilator unit              | 13/45 (28.9%) | 9/10 (90%)        |                 |
| Tracheostomy                                     | 34 (29.8%)    | 3 (2.6%)          | <b>&lt;.001</b> |
| Chronic pulmonary disease#                       | 42 (36.8%)    | 18 (15.9%)        | <b>&lt;.001</b> |
| Chronic kidney disease (CKD)                     | 21 (18.4%)    | 11 (9.7%)         | 0.09            |
| Hemodialysis                                     | 7 (6.1%)      | 8 (7.1%)          | 0.80            |
| Diabetes mellitus                                | 47 (41.2%)    | 46 (40.7%)        | 1.00            |
| Charlson Comorbidity Index (CCI) ≥3              | 97 (85.1%)    | 69 (61.1%)        | <b>&lt;.001</b> |
| Immunosuppressant therapy                        | 15 (13.2%)    | 7 (6.2%)          | 0.12            |
| HIV/AIDS (CD4 < 200 cells/mm3)                   | 2 (1.8%)      | 2 (1.8%)          | 1.00            |
| Malignancy on chemotherapy/ radiation therapy    | 2 (1.8%)      | 1 (0.9%)          | 1.00            |
| Solid organ transplant                           | 3 (2.6%)      | 1 (0.9%)          | 0.62            |
| Travel outside of the US in the previous 14 days | 5 (4.4%)      | 0 (0%)            | 0.06            |

\*Other race: Bangladeshi, Trinidadian, West Indian, "other" per electronic medical record  
 #Chronic pulmonary disease: COPD, structural lung disease, bronchiectasis

## Results

Figure 1: Factors Associated with Drug Resistant Organisms



ICU: intensive care unit  
 IMCU: intermediate care unit  
 \*Severe pneumonia based on IDSA/ATS CAP Severity Criteria

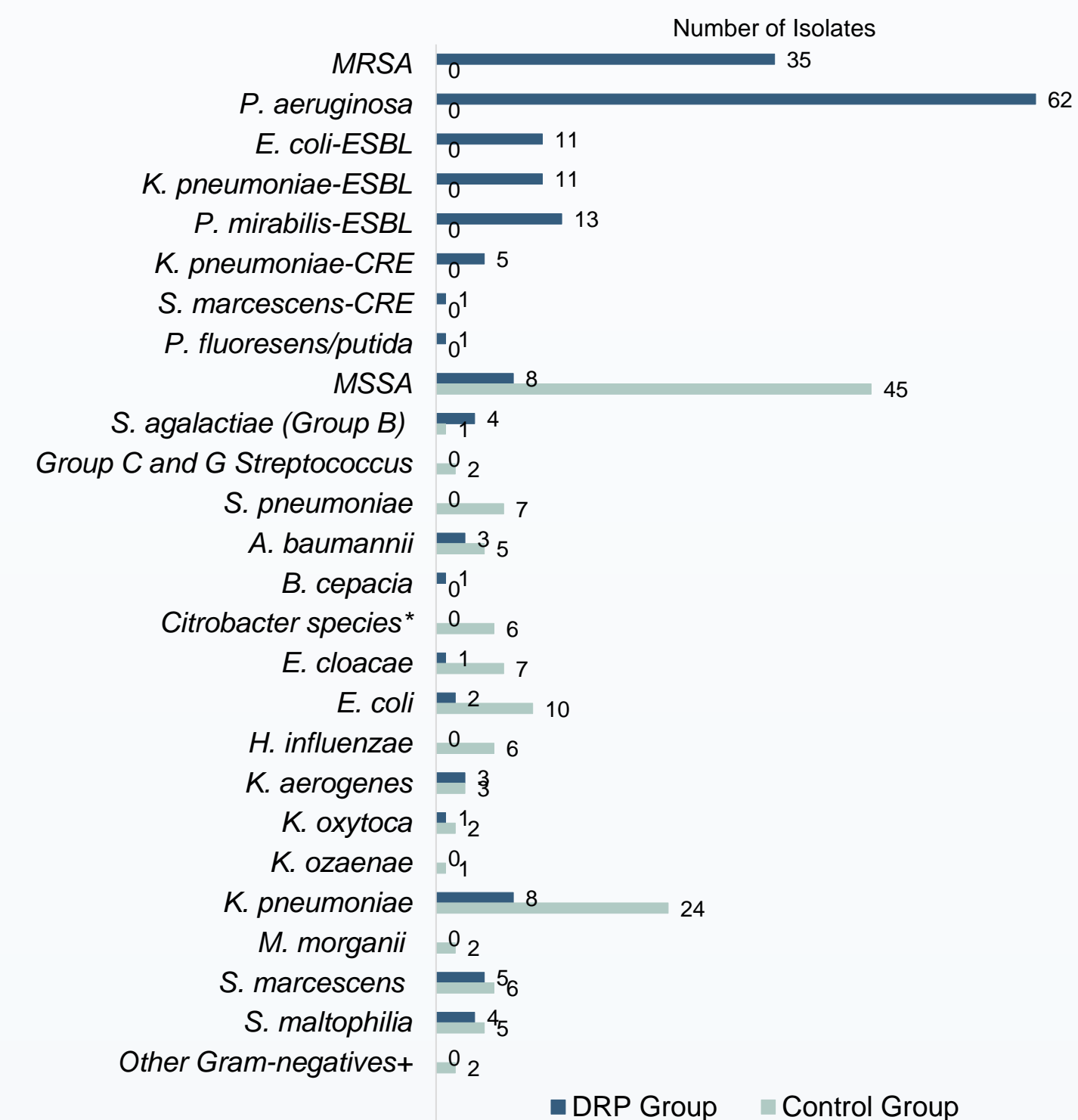
| Criteria                                | DRP (n = 114)   | Control (n = 113) | P values        |
|---|-----------------|-------------------|-----------------|
| <b>Major (2 Points)</b>                 |                 |                   |                 |
| Antibiotic use within previous 60 days  | 41 (35.9%)      | 15 (13.2%)        | <.001           |
| Residence in a LTC facility             | 45 (39.5%)      | 10 (8.8%)         | <.001           |
| Tube feeding                            | 34 (29.8%)      | 3 (2.7%)          | <.001           |
| Prior infection with a DRP (1 yr)       | 16 (14%)        | 2 (1.8%)          | <.001           |
| <b>Minor (1 Point)</b>                  |                 |                   |                 |
| Hospitalization within previous 60 days | 49 (42.9%)      | 16 (14.2%)        | <.001           |
| Chronic pulmonary disease               | 42 (36.8%)      | 18 (15.9%)        | <.001           |
| Poor functional status                  | 62 (54.4%)      | 18 (15.9%)        | <.001           |
| Gastric acid suppression                | 48 (42.1%)      | 19 (16.8%)        | <.001           |
| Wound care                              | 36 (31.6%)      | 6 (5.3%)          | <.001           |
| MRSA colonization (1 yr)                | 2 (1.8%)        | 1 (0.9%)          | 1.000           |
| <b>DRIP score of ≥4</b>                 | <b>57 (50%)</b> | <b>11 (9.7%)</b>  | <b>&lt;.001</b> |

| Organism             | Cutoff | Sensitivity | Specificity | Positive Predictive Value | Negative Predictive Value |
|----------------------|--------|-------------|-------------|---------------------------|---------------------------|
| All DRP              | 2      | 71.9%       | 72.6%       | 72.6%                     | 71.9%                     |
|                      | 3      | 59.7%       | 84.1%       | 79.1%                     | 67.4%                     |
|                      | 4      | 50.0%       | 90.3%       | 83.8%                     | 64.2%                     |
|                      | 5      | 43.9%       | 92.9%       | 86.2%                     | 62.1%                     |
| MRSA                 | 2      | 65.7%       | 72.6%       | 42.6%                     | 87.2%                     |
|                      | 3      | 54.3%       | 84.1%       | 51.4%                     | 85.6%                     |
|                      | 4      | 45.7%       | 90.3%       | 59.3%                     | 84.3%                     |
| <i>P. aeruginosa</i> | 2      | 82.3%       | 72.6%       | 62.2%                     | 88.2%                     |
|                      | 3      | 67.7%       | 84.1%       | 70.0%                     | 82.6%                     |
|                      | 4      | 56.5%       | 90.3%       | 76.1%                     | 79.1%                     |
|                      | 5      | 51.6%       | 92.9%       | 80.0%                     | 77.8%                     |
| ESBLs                | 2      | 70.0%       | 72.6%       | 40.4%                     | 90.1%                     |
|                      | 3      | 66.7%       | 84.1%       | 52.6%                     | 90.5%                     |
|                      | 4      | 63.3%       | 90.3%       | 63.3%                     | 90.3%                     |
|                      | 5      | 60.0%       | 92.9%       | 69.2%                     | 89.7%                     |

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| MRSA colonization (1 yr)                | 2 (1.8%)        | 1 (0.9%)          | 1.000           |
| <b>DRIP score of ≥4</b>                 | <b>57 (50%)</b> | <b>11 (9.7%)</b>  | <b>&lt;.001</b> |

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|                      | 3      | 66.7%       | 84.1%       | 52.6%                     | 90.5%                     |
|                      | 4      | 63.3%       | 90.3%       | 63.3%                     | 90.3%                     |
|                      | 5      | 60.0%       | 92.9%       | 69.2%                     | 89.7%                     |

Figure 2: Organism Distribution



\*Citrobacter species: *C. amalonaticus* = 2, *C. koseri* = 3, *C. youngae* = 1  
 \*Other Gram-negatives = *A. xylosoxidans* = 1, *B. bronchiseptica* = 1

## Limitations

- Single center, retrospective study
- Small sample size
- DRPs are not equally represented
- Organisms with intrinsic resistant included in the control group (E.g. *S. maltophilia*)
- Analysis included tracheostomy patients admitted from ventilator units of LTC facilities

## Conclusion

Demographic risk factors may exist for DRP in CAP, e.g. chronic pulmonary disease. Using a DRIP score cut off of ≥4 missed 50% of the DRP in our study population. Despite a DRIP score ≥4 having a specificity of 90.3%, with a NPV of 64.2% this scoring tool may underestimate the prevalence of DRP in our patient population. Based on our findings, institutions should consider local validation of the DRIP score prior to implementing use at their site.

## References

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## Key Findings:

- Demographic risk factors may exist for DRP in CAP
  - E.g. chronic pulmonary disease, tube feedings, baseline Charlson Comorbidity Index ≥3
- Different risk factors may exist for the specific DRPs: MRSA, *P. aeruginosa* and ESBL
- All DRIP score components were associated with the isolation of DRP in our patient population, except for MRSA colonization
- The DRIP scoring system may underestimate the prevalence of DRP in our patient population
  - DRIP scores ≥2, ≥3 and ≥4 had low negative predictive values (NPV) for the isolation of DRP in CAP