

# Treatment Characteristics and Predictors of Mortality in Patients with Infected Chronic Pressure Ulcers in Detroit

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## Introduction

Infected chronic pressure ulcers (ICPUs) are a significant burden for patients suffering from these wounds and present a challenge for antimicrobial stewardship. Populations at risk for these infections include those with spinal cord and other traumatic injuries which cause limb paralysis, including motor vehicle accident and gun-shot wound patients. Despite limited knowledge about the incidence of multi-drug resistant organisms in this population, broad-spectrum antimicrobials are routinely prescribed. The quantification of burden of illness and outcomes of ICPUs are also poorly defined.

The objective of this study was to characterize treatment characteristics and risk factors for poor outcomes in patients with ICPUs at a large urban health-system.

## Methods

### Study Design

This was an IRB approved, cross sectional study conducted at four acute-care hospitals throughout southeast Michigan. A nested case-control study was performed to identify risk factors for poor patient outcomes, including all-cause or in-hospital 30-day mortality.

### Study Population

The study population included hospitalized patients with ICPUs who received treatment with systemic antimicrobials from June 2013 to June 2017.

Inclusion Criteria	Exclusion Criteria
<ul style="list-style-type: none"> <li>Age ≥ 18 years</li> <li>Confirmed diagnosis of pressure ulcer</li> <li>Hospitalization at time of ulcer assessment</li> <li>Treatment with a systemic antimicrobial agent</li> </ul>	<ul style="list-style-type: none"> <li>Pressure ulcer developed ≤ 2 weeks</li> <li>Diabetic foot ulcers</li> </ul>

### Data Collection

Data collected included: patient demographics, select comorbid conditions, functional status via Braden Score, pressure ulcer and infection characteristics, microbiology, antimicrobial treatment exposures, and patient outcomes (e.g., mortality, readmission). Pressure ulcer staging was assessed through clinician or wound-care nursing records when available. All microbiologic species identification was completed by a central microbiology laboratory in accordance to Clinical & Laboratory Standards Institute (CLSI) standards. Data were collected using a standardized electronic case report form.

### Key Definitions

- Infected ulcer:** diagnosis by admitting and discharging providers with documentation of at least one *a priori* determined infectious symptom: i) purulent exudate, ii) surrounding erythema, iii) ulcer pain, and iv) other unexplained sepsis attributable to no other possible cause
- Multi-drug resistant organisms:** methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus* spp. (VRE), Enterobacteriaceae characterized as extended-spectrum beta-lactamase producers (ESBL) or carbapenem-resistant Enterobacteriaceae (CRE), any *Pseudomonas aeruginosa* (PsA) regardless of susceptibilities, any *Acinetobacter baumannii* (ACBI) regardless of susceptibilities
- High quality culture:** non-superficial cultures that include deep tissue, surgical, abscess, bone, or biopsy cultures of the ICU.

### Statistical Analyses

Descriptive statistics were used to describe the patient population and ICPUs. Baseline patient characteristics were compared using bivariate analyses: categorical variables were compared by the Pearson's  $\chi^2$  or Fisher's exact test, continuous variables were compared by the student's *t*-test or the Mann-Whitney U-test; *P*-values <0.05 were considered statistically significant. Variables associated with mortality (*P* < 0.2) from univariate analysis were included into a multivariable logistic regression model to determine independent associations. All statistics were performed using IBM SPSS Statistics for Macintosh version 23.0.

### Disclosures:

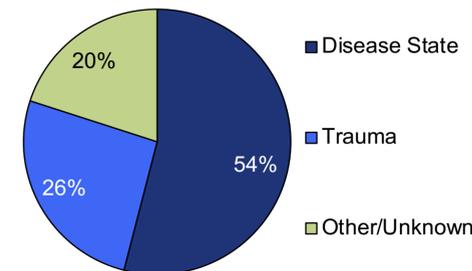
The investigators report no potential conflicts of interest related to this study.

## Results

### Patient Characteristics

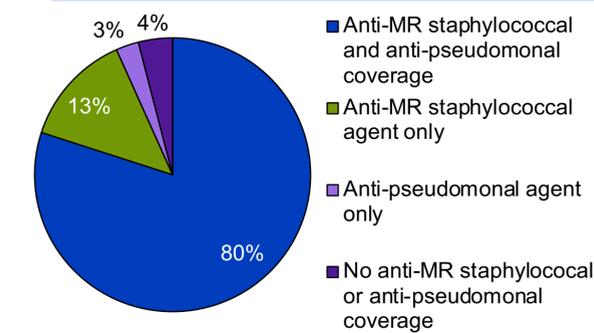
Covariate <i>n</i> (%) or median (IQR)	<i>n</i> = 225
Median age, years	69 (55-83)
Sex, male	121 (54%)
Hemi-or quadriplegia	101 (45%)
Pressure Ulcer Stage ≥ 3	189 (84%)
Previous antibiotic use, 6 months	131 (58%)
Previous MDRO isolated, 6 months	51 (23%)

### Cause of Pressure Ulcer



### Patient Treatment and Outcomes

#### Empiric Treatment Regimens

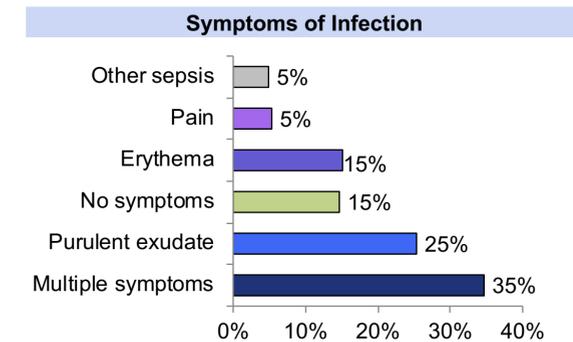


#### Treatment characteristics

Treatment characteristics	<i>n</i> (%) or median (IQR)
Surgical intervention	161 (72%)
Receipt of targeted therapy*	112/142 (79%)
Median duration of antimicrobials, days	18 (10-36)

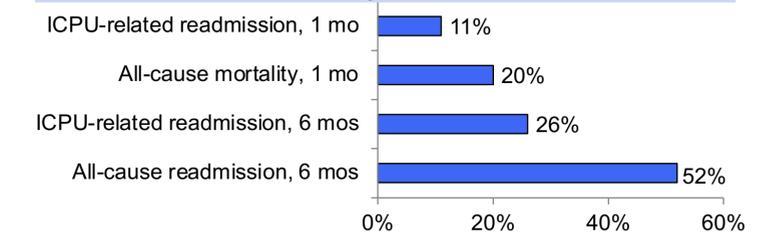
\*Quality ICU cultures were obtained in 142 patients, making targeted therapy possible in only 63% of the population.

### Infection Characteristics



Variables	<i>n</i> (%)
Pressure ulcer of sacrum	143 (63%)
Underlying osteomyelitis	88 (39%)
Admission to intensive care unit	49 (22%)
Concomitant infection	26 (12%)

### Follow-up Outcomes



### Variables Associated with all-cause 30-day Mortality, *n* = 46

Variables	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	<i>P</i> -value
Bacteremia secondary to ICU	4.9 (2.0-11.9)	7.1 (2.4-20.8)	<0.001
Braden Score < 10	3.2 (1.2-8.6)	3.6 (1.1-11.1)	0.03
Admission to intensive care unit	2.7 (1.3-5.5)	2.1 (0.74-5.8)	0.17
Anti-pseudomonal coverage, empiric	1.0 (0.4-2.3)	1.4 (0.5-4.1)	0.51
Quality ICU culture	0.3 (0.15-0.7)	0.4 (0.1-0.9)	0.03

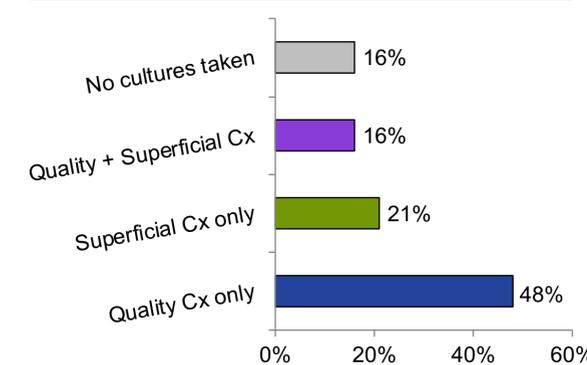
## Summary

- ICPU management is varied and empiric broad-spectrum antimicrobials are frequently used. *P. aeruginosa* was rarely isolated, but the majority of patients received empiric therapy with an anti-pseudomonal agent.
- Risk factor identification for *P. aeruginosa* would better guide appropriate empiric therapy in ICPUs.
- Patients with ICPUs frequently had poor outcomes, and quality ICU cultures were obtained in slightly over half of the population. This prevented the possibility of targeted antimicrobial therapy in a high proportion of patients.
- Obtaining quality ICU cultures was associated with improved patient outcomes, possibly in part to employing targeted therapy.

### Pressure Ulcer Microbiology

- 135/188 (72%) patients with cultures yielded 228 organisms: 46% were polymicrobial and 30% were culture negative ICPUs. Of all organisms isolated, 76 (33%) were multi-drug resistant: 40 (52%) MRSA, 11 (14%) PsA, 8 (11%) VRE, 7 (9%) ESBL, 6 (8%) CRE, and 4 (5%) ACBI.

#### Culture Types in ICU patients, *n* = 225



#### ICPU Organisms (including polymicrobial), *n* = 228

