Procalcitonin Utilization in Patients Hospitalized with Pneumonia in Michigan Hospitals: A Cohort Study

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Background

- Procalcitonin is a blood test that rises in bacterial infections

- Evidence-based procalcitonin use for pneumonia includes:

  - Using initial levels to determine whether to start antibiotics

  - Repeating an initially negative test within 6-24 hours, if suspicion for a bacterial infection is high

  - Trending levels and stopping antibiotics when levels normalize

- Procalcitonin-based algorithms have been shown to reduce antibiotic initiation, duration of treatment, and adverse drug events

- Despite this potential benefit, algorithm compliance in the US may be low, which could hinder the expected reduction of antibiotic use

Aim:

- For patients hospitalized with pneumonia in Michigan, determine:
  - The availability and current patterns of use of procalcitonin testing
  - Whether procalcitonin is used in an evidence-based fashion
 - The effect of procalcitonin utilization on antibiotic duration

Methods

- From 11/15 - 10/16, trained abstractors from the Michigan Hospital Medicine Safety Consortium collected data from non-ICU medical patients admitted with community-acquired (CAP) or healthcare-associated pneumonia (HCAP) at 10 diverse Michigan hospitals

- Outcomes: duration of antibiotics, procalcitonin use, procalcitonin positivity. Predictor variables: procalcitonin positivity, final diagnosis (CAP, HCAP, not pneumonia), Pneumonia Severity Index (PSI; or age, Charlson Comorbidity Index, sepsis), admitting service, and renal disease

- Multivariable logistic or linear regression with adjustment for hospital clustering was used, as appropriate

- All statistical analyses were performed using Stata/MP 14.1 (College Station, Texas). $p < 0.05$ was considered significant

Results

- There were 1,995 patients total. Half (5/10) of surveyed hospitals had procalcitonin available, but only 3 tested on general medical patients

**Figure 1.** CAP and HCAP Patients with Procalcitonin Testing, by Hospital
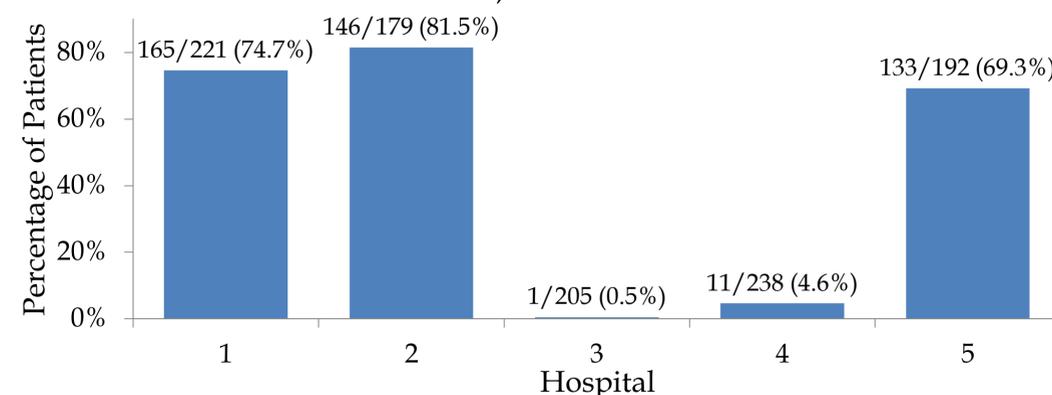
Procalcitonin use was associated with:
- Admission service: hospitalists [81.1% (95% C.I. 75.6-86.7)] ordered most frequently followed by general [72.3% (64.7-79.9)], family [53.1% (38.9-62.3)], and subspecialty [54.4% (45.6-63.2)] medicine physicians
- A higher PSI [OR 1.15 (1.06-1.24) per increase in class]
  - Class I: 68.3% (65.3-71.3), Class V: 78.4% (72.9-83.9)
- Renal disease and final diagnosis were not predictors of use

- A single procalcitonin was ordered in 71.2% (316/444) of patients tested

- Negative values were repeated only 23.1% of the time (68/295)

- Factors associated with a positive (>0.25 mcg/L) procalcitonin:
  - Sepsis: OR= 1.73 (95% CI: 1.55-1.94) for sepsis vs. no sepsis
    - Sepsis: 39.3% (95% CI: 37.6-40.9) positive
    - No sepsis: 27.9% (95%CI: 24.3-31.5) positive
  - Age: OR=1.12(1.05-1.20) for every 10 years
    - 20 years: 23.1% (17.0-29.2) ; 100 years: 41.7% (36.5-46.8) positive
  - Chronic Kidney Disease: OR 1.75 (95% CI: 1.30-2.35)
  - Acute kidney injury, Charlson Comorbidity Index, and final diagnosis were not associated with a positive test

Results (continued)

Figure 2. Effect of Procalcitonin Use on Mean Antibiotic Duration in Patients with Pneumonia
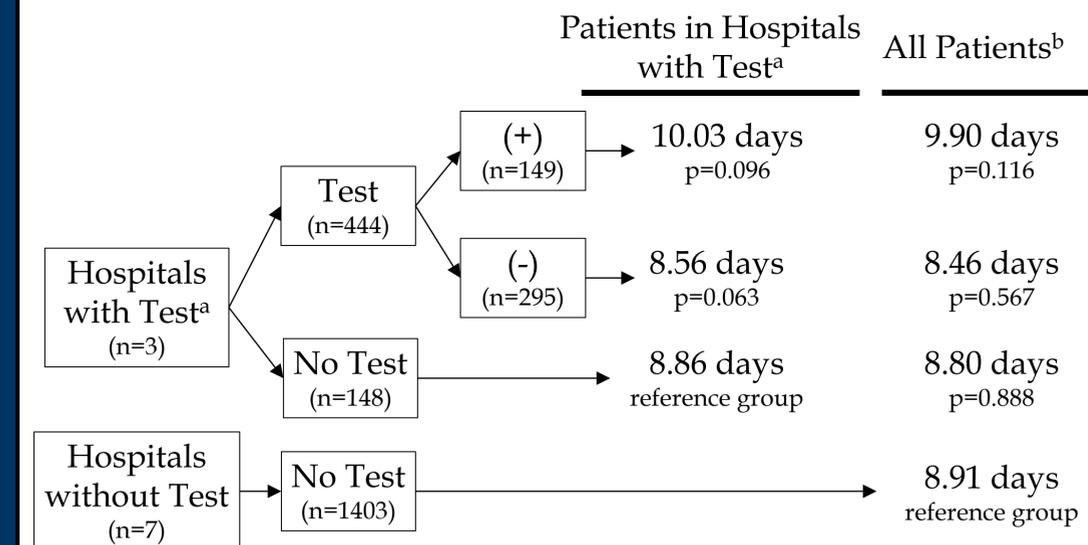
Antibiotic duration is adjusted for Charlson Comorbidity Index, admission service, age, sepsis, and hospital clustering. a) Adjustment and comparisons made include patients in hospitals with consistent procalcitonin usage. b) Adjustment and comparisons made using all patients. A positive procalcitonin is >0.25 mcg/L.

Summary

- The duration of antibiotic therapy for pneumonia is excessive

- When available, procalcitonin use in pneumonia patients is common

- Physicians do not trend positive or repeat initial negative values

- Procalcitonin use is not associated with a reduced antibiotic duration

- Non-algorithmic use of procalcitonin may negate the effect of procalcitonin at reducing antibiotic utilization

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