

Evaluating the Role of Procalcitonin in Respiratory Infections

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Disclosures

- Potential conflicts of interest: none
- Sponsorship: none
- Proprietary information and results of ongoing research may be subject to different interpretations
- Speaker's presentation is educational in nature and indicates agreement to abide by the non-commercialism guidelines provided

UW Medicine: Valley Medical Center

- 341-bed acute care hospital
- Serves more than 600,000 residents in south King County
- Largest nonprofit healthcare center between Seattle and Tacoma
- 77,344 emergency room visits in 2020 fiscal year



Valley Medical Center. About Us. <https://www.valleymed.org/About-Us/About-Us/>. Accessed May 23, 2021.

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Pre-Assessment Questions

1. What are the benefits to having biomarkers that are specific to bacterial infections?
 - a) Limits unnecessary antibiotic use
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 - d) All of the above
2. Which diseases have symptoms that overlap with lower respiratory tract infections (LRTIs)?
 - a) COPD
 - b) Diabetes
 - c) Heart Failure
 - d) A&C
 - e) All of the above
3. True or False: PCT is a definitive biomarker for bacterial infections

Learning Objectives



Evaluate the utility of procalcitonin at Valley Medical Center



Discuss limitations of procalcitonin



Assess potential improvements that can be made to the current procalcitonin algorithm

Background

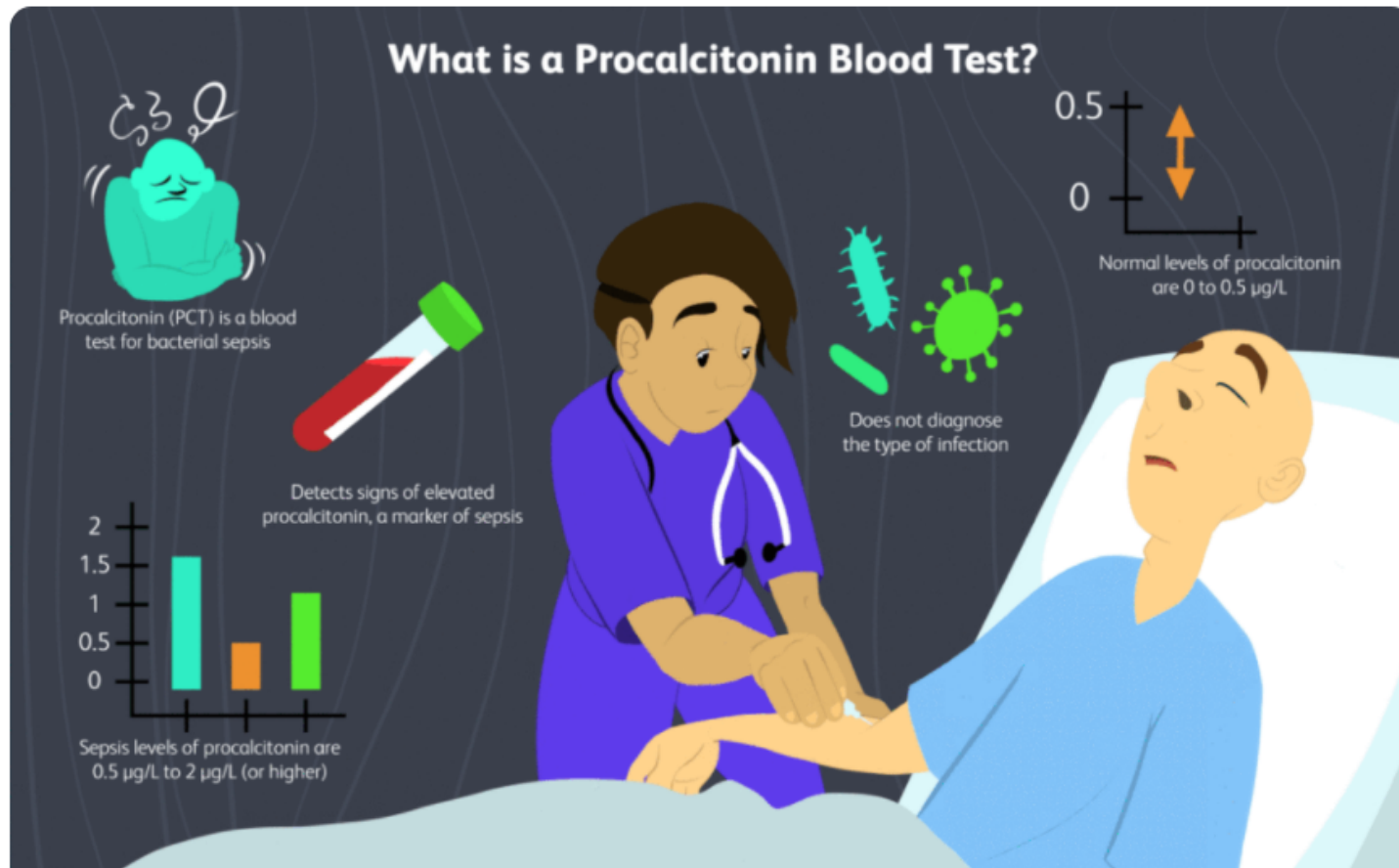
Issue with Procalcitonin

- Antibiotics are overprescribed
 - Antibiotic resistance
 - Unnecessary antibiotic related adverse effects
 - Increase in healthcare costs
- Need to identify tools to better evaluate the need for antibiotics



<https://domf5oi6qrcr.cloudfront.net/medialibrary/5290/1018g16207257685884.jpg>

Procalcitonin (PCT)



[https://www.verywellhealth.com/thmb/OHEW4ODWSGUbWdJlNaUEvPDkk~/1200x800/filters:no_upscale\(\):max_bytes\(150000\):strip_icc\(\)/procalcitonin-results-and-what-they-mean-3156825_final-849cc6f2339d4611aaf2098b8b760744.gif](https://www.verywellhealth.com/thmb/OHEW4ODWSGUbWdJlNaUEvPDkk~/1200x800/filters:no_upscale():max_bytes(150000):strip_icc()/procalcitonin-results-and-what-they-mean-3156825_final-849cc6f2339d4611aaf2098b8b760744.gif)

Trials

- **ProHOSP Trial**

- Design: Multicenter, noninferiority, RCT in emergency departments of 6 tertiary care hospitals in Switzerland with 1359 patients with mostly severe LRTIs
- Primary Outcome: Composite of overall adverse outcomes occurring within 30 days following the ED admission
- Secondary Outcomes: Duration of antibiotic exposure, adverse effects from antibiotic treatment, and length of hospital stay
- Conclusion: PCT guidance compared with standard guidelines resulted in **similar rates of adverse effects**, as well as **lower rates of antibiotic exposure and antibiotic-associated adverse effects**

Procalcitonin Algorithm

Initiating Antibiotics

PCT $\leq$ 0.10 ng/mL

Highly
unlikely to
be a
bacterial
infection

PCT < 0.25 ng/mL

Unlikely to
be a
bacterial
infection

PCT $\geq$ 0.25
and $\leq$ 0.5 ng/mL

Likely to be
a bacterial
infection

PCT > 0.5 ng/mL

Highly likely
to be a
bacterial
infection

Discontinuing Antibiotics

PCT < 0.10 ng/mL

Stopping
antibiotics
strongly
encouraged

Decrease by > 80%
from peak
OR
PCT < 0.25 ng/mL

Stopping
antibiotics
encouraged

Decrease by < 80%
from peak
AND
PCT $\geq$ 0.5 ng/mL

Continuing
antibiotics
encouraged

Increased
concentration
AND
PCT > 0.5 ng/mL

Continuing
antibiotics
strongly
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Trials

- **ProACT Trial**

- Design: Multicenter, RCT in 14 United States hospitals with 1656 patients presented for LRTIs
- Primary Outcome: Total antibiotic exposure within 30 days of enrollment
- Secondary Outcomes: adverse outcomes attributable to holding antibiotics, prescription of antibiotics in the ED, antibiotic receipt by day 30, antibiotic-days during the hospital stay, admission to the ICU, subsequent ED visits by day 30, and quality of life assessment
- Conclusion: The provisions of procalcitonin assay results **did not result in less use of antibiotics than did usual care among patients with suspected LRTIs**

Infectious Diseases Society of America Stance

- Procalcitonin
 - Not recommended to determine need for initial antibacterial therapy
 - Procalcitonin does not completely rule out bacterial pneumonia

Methods

Study Goal

- To understand how PCT is incorporated in the management of patients with suspected respiratory infections at Valley Medical Center



<https://www.happierhuman.com/wp-content/uploads/2018/11/goal-setting-research.jpg>

Study Objectives

- **Primary Objective:** To evaluate how PCT levels impacted antibiotic utilization among inpatients admitted with suspected respiratory infections.
- **Secondary Objective:** To evaluate the impact of using PCT on length of stay, mortality, Clostridium difficile rates, and readmission rates.

Design and patient selection

- Single center retrospective medical chart review
- Inclusion criteria:
 - Age $\geq$ 18 years old
 - Prescribed IV azithromycin in the Emergency Department (ED) for a respiratory indication from September 1, 2019 to March 1, 2020

Outcomes

- **Primary Outcome:**
 - To compare antibiotic utilization, measured by duration of antibiotic therapy between patients with PCT levels versus those without PCT levels
- **Secondary Outcomes:**
 - Length of stay
 - Confirmed community acquired pneumonia
 - 30-day all-cause rate of readmission
 - In-hospital mortality
 - Clostridium difficile rates

Statistical Analysis

- **Primary Outcome**
 - Descriptive
 - Poisson Regression
- **Secondary Outcomes**
 - Descriptive

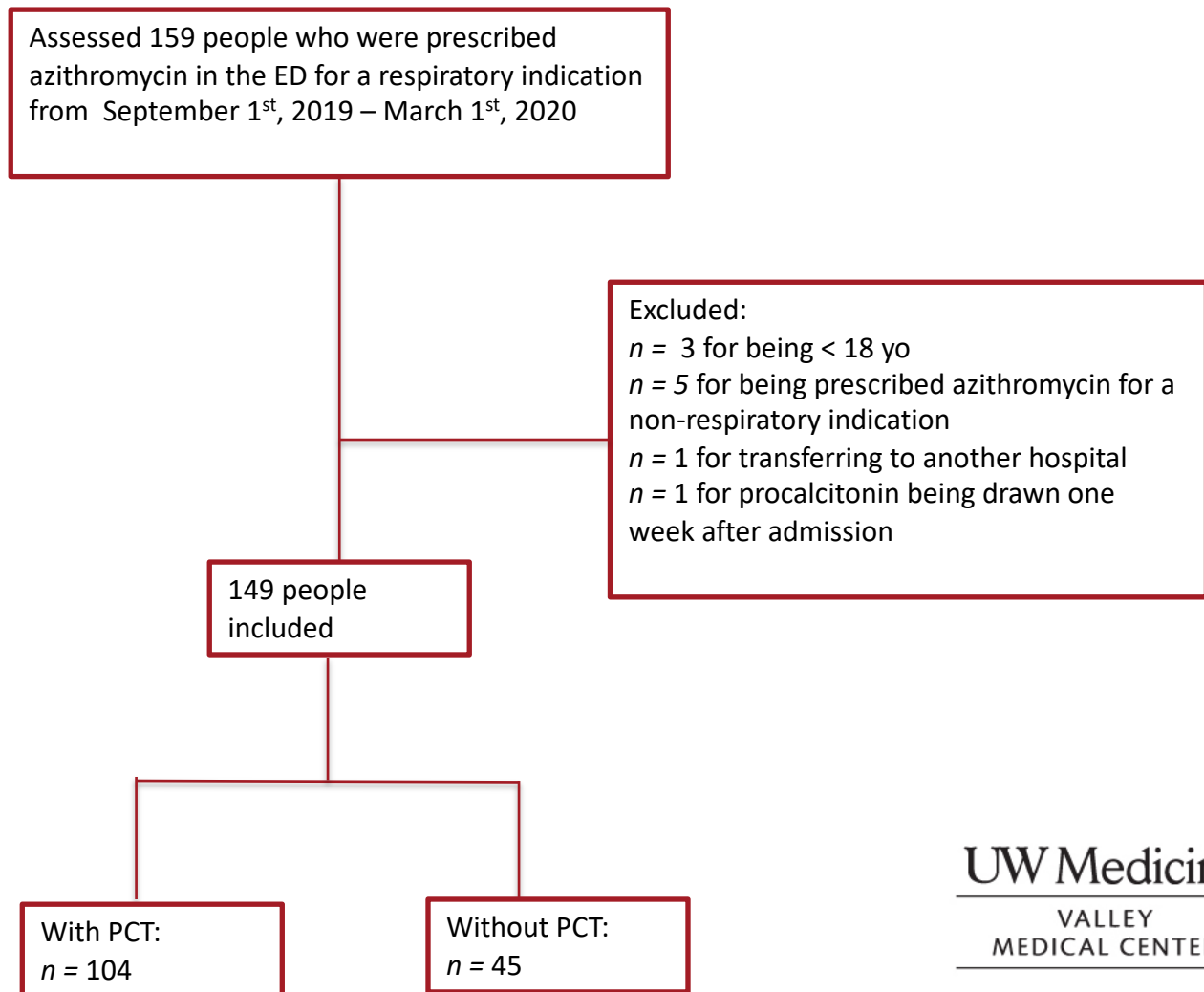


Statistical Analysis

- Groups
 - Procalcitonin vs. No Procalcitonin
 - Admission Diagnosis:
 - Infection - suspicious for LRTI
 - Infection - not suspicious for LRTI
 - Non-Infectious
 - Unclear – infectious vs. non-infectious
 - Procalcitonin level
 - Highly Likely > 0.5 ng/dL
 - Likely $0.25 - 0.5$ ng/dL
 - Unlikely $0.1 - 0.24$ ng/dL
 - Highly Unlikely < 0.1 ng/dL

Results

Results: Data Flow Diagram



Baseline Characteristics

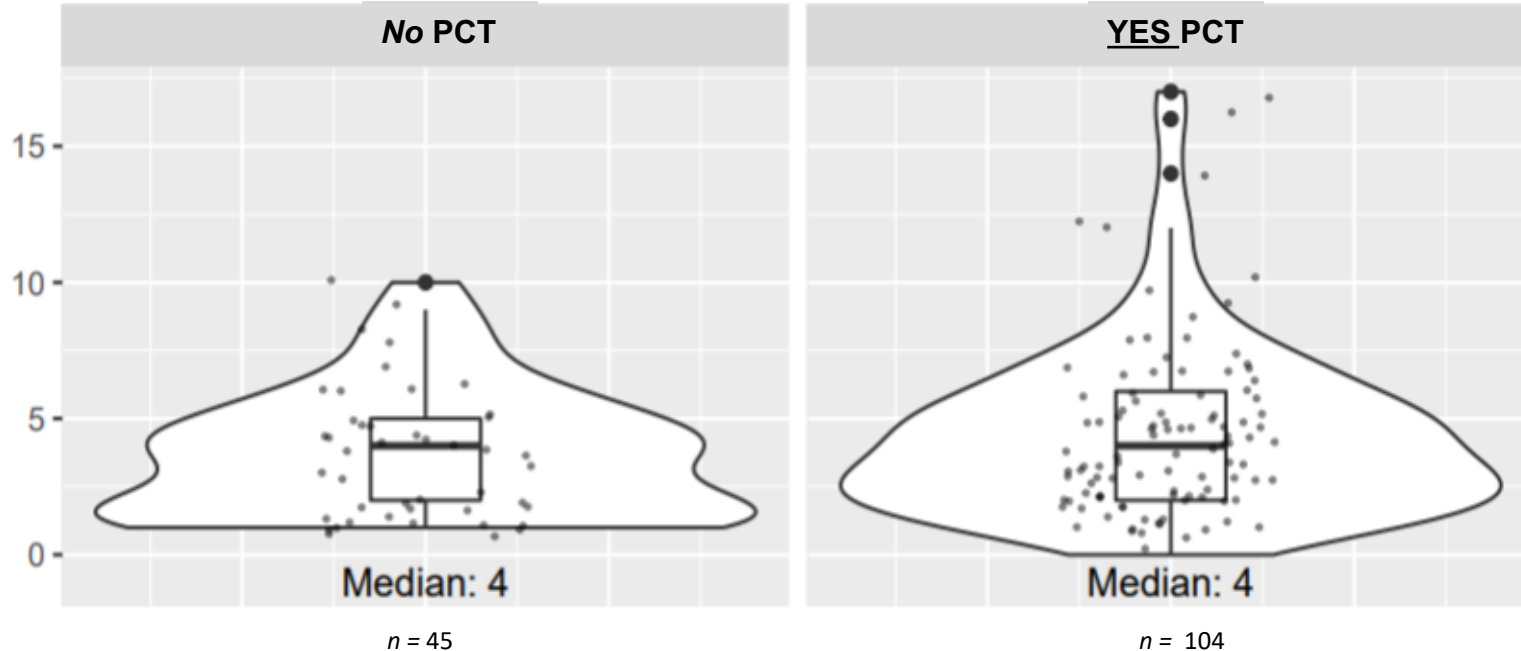
Variable	PCT Yes (<i>n</i> = 104)	PCT No (<i>n</i> = 45)
Sex (M/F)	F - 56 (0.54)	F - 21 (0.47)
Respiratory co-morbidities (Y/N)	Y - 55 (0.53)	Y - 22 (0.49)
Abnormal chest X-ray(Y/N)	Y - 85 (0.82)	Y - 39 (0.87)
Conditions that could falsely elevate PCT (Y/N)	Y - 49 (0.47)	Y - 20 (0.44)
Oxygen use at home (Y/N)	Y - 17 (0.16)	Y - 6 (0.13)
Supplemental oxygen required (Y/N)	Y - 74 (0.71)	Y - 27 (0.60)
ICU admission within 48 hours (Y/N)	Y - 31 (0.30)	Y - 6 (0.13)
Confirmed pneumonia (Y/N)	Y - 47 (0.45)	Y - 34 (0.76)
30-day all cause rate of readmission (Y/N)	Y - 18 - (0.17)	Y - 13 (0.29)

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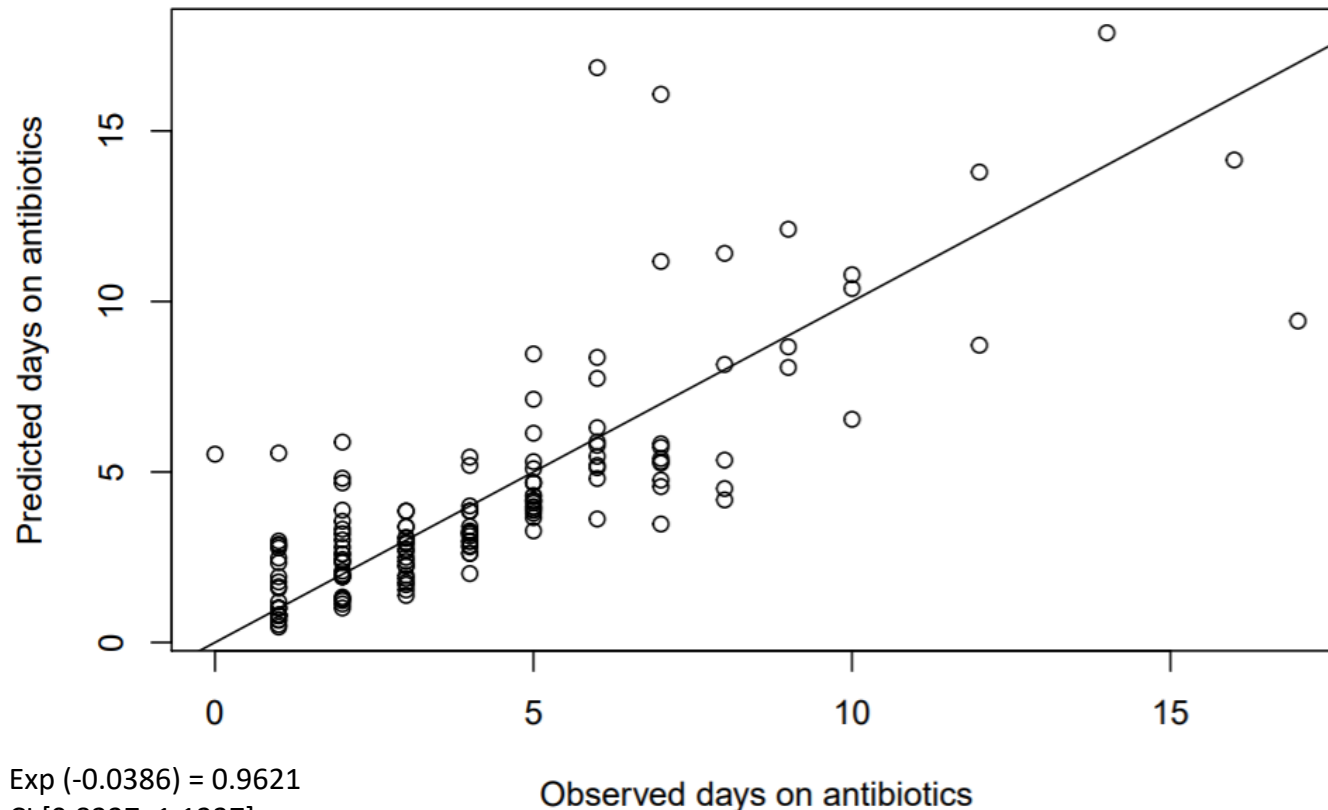
Primary Outcome: Days on antibiotics during hospitalization

- Days on antibiotics during hospitalization



Primary Outcome: Days on antibiotics during hospitalization

- Poisson Regression

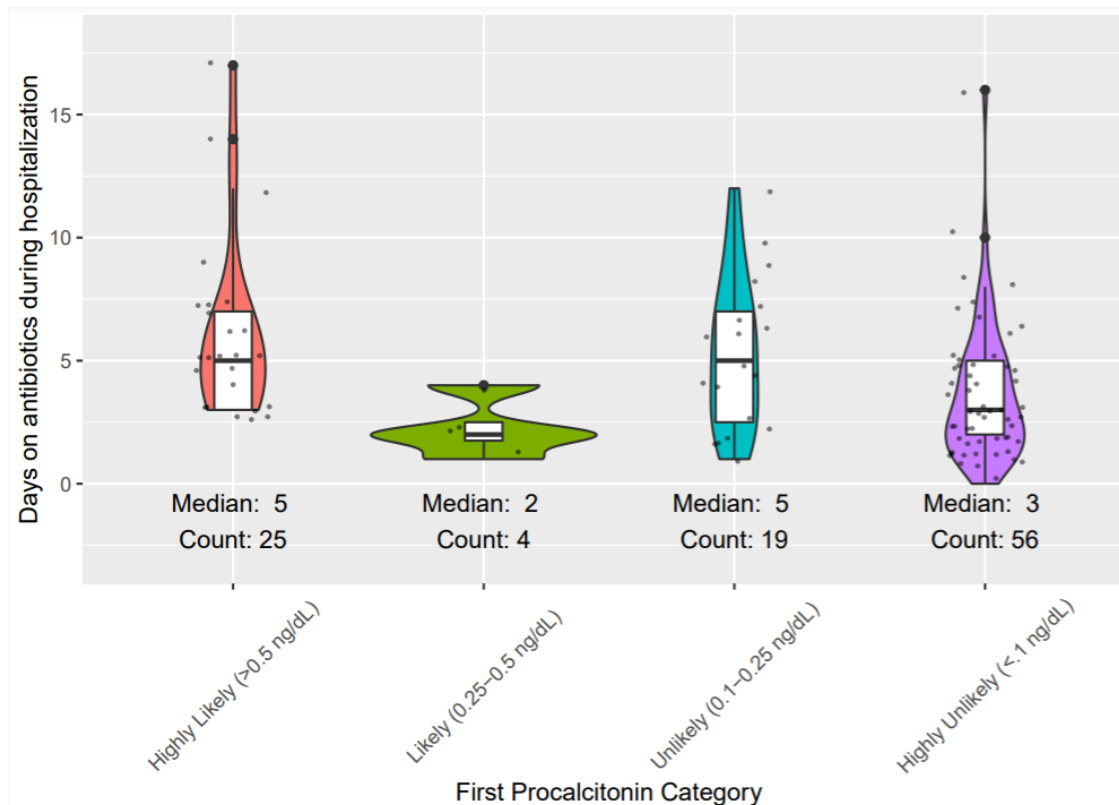


Factors taken into consideration:

- ICU admission
- Gender
- Abnormal chest X-ray
- Conditions that falsely elevate procalcitonin

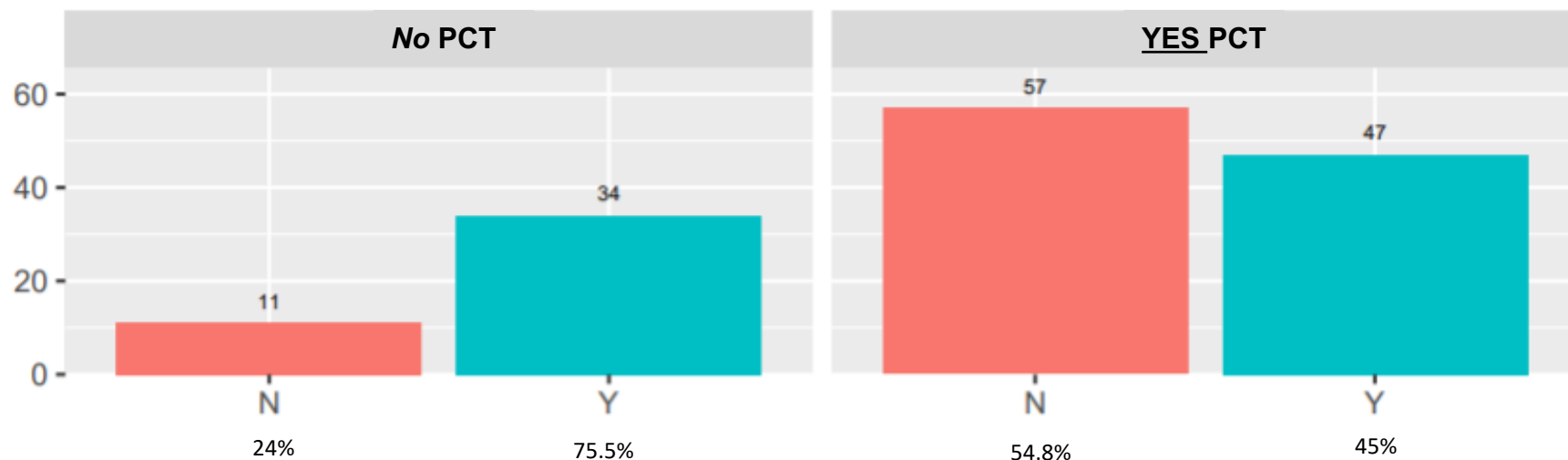
Primary Outcome: Days on antibiotics during hospitalization

- Days on antibiotics during hospitalization based on PCT level



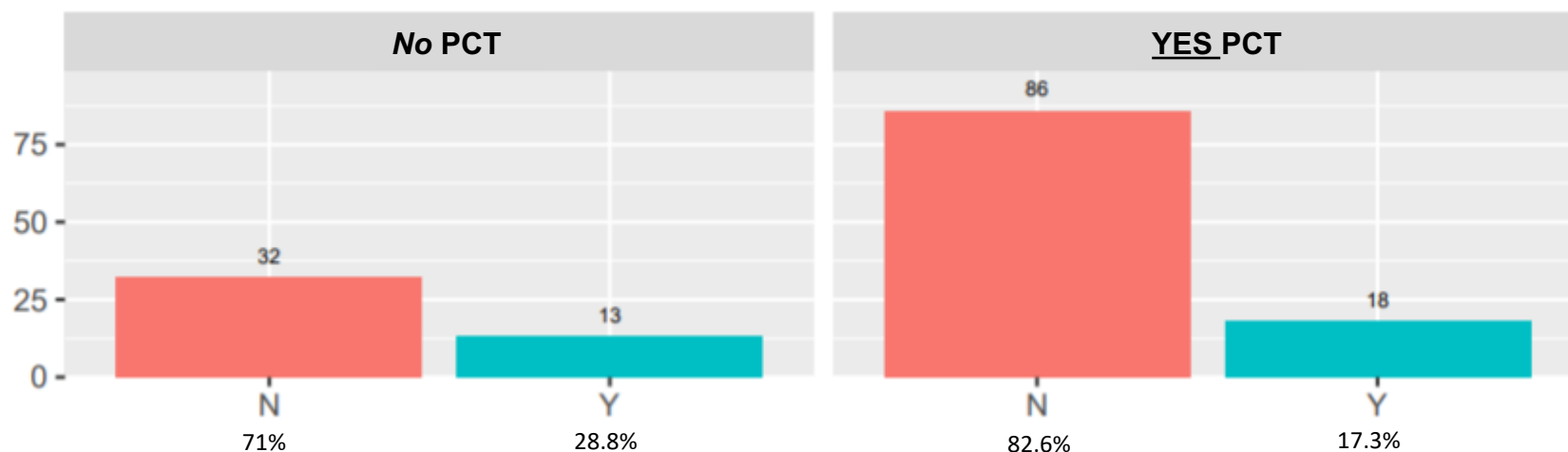
Secondary Outcomes: confirmed community acquired pneumonia

- Confirmed community acquired pneumonia through discharge diagnosis



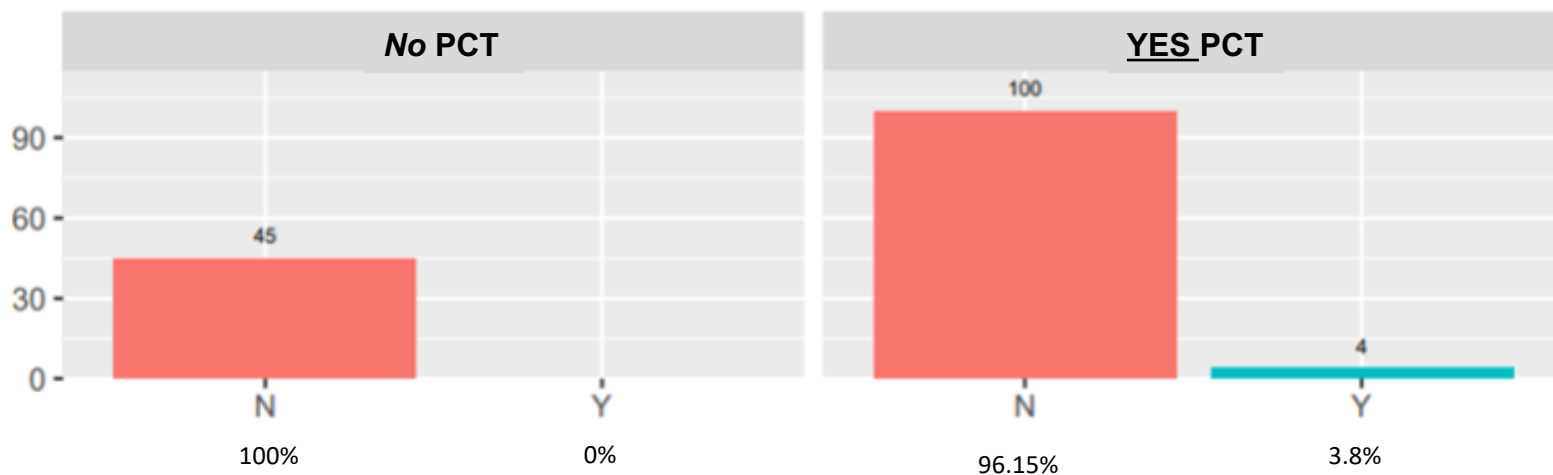
Secondary Outcomes: 30-day all cause rate of readmission

- 30-day all cause rate of readmission



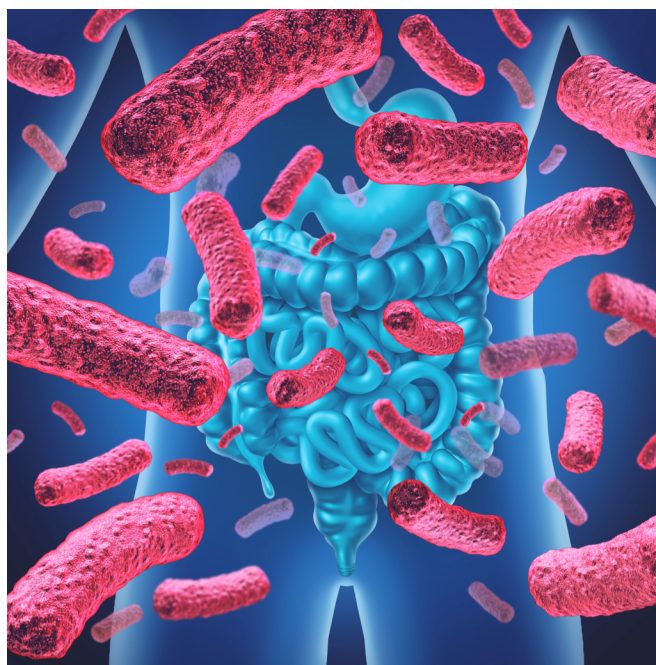
Secondary Outcomes: in-hospital mortality

- In-hospital mortality



Secondary Outcomes: Clostridium difficile rates

- Clostridium difficile (CDI) rates
 - 2 cases of Clostridium difficile in the no PCT arm



Limitations

- Retrospective study
- Hospitalists chart in different ways
- Does not account for multiple PCT levels
- Multiple confounding factors
 - Comorbidities affecting the PCT level

Summary

- People in the arm who did not receive a PCT level had more confirmed cases of CAP
- Group without a PCT level had a higher rate of readmission
- Days on antibiotics did not differ between each group
- Higher in hospital mortality and less CDI rates in the group with PCT
- Group with a PCT level had higher oxygen requirements and more people admitted to the ICU
- Days on antibiotics did not differ between each group, but trended appropriately based on procalcitonin level

Future Directions

- Design a study to identify if there are subgroups that would benefit from a procalcitonin
- Assess pharmacist's role of ordering PCT
- Evaluate cost-effectiveness of PCT
- Identify which providers are utilizing the PCT algorithm

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