U.S. Department of Veterans Affairs
Veterans Health Administration

# Predictive Value of Procalcitonin across Disease States within an Inpatient Veteran Population

Jarred Bowden, PharmD[1], Kelly Davis, PharmD[3], Jessica Bennett, PharmD[1], Jane Eason, MD[1,2], Anwesh Dash, BA[2], William Callicott, DO[2], Rachel Minrath, PharmD[3], Evan Stearns, MD[4], Neena Thomas-Gosain, MD[1,2]
[1]Memphis VA Medical Center, [2]University of Tennessee Health Science Center, [3]Lexington VA Health Care System, [4]University of Kentucky Healthcare

## BACKGROUND

Procalcitonin (PCT) is an inflammatory marker that can be elevated in a variety of autoimmune and infectious diseases. Its popularity has increased in the past decade with most of the evidence supporting its use in shortening the duration of antibiotics, particularly in those patients with respiratory infections. However, there is increasing interest in expanding the use of procalcitonin. One such area is in aiding with decision-making in initiation of antibiotics. Its elevation in bacterial infections has been promoted as a feature that may help clinicians distinguish bacterial from viral infections. More recently, the role of procalcitonin in initiation of antibiotics became even more topical with the arrival of COVID-19, when concerns about bacterial co-infection were raised and elevated procalcitonin was postulated as a tool that may help determine if bacterial co-infection was present. However current evidence is not robust enough to support this practice and debate persists about the utility of procalcitonin in diagnosis and monitoring of septic patients. We aim to examine the relationship between procalcitonin levels and presence of bacterial infection across various common disease states in a medically complex patient population.

## METHODS

Patients admitted to two VA Medical Centers from 4/1/2019 through 7/1/2021 with a procalcitonin obtained within the first 72 hours of admission were identified from the Veterans Affairs Corporate Data Warehouse. Patients with specified infectious disease diagnoses (as determined by ICD-10 codes) were included in analysis and stratified into four different groups: COVID-19, sepsis from respiratory source, sepsis from non-respiratory source and respiratory infection without sepsis. Encounters without cultures or transferred from outside were excluded from analysis. Additional variables within the first 72 hours of admission collected include abnormal vital signs (temp >38C or <36C, HR >90 and RR>20), abnormal WBC (>12k or <4K), CRP, and all culture results. Presence of comorbidities was also collected- CKD, ESRD, CHF, pulmonary condition (ILD, asthma, COPD), immunocompromised status, any surgery in the past 7 days. Data was analyzed on a per encounter basis with normal (< 0.25 ng/mL) vs elevated (≥0.25 ng/mL) PCT levels compared to culture results. Primary outcomes were predictive values (PV) of PCT in the diagnosis of bacterial infection overall as well as within the pre-specified groups. Secondary outcomes include PV of PCT in concert with standard tools in diagnosis of infection and the impact of comorbidities on the utility of PCT.

## RESULTS

815 of 894 encounters were analyzed. PCT was elevated twice as often in septic groups and immunocompromised or recent surgery patients (**Table 1**). PPV varied from 31% to 66% as compared to NPV 51%-74% among the disease state groups (**Figure 1**) with the highest NPV seen in non-septic groups (COVID-19 and Resp). A similar trend was seen when PVs were calculated by comorbidity, with NPV >70% in CHF or a pulmonary disease (**Figure 2**). Although small numbers, the NPV of PCT improves to >80% in patients with fever and leukocytosis (**Table 2**), with NPV 100% in patients with respiratory diagnoses (septic and non-septic).

| DEMOGRAPHICS | Elevated PCT | Normal PCT |
|---|---|---|
| **Mean age** | 71 | 71 |
| **Male gender** | 445 (98%) | 346 (96%) |
| **COMORBIDITIES** | | |
| CKD/ESRD | 150 (69%) | 67 (31%) |
| CHF | 161 (56%) | 126 (44%) |
| Pulmonary | 190 (48%) | 87 (52%) |
| Immunocompromised | 55 (63%) | 32 (37%) |
| Surgery < 7 Days | 10 (71%) | 4 (29%) |
| **ID DIAGNOSIS GROUP** | | |
| COVID | 74 (47%) | 84 (53%) |
| Resp | 109 (41%) | 159 (59%) |
| Sepsis-Resp | 105 (68%) | 49 (32%) |
| Sepsis-NonResp | 167 (71%) | 68 (29%) |

**Table 1: Study Group Characteristics**

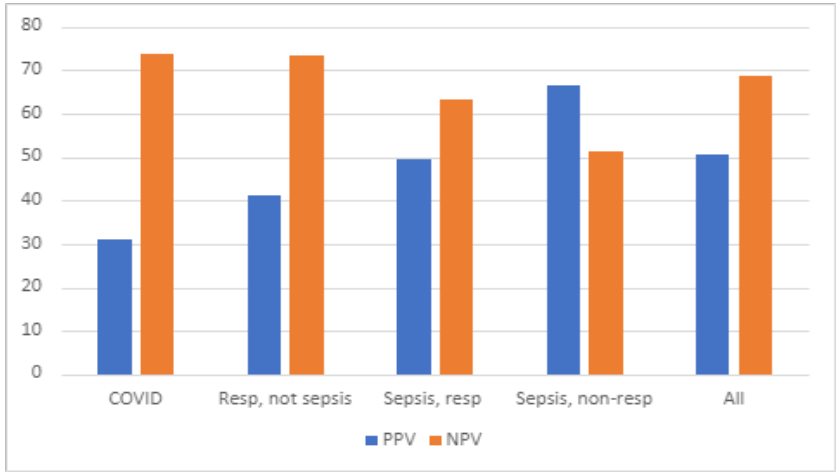


**Figure 1: Predictive Values by ID Diagnosis**

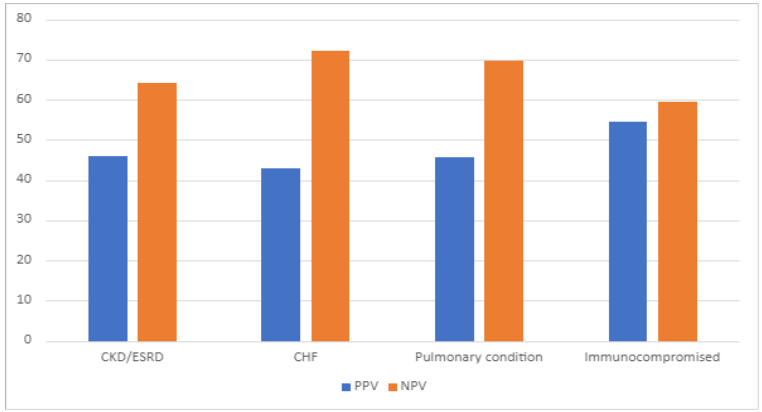


**Figure 2: Predictive Values by Comorbidity**

| FEVER + ↑WBC (n) | ↑Procal | PPV | NPV |
|---|---|---|---|
| **COVID (13)** | 7 | 28.6% | 83.3% |
| **Resp (8)** | 7 | 57.1% | 100% |
| **Sepsis-Resp (20)** | 17 | 29.4% | 100% |
| **Sepsis-NonResp (34)** | 33 | 69.7% | 0% |
| **Total (75)** | 64 | 53.1% | 81.8% |

**Table 2: PV in Febrile + Leukocytosis**

## CONCLUSIONS

Our study found higher NPV than PPV rates which supports current recommendations against using PCT as a diagnostic tool, but rather as a tool for antibiotic de-escalation. Our data suggests PCT is less reliable in ruling out bacterial infection in septic versus non-septic patients. The NPV increased when fever and leukocytosis were considered, a finding that is contrary to expectations. These findings suggest that PCT adds little to current standard of care in the diagnosis of bacterial infection.

## REFERENCES

1. Hamade B, Huang DT. Procalcitonin: Where Are We Now? Crit Care Clin. 2020 Jan;36(1):23-40.
2. Paudel R, Dogra P, Montgomery-Yates AA, Coz Yataco A. Procalcitonin: A promising tool or just another overhyped test? Int J Med Sci. 2020 Jan 18;17(3):332-337.