Utility of the PITT Bacteremia Score for Predicting Mortality in CRE Colonized and Infected Patients


## Abstract

Background

Pitt Bacteremia Scoring is used for 14 Day inpatient Mortality in Blood Stream infection.In this study we determine if PBS scoring can be used as mortality Predictor in CRE colonized and Infected Patients.

Methods

Patients in ICU who had Carbapenem Resistance were selected and each component of PBS score was assessed individually. Patient outcome was noted after 14 days and a cutoff score of PBS in predicting mortality was analyzed

Results

Out of total 30 patients ,26 expired (86%) and 4 survived(14%).The most appropriate cutoff level was <4 vs ≥4 as mortality exponentially increased at PBS score>4



**Keywords**:Pitt bacteremia score,Carbapenem-resistant Entrobacteriacae,Mortality score,Risk score




## Introduction

The exorbitant worldwide rise in the rate of multidrug resistant Enterobacteriaceae infections over the past few years is a major public health crisis (1). Carbepenem resistant Enterobacterales are one of the most threatening pathogens affecting severely ill patients admitted in intensive care units (ICUs). Underlying comorbid conditions in these patients increases the mortality rate among these patients (2–4 ) CRE colonization in these patients is associated with increased likelihood of CRE infection.(5) . Predicting the outcome in these patients may help in more aggressive management. An easily identifiable and measurable predictor may prove to be even more useful. [6] Thus a valid, reliable, and measurable indicator of acute severity of illness is required to stratify patients by baseline risk of mortality.

Several recent studies have introduced new risk assessment tools tailored specifically for patients diagnosed with CRE infections. The INCREMENT-CPE score (ICS) was initially designed to

predict mortality within 14 days among individuals with carbapenemase-producing Enterobacteriaceae (CPE) bacteremia. Subsequent modifications extended its applicability to predicting 30-day mortality in both bacteremic and non-bacteremic CPE infections. Another notable tool is the Pitt bacteremia score (PBS), along with its simplified version, the qPitt, which have recently been validated across a large cohort of patients affected by both bacteremic and non-bacteremic CRE infections [3,4,6,].

PBS is a scoring system that predicts the 14-day mortality of a patient in a clinical observation based on the data of physical examination. PBS has fewest parameters and is easiest to calculate.[7] It assess the severity of acute illness based on patient specific variables thus it has major advantages over other scores like APACHE and SOFA[8]. The absence of laboratory results allows for the immediate application of the PBS at the bedside, without delays for venous puncture and the subsequent receipt of laboratory results. PBS is generally used for BSI infections [3] but there are limited studies on its validation in non-bacteremic infections (PITT). consequently, there is uncertainty regarding the performance of these risk scores in the context of the current era of more effective and safer antibiotic therapies
There are very few studies predicting the outcome of CRE patients using the Pitt's bacteremia score and as far as our knowledge no study from India predicting the mortality in CRE colonized and infected patients using the Pitt's Bacteremia score.

**OBJECTIVES**

1.To evaluate the utility of Pitt bacteremia score for predicting the mortality in CRE colonized infected patients
2.To assess the contribution of each component of the PBS to predict the mortality in subjects

**Methodology**

**Type of study /Study design** - Cross sectional - Prospective observational study
**Study population/ participants** - Patients above 18 years of age admitted to the ICUs in a northern central India's tertiary care center.

**Consent** - Informed and written consent is taken from all the study participants (or their attendees if the participant is not conscious) to enroll in the study with the nature of study explained in local language .

**Sample Method and sample size -**

All patients under the inclusion criteria during the study period are included.

**Inclusion criteria -**

1. Patients admitted in ICU and colonized or infected with CRE

**Exclusion criteria -**

1. Outdoor Patients
2. Patients not willing to enroll in the study
3. Pregnant females
4. children less than 18 years of age

**Methods** –

1. The patients admitted in the ICUs are enrolled in the study after obtaining proper informed consent.
2. Detailed clinical history (including demographic and personal history – to identify different risk factors) and clinical examination will be done.
3. Rectal swabs are collected from patients admitted in ICU and will be cultured on MacConkey agar for colonization by GNR. Carbepenem resistance will be detected by kirbybauer disc diffusion using meropenem,imipenem, ertapenem disc
4.For patients showing signs of infections, respective samples are sent to the microbiology laboratory. Patient's infected with carbapenem resistant Enterobacteriaceae will be included in the study
5. Pitt Bacteremia Score : For each patient, baseline is defined as the date of collection of the CRE positive culture that will be included in this analysis. The outcome of interest was 14-day all-cause inpatient mortality, measured from baseline. The PBS is calculated for each patient at baseline pitt bacteremia. The hypotension, mechanical ventilation, mental status, and maximum temperature parameters of the PBS are measured on the baseline date. For each variable, the worst reading on the calendar day of the index culture will be recorded. Cardiac arrest will be considered present if it occurred on the baseline date or within the previous 48 hours

List 1-Weightage of each variable in PBS Scoring

| Variable | Weight |
|---|---|
| Hypotension | 2 |
| Mechanical ventilation | 2 |
| Cardiac arrest | 4 |
| Mental status | |
| Disoriented | 1 |
| Stuporous | 2 |
| Comatose | 4 |
| Maximum temperature(referent: 36.1–38.9) | |
| 35.1–36.0 or 39.0–39.9 | 1 |
| ≤35.0 or ≥40.0 | 2 |

**IMPLICATIONS**

1. The prediction scores may help in feasible and rapid triaging of patients with CRE infections

2. Early identification of high-risk patients in low resource setting will help in timely and better management of patients

3.The prediction and standardized scoring system helps to compare analysis of different populations

## RESULTS

### Study Population and 14-Day Inpatient Mortality

#### Patient overview

A total of 42 Carbapenem-resistant Enterobacteriaceae–positive Culture were collected from the ICU as clinical samples and Rectal swabs out of which 28 had positive CRE positive cultures from BAL and Tracheal sample and rectal swabs while 2 patients had no growth from Tracheal sample but showed CRE in rectal swab screening. Flow chart 1

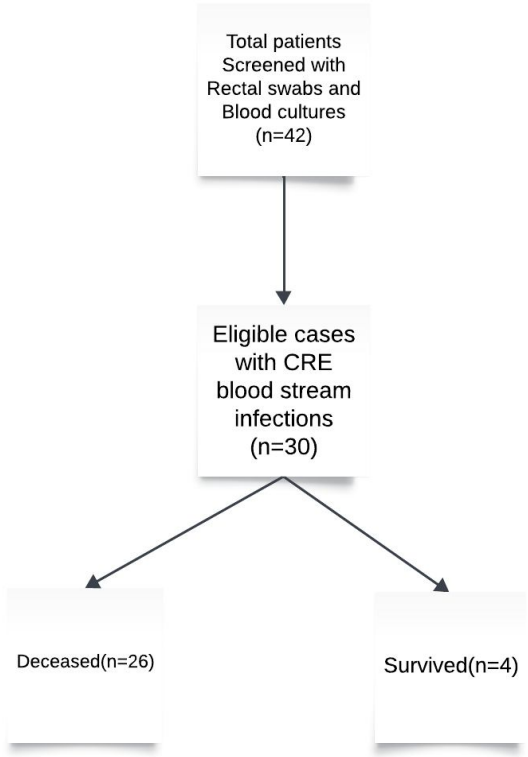



Fig 1- Study protocol

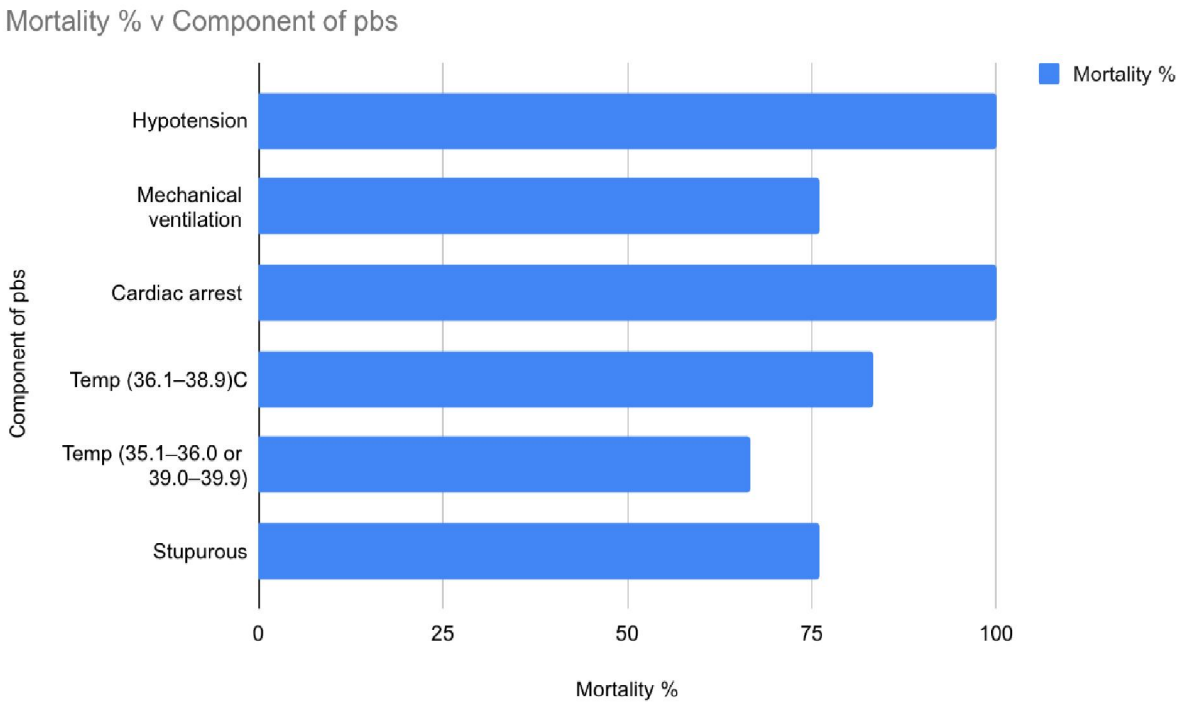
## Contribution of individual component of PBS In Mortality

When analyzed each component of PBS had a significant effect on mortality. All the patients who had hypertension (n=12) expired within 14 days. Cardiac arrest was significantly associated with mortality with 100% mortality

Table 2. Contribution of individual component of PBS In Mortality

| Characteristic | TOTAL | Died | SURVIVED |
|---|---|---|---|
| Hypotension | 12/30(40%) | 12 | 0 |
| Mechanical ventilation | 30/30(100%) | 23 | 7 |
| Cardiac arrest | 4/30(13.3%) | 4 | 0 |
| Maximum temperature (°C) | | | |
| 36.1–38.9 | 18/30(60%) | 15 | 3 |
| 35.1–36.0 or 39.0–39.9 | 12/30(40%) | 8 | 4 |
| ≤35.0 or ≥40.0 | 0 | 0 | 0 |
| Mental status | | | |
| Normal | 0 | 0 | 0 |
| Disoriented | 0 | 0 | 0 |
| Stuporous | 30/30(100%) | 23 | 7 |
| Comatose | 0 | 0 | 0 |

Fig 2-Contribution of individual component of PBS In Mortality



K. pneumoniae was isolated from 24/30 patients. From. The remaining 6 isolates were Enterobacter sp. (4), Escherichia coli (2)

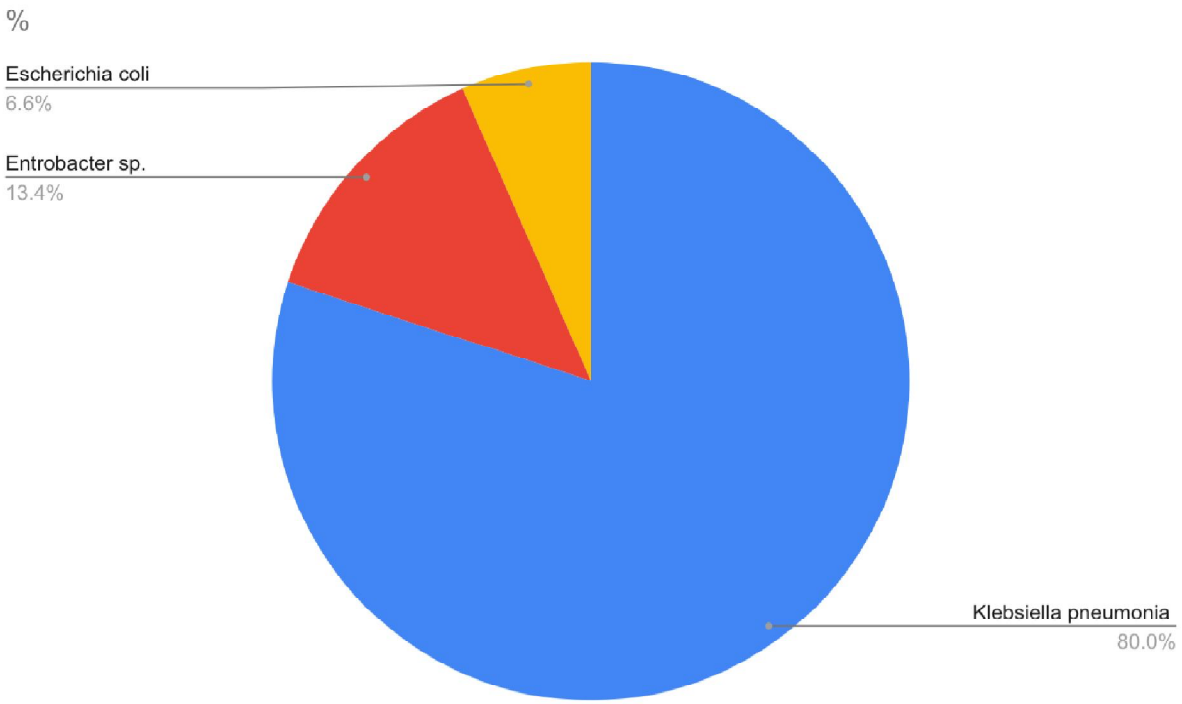



Fig 3- Pie chart showing martality percentage

The most appropriate cutoff for the PBS,is as the PBS increased from 3 to 4, mortality increased markedly and continued in an increasing trend as the PBS increased above 4. The most appropriate cutoff level was <4 vs ≥4

Table 1-PBS score sheet

| PBS SCORE | EXPIRED | DISCHARGED |
|---|---|---|
| 1 | 0 | 0 |
| 2 | 0 | 0 |
| 3 | 0 | 2(100%) |
| 4 | 1(16.6%) | 5(84%) |
| 5 | 9(100%) | 0 |
| 6 | 9(100%) | 0 |

| | | |
|---|---|---|
| >=7 | 4(100%) | 0 |



Table 2-Coordinates of the Curve

| | | |
|---|---|---|
| Test Result Variable(s): PB Score | | |
| Positive if Greater Than or Equal To | Sensitivity | 1 - Specificity |
| 2.00 | 1.000 | 1.000 |
| 3.50 | 1.000 | .714 |

| | | |
|---|---|---|
| 4.50 | .955 | .000 |
| 5.50 | .545 | .000 |
| 6.50 | .182 | .000 |
| 8.00 | .000 | .000 |

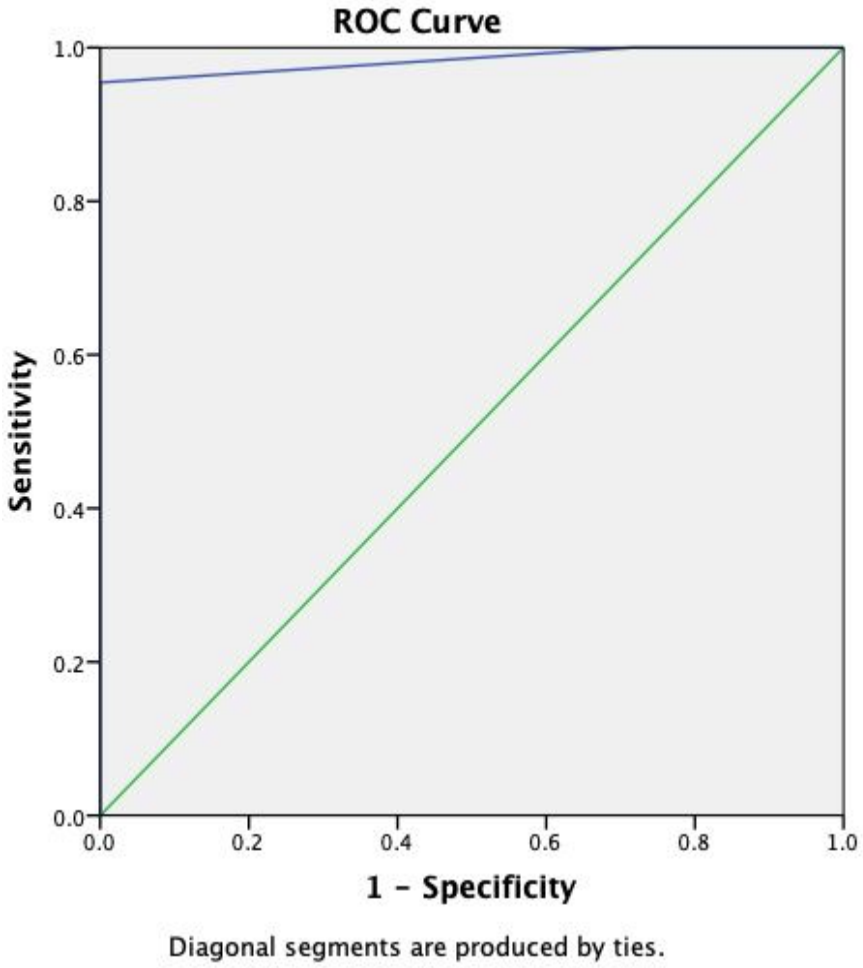



Fig 4 Sensitivity vs Specificity diagram

**Antimicrobial susceptibility testing results**

Antibiotic sensitivity of the positive cultures (Resistant to meropenem) showed maximum resistance to Gentamicin 73% followed by Amikacin 53%. Graph 1

| Pit | Amc | Ak | Le | Cot | Ctr | At | Mrp |
|---|---|---|---|---|---|---|---|
| 53 | 73 | 53 | 53 | 33 | 26 | 3 | 100 |

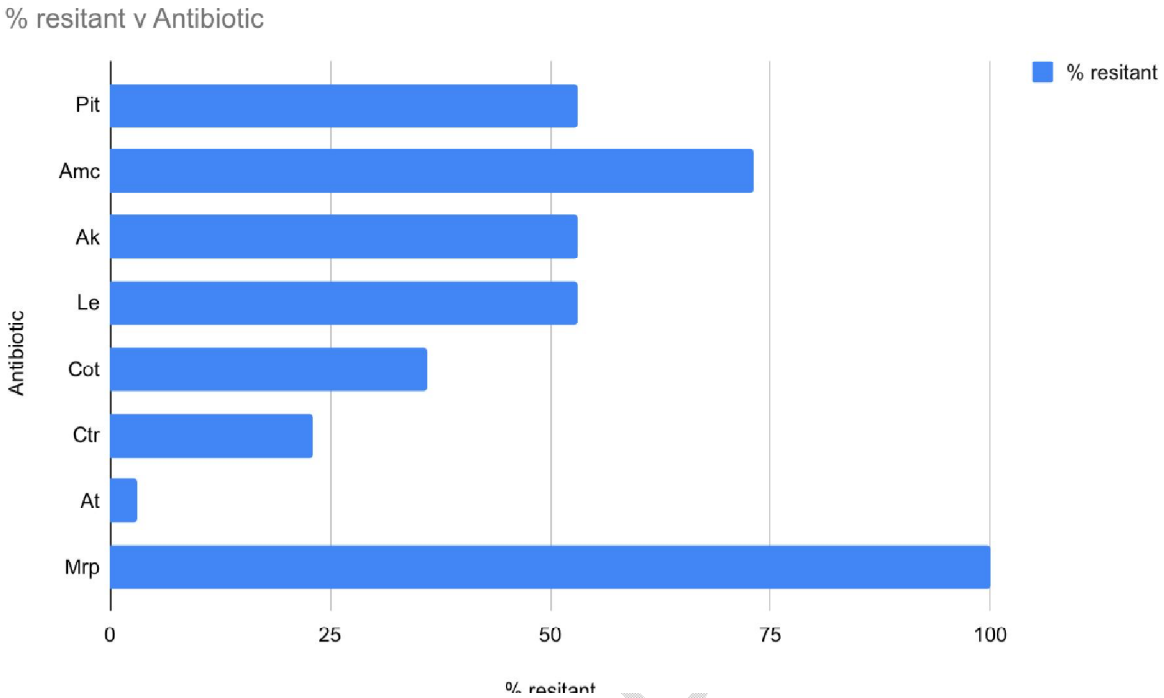



Fig 5-Antimicrobial susceptibility testing results

**Discussion:**

Our study aimed to evaluate the predictive utility of the Pitt Bacteremia Score (PBS) in determining mortality among critically ill patients admitted to ICUs and colonized or infected with Carbapenem-resistant Enterobacteriaceae (CRE). Our findings revealed a compelling association between elevated PBS scores and heightened mortality risk, particularly pronounced in patients exhibiting critical conditions such as hypotension, cardiac arrest, mechanical ventilation, and altered mental status (stuporous). These findings align closely with several seminal studies.

Meta-analysis by Johnson et al. (2020) corroborates our study's findings by affirming PBS's effectiveness in predicting mortality across various infection types, including gram-negative bacterial infections. This broader validation supports PBS's applicability in ICU settings for risk assessment and clinical decision-making in critically ill patients.[9]

Vincent et al. (1996) compared PBS with the Sequential Organ Failure Assessment (SOFA) score in septic patients, emphasizing PBS's specificity in assessing bacteremia-related mortality risks compared to SOFA's broader organ dysfunction markers. This distinction underscores PBS's tailored approach in identifying high-risk patients specifically in infectious contexts.[14]

Our study extends this body of evidence by focusing explicitly on PBS's application in CRE infections, providing nuanced insights into bacteremia-related mortality risks in this challenging

patient population. By identifying specific PBS components associated with increased mortality, such as hypotension and mechanical ventilation, our findings underscore the clinical relevance of PBS in guiding targeted therapeutic interventions and optimizing resource allocation in ICU settings.

**Conclusion**:

Our study contributes to the growing understanding of PBS as a pivotal tool for mortality prediction in critically ill patients with CRE infections. The consistent findings across various infection types and patient populations reinforce PBS's reliability and clinical relevance in modern healthcare settings. Moving forward, further multicenter studies and prospective validations will be crucial to solidify PBS's role as a standard prognostic tool in managing antibiotic-resistant infections and improving patient outcomes.

**Limitation:**

1. Small Sample Size: Limited to patients from a single tertiary care center in northern central India, limiting generalizability.
2. Observational Study Design: Susceptible to biases and confounding factors that may influence the interpretation of PBS's predictive value.
3. Short-Term Outcome Focus: Primarily focused on 14-day inpatient mortality, may not capture longer-term outcomes or chronic effects of CRE infections.

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