"A STUDY OF BLOOD UREA NITROGEN AND SERUM ALBUMIN RATIO IN PATIENTS OF PNEUMONIA AT A TERTIARY CARE HOSPITAL, BELAGAVI"

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LIST OF ABBREVIATIONS

ABG – Arterial Blood Gas

AICA – Anterior Inferior Cerebellar Artery

APACHE – Acute Physiology and Chronic Health Evaluation

ATS – American Thoracic Society

BAR – Blood Urea Nitrogen to Albumin Ratio

BUN – Blood Urea Nitrogen

CAP – Community-Acquired Pneumonia

CBC – Complete Blood Count

COPD – Chronic Obstructive Pulmonary Disease

CRP – C-Reactive Protein

CT – Computed Tomography

CURB-65 – Confusion, Urea, Respiratory rate, Blood pressure, Age ≥ 65 years (Pneumonia severity score)

ESCMID – European Society of Clinical Microbiology and Infectious Diseases

ERS – European Respiratory Society

FiO_2 – Fraction of Inspired Oxygen

GCS – Glasgow Coma Scale

HAP – Hospital-Acquired Pneumonia

HESA – Hepatic Encephalopathy Scoring Algorithm

ICMR – Indian Council of Medical Research

ICU – Intensive Care Unit

ILD – Interstitial Lung Disease

INR – International Normalized Ratio

JRS – Japanese Respiratory Society

KFT – Kidney Function Test

LFT – Liver Function Test

MELD – Model for End-Stage Liver Disease

MRI – Magnetic Resonance Imaging

NIHSS – National Institutes of Health Stroke Scale

PaO_2 – Partial Pressure of Oxygen

PCA – Posterior Cerebral Artery

PICA – Posterior Inferior Cerebellar Artery

PLR – Platelet-to-Lymphocyte Ratio

PSI – Pneumonia Severity Index

RT-PCR – Reverse Transcription Polymerase Chain Reaction

SPSS – Statistical Package for the Social Sciences

VAP – Ventilator-Associated Pneumonia

WBC – White Blood Cell

ABSTRACT

Abstract

This study evaluates the prognostic significance of the Blood Urea Nitrogen to Serum Albumin Ratio (BAR) in patients with pneumonia admitted to the Medical Intensive Care Unit (ICU). Conducted as a single-center, cross-sectional study in a tertiary care hospital, the research assessed the relationship between BAR and ICU admission, ventilatory support, and mortality. A total of 100 patients meeting the inclusion criteria were analyzed. The results indicate that elevated BAR is significantly associated with ICU admission, increased need for inotropic support, and higher mortality. The study concludes that BAR is a simple yet effective biomarker for predicting disease severity and outcomes in pneumonia patients.

Introduction

Pneumonia is a major cause of morbidity and mortality, particularly in critically ill patients. The ability to predict patient outcomes is crucial for effective clinical management. Traditional scoring systems like CURB-65 have limitations in accurately identifying high-risk patients. Recent studies suggest that BAR, an easily obtainable biomarker, could serve as a reliable predictor of disease severity. This study aims to investigate the prognostic value of BAR in pneumonia patients admitted to the ICU.

Materials and Methods

This hospital-based, single-center, cross-sectional study was conducted in the Medical ICU of a tertiary care hospital in Belagavi, India, over 12 months (April 2023–March 2024). The study included adult patients diagnosed with pneumonia based on clinical

and radiological criteria. Patients with prior lung conditions, recent hospitalization, or immunocompromised states were excluded. Blood samples were collected within 24 hours of admission to measure blood urea nitrogen (BUN) and serum albumin. The primary outcomes assessed were ICU admission, need for ventilatory or inotropic support, and in-hospital mortality. Statistical analysis was performed to determine the association between BAR and patient outcomes.

Results

Out of 100 patients, 49 required ICU admission. Patients with a higher BAR were more likely to need ventilatory support and inotropic intervention. The study found a significant correlation between elevated BAR and ICU admission ($p<0.05$). Additionally, patients with BAR >12.46 had a higher mortality rate (17.35%). The CURB-65 score showed limited predictive value compared to BAR.

Conclusion

The findings suggest that BAR is a simple and reliable tool for assessing the severity of pneumonia and predicting ICU admission, ventilatory support, and mortality risk. Given its ease of measurement and strong predictive value, BAR could be incorporated into routine clinical assessment for pneumonia patients. Future studies with larger sample sizes are needed to validate these findings and explore its applicability across different patient populations.

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INTRODUCTION

Pneumonia is a pathological process characterised by infection and infiltration of interstitial lung tissue, distal airways, and alveoli. Its clinical definition is a set of symptoms that include tachypnea, increased sputum production, productive cough, chills, increased bronchial lung sounds, fever, or pleuritic chest pain, all of which are followed by chest X-ray infiltration. Pneumonia has a prevalence of 20% to 30% in low- and middle-income nations, but only 3% to 4% in developed countries. It is one of the leading causes of mortality and morbidity. According to studies, it is one of the top five causes of death in elderly individuals.

The Pneumonia Patients Outcome Research Team score was developed in 1997 to quantify the severity of CAP following a study of over 50,000 patients. [1] The American Thoracic Society/Infectious Diseases Society of America developed Pneumonia Severity Index (PSI), which is currently the preferred severity assessment score for CAP. More basic scores for CAP, such as the CURB-65 score have been observed. [2] The British Thoracic Society recommends the CURB-65 five-point CAP scoring system, which includes disorientation, urea > 7 mmol/L (20 mg/dL), respiratory rate ≥ 30 breaths per minute, low blood pressure, and age ≥ 65 years. However, these grading systems might get influenced by a clinician's subjective judgement. For example, it is generally difficult for clinicians to assess the mental health of patients with CAP who have dementia or are elderly, hence the severity score may differ from clinician to clinician. [3,4]. However, these grading techniques are influenced by the subjective decisions of individual doctors. As a result, clinicians face a significant issue in determining whether these patients require ICU care. As a result, clinicians require simple blood indicators to make critical decisions about whether or not to admit these patients to the ICU during their therapy.

In contrast, some serum indicators have been shown to predict mortality and the severity of CAP. These include inflammatory indicators such as C-reactive protein [5-7] and procalcitonin [8-11], which are linked to CAP mortality and severity. Previous research has shown that nonsurvivors of CAP had greater blood urea nitrogen levels [2, 12, 13] and lower serum albumin levels [2, 14, 15] than survivors.

In recent years, several research have been conducted on the use of certain serum biomarkers in pneumonia patients. These inflammatory indicators were found to be linked with pneumonia severity and fatality rates. Blood urea and serum albumin are two laboratory indicators that are commonly tested and linked to pneumonia disease development. Many investigations have found that individuals who developed problems had lower serum albumin levels than those who were effectively treated.

The current study was conducted to determine the effect of BUN and albumin in determining the need for ICU care and mortality in these individuals. Previous research found that nonsurvivors of cap had greater blood urea nitrogen levels and lower serum albumin levels than survivors of cap. As a result, we hypothesized that blood urea nitrogen to serum albumin (b/a) ratio in individuals who are critically ill patients of pneumonia would be higher and associated with death or pneumonia severity. In this single-center and prospective, observational trial, we looked at how routinely used laboratory indicators, particularly the b/a ratio, correlated with pneumonia clinical outcomes.

AIMS AND OBJECTIVES

AIM:

To study the ratio of blood urea nitrogen and serum albumin ratio in patients of pneumonia.

OBJECTIVES:

1. To estimate the ratio of blood urea nitrogen and serum albumin ratio among patients of pneumonia.

REVIEW OF LITERATURE

PNEUMONIA

Pneumonia is defined as an infection of the lung parenchyma. Rather than viewing pneumonia as a single disease, health care practitioners must remember that it refers to a group of syndromes produced by a range of organisms, each with its own set of signs and complications[16].

Many attempts have been made to define pneumonia based on the aetiology, clinical environment in which the patient contracted the infection, and pattern of lung parenchyma involvement, among other criteria.

Classification by American Thoracic Society

Community-Acquired Pneumonia (CAP)

Any pneumonia contracted outside of a hospital in a community setting[17].

Hospital-Acquired Pneumonia (HAP)

HAP is defined as pneumonia which is acquired 48 hours post hospitalization to inpatient facility, such as hospital, and that was not in incubation period when admitted. This classification serves to clear up any confusion concerning the words healthcare-associated and hospital-acquired pneumonia. All pneumonia obtained in assisted-living institutions, rehabilitation centres, and other healthcare facilities is now classified as community-acquired pneumonia, and hospitalisation is required to define such pneumonia as HAP[18].

Ventilator Associated Pneumonia (VAP)

Any pneumonia developed 48 hours post endotracheal intubation is classified as VAP[19].

Such classifications aided in identification of common organisms that are responsible for each and every type of pneumonia, as well as the development of therapeutic guidelines for effective therapy in both inpatient and outpatient settings.

Based on the pattern of the involvement of lobes , pneumonia was examined as :

- Focal, non-segmental or lobar pneumonia involves only one lung lobe.
- Multifocal bronchopneumonia or lobular pneumonia.
- Focal or diffuse interstitial pneumonia [20].

Aetiology

Evn though, identification of the etiological agent of pneumonia is critical for effective and proper treatment and epidemiological records, it is rarely encountered in the clinical practice. According to the widespread evaluations, a single cause of pneumonia is frequently recognised in < 10% of the patients who report to the department of emergency medicine [21]. Nonetheless, the organisms that are the most prevelant in causing pneumonia can sure be investigated under previously listed categories.

Community-Acquired Pneumonia

Bacteria

Bacteria have traditionally been classified as "typical" or "atypical" organisms based on their ease of cultural positively. Common characteristic organisms include

Pneumococcus, Haemophilus influenzae, Moraxella catarrhalis, Group A Streptococcus, and various aerobic and anaerobic gram-negative organisms. Legionella, Mycoplasma, and Chlamydia are some of the atypical organisms regularly seen in clinical practice [22]. In the United States, the most prevalent bacterial causes of CAP are Streptococcus pneumoniae, Staphylococcus aureus, Mycoplasma pneumoniae, and gram-negative enteric bacilli [23].

Virus

Viral species frequently colonise the nasopharynx of those patients with CAP. The question of whether these are the fundamental cause or if they contribute to pathogenesis through secondary causes is still under research. However, influenza virus is one of the most common viral agents associated with CAP in the United States, followed by respiratory syncytial virus, parainfluenza virus, and adenoviruses [23].

Fungus

Fungal infections are typically associated with people who have preexisting immunocompromised states such as HIV and people who are recipients of organ transplatation, amongst other conditions. However, few species of fungi, which are frequently ignored, can be the cause of pneumonia in such immunocompetent persons, resulting in delay of diagnosis and poor outcomes. The three most prevalent ones in North America are Histoplasma capsulatum, Blastomyces, and Coccidioides[24].

Hospital-Acquired Pneumonia , Ventilator-Associated Pneumonia

The causative agents in non ventilated hospitalised patients and patients on ventilator with pneumonia are very similar, thus they should be considered jointly. Gram negative bacteria include Escherichia coli, Pseudomonas Aerugenosa, Acinetobacter, and Enterobacter amongst other organisms.

- Gram-positive cocci, such as Staphylococcus aureus, can be methicillin-sensitive or resistant, with resistant being common [25, 26].
- Certain viruses and fungi are seen commonly in immuno compromised as well as severely unwell patients.

Pathophysiology

A delicate balance is maintained between organisms that live in the lower respiratory tract and the local and systemic defence mechanisms. when disrupted causes inflammation of lung parenchyma, i.e. pneumonia. The defence systems impaired in development of pneumonia are:

- Certain disorders, such as common variable immunodeficiency, X-linked agammaglobulinemia , and functional asplenia , might impair humoral and complement-mediated immune systems. Individuals with impaired cell-mediated immunity are predisposed to infection by intracellular organisms such as viruses, low-virulence organisms like Pneumocystis pneumonia and fungal infections.
- Tobacco smokers, post viral individuals, Kartergerner syndrome, other disorders can affect mucociliary clearance.
- Comatose patients and substance abuse can cause impaired cough reflexes.
- Secretions can accumulate in cystic fibrosis and cause bronchial blockage.

The local macrophages help the lungs defend against external germs. The inflammatory response induced by the macrophages causes histological as well as clinical abnormalities seen in patients of pneumonia. Macrophages consume such pathogens, triggering signal molecules i.e, cytokines such as TNF-a, IL-8, and IL-1, which attract inflammatory cells such as neutrophils to the site of infection. They present these antigens to T-cells, triggering cellular as well as humoral defence systems, activating the complement system, and produce antibodies against such pathogens. This, induces inflammation in lung parenchyma and makes the capillaries that line the parenchyma "leaky," resulting in exudative congestion that emphasizes the aetiology of pneumonia.

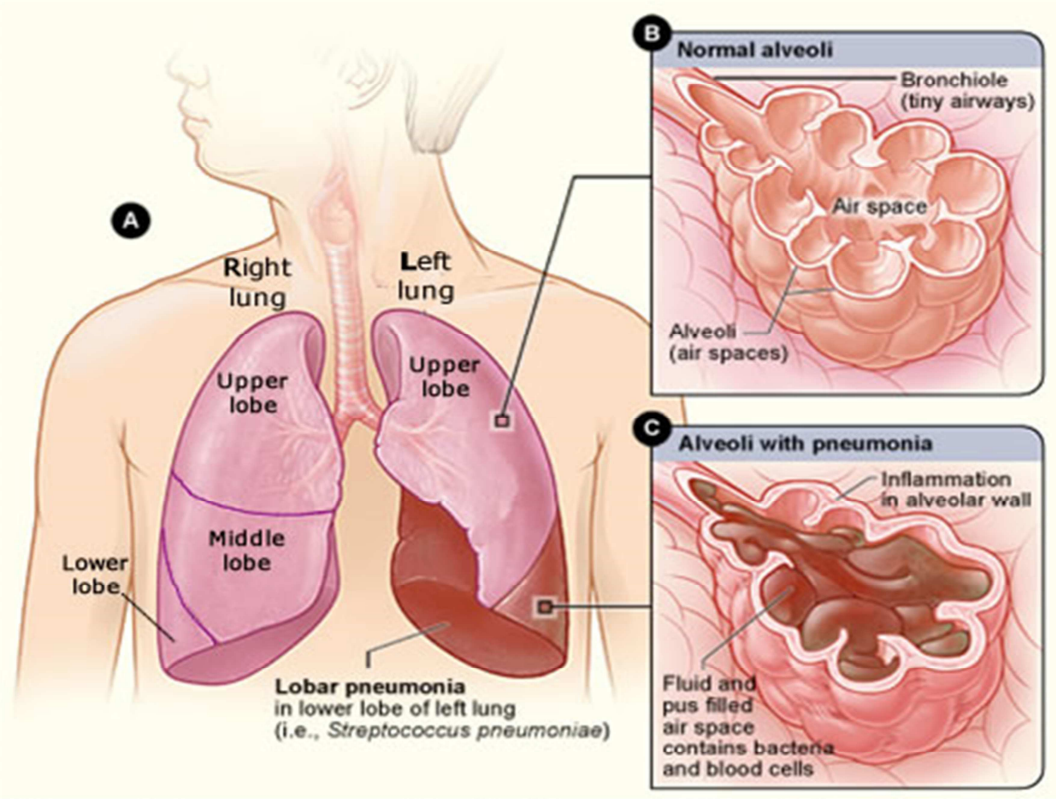


Figure A shows pneumonia affecting part of the left lower lobe. **Figure B** shows healthy alveoli (air sacs). **Figure C** shows alveoli filled with mucus

https://www.nhlbi.nih.gov/health-topics/pneumonia

Pathophysiology of pneumonia

Histopathology

Histologically pneumonia is classified into two types: Bronchopneumonia or lobular pneumonia and Lobar pneumonia.

Lobar Pneumonia.

This type of pneumonia is a widespread accumulation that affects the entire lobe of the lung. Its evolution can be divided as four stages:

- Congestion: It is characterised by heavy and swampy lung tissue, widespread congestion, vascular engorgement, and deposition of infected alveolar fluid. At this stage, there are only a few RBC and neutrophils.
- Red hepatization occurs when RBC , neutrophils, and fibrin infiltrate the alveolar fluid. Grossly, lungs seem red and solid, similar to liver, hence called as hepatization.
- Grey hepatization occurs when red blood cells break down and generate fibrinopurulent exudates, resulting in a red to grey colour transition.
- Resolution: Exudates are cleared by local macrophages, with/without scar tissue development.

Bronchopneumonia

It is defined by suppurative-inflammation in patches around the bronchi, which might or might not be limited to a single lobe.

Severe kinds of pneumonia, on rare occasions, can cause lung abscess, full tissue disintegration, and the creation of pus filled pockets in specific parts of lung.

Furthermore, the infection might spread to pleural space, resulting in a fibrinopurulent discharge known as empyema.

Examination

Historically, the most common complaints in cases of pneumonia have been systemic symptoms such as fever with chills, malaise, loss of appetite, and myalgia. These findings are more common in viral pneumonia than bacterial pneumonia. A small number of individuals may experience changed mental status, abdominal pain, chest pain, or other systemic symptoms. Coughing, with or without sputum production, is a pulmonary finding. Bacterial pneumonia is characterised by purulent or either blood-tinged sputum. Where as, Viral pneumonia causes watery or muco-purulent sputum. Pleuritic chest pain can be present when the pleura is also involved. Dyspnoea and widespread chest heaviness are also observed on occasion.

Symptoms may include tachypnea, tachycardia, fever, decreased breath sounds or bronchial breath sounds, egophony, tactile vocal fremitus, crackles on auscultation, and dullness on percussion.

Evaluation

Clinical evaluation usually involves a complete history as well as physical examination.

Radiological Evaluation

According to the Infectious Diseases Society of America (IDSA) and American Thoracic Society (ATS) criteria, a demonstrable infiltration on a chest xray is required and is regarded as the best approach (along with supporting clinical symptoms) for the

diagnosis of pneumonia [17]. Findings can range from lobar to interstitial infiltrates, as well as cavitary lesions with air fluid levels indicating more serious disease.

Laboratory Evaluation

This includes tests like blood culture, sputum culture , microscopic examination, routine blood counts and lymphocytic count. Certain pathogens may be detected using specialised procedures like urine antigen testing, bronchial aspirate and induced sputum. When clinical and radiographic results are inconclusive, tests such as procalcitonin and C reactive protein, can assist distinguish between viral and bacterial origins. It is also worth noting that empiric antibiotic treatment can be commenced in all typical instances of pneumonia, and a full battery of diagnostics is rarely required [17].

However, the evaluation of VAP differs from that of CAP. Before beginning antimicrobial therapy, radiographic and microbiological evidence must be obtained. VAP should be suspected in those patients who are ventilated with new onset dyspnoea, a drop in saturation with the same ventilatory settings, fever with chills, or new lung infiltrates. Suspected patients need a chest xray or a CT scan . To detect causative microbes, invasive collection techniques such as small broncho-alveolar lavage, Bronchoscopic BAL, or protected specimen brush (PSB) are required. Once the diagnosis has been verified, the proper antibiotic therapy can begin [27].

Management

The first step in managing CAP is to assess the patient's risk and determine whether the patient should be managed as outpatient, in ward, or in ICU. The "CURB-65" score has been widely utilised for the same purpose. This score evaluates confusion, uremia (BUN > 20 mg/dl), respiration rate > 30 per minute, blood pressure < 90 mm

Hg systolic or < 60 mm Hg diastolic, and age > 65. One point is allotted for each favourable criteria that patient meets. The patient's management is decided as shown below.

- Outpatient management score ranges from 0 to 1. These individuals are usually treated empirically with fluoroquinolones or beta lactams plus macrolides, if they have unfavourable comorbidities, and with either macrolides or doxycycline if they do not.
- A score of 2–3 implies admission and management in ward. The first line treatment consists of fluoroquinolones or macrolides combined with beta-lactams.
- A score of 4 or higher indicates the need for ICU treatment. In this case, the empiric regimen consists of either a beta-lactam plus fluoroquinolones or beta-lactams plus macrolides [17,28].

The management of VAP and HaP follows the ATS/IDSA guidelines. It is time-consuming, difficult, and requires use of broad-spectrum antibiotics than CAP treatment. Before beginning empiric medication, it is necessary to identify indications of pneumonia early and conduct a complete evaluation, as previously stated. Empirical therapy is guided by regional patterns of resistance and risk factors of patients for multidrug-resistant pathogens. HAP and VAP patients are typically treated with regimens that include S. aureus, Pseudomonas, and gram-negative bacilli. For individuals lacking MDR risk factors, the standard regimen is piperacillin/tazobactam with cefepime plus levofloxacin [29]. For patients with MDR risk factors, the optimal regimen consists of an aminoglycoside combined with one of the following: imipenem, meropenem, aztreonam, piperacillin/tazobactam, ceftazidime, or cefepime[18].

Complications

Untreated or under-treated pneumonia can cause respiratory failure, sepsis, metastatic infections, empyema, lung abscess, and multi-organ dysfunction [22].

BLOOD UREA NITROGEN TO SERUM ALBUMIN RATIO IN PNEUMONIA

BUN/Albumin Ratio (BAR) has been gaining popularity as a prognostic marker in pneumonia, particularly for determining illness severity and predicting death. BUN and albumin levels are influenced by a patient's hydration, nutritional state, and systemic inflammation, all of which are important variables in pneumonia progression.

1…. Understanding the BUN/Albumin Ratio

$$\text{BUN/Albumin Ratio} = \frac{\text{BUN (mg/dL)}}{\text{Serum Albumin (g/dL)}}$$

- **BUN** reflects **kidney function, protein metabolism, and dehydration.**
- **Serum Albumin** is a marker of **nutrition, inflammation, and liver function.**

A high BAR suggests:

- Dehydration (which increases BUN)
- Malnutrition or inflammation (which lowers albumin)
- Potential kidney dysfunction (especially in sepsis-related pneumonia)

BAR in Pneumonia: Prognostic Value

High BAR and Increased Mortality Risk

- Research indicates that a BUN/Albumin Ratio >8-10 is linked to greater fatality rates in pneumonia patients.
- A BAR greater than 10-15 may indicate severe pneumonia requiring ICU hospitalisation and mechanical breathing.
- Elderly individuals with pneumonia and a high BAR are more likely to die, even if their vital signs remain stable.

Key Findings from Research:

- A **BUN >20 mg/dL** and **albumin <3.5 g/dL** are often seen in **severe pneumonia cases**.
- Patients with a **BAR >10–15** had a **significantly higher 30-day mortality rate** in studies.
- BAR has been suggested as an **independent predictor of pneumonia severity**, sometimes outperforming the CURB-65 score.

BAR and Pneumonia Severity Scores

BAR can be **used alongside** or **compared to** established severity scores:

Score	Components	Use in Pneumonia
CURB-65	Confusion, Urea >20 mg/dL, RR >30, BP <90/60, Age ≥65	Predicts **mortality & need for hospitalization**
PSI (Pneumonia Severity Index)	Age, comorbidities, vitals, labs	Categorizes **risk levels** in pneumonia

SOFA Score	Organ dysfunction markers	Evaluates **sepsis-related pneumonia**
BAR	BUN/Albumin Ratio	Quick and useful **biomarker for prognosis**

BAR is simple to calculate and can be used in emergency settings when other scoring systems are not immediately available.

2.… Clinical Implications of BUN/Albumin Ratio in Pneumonia

BUN/Albumin Ratio	Clinical Implication
<8	Lower risk, likely mild pneumonia
8–10	Moderate risk, consider hospitalization
>10–15	High risk, potential ICU admission needed
>15–20	Very high risk, increased mortality likelihood

- **Patients with BAR >10–15 should be monitored closely** for worsening respiratory function, sepsis, or multi-organ failure.
- **Low albumin** in pneumonia may indicate **poor immune response**, making infections harder to clear.
- **High BUN** suggests **systemic stress and dehydration**, which can worsen outcomes.

3.… Importance of BAR

- **Quick and Easy to Calculate**: Uses routine blood tests available in most hospitals.

- **Early risk stratification** identifies high-risk individuals and allows for aggressive action.
- **Better Decision Making**: Can help determine if a patient **requires ICU admission** or can be managed in a general ward.
- **Useful in resource-limited settings:** BAR can guide triage decisions when complex pneumonia ratings are not available.

Limitations of BUN/Albumin Ratio

- **Affected by non-pneumonia factors** (e.g., kidney disease, liver disease, dehydration, malnutrition).
- **Not a standalone diagnostic tool** but should be used alongside other clinical parameters.
- **Doesn't account for respiratory parameters** like oxygen saturation or respiratory distress.

BAR in Pneumonia

- **BAR should be considered as a complementary tool** for pneumonia risk assessment.
- **BAR >10–15** can help identify **those at higher risk of death or severe complications**.
- To be **used along with CURB-65, PSI, and clinical judgment** to guide treatment decisions.

Recent studies have investigated prognostic value of the BUN to BAR in those with pneumonia, particularly in predicting disease severity and mortality.

1. **Meta-Analysis on BAR as Prediction to Pneumonia Outcomes[30]**

   Comprehensive meta-analysis evaluated the role of BAR in predicting poor outcomes, such as ICU admissions or demise, in pneumonia patients. This analyzed data from over 1,900 subjects with many variants of pneumonia and found:

   - **Pooled Sensitivity:** 0.551
   - **Pooled Specificity:** 0.892
   - **Area Under the Curve (AUC):** 0.717

   Optimal BAR cut-off was 13.29, suggesting that patients with a BAR above this threshold are at higher risk for poor outcomes. Notably, the specificity of BAR was consistently above 0.85 across all subgroups and outcomes, indicating its effectiveness in identifying high-risk patients.

2. **Prognostic Implications of Serum Albumin and BAR in Community-Acquired Pneumonia (CAP)[31]**

   A study focusing on CAP patients assessed the necessity of ICU admission and 30-day mortality in relation to serum albumin levels and BAR. The findings revealed that patients with lower serum albumin levels and higher BARs were more likely to require ICU care. Specifically, a BAR cutoff of ≥12.94 was associated with a sensitivity of 91.30% and specificity of 65.79% for predicting ICU admission. Decreased serum albumin was identified as an independent risk factor for ICU requirement, underscoring the importance of these biomarkers in assessing CAP severity.

3. **BAR: Independent Predictor for Mortality and Severity among CAP[32]**

Research involving 175 CAP patients examined the association of BAR and clinical outcomes, including 28-day mortality and the need for intensive care. The study concluded that a higher BAR is independent factor of both mortality and disease severity. Analysis identified the requirement for intensive care, Pneumonia Severity Index (PSI) class, and BAR as significant factors associated with mortality. Similarly, PSI class, CURB-65 score, and BAR were linked to the necessity for intensive care, highlighting the ratio's utility in clinical assessments.

4. Role of BAR in Predicting Severity of CAP[33]

A prospective observational study with 112 CAP patients investigated various risk factors, including BAR, in relation to clinical outcomes. The analysis revealed that age, CURB-65 score, procalcitonin levels, and BAR were independent risk factors for ICU admission as well as mortality. Notably, the odds ratio of BAR for predicting mortality was 67.8, and 11.2 for ICU admission, indicating a strong association between elevated BAR and adverse outcomes. Additionally, Cox regression analysis demonstrated a significant relationship between BAR values and time to mortality, further supporting its prognostic value.

Collectively, these studies underscore the significance of the BUN to BAR as a valuable prognostic marker in pneumonia patients. Elevated BARs are consistently associated with increased disease severity, higher likelihood of ICU admission, and greater mortality risk. Incorporating BAR into clinical assessments can aid healthcare providers in identifying high-risk patients and making informed decisions regarding their management.

EVIDENCE FROM PREVIOUS LITERATURE

1. **Motoi Ugajin, et al.,** conducted study in consecutive those with community acquired pneumonia admitted to Ichinomiya Nishi Hospital (a 400-bed teaching hospital, Ichinomiya City, Aichi, Japan) from January to December 2011 to investigate the correlation between commonly used laboratory markers, in particular the B/A ratio, and clinical outcomes of community-acquired pneumonia. Blood counts, commonly used laboratory markers, microbiological tests, and calculation of Pneumonia Severity Index (PSI) and CURB-65 were done on admission. The endpoints were mortality within 28 days of admission and requirement for intensive care. One hundred and seventy-five patients with community-acquired pneumonia were enrolled. Nineteen patients died within 28 days of admission and 29 patients required intensive care. Using multivariate analysis, independent factors associated with mortality were the requirement for intensive care (odds ratio [OR] 14.96, 95% confidence interval [CI] 3.73–60.03, P < 0.001), PSI class (OR 3.55, 95% CI 1.08–11.66, P = 0.037), and B/A ratio (OR 1.10, 95% CI 1.01–1.20, P = 0.037). Similarly, independent factors associated with need for intensive care were PSI class (OR 5.35, 95% CI 1.90–15.06, P = 0.002), CURB-65 (OR 2.37, 95% CI 1.26–4.45, P = 0.007), and B/A ratio (OR 1.27, 95% CI 1.09–1.47, P = 0.002). The B/A ratio is a simple but independent predictor of mortality and severity of community-acquired pneumonia [32].

2. **Mehul Agarwal, et al.,** did prospective study in those with the diagnosis of CAP and requiring indoor admission in a tertiary level hospital in the Indian State of Rajasthan from June 2019 to December 2019to look at the predictive power of B/A ratio and also to compare it with a standard scoring system like CURB -65 in CAP. This was a prospective observational study in which 112 admitted patients

with the diagnosis of CAP underwent routine blood examinations, ABG, procalcitonin and chest X-ray. Univariate analysis among various risk factors, CURB-65 scores, blood parameters including B/A ratios and clinical outcomes were carried out followed by multiple logistic regression. Cox regression was done to look at B/A values and time to mortality. In the logistic regression, age, CURB-65 score, B/A ratio and procalcitonin came out to be independent risk factors for ICU admission and mortality. Odds ratio of B/A in predicting mortality and ICU admission came out to be 67.8(49.2- 95.4) and 11.2 (8.4-14), respectively. Cox regression showed B/A values were also found to have a statistically significant relationship with time to mortality (p=0.001). B/A ratio has the potential to become a veritable predictor of poor clinical outcomes in patients with CAP. [33].

3. **Kuo-Chuan Hung, et al.,** conducted a meta-analysis to create evidence for testing validity of use to predict disease severity in COVID-19patients. Results from analysis of 7 cohort studies (3600 individuals with COVID-19) published between 2020 and 2022 showed a higher BUN/Albumin ratio in the poor-prognosis group (Mean difference: = 2.838, 95% confidence interval: 2.015–3.66, P < .001, I 2 = 92.5%) than the good-prognosis group. Additional investigation into the connection between BUN/Albumin ratio as a binary variable (i.e., high or low) and the risk of poor outcome also supported an association between a higher BUN/Albumin ratio and a poor prognostic risk (odd ratio = 3.009, 95% confidence interval: 1.565–5.783, P = .001, I 2 = 93.7%, 5 studies). Merged analysis of poor prognosis produced a sensitivity of 0.76, specificity of 0.72, and area under curve of 0.81. This meta-analysis demonstrated a positive correlation between BUN/albumin ratio and poor outcome in patients with COVID-19 [34].

4. **Ding-Yun Feng, et al.,** conducted a study with aim in evaluating factors affecting 30-day mortality of patients with HAP. The data used in this study were collected from all HAP occurred in our hospital between January 2014 and December 2017. A total of 1158 cases were included.150 (13.0%) of whom died within 30 days. -is reported mortality identified by the univariate Cox regression analysis is found to have been affected by the following factors: age greater than 70 years, presence of diabetes mellitus and chronic obstructive pulmonary disease, gastric tube intubation, administration of proton-pump inhibitor, blood albumin level less than 30 g/l,elevated neutrophil-to-lymphocyte ratio, antibiotics therapy in the preceding 90 days, intensive care unit (ICU) admission, blood lymphocyte count less than 0.8 ×109/L, elevated blood urea nitrogen/albumin (BUN/ALB) level, and presence of multidrugresistant (MDR) pathogens. In the second multivariate analysis, administration of proton-pump inhibitor, administration of antibiotics in the preceding 90 days, ICU admission, blood lymphocyte count less than 0.8 ×109/L, elevated BUN/ALB level, and presence of MDR pathogens were still associated with 30-day mortality. The area under the receiver operating characteristic curves in the BUN/ALB predicting 30-day mortality due to HAP was 0.685. A high BUN/ALB was significantly associated with a worse survival than a low BUN/ALB ($P < 0.001$). Therefore, an elevated BUN/ALB level is a risk factor for mortality on patients with HAP [35].

5. **Aksel Özdemir, et al.,** conducted a study in Bursa Yuksek Ihtisas Training and Research Hospital of Health Sciences University, Turkey to investigate whether the Blood Urea Nitrogen to Serum Albumin ratio (BAR) as well as the CURB-65, NEWS-2, and TREWS scores which are measured at admission are effective predictors of mortality and prognosis in patients with COVID-19 pneumonia.

BAR, CURB-65, NEWS-2, and TREWS scores were calculated and a ROC curve was drawn to examine their diagnostic value in predicting 28-day mortality. The BAR ($p<0.001$), CURB-65 ($p<0.001$), NEWS-2 ($p<0.001$), and TREWS ($p<0.001$) scores of the patients who died within the 28-day period were statistically significantly different. In the ROC analysis to predict 28-day mortality, the area under the curve (AUC) was found to be 0.875 for BAR [(95% CI 0.826-0.924), ($p<0.001$)], 0.887 for CURB-65 [(95% CI 0.834-0.940), ($p<0.001$)], 0.837 for NEWS-2 [(95% CI 0.768-0.907), ($p<0.001$)], and 0.852 for TREWS [(95% CI 0.787-0.918), ($p<0.001$)]. When the cut-off value of BAR in predicting 28-day mortality was taken as 4.440, the sensitivity was found to be 93.2%, specificity was 70.6%. The BAR, which is a simple, inexpensive and easily available parameter, is highly effective in predicting 28-day mortality in patients with COVID-19 pneumonia. It can also be used with other scoring systems [36].

6. **Zixiong Zeng, et al.,** conducted a study to evaluate usefulness of BUN/ALB ratio as predictor for mortality. They documented the lab and clinical data of patients on admission. By drawing the ROC curve for the patients, we obtained the cut-off point for the BUN/ALB ratio for in-hospital death. Multivariate logistic regression was used for analyses of the factors of in-hospital mortality and multivariate Cox regression was used to analyze the factors of 90-day all-cause mortality. Results: A total of 362 patients were recruited and 319 patients were fnally analyzed. Twenty-three patients died during hospitalization and the fatality rate was 7.2%. Furthermore, 14 patients died by the 90-day follow-up. Compared with in-hospital survivors, patients who died in hospital were older (80.78±6.58 vs. 75.09±9.73 years old, P=0.001), had a higher prevalence of congestive heart failure(69.6% vs.

27.4%, P<0.001), had a higher BUN/ALB ratio [0.329 (0.250–0.399) vs. 0.145 (0.111–0.210), P<0.001], had higher neutrophil counts [10.27 (7.21–14.04) vs. 6.58 (4.58–9.04), P<0.001], higher blood urea nitrogen levels [10.86 (7.10–12.25) vs. 5.35 (4.14–7.40), P<0.001], a lower albumin level (32.58±3.72 vs. 36.26±4.53, P<0.001) and a lower lymphocyte count [0.85 (0.58–1.21) vs. 1.22 (0.86–1.72), P=0.001]. The ROC curve showed that the area under the curve (AUC) of BUN/ALB ratio for in-hospital death was 0.87, (95%CI 0.81–0.93, P<0.001), the best cut-of point value to discriminate survivors from non-survivors in hospital was 0.249, the sensitivity was 78.3%, the specifcity was 86.5%, and Youden's index was 0.648. Having a BUN/ALB ratio≥0.249 was an independent risk factor for both in-hospital and 90-day all-cause mortality after adjustment for relative risk (RR; RR=15.08, 95% CI 3.80–59.78, P<0.001 for a multivariate logistic regression analysis) and hazard ratio (HR; HR=5.34, 95% CI 1.62–17.57, P=0.006 for a multivariate Cox regression analysis). An elevated BUN/ALB ratio was a strong and independent predictor of in-hospital and 90-day all-cause mortality in patients with AECOPD [37].

7. **Qiang Xiao, et al.,** did a retrospective cohort study from Medical Information Mart for Intensive Care IV (MIMIC-IV) databases, built by the Massachusetts Institute of Technology and provided by Beth Israel Deaconess Medical Center (BIDMC) to ascertain the association between the BUN-to-albumin ratio (BAR) and mortality in patients at high risk for acute respiratory failure (ARF). The analysis included all patients (≥18 years old) in the database diagnosed with ARF using the International Classification of Disease, Ninth Revision (ICD-9) and ICD10 codes. The study enrolled 9,734 patients with ARF. In comparison to survivors, non-survivors exhibited higher BAR [10.79 (6.25–18.81) vs. 7.35

(4.48–13.62), P11.76 mg/g) with hazard ratio (HR) 1.54 [95% confidence interval (CI): 1.39–1.70]. A high BAR was linked to a higher risk of mortality in ARF patients. BAR is a straightforward and possibly useful prognostic biomarker for ARF [38].

8. **Tingting Xia, et al.,** did a retrospective cohort study from Medical Information Mart for Intensive Care III (MIMIC-III) database, in which patients in ICU were diagnosed with aspiration pneumonia to investigate the relationship between the blood urea nitrogen (BUN) to serum albumin ratio (BAR) in critically ill patients with aspiration pneumonia (AP). A total of 1121 critically ill patients with AP were enrolled.Patients in 28-day non-survivor group had significantly higher levels of BAR (P<0.001). The area under the curve (AUC) for predicting 28-daymortality, 90-day and 365-day mortality of BAR (0.693, P<0.001; 0.701, P<0.001; 0.703, P<0.001) was superior to that of SOFA scores orCURB-65 scores. Kaplan-Meier curves also showed similar results (P < 0.001). After controlling for age, gender, ethnicity, risk factors, comorbidities, interventions, score system, vital signs, and laboratory results, multivariate cox regression analysis revealed that BAR was a significant risk factor for 28-day (HR=1.89, 95%CI 1.37-2.60, P0.001), 90-day (HR=1.76, 95%CI 1.34-2.31, P0.001), and 365-day (HR=1.50, 95%CI 1.18-1.89, P=0.001) mortality. This was also seen intuitively in the constrained cubic spline curve. Furthermore, subgroup analysis found a significant link between increased BAR and 28-day mortality in the majority of relevant subclasses. Easy access to BAR is a good prognostic factor for severely ill AP patients [39].

MATERIALS AND METHODS

STUDY DESIGN:

Hospital based single centered, cross-sectional study

STUDY SETTING:

Medical Intensive Care Unit in the Tertiary Care Hospital, Belagavi, India

STUDY PERIOD:

12 months - April 2023 to March 2024 after getting approval from IRB (Ethical and Scientific Clearance).

STUDY POPULATION:

Patients admitted to Medical Intensive Care Unit in the Tertiary Care Centre, Belagavi, India.

i. Inclusion criteria:

- Age > 18 years
- All patients of pneumonia (clinical/radiological)

Exclusion criteria:

- Pregnant/lactating females
- Patients with history of hospitalisation 2 weeks prior to present admission
- Immunocompromised patients
- Patients with prior lung conditions
- Patients of CLD,CKD

SAMPLE SIZE:

Calculated as per previous 3 years admission to medicine wards/ICU

Formula used for sample size estimation is,

Formula used for sample size calculation is,

$$n = \frac{(1-)Z\underline{\propto}^{2}}{(1-Prev)*d^{2}}$$

where n - sample size required, is the pre-determined values of specificity, d - maximum marginal error required, $Z\underline{\propto}$ - value corresponding to level of confidence

2

needed and prevalence is the prevalence of disease.

The specificity of BUN/BAR to determine mortality is 92% among patients with pneumonia. Considering that the specificity of BUN/Albumin ratio will be at least 85% in our study, with 50% prevalence, at 95% CL and 10% maximum error, sample size needed is 98.

SAMPLING TECHNIQUE:

A total number of 100 patients admitted to Medical Intensive Care Unit in the Tertiary Care Hospital, Belagavi, India satisfying inclusion and exclusion criteria were selected by convenient sampling and were included.

METHOD OF COLLECTION OF DATA AND METHODOLOGY:

- A hospital-based, cross-sectional study was done among patients admitted to the Medical Intensive Care Unit at the Tertiary Care Centre in Belagavi, India. • After ethical clearance, informed written agreement was acquired.

- Patients and attendees were informed about the study's implications and outcomes in their preferred language.
- They were told that they may choose whether or not to participate in the study, and that doing so would have no effect on the therapy procedure.
- Patients were selected according to clinical and radiological features of Pneumonia and blood sample were drawn for determination of serum blood urea nitrogen and serum albumin within first 24 hours of admission in medicine wards/ ICU. This blood investigation was done in routine complete count investigation.

Assessment of parameters:

- Detailed history was taken from the patients or attendants including demographic details and past medical history.
- A complete physical examination with monitoring of vitals (temperature, PR, RR, and BP) was done.

Investigations:

- Venous blood samples were collected from patients upon admission. Blood counts and serum biochemical indicators (such as blood urea nitrogen, albumin, glucose, creatinine, sodium, and C-reactive protein) were measured immediately upon sample.
- Blood urea nitrogen was quantified using urease and glutamate dehydrogenase.
- Serum albumin and C-reactive protein levels were measured using the bromocresol green method and latex coagulating nephelometric test, respectively.
- Standard procedures were used to analyse other biochemical indicators.

Methodology:

- Informed consent was taken from the patient.
- A pre-structured and pretested proforma was used to collect the data.
- Baseline data including socio-demographic data and medical history were collected.
- The details were collected.
- Clinical examination and related investigations were completed.
- All participants had their PSI[1] and CURB-65[2] calculated upon entrance.
- On admission, microbiological sputum and urinary antigen tests were performed for Streptococcus pneumoniae and Legionella pneumophila serogroup 1.
- The antibiotic course was chosen based on the Japanese Respiratory Society's CAP recommendation.
- The study's goals included mortality within 28 days of admission and the need for intensive care, such as mechanical ventilation or vasopressor therapy for septic shock.
- Additionally, clinical risk factors were identified to predict poor outcomes.
- Comorbidities such as COPD, ILD, post-tubercular sequelae, ischaemic heart disease, hypertension, chronic kidney disease, and diabetes were identified.
- All patients underwent routine blood tests, including CBC, LFT, KFT, serum electrolytes, procalcitonin, sputum pyogenic and fungal culture, Ziehl Neelsen staining, mycobacterial culture, and chest X-ray, upon admission.
- All patients had routine ABG and procalcitonin screening upon admission.
- Nasopharyngeal swabs were collected as needed for H1N1 RT-PCR testing. Other procedures, such as CT scans or bronchoscopy-guided respiratory

sample collection, were carried out according to the judgements of the treating physician.

STATISTICAL ANALYSIS

- Data was imported into MS Excel and analysed with Statistical Package for Social Sciences software version 23.
- Descriptive statistics were used to summarise quantitative factors in clinical data. The standard deviation was determined as a measure of variability.
- Qualitative factors were reported as percentages with 95% CI.
- Statistical significance was examined for mean value differences across groups using the student's t test or Mann Whitney test for non-normal distributions.
- Chi-square and Fisher's exact tests were used to compare proportional differences.
- The Pearson correlation coefficient was used to analyse the relationship between PLR and NIHSS during admission and discharge.
- The level of significance [P-Value] was $P<0.05$.

ETHICAL CONSIDERATIONS

All patients participating in the study followed the rules provided by ICMR (1994) and the Helsinki Declaration (modified 2000).

- Patients who enrolled in the trial were informed.
- Patients were fully told about the study's objectives, methodology, funding sources, researcher conflicts of interest, institutional affiliations, predicted benefits and hazards, potential discomfort, and available remedies.
- The study was conducted with utmost respect for the patient's privacy, confidentiality, and little influence on their emotional and physical well-being.

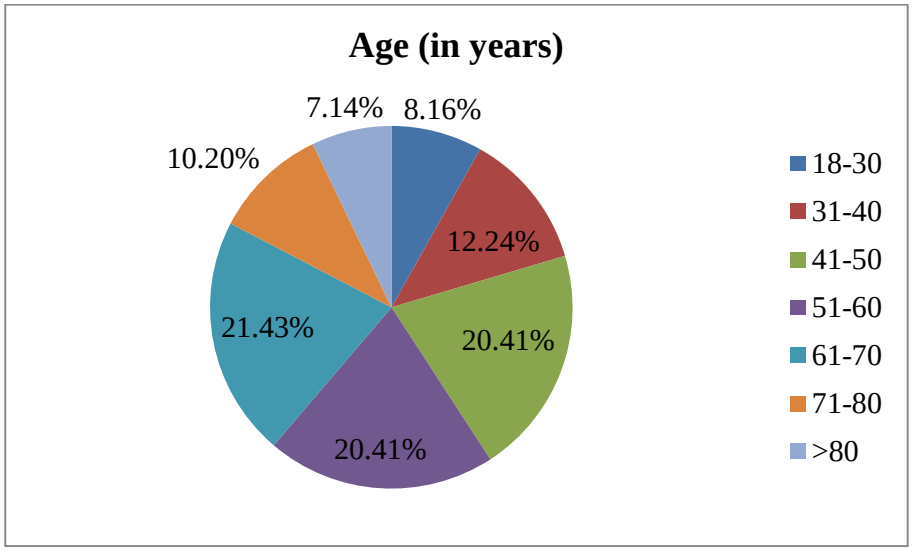
- All possible treatment options were given and none were withheld.
- There was no discrimination of patients and all were treated in the best interest of the patient.
- Patients were given the option to withdraw from the research at any time without consequences.
- At all stages of the research, care and caution were used to minimise patient risk, prevent irreversible bad effects, and maximise benefit.
- All patients enrolled in the study provided informed consent.
- Management for the participants was as percurrent standard departmental protocol.

RESULTS

Table 1: Distribution of patients according to age

Age (in years)	Number	Percentage
18-30	8	8.16%
31-40	12	12.24%
41-50	20	20.41%
51-60	20	20.41%
61-70	21	21.43%
71-80	10	10.20%
>80	7	7.14%
Total	**98**	**100.00%**

Figure 1: Pie chart showing distribution of patients according to age



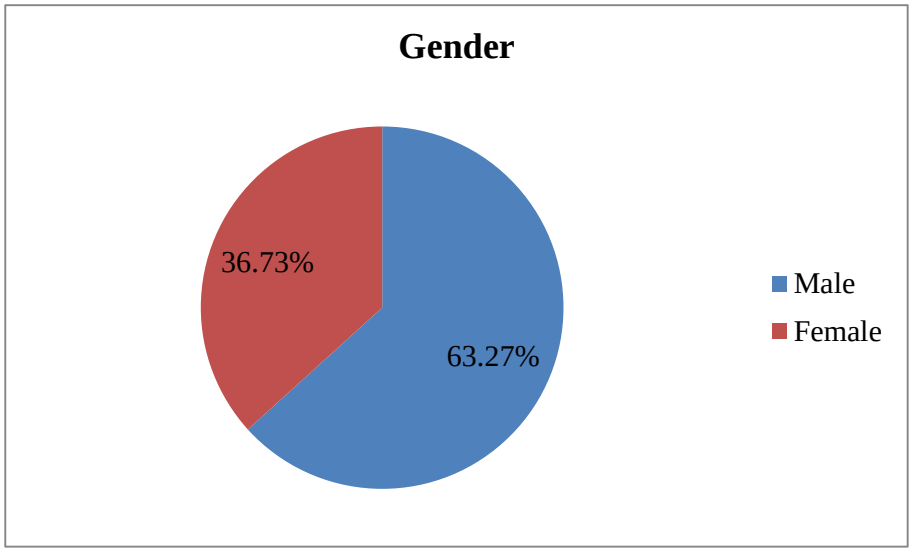
In our present study of 98 patients, there were 21 patients in age group of 61 to 70, 20 each in 41 to 50, 51 to 60, 12 patients in 31 to 40, 10 in 71 to 80, 8 in 18 to 30 and 7 in >80 years.

The youngest patient was 19 years, oldest was 94 years old with mean age of +/- 54.77 years.

Table 2: Distribution of patients according to gender

Gender	Number	Percentage
Male	62	63.27%
Female	36	36.73%
Total	98	100.00%

Figure 2: Pie chart showing distribution of patients according to gender

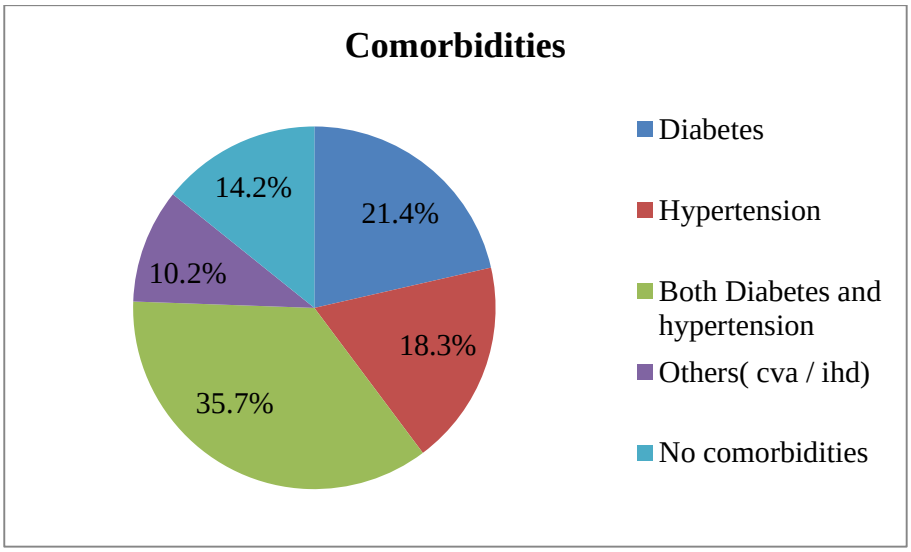


In our present study, out of 98 patients 62 were males and 36 were female with male preponderance noted with Male : Female ratio of 1.72:1

Table 3: Distribution of patients according to comorbidities

Comorbidities	Number	Percentage
Diabetes	21	21.4%
Hypertension	18	18.3%
Both Diabetes and hypertension	35	35.7%
Others(cva / ihd)	10	10.2%
No comorbidities	14	14.2%
Total	98	100.0%

Figure 3: Pie chart showing distribution of patients according to comorbidities

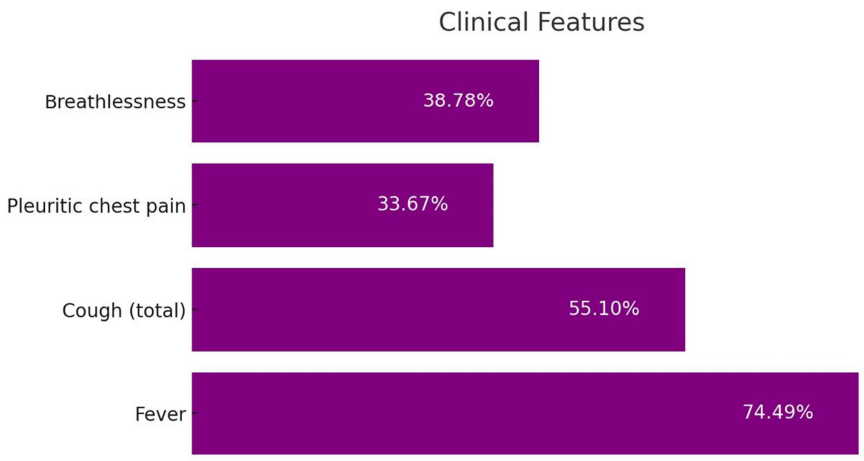


In our present study, we tried to take comorbidities into consideration, and we found 35 patients had type 2 diabetes mellitus and hypertension together, 21 patients had only diabetes, 18 obly had hypertension, others like cerebro vascular accident, ischemic heart disease there were 10 patients, 14 patients didnot have any comorbidities.

Table 4: Distribution of patients according to clinical features

Clinical features	Number	Percentage
Fever	73	74.49%
Cough (Total)	54	55.10%
Pleuritic chest pain	33	33.67%
Breathlessness	38	38.78%

Figure 4: Bar diagram showing distribution of patients according to clinical features



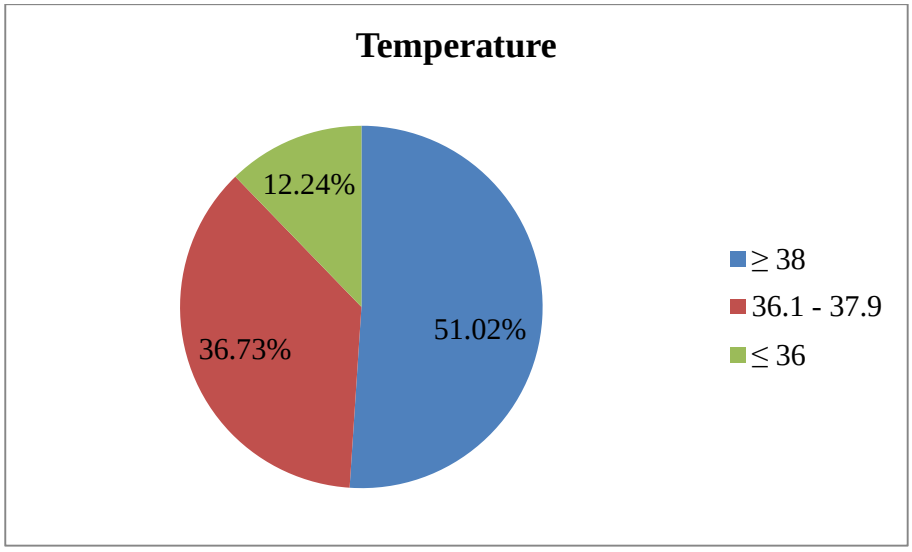
All our 98 patients presented with one or the other symptoms of pneumonia withvarying combinations and percentages (table 4).

Table 5: Distribution of patients according to clinical parameters

Table 5A: Distribution of patients according to Temperature

Temperature	Number	Percentage
≥ 38	50	51.02%
36.1 - 37.9	36	36.73%
≤ 36	12	12.24%
Total	98	100%

Figure 5A: Pie chart showing distribution of patients according to temperature

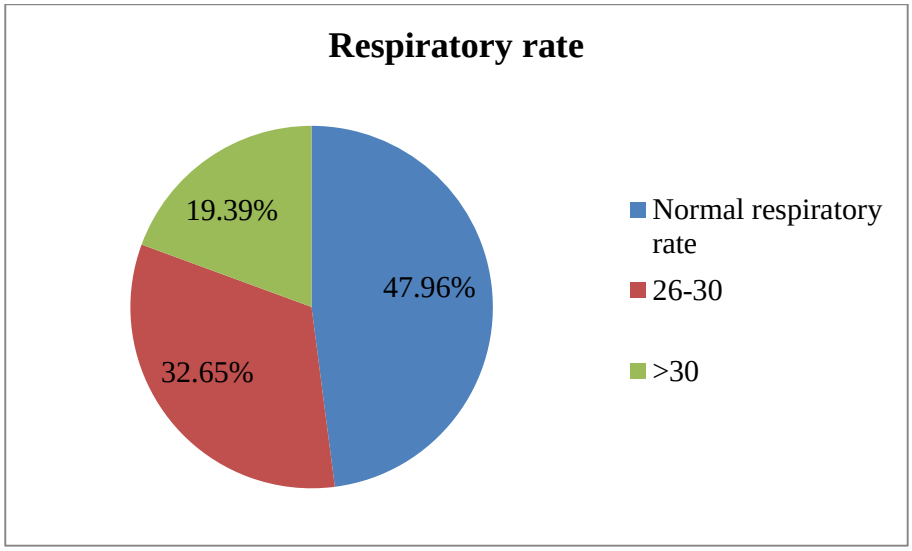


Majority of our patients, N = 50 (51.02%) presented with ≥38 °c , 36 patients presented with temperature ranging between 36.1 - 37.9°c , and only 12 patients had ≤ 36°c

Table 5B: Distribution of patients according to Respiratory rate

Respiratory rate	Number	Percentage
Normal respiratory rate	47	47.96%
26-30	32	32.65%
>30	19	19.39%
Total	98	100.00%

Figure 5B: Pie chart showing distribution of patients according to Respiratory rate

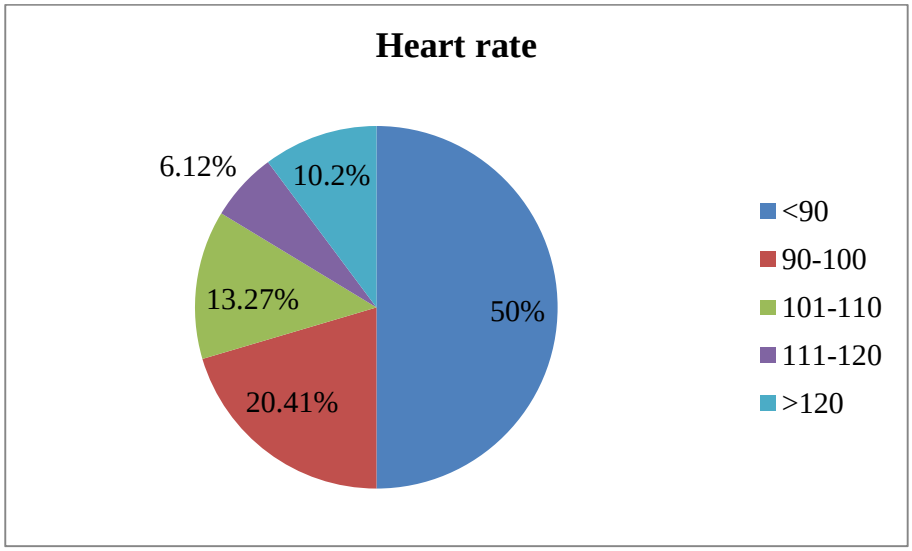


When we took respiratory rate into consideration, 47 of our patients had normal respiratory rate , remaining 51 patients had respiratory ranging between 26 to >30 i.e. , N=51(52.04%)

Table 5C: Distribution of patients according to Heart rate

Heart rate	Number	Percentage
<90	49	50.00%
90-100	20	20.41%
101-110	13	13.27%
111-120	6	6.12%
>120	10	10.20%
Total	98	100.00%

Figure 5C: Pie chart showing distribution of patients according to Heart rate

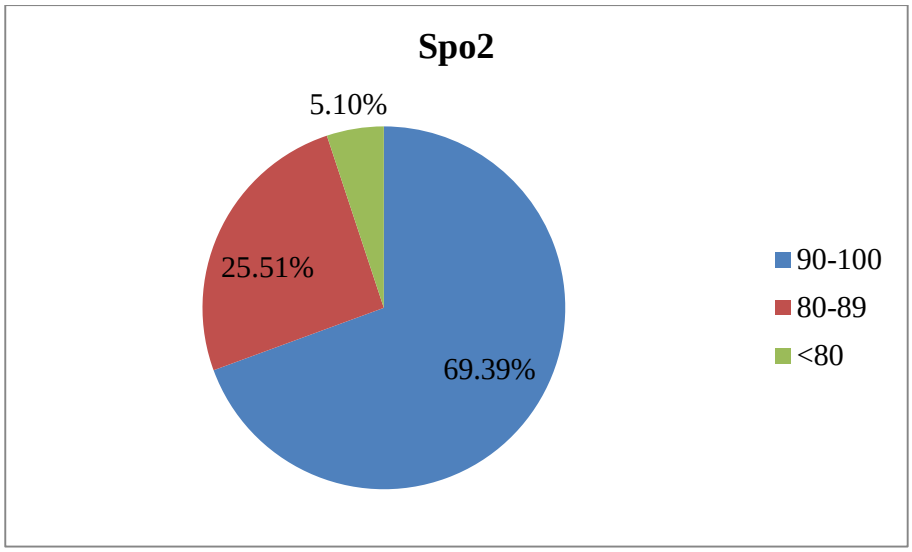


Majority of our patients i.e N=49(50.00%) had a heart rate of ≤ 90 , remaining 49 patients had a heart rate of 90-≥120 (table 5c)

Table 5D: Distribution of patients according to Saturation

Spo2	Number	Percentage
90-100	68	69.39%
80-89	25	25.51%
<80	5	5.10%
Total	98	100.00%

Figure 5D: Pie chart showing distribution of patients according to Saturation

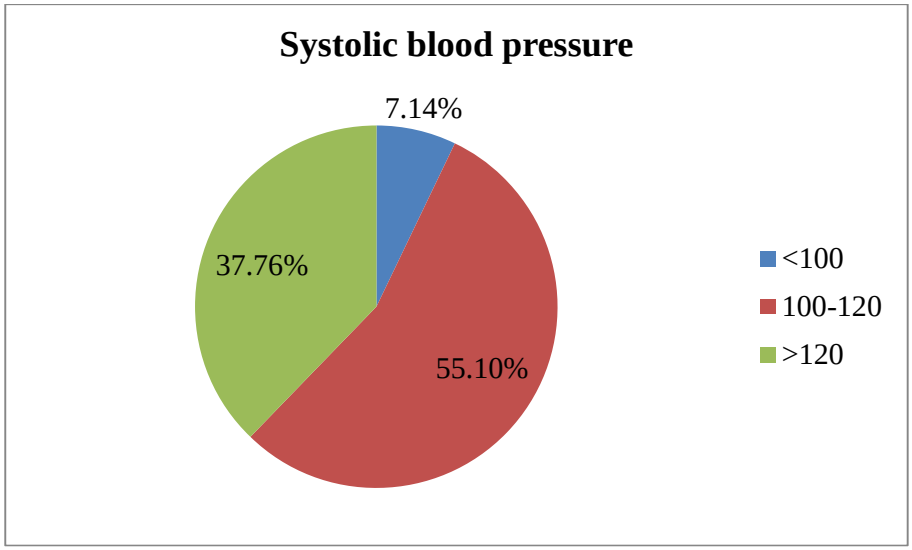


Similarly we looked for saturation of these 98 patients and found to have 68 patients had a saturation of 90-100, 25 patients between 80-89 and only 5 patients had below 80 (N=5)

Table 5E: Distribution of patients according to Blood pressure

Systolic blood pressure	Number	Percentage
<100	7	7.14%
100-120	54	55.10%
>120	37	37.76%
Total	98	100.00%

Figure 5E: Pie chart showing distribution of patients according to Systolic blood pressure



We subjected all our 98 patients for blood pressure measurement and found to have 7 patients had hypotension , remaining 91 patients their systolic bp ranged between 100-120, diastolic bp ranged between

Table 5F: Distribution of patients according to ventilatory mode

Invasive and non invasive mechanical ventilation	Number	Percentage
Invasive mechanical ventilation		
Yes	24	24.49%
No	74	75.51%
Total	98	100.00%
Non invasive mechanical ventilation		
Yes	31	31.63%
No	67	68.37%
Total	98	100.00%

Figure 5F: Bar diagram showing distribution of patients according to ventilatory mode

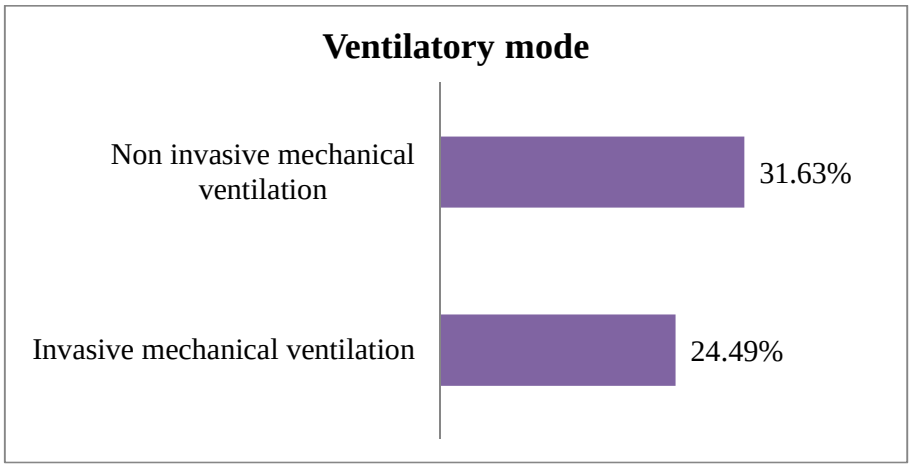
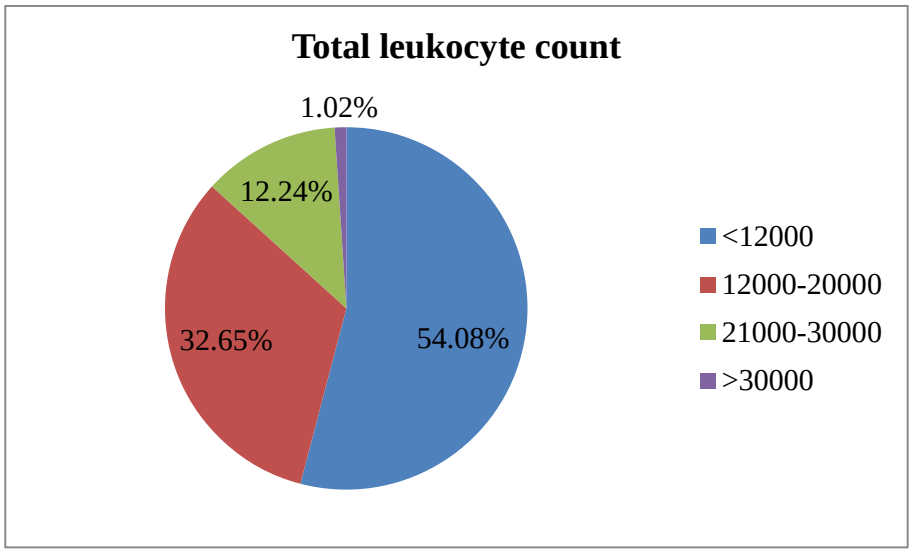


Table 5f shows patients requiring either invasive or non invasive support for their maintenance of saturation is shown in above table (table 5f).

Table 6: Distribution of patients according to total leukocyte counts

Total leukocyte count	Number	Percentage
<12000	53	54.08%
12000-20000	32	32.65%
21000-30000	12	12.24%
>30000	1	1.02%
Total	98	100.00%

Figure 6: Pie chart showing distribution of patients according to total leukocyte counts



All our 98 patients were subjected to total wbc count (4.0 - 10.0x10ˆ3ml),53 patients had below 12,000ml , 32 patients had count ranging between 12,000 to 20,000ml,12 patients between 21 to 30,000 and only one patient had >30,000 ml.

Table 7: Distribution of patients according to renal function tests

Table 7A: Distribution of patients according to serum blood urea nitrogen levels

Serum BUN	Number	Percentage
<8.00	14	14.29%
8.00-23.00	43	43.88%
>23.00	41	41.84%
Total	98	100.00%

Figure 7A: Pie chart showing distribution of patients according to serum blood urea nitrogen levels

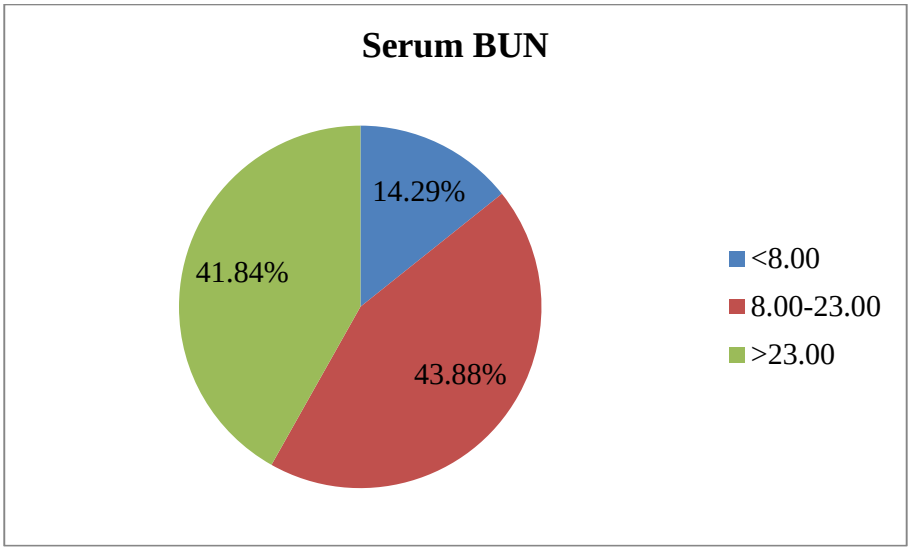
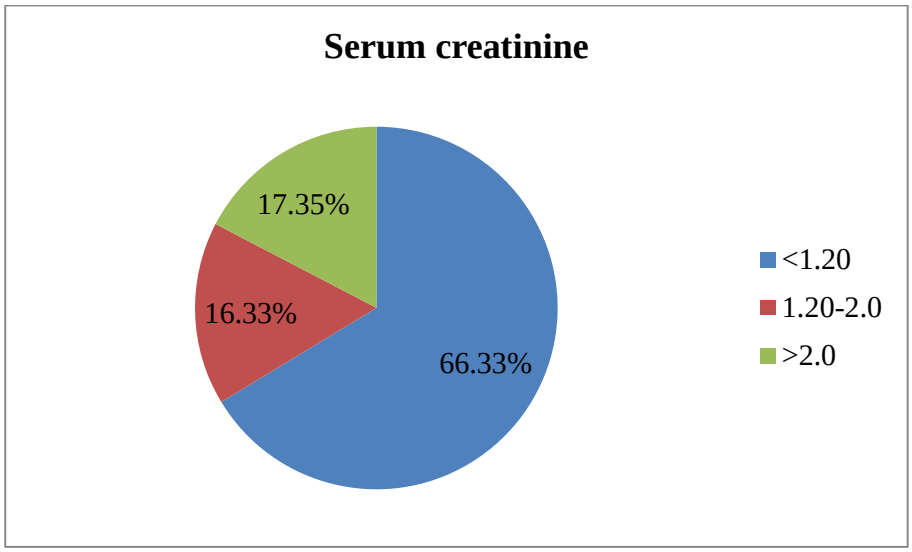


Table 7B: Distribution of patients according to serum creatinine levels

Serum creatinine	Number	Percentage
<1.20	65	66.33%
1.20-2.0	16	16.33%
>2.0	17	17.35%
Total	98	100.00%

Figure 7B: Pie chart showing distribution of patients according to serum creatinine levels



We subjected all our patients , for estimation of blood urea nitrogen and serum creatinine only.

Table 7A shows distribution of patients according to their blood urea nitrogen levels (8.0 - 23.00 mg/dl).

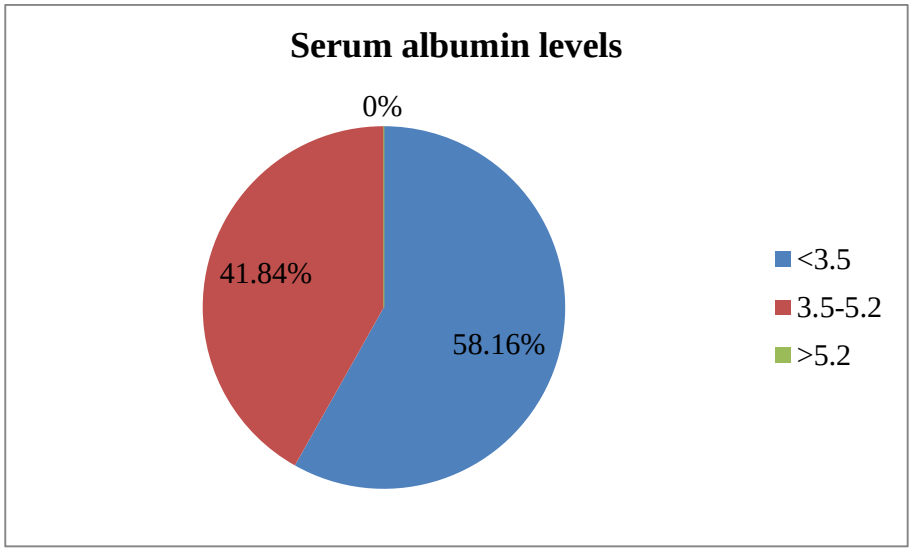
Table 7B shows, distribution of patients according to their serum creatinine (0.50 - 0.95 mg/dl).

Table 8: Distribution of patients according to Liver function tests

Table 8A: Distribution of patients according to serum albumin levels

Serum albumin levels	Numbers	Percentage
<3.5	57	58.16%
3.5-5.2	41	41.84%
>5.2	0	0.00%
Total	98	100.00%

Figure 8A: Pie chart showing distribution of patients according to serum albumin levels

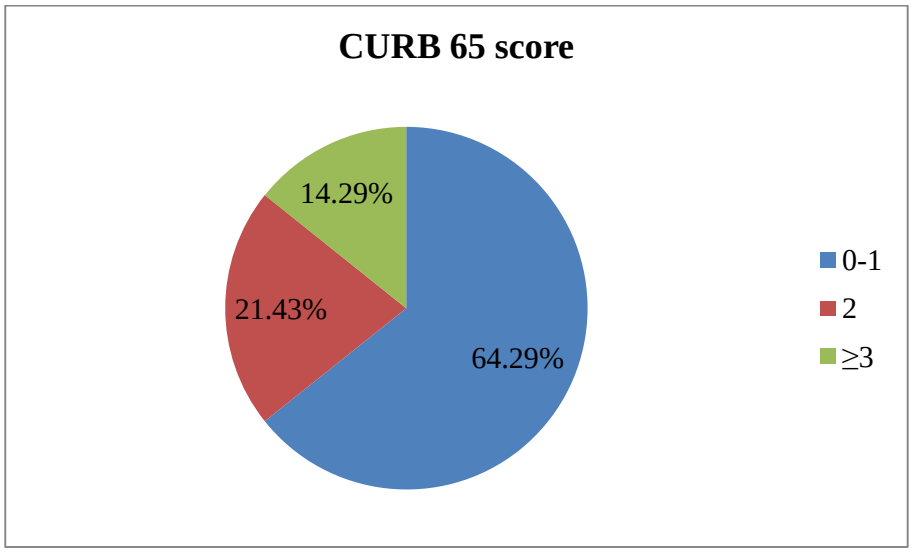


All our patients were subjected to serum albumin estimation and the results obtained are tabulated as shown in the above table (3.5 - 5.2 gm/dl)

Table 9: Distribution of patients according to CURB 65 score

CURB 65 score	Number	Percentage
0-1	63	64.29%
2	21	21.43%
≥3	14	14.29%
Total	98	100.00%

Figure 9: Pie chart showing distribution of patients according to CURB 65 score

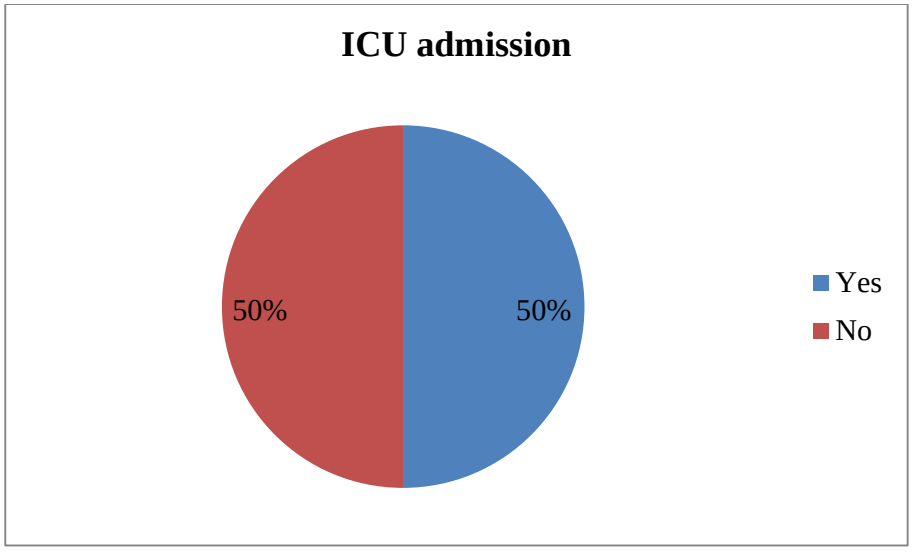


We tried to categorize all our 98 patients according to curb 65 score, and the results found are shown in table no.9

Table 10: Distribution of patients according to ICU admission

ICU admission	Number	Percentage
Yes	49	50.00%
No	49	50.00%
Total	98	100.00%

Figure 10: Pie chart showing distribution of patients according to ICU admission

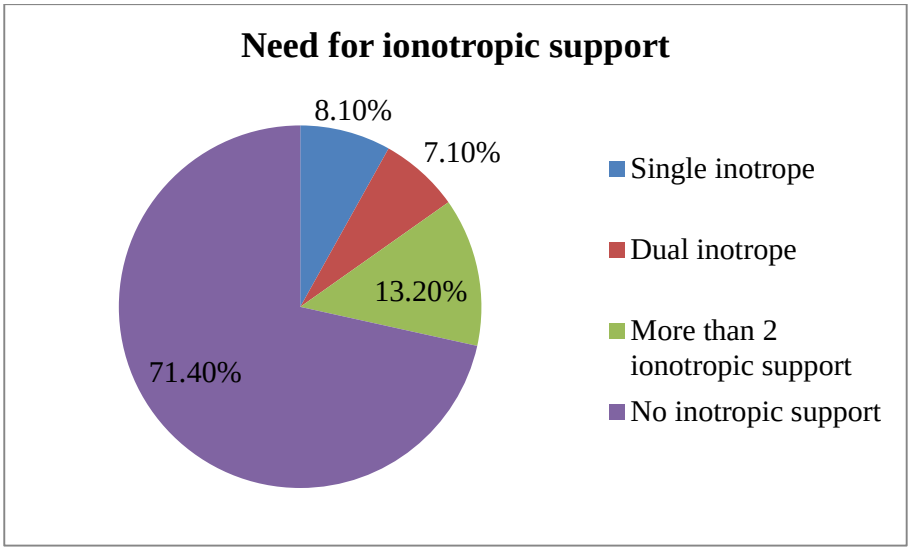


With help of curb 65 scoring, we further divided patients requiring icu or non icu supervised treatment in the wards, However patients who were in curb 65 score of ≤ 3 required the icu treatment, suggesting curb 65 scoring may not be as helpful as Bun/Albumin ratio, which is simple lab tool.

Table 11: Distribution of patients according to inotrope support

Need for ionotropic support	Number	Percentage
Single inotrope	8	8.1%
Dual inotrope	7	7.1%
More than 2 ionotropic support	13	13.2%
No inotropic support	70	71.4%
Total	98	100%

Figure 11: Pie chart showing distribution of patients according to inotrope support

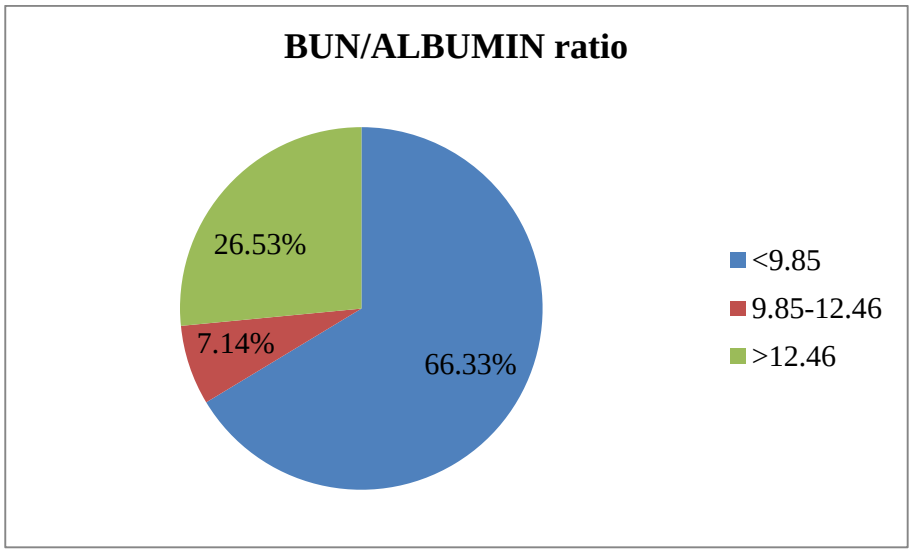


Majority of our patients i.e.,N = 70 required no inotrope support, however remaining 28 patients did require inotrope support for their maintenance of blood pressure, 13 required >2 inotrope support, 8 required a single inotrope support whereas remaining 7 required 2 inotrope support.

Table 12: Distribution of patients according to BUN/Albumin ratio

BUN/ALBUMIN ratio	Number	Percentage
<9.85	65	66.33%
9.85-12.46	7	7.14%
>12.46	26	26.53%
Total	98	100.00%

Figure 12: Pie chart showing distribution of patients according to BUN/Albumin ratio

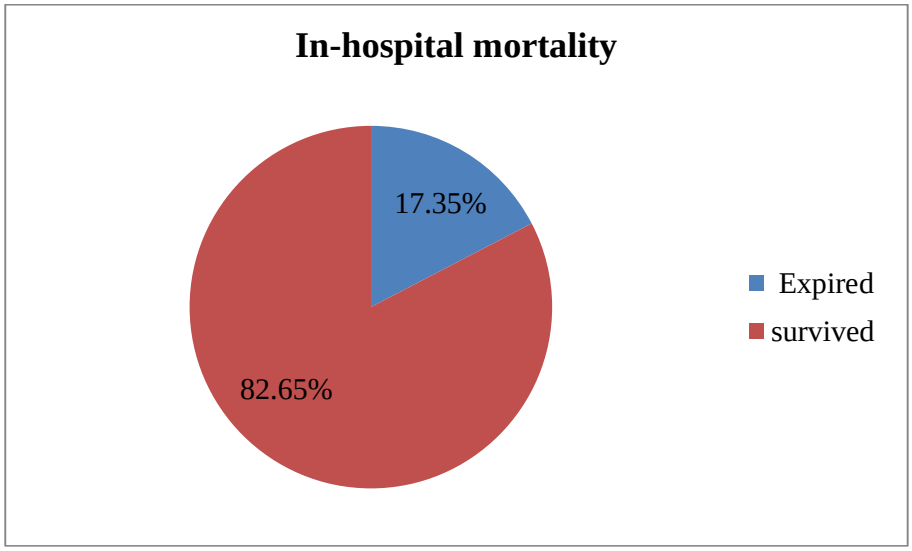


We tried categorizing our patients based on Bun/Albumin ratio and found majority of our patients i.e,65, the ratio was <9.85 (9.85 - 12.46). However remaining 33 patients of which 7 had a ratio of 9.85 - 12.46, who required icu management and remaining 26 patients whose Bun/Albumin ratio was .12.46, who also required icu supervised treatment, as well as who had increased risk of mortality(table 12) .

Table 13: Distribution of patients according to in-hospital mortality

Mortality rate	Percentage
17 (Expired)	17.35%
81 (survived)	82.65%
98 (Total)	100.00%

Figure 13: Pie chart showing distribution of patients according to in-hospital mortality

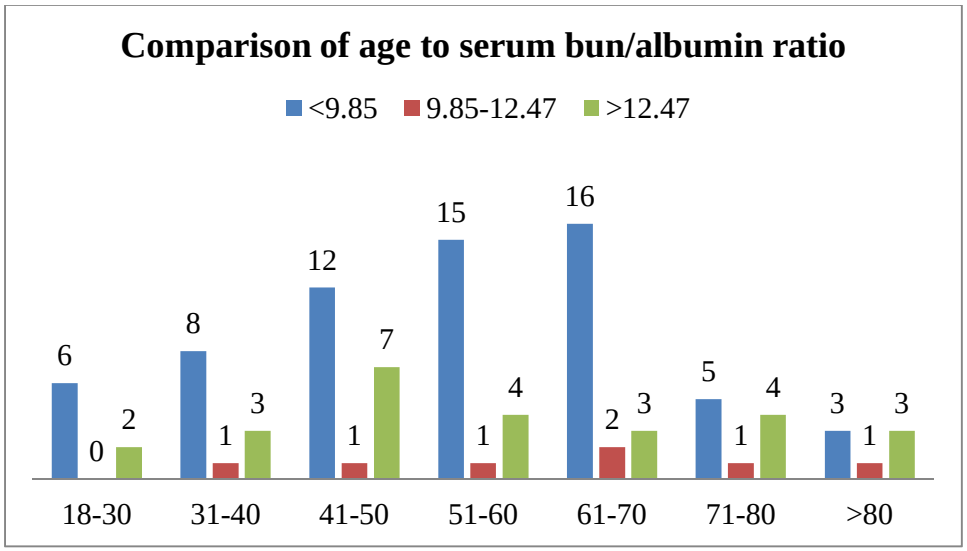


Out of 98 patients, the mortality was observed in 17 patients and remaining 81 survived

Table 14: Comparison of age to serum bun/albumin ratio

Serum bun / albumin	18-30	31-40	41-50	51-60	61-70	71-80	>80	Total
<9.85	6	8	12	15	16	5	3	65
9.85-12.47	0	1	1	1	2	1	1	7
>12.47	2	3	7	4	3	4	3	26
Total	8	12	20	20	21	10	7	98

Figure 14: Bar diagram showing comparison of age to serum bun/albumin ratio

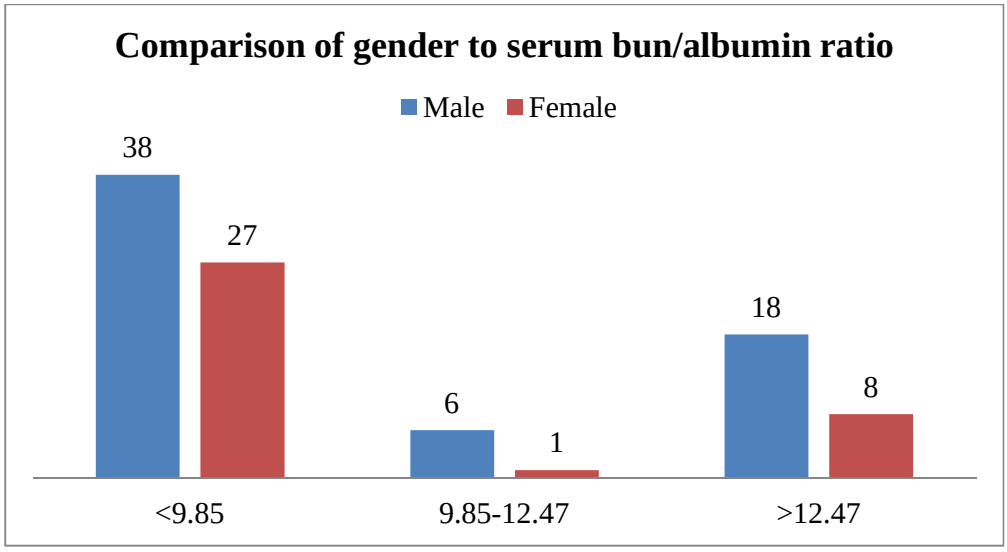


Similarly, we took age into consideration and compared the Bun/Albumin ratio, the results obtained are given in table 14. The p value is 0.869 which shows no statistical significance

Table 15: Comparison of gender to serum bun/albumin ratio

Serum BUN/ALBUMIN	Male	Female	Total
<9.85	38	27	65
9.85-12.47	6	1	7
>12.47	18	8	26
Total	62	36	98

Figure 15: Bar diagram showing comparison of gender to serum bun/albumin ratio

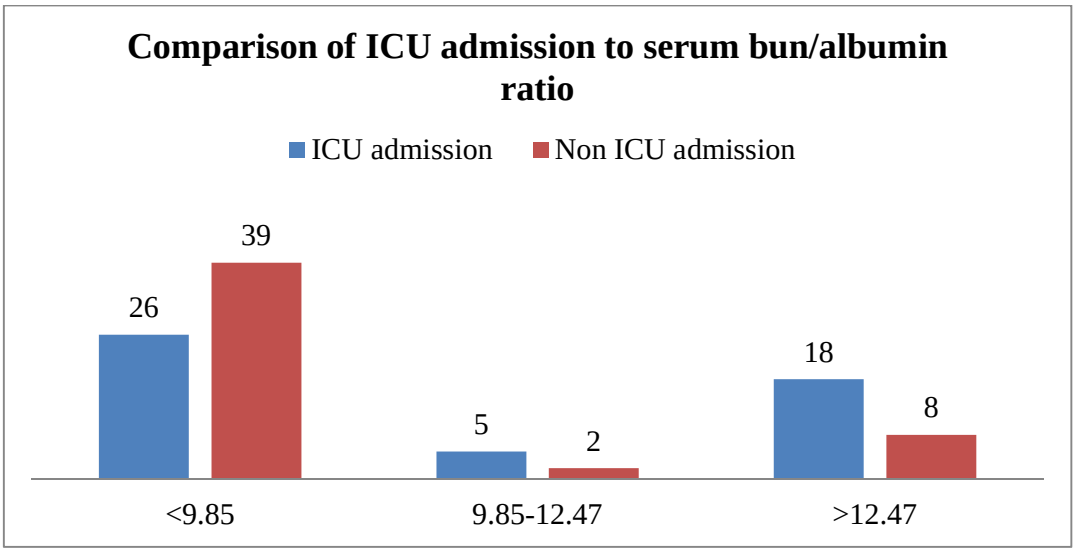


Gender was also compared with serum bun/albumin ratio. The results are shown in above table, with a p value of 0.278 which shows no statistical significance.

Table 16: Comparison of ICU admission to serum bun/albumin ratio

Serum BUN/ALBUMIN	ICU admission	Non ICU admission	Total
<9.85	26	39	**65**
9.85-12.47	5	2	**7**
>12.47	18	8	**26**
Total	**49**	**49**	**98**

Figure 16: Bar diagram showing comparison of ICU admission to serum bun/albumin ratio

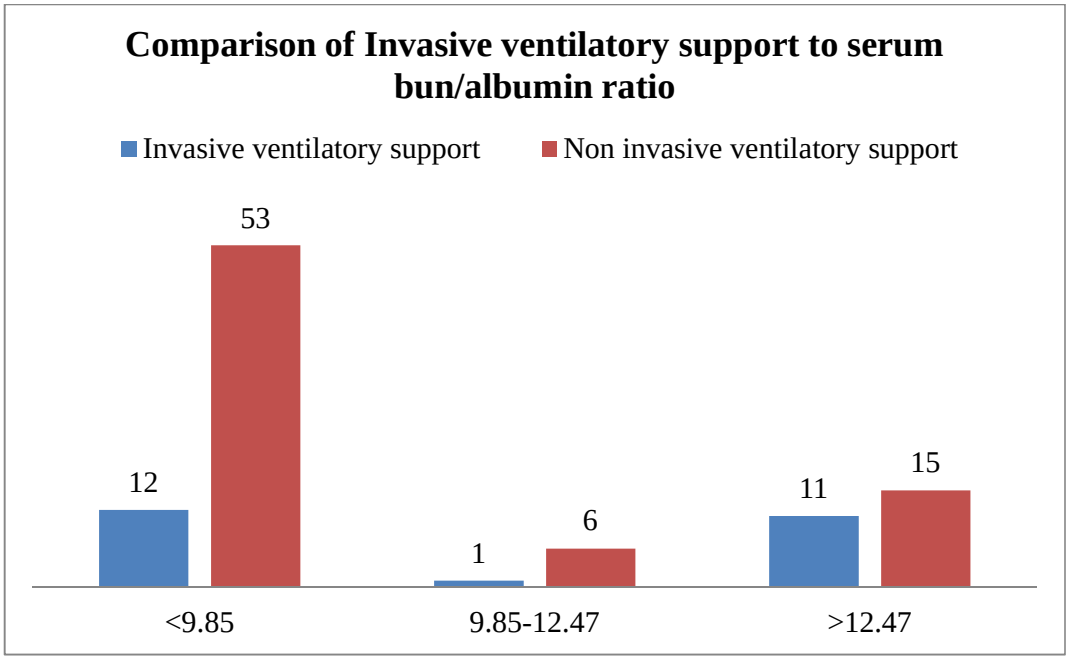


Comparison of Bun/Albumin ratio in patients admitted in ICU, 26 patients the ratio was within normal limits, 18 patients had a ratio >12.47 and remaining 5 had ratio of 9.82 - 12.47. The p value of which is 0.021 which shows a statistical significance between Bun/Albumin ratio and ICU admission

Table 17: Comparison of ventilatory support (Invasive ventilatory support) to serum bun/albumin ratio

Serum BUN/ALBUMIN	Invasive ventilatory support	Non invasive ventilatory support	Total
<9.85	12	53	**65**
9.85-12.47	1	6	**7**
>12.47	11	15	**26**
Total	**24**	**74**	**98**

Figure 17: Bar diagram showing comparison of Invasive ventilatory support to serum bun/albumin ratio



Similarly, a need for ventilatory support in patients with Bun/Albumin ratio we found in a patients (N=12) though Bun/Albumin ratio was within normal limits, 12 required invasive ventilatory support, 53 did not require

1 patient required invasive ventilatory support in ratio 9.85-12.47, 6 did not require

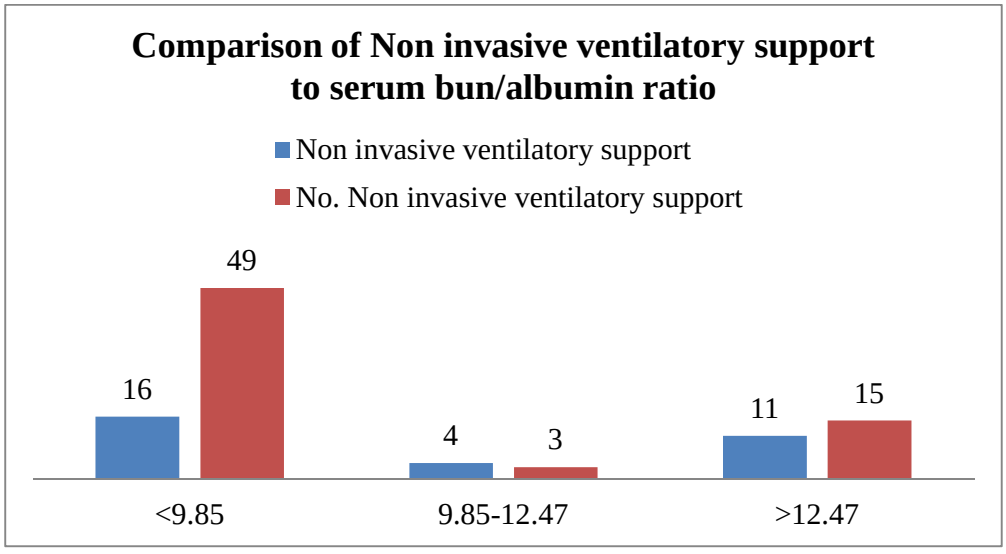
Patients with Bun/Albumin ratio > 12.47, N= 11 required invasive ventilatory support, 15 did not require

The p value of the above table is 0.047 which indicates a statistically significant association between Bun/Albumin ratio and the need for invasive ventilatory support

Table 18: Comparison of ventilatory support (Non invasive ventilatory support) to serum bun/albumin ratio

Serum BUN/ALBUMIN	Non invasive ventilatory support	No. Non invasive ventilatory support	Total
<9.85	16	49	**65**
9.85-12.47	4	3	**7**
>12.47	11	15	**26**
Total	**31**	**67**	**98**

Figure 18: Bar diagram showing comparison of Non invasive ventilatory support to serum bun/albumin ratio

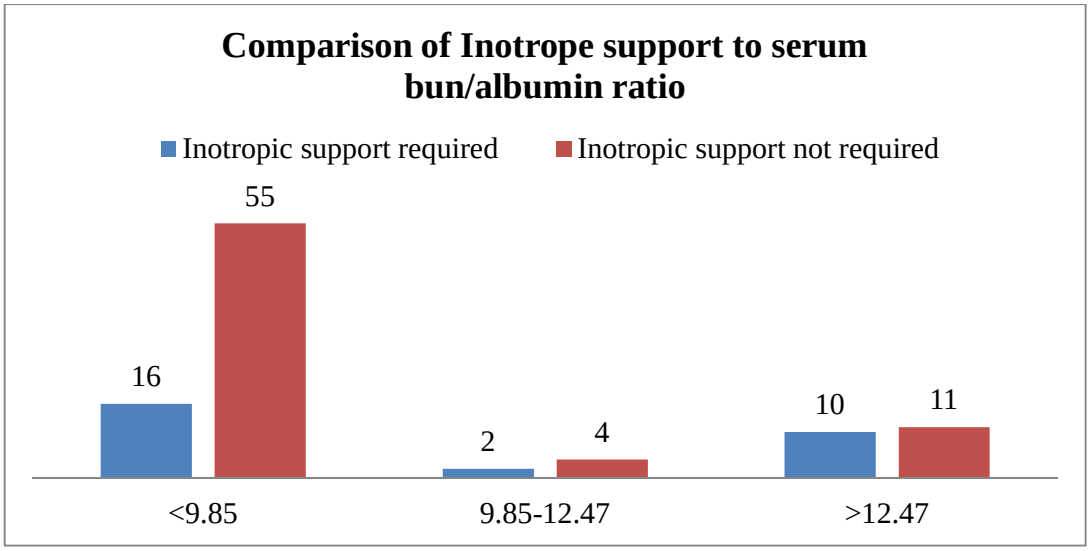


We attempted to see patients who required non invasive ventilatory support initially , however they did require invasive ventilation which reflects overlapping, the split of same is shown in table 18. The p value is 0.084 which shows no statistically significant association between Bun/Albumin ratio and the need for non invasive ventilatory support

Table 19: Comparison of Inotrope support to serum bun/albumin ratio

Serum BUN/ALBUMIN	Inotropic support required	Inotropic support not required	Total
<9.85	16	55	**71**
9.85-12.47	2	4	**6**
>12.47	10	11	**21**
Total	**28**	**70**	**98**

Figure 19: Bar diagram showing comparison of Inotrope support to serum bun/albumin ratio



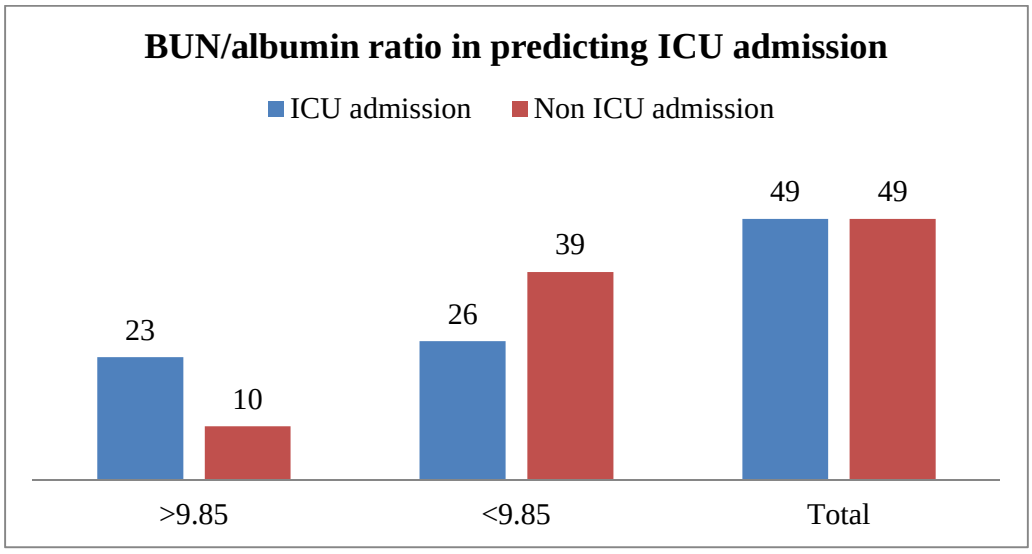
Comparison of inotrope support to Bun/Albumin ratio the results found are tabulated in table no 19

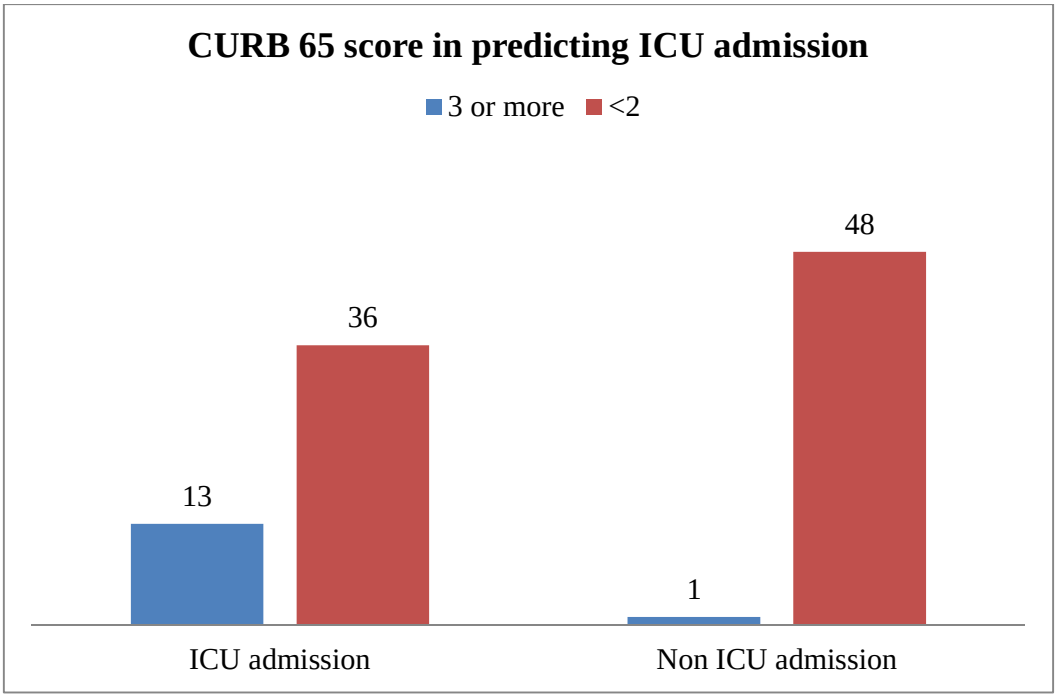
The p value is 0.0014 which indicates a highly statistically significant association between Bun/Albumin ratio and need for inotrope support

Table 20: Comparison of CURB 65 score to BUN/albumin ratio in predicting ICU admission

BUN/ALBUMIN RATIO	ICU admission	Non ICU admission	curb 65	ICU Admission (CURB 65)	NON-ICU Admission (CURB 65)
>9.85	23(46.94%)	10(20.41%)	3 or more	13(26.53%)	1(2.04%)
<9.85	26(53.06%)	39(79.59%)	<2	36(73.47%)	48(97.96%)
Total	49(100%)	49(100%)	total	49(100%)	49(100.00%)

Figure 20: Bar diagrams showing comparison of CURB 65 score to BUN/albumin ratio in predicting ICU admission





Finally, we compared the curb 65 score to Bun/Albumin ratio weather CURB 65 scoring to these ratios helps in predicting the ICU admission and the results obtained are tabulated in the above table and the same has been already stated in table no 10

The p value for Bun/Albumin ratio compared to ICU admission is 0.0103

The p value for Bun/Albumin ratio compared to CURB 65 score is 0.0015

DISCUSSION

In our present study of 98 patients, comparison of BAR in patients of pneumonia , the age group wise distribution of our patients ,we found there were 21 patients in age group of 61 to 70, 20 each in 41 to 50, 51 to 60, 12 in 31 to 40, 10 in 71 to 80, 8 in 18 to 30 and only 7 patients in the age group of more than 80 years, 8 in 18 to 30 and only 7 in the age group of more than 80 with mean age of 54.77±16.37 years.

A study by Akihiro Ito et al., in their study population of 1834, their patients mean age was 73.5 ± 14.3 years as compared to our study. This difference could be because of their sample size being more.

Another study by F.Tokgoz Akyil et al., in their sample size of 785, the mean age in their study population was 67 ± 16 years, almost comparable to our study but for sample size.

In our present study there was a male preponderance observed, there were 62 male patients (63.27%), 36 female patients (36.73%) with ratio of 1.72:1.

A study by Yu Tian et al., they also observed a male preponderance in their study population, male patients were 70.8% as compared to 29.2% female in their study group.

A study by Jyothi R.S et al., did not find any influence of age or gender in these patients of pneumonia.

In our study also neither the age, nor the gender did influence these patients of pneumonia.

Taking into account, the comorbidities, we found majority of our patients had both diabetes and hypertension as comorbidities i.e,N=35(35.7%), only type 2 diabetes in

21 (21.4%), hypertension in 18(18.3%), other comorbidities like CVA /IHD in 10(10.2%), and 14 patients did not have any comorbidities.

A study by Akihiro Ito et al., in their study population of 1834, the majority of their patients had COPD as their major comorbidity with P value being statistically significant. Next comorbidity associated with pneumonia was chronic heart disease, other comorbidities like type 2 diabetes mellitus, cerebrovascular accident was observed by them.

The other comorbidities they noted were malignancy, chronic kidney disease and chronic liver disease.

In our study population we ruled out malignancy, chronic kidney disease, chronic liver disease and chronic obstructive pulmonary disease.

A study by Mehul Agarwal et al., in their study population of 112 patients, who observed the common comorbidities, were patients with cardiac ailments followed by diabetes and COPD. In their study population on univariate analysis, COPD was having increased risk factor for mortality followed by both COPD and cardiac patients. The reason for patients with diabetes having increased risk of pneumonia could be because of depressed immunity, increased pro-inflammatory response and oxidative stress. Type 2 diabetes mellitus is a well-known factor for reduced immunity, the reduced polymorphonuclear cell function, the leukocyte adherence, chemotaxis and phagocytosis are also affected. The antioxidant system for bactericidal action is also affected. All these factors are more affected if so associated with acidosis in patients of type 2 diabetes mellitus.

we categorized all our 98 patients based on their symptomatology with various permutations and combinations (table 4).

In a study by F.Tokgoz Akyil et al., in their study population of 785 majority of their patients presented with fever and cough, which is almost similar to our patients presentation but for sample size.

All our 98 patients, were subjected for seeing their clinical parameters like temperature, respiratory rate, heart rate, saturation and blood pressure which is depicted from Table 5 (A- temperature , B- respiratory rate , C- heart rate , D- blood pressure , E- saturation ,F- ventilatory support) and the results obtained are shown in tables mentioned.

A study by F.Tokgoz Akyil et al., they found that patients who presented with subnormal temperature, had a poor outcome as compared to patients who had fever. Fever with infection reflects, a better host immunity and effective host defense.

Hence the outcome is better as compared to patients with hypothermia (subnormal temperature).

Though in our study there were 12 patients who had subnormal temperature, that did not affect their outcome.

A study by Lily Zhao et al., in their study population applying receiver operating characteristic curve with curb 65 score, the respiratory rate ≥ 24 beats per minute, did help them to predict the mortality with sensitivity, specificity of 65% and 91.33% respectively.

In our patients, with respiratory rate > 30, required ventilatory support more. However, there was no influence on mortality rate.

Heart rate did not have any correlation in study population and to the best of our knowledge, majority of the authors did not take into consideration heart rate as a clinical parameter which could influence the outcome.

In our study, 29 patients the heart rate was > 100, 10 ranged between > 100 to 120 in 20 patients in between 90 to 100, in 49 less than 90 per minute.

In majority of our patients that is 68, (69.39%), the saturation was between 90 to 100 in 25 patients it was between 80 to 89, only 5 patients it was below 80.

In our patients those whose saturation was below 90 did require invasive or non-invasive ventilatory support.

Taking blood pressure into consideration (systolic), only 7 patients in our study had blood pressure < 100 (all required pressure support), remaining 91 patients their blood pressure ranged between 100 to > 120 at presentation.

However, some patients did require pressure support later on during their hospital stay.

All our 98 patients, segregated according to their need for ventilatory support and found 24 patients required invasive mechanical ventilation for their maintenance of saturation, and 31 patients required noninvasive ventilatory support for their maintenance.

Some of the patients on noninvasive ventilatory support group did require invasive ventilatory support later on during their stay due to their worsening condition and saturation.

Most of the studies we have quoted have not taken the clinical parameters like heart rate, saturation, ventilatory support and blood pressure in their study.

All our patients were subjected to total WBC count and found to have majority N =53(54.08%) found to have WBC count less than 12000. In 32 patients, count ranged between 12000 to 20,000, in 12 patients it was the counts were 21000 to 30,000, only 1 patient more than 30,000.

Study by Lily Zhao et al., in their study population of 366 patients, taking total WBC count, they found in patients of survival group, N = 346 (94.54%) the count was within normal limits, in non-survival group however it was observed all had Leukocytosis and P value was non-significant in their study population.

All our patients were subjected to lab parameters like blood urea nitrogen estimation, the results obtained are tabulated in table no 7 [Table 7A,cut off value : 8.00 to 23.00 mg/dl].

In 41 patients, the blood urea nitrogen was elevated more than 23mg/dl, remaining 43, it was within the normal limits cut off value and 14 patients below normal.

A study by Akihiro Ito et al., they observed high levels of blood urea nitrogen levels was predictor of poor prognosis in patients of pneumonia.

Study by Swarnima Singh et al., the BUN levels were higher in patients of non-survivor as compared to survivor group and P value was statistically significant in their study.They also found that elevated BUN at admission had strong association with increased mortality in critically ill patients even in patients rectifying the confounders like renal failure.

All our patients were subjected to estimation of serum creatinine level at the presentation along with BAR.

A Study by Filiz Ata et al,. in their study population of 358 along with BUN they have done serum creatinine estimation and found to have to have elevated serum creatinine levels along with altered BUN levels with increased mortality with significant P value.

A Study by Qiang Xiao et al., along with BUN estimated their patients to serum creatinine and are of the opinion elevated BUN is more pronounced than serum creatinine which has got a high predictive value than serum creatinine level. However, we have not taken serum creatinine values into consideration.

All our patients were subjected for albumin level estimation, the results obtained were 57 patients had albumin levels less than 3.5gm/dl, remaining 41 had a range between 3.5 to 5.2gm/dl, none had more than 5.2 level.

A Study by Evrim Eylem et al., in their study population of 216 found low level of albumin has an independent predictive value for the development of complications and the outcome. Though they did not find increased mortality with low albumin levels ,however they did find increased complications and need for increased ICU admission in patients of low albumin levels.In their study, the other studies quoted have shown the increased predictive value for mortality in patients of pneumonia with hypoalbuminemia.

A Study by Muhammad Adnan et al., in their study population of 134 patients of pneumonia also found patients with hypoalbuminemia had significant association with ICU admission, P value was statistically significant.They also found there was an increased risk of ICU admissions in patients of less than 3.5 gm level albumin levels.

A Study by Lily Zhao et al., found in their study population mild to moderate negative correlation with respiratory rate, CURB- 65 and PSI index but did find a protective effect of increased albumin level.

We subjected all our patients to scoring of CURB-65, there were 63 patients (64.29%) in CURB-65 score of 0 to 1, 21(21.43%) in CURB- 65 of 2 and only 14 (14.29%) in CURB- 65 score of ≥ 3

All patients irrespective of CURB-65 score did require ICU admission and supervised treatment.

So, CURB-65 score is not a true reflection of severity of patients whether we can decide a need for ICU admission.

A Study by Muhammad Adnan et al., they are of the opinion there is a disagreement amongst the physician's decision whether to offer treatment to these patients with adhering to CURB-65 scoring system.In their study population of 134, 36.6% of patients required treatment in general ward, 22.5% required treatment in ICU. some patients who required ICU treatment were treated in ward; reason not known.

Study by Mehul Agarwal et al., in their study population of 112, feel that curb 65 scoring is easy to apply to the patients and not dependent on the operators capacity to correctly gauge the level of confusion of patients as required in curb 65 score .They feel instead of PSI index which is cumbersome this is easy and can be applied without much bias.

Apache 2 scoring system is an important surrogate marker for complications in patients of pneumonia.

In our study of 98 patients the curb 65 scoring did not have direct correlation with patients need for ICU admission, ventilatory support ,pressure support we are also the feeling CURB-65 may be used as a guide and cannot be taken as a surrogate marker for severity of these patients.

All of our patients, we divided treated in ICU setting versus Ward i.e,Non ICU setting.49 patients were treated in ICU setting, remaining 49 were treated in a non ICU setting.

However, some of the patients who were initially treated in non ICU setting did require ICU management later on.

A Study by Muhammad Adnan et al., in their study population of 134 ,19.4% patients required ICU treatment and 80.6% patients require treatment and the ward.

In their both groups the albumin levels were low however the levels reduced further in ICU patients and P value was statistically significant in these patients. Patients who were treated in ICU had an elevated mean level of BAR patients who had increased blood urea, creatinine [P value < 0.05 which is statistically significant] had a prolonged hospital stay, higher CURB-65 score in their study population.

A Study by Evrim Eylem et al., In their study population of 260 patients, 9.7% of their patients required ICU treatment, they found patients who were treated in non-ICU setting had higher albumin levels when compared to ICU setting. The P value was < 0.0001 statistically significant who required ICU admission and albumin levels were low these patients had mortality of 6.7% .They also found that the patients who were treated in ICU setting, their age, gender, commodities did not influence the need for ICU treatment. However, BAR which was helpful for need for ICU treatment.All these patients had low levels of albumin P value was statistically significant.

In our present study of 98 patients, 70 patients did not require the inotrope support, the remaining 28 patients required either single or dual or more than two inotrope support for maintenance of blood pressure (table 11)

A study by Dr Preethi. R.Gandhi et al ., in their study population of 50 patients, they indirectly calculated the need for ICU admission based on BUN, serum albumin, BAR as well as patients who required invasive ventilatory and vasopressor support 32% of their patients required intensive respiratory [invasive ventilatory support] and vasopressor support.

Patients with increased BAR, not only required ICU treatment, they required ventilatory as well as pressure support in most of the studies we have quoted.

Even in our setting those with increased BAR required ICU, invasive ventilatory and pressure support.

All of our 98 patients were subjected to BAR and the results obtained are shown in table number 12.The cutoff value being ≤ 9.85 which is taken into consideration as quoted by many other authors for their study purpose. The cutoff is in standard textbook is not quoted to best of our knowledge.

A Study by Ding-yun Feng et al., in their study population of 1158, the BAR is a significant predictor of survival using Roc curve and Cox regression. They found that in their study population of 1158, observed high BAR levels were significantly associated with worse outcome, survival with P value <0.001, being statistically significant

A Study by Evrim Eylem AKPINAR MD et al., In their study population of 228 patients, have given the explanation the albumin synthesis is reduced in acute phase of

inflammation [pneumonia], further because of acute inflammation the release of endotoxemia from gram negative organisms, cytokines like interleukin 6, chemokines may all lead to capillary leakage of albumin thus hypoalbuminemia is a strong predictor of worse prognosis in hospitalized critically ill patients. Patients with hypoalbuminemia, there is an increased mortality in hospital setting, however in their patients albumin was not an effective factor for one month mortality in these patients. Low albumin levels were associated with increase in development of complications and ICU treatment.

All our 98 patients were analyzed for their survival and found 81 patients survived and remaining 17 patients expired during their stay in hospital.

A Study by Muhammad Adnan et al., In their study population of 134, they categorize their patients as non survivors and survivors and they found 121 patients were survivors and remaining 13 were non survivors, and they implicated it to age factor, systolic blood pressure, BUN, creatinine, BAR and CURB-65 score. They did not find any change in the mortality as far as gender was concerned [mortality was almost similar in both the genders]. Mortality was more observed in ICU setting patients than in non ICU setting patients in their study.They also observed increase in CURB-65 score, gradually increase their incidence of mortality. The direct relationship between the score and in hospital mortality was observed by them.

In our study, we have taken BAR to assess the patient's survival, ICU admission.

The BAR was compared to factors like age, sex and other factors like ICU admission, ventilatory support, pressure support, CURB-65 score and mortality.

In our study of 98 patients, we compared BAR with age, did not find any significant correlation between age and BAR.

A Study by Muhammad adnan et al., Age in their study group did affect the outcome and need for icu admission.

A Study by Jyoti R.S et al., also in their study population of 53 patients, did not find any association with need for ICU admission as far as age and sex were considered. They only found patients who required ICU admission had a common factor of low albumin level.

In our study, we did not find any correlation of BAR to gender.

Similarly A study by Jyoti R.S et al., did not find any correlation of gender with BAR.

A Study by Muhammad Adnan et al., also did not find any difference and correlation with BAR to gender including mortality.

In our study of 98 patients, we compared BAR to ICU admission(table 16).

26 patients who were treated in ICU had a BAR ≤ 9.85, remaining 39 were treated in non-ICU setting. There were five patients treated in ICU setting with BAR of 9.85 to 12.47 and two in non-ICU setting. 18 patients were treated in ICU setting with BAR of > 12.47 and only 8 patients in non-ICU setting with BAR of >12.47.

However, some patients who were treated in non ICU setting were treated in ICU setting later on. P value was statistically significant in our study in patients who were treated in ICU setting.

A study by F.Tokgoz Akyil et al., Have found patients with decreased albumin increased urea, increased BAR have shown to have increased mortality.

Increased BAR was first described as a predictor of mortality by Ugajin et al.,

A study by Mehul Agarwal et al., Have felt instead of comparing the patients CURB-65 or cumbersome PSI scoring system, the best guide and predictor of these patients is BAR which is easy and more predictive.

Similarly, BAR was compared to patients requiring ventilatory versus non ventilatory support. in patients with invasive ventilatory support requirement (table 17A),12 patients required invasive ventilatory support BAR ≤ 9.85 1 in 9.85 to 12.47, 11 in more than 12.47

Similarly, table 17B reflects noninvasive ventilatory support in 16 patients with < 9.85, 4 in 9.85 to 12.47, 11 in more than 12.47. there were 49 patients in BAR < 9.85, 3 in 9.85 to 12.47, 15 in > 12.47 who did not require noninvasive ventilatory support. The P value was statistically significant in patients of invasive ventilatory support(P value -0.047), as compared to noninvasive ventilatory support in our study population [P value 0.084].

A Study by Dr Preethi.R.Gandhi et al., In their study population of 50 patients, 16 patients required invasive respiratory support, remaining 32 did not require invasive respiratory support. In two groups, the BAR was higher in patients requiring invasive respiratory support as well as vasopressor support.

Comparison of inotrope support to BAR [table 18], patients of blood urea nitrogen to albumin ratio ≤ 9.85, 16 required ionotropic support as compared to 55 who did not require, in patients with BAR of 9.85 to 12.47 2 required inotrope support as compared to 4 who did not require, in patients with BAR of > 12.47, 10 required inotrope support and 11 did not require P value was statistically significant in patients who required inotrope support(p value – 0.0014).

A study by Dr Preethi.R.Gandhi et al., In their study population of 50 patients ,found statistically significant p value in their study population who required pressure support.

Similarly , we compared BAR with curb 65 score in protecting ICU admission and found that among 49 patients requiring ICU admission, BAR was able to predict that 23 patients required ICU admission [BAR> 9.85], with P value of 0.0103 which is statistically significant, whereas curb 65 score was able to predict only 13 patients required ICU admission [curve 65 ≥3], which shows that blood urea nitrogen ratio is a better score in predicting ICU admission compared to CURB- 65.

A study by Izmir Katip Celebi University et al., They found in their study population of 1086, BAR and PSI index as a significant indicator of hospital mortality. The BAR was more relevant predictor of mortality compared to other markers like curb 65 score.

We compared BAR with in hospital mortality and found that patients with BAR ≤9.85, 6 expired and 59 survived , no one expired in ratio of 9.85 to 12.46 and in ratio of > 12.46 , 11 expired with a statistically significant P value.

So, we feel simple Blood urea nitrogen to aluminum ratio is a good predictor of ICU admission and mortality as compared to CURB-65 score alone

In our study including, the studies we have quoted in our discussion, we feel that BAR is a simple reliable and strong predictor of ICU admission with outcome of the patients which can be easily done and can be used in protection of patients with pneumonia in hospital setting. If applied for large population, same can be applied to prediction of ICU admission and in hospital mortality as a surrogate marker [indicator / predictor] in day-to-day clinical practice.

CONCLUSION

In our present study of blood urea nitrogen to serum albumin ratio in patients of pneumonia was undertaken in KLE'S Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi in the Department of General Medicine, the study period was one year from 01-04-2023 to 31-03-2024.

In our 98 patients of pneumonia, there were 21 patients in the age group of 61 - 70, 20 each in 41 - 50, 51 - 60. There were only 7 patients in age group of >= 80 years.

The youngest patient in the study was 19 years and oldest was 94 years of age. The mean age was 54.77+_ 16.37.

There were more number of male patients compared to female (M :- N = 62 ; F :- N = 36) , with a ratio of M:F = 1.72:1.

Diabetes and hypertension was combined comorbidity in 35 patients, Type 2 diabetes mellitus alone 21 patients were there, Hypertension 18 patients.

Patients with other comorbidities like cerebrovascualar accident/Ischemic heart disease were 10. 14 patients were without any comorbidities.

Most of our patients presented wuth permutation and combination of Fever, Cough,Pleuritic chest pain and Breathlessness.

Most of our patients, presented with clinical signs of elevated temperature, increased respiratory rate, only one third of the patients presented with increased heart rate, 30 patients with saturation < 90, and only 7 patients had a systolic blood pressure of below 100. Initially patients with normal blood pressure did require pressure support later on.

Patients with decreased saturation and respiratory rate required one or the other mode of respiratory support for maintenance of their saturation (Invasive/ Non invasive).

Factors like Age,Sex,Comorbidities did not effect Blood urea nitrogen to Serum Albumin ratio in our study.

Patients with elevated Blood urea nitrogen to Serum Albumin ratio, they required ICU admission, P value was statistically significant. The curb 65 scoring system did not help us to decide whether patients will require ICU admission or not.

P value was statistically significant in patients requiring Invasive ventilatory support, when compared to Blood urea nitrogen to Serum Albumin ratio.

Similarly, elevated Blood urea nitrogen to Serum Albumin ratio suggested that patients required one or more inotrope support for maintenance of blood pressure.

Mortality was more observed in patients of elevated Blood urea nitrogen to Serum Albumin ratio.

Finally we conclude our study stating that if we use this regularl i.e, Blood urea nitrogen to Serum Albumin ratio in all patients presenting with serious illness, we can not only predict who requires ICU treatment, supportive ventilation, pressure support, we can also predict their prognosis and mortality.

We have used this tool in pneumonia patients.

It is a simple tool that can be done easily and applied which is a strong predictor in the clinical practice.We are of the opinion, if large number of patients are enrolled, we can state it’s importance in various other confounding factors like Age, Sex, Comorbidities, Clinical presentations etc.

SUMMARY

.The present study of Blood urea nitrogen to Serum Albumin ratio in patients of pneumonia in KLE'S Dr.Prabhakar Kore Hospital and Medical Research Centre,Belagavi , study period from 01-04-2023 to 31-03-2024.

Patients with elevated Blood urea nitrogen to Serum Albumin ratio required ICU admission, pressure support, ventilatory support. Patients with elevated Blood urea nitrogen to Serum Albumin ratio had more mortality.

Though curb 65 score, many others feel that specificity and sensitivity is questionable, it has helped in some studies quoted by us. However, in our study it has it had limited role , though it predicted the nedd for icu admission, but didnot reflect directly.

BIBLIOGRAPHY

1. Fine MJ, Auble TE, Yealy DM, et al. A prediction rule to identify low-risk patients with community-acquired pneumonia. N Engl J Med. 1997;336:243–250.
2. Lim WS, van der Eerden MM, Laing R, et al. Defining community acquired pneumonia severity on presentation to hospital: an international derivation and validation study. Thorax. 2003;58: 377–382.
3. Rudolph JL, Zanin NM, Jones RN, et al. Hospitalization in communitydwelling persons with Alzheimer's disease: frequency and causes. J Am Geriatr Soc. 2010;58:1542–1548.
4. Shah BA, Ahmed W, Dhobi GN, Shan NN, Khursheed SQ, Hag I. Validity of pneumonia severity index and CURB-65 severity scoring systems in community acquired pneumonia in an Indian setting. Indian J Chest Dis Allied Sci. 2010;52:9–17.
5. Smith RP, Lipworth BJ, Cree IA, Spiers EM, Winter JH. C-reactive protein. A clinical marker in community-acquired pneumonia. Chest. 1995;108:1288–1291.
6. Coelho L, Póvoa P, Almeida E, et al. Usefulness of C-reactive protein in monitoring the severe community-acquired pneumonia clinical course. Crit Care. 2007;11:R92.
7. Chalmers JD, Singanayagam A, Hill AT. C-reactive protein is an independent predictor of severity in community-acquired pneumonia. Am J Med. 2008;121:219–225.
8. Boussekey N, Leroy O, Georges H, Devos P, d'Escrivan T, Guery B. Diagnostic and prognostic values of admission procalcitonin levels in community-acquired pneumonia in an intensive care unit. Infection. 2005;33:257–263.

9. Masiá M, Gutiérrez F, Shum C, et al. Usefulness of procalcitonin levels in community-acquired pneumonia according to the patients outcome research team pneumonia severity index. Chest. 2005;128: 2223–2229.
10. Krüger S, Ewig S, Marre R, et al. Procalcitonin predicts patients at low risk of death from community-acquired pneumonia across all CRB-65 classes. Eur Respir J. 2008;31:349–355.
11. Schuetz P, Suter-Widmer I, Chaudri A, et al. Prognostic value of procalcitonin in community-acquired pneumonia. Eur Respir J. 2011; 37:384–392.
12. Farr BM, Sloman AJ, Fisch MJ. Predicting death in patients hospitalized for community-acquired pneumonia. Ann Intern Med. 1991; 115:428–436.
13. Raz R, Dyachenko P, Levy Y, Flatau E, Reichman N. A predictive model for the management of community-acquired pneumonia. Infection. 2003;31:3–8.
14. Potgieter PD, Hammond JM. The intensive care management, mortality and prognostic indicators in severe community-acquired pneumococcal pneumonia. Intensive Care Med. 1996;22:1301–1306.
15. Lee JH, Kim J, Kim K, et al. Albumin and C-reactive protein have prognostic significance in patients with community-acquired pneumonia. J Crit Care. 2011;26:287–294.
16. Mackenzie G. The definition and classification of pneumonia. Pneumonia (Nathan). 2016;8:14.
17. Mandell LA, Wunderink RG, Anzueto A, Bartlett JG, Campbell GD, Dean NC, Dowell SF, File TM, Musher DM, Niederman MS, Torres A, Whitney CG., Infectious Diseases Society of America. American Thoracic Society. Infectious Diseases Society of America/American Thoracic Society consensus guidelines on the management of community-acquired pneumonia in adults. Clin Infect Dis. 2007 Mar 01;44 Suppl 2(Suppl 2):S27-72.

18. Kalil AC, Metersky ML, Klompas M, Muscedere J, Sweeney DA, Palmer LB, Napolitano LM, O'Grady NP, Bartlett JG, Carratalà J, El Solh AA, Ewig S, Fey PD, File TM, Restrepo MI, Roberts JA, Waterer GW, Cruse P, Knight SL, Brozek JL. Executive Summary: Management of Adults With Hospital-acquired and Ventilator-associated Pneumonia: 2016 Clinical Practice Guidelines by the Infectious Diseases Society of America and the American Thoracic Society. Clin Infect Dis. 2016 Sep 01;63(5):575-82.
19. Canadian Critical Care Trials Group. A randomized trial of diagnostic techniques for ventilator-associated pneumonia. N Engl J Med. 2006 Dec 21;355(25):2619-30.
20. Gharib AM, Stern EJ. Radiology of pneumonia. Med Clin North Am. 2001 Nov;85(6):1461-91, x.
21. Bartlett JG. Diagnostic tests for agents of community-acquired pneumonia. Clin Infect Dis. 2011 May;52 Suppl 4:S296-304.
22. Sattar SBA, Nguyen AD, Sharma S. StatPearls [Internet]. StatPearls Publishing; Treasure Island (FL): Feb 26, 2024. Bacterial Pneumonia.
23. Jain S, Self WH, Wunderink RG, Fakhran S, Balk R, Bramley AM, Reed C, Grijalva CG, Anderson EJ, Courtney DM, Chappell JD, Qi C, Hart EM, Carroll F, Trabue C, Donnelly HK, Williams DJ, Zhu Y, Arnold SR, Ampofo K, Waterer GW, Levine M, Lindstrom S, Winchell JM, Katz JM, Erdman D, Schneider E, Hicks LA, McCullers JA, Pavia AT, Edwards KM, Finelli L., CDC EPIC Study Team. Community-Acquired Pneumonia Requiring Hospitalization among U.S. Adults. N Engl J Med. 2015 Jul 30;373(5):415-27.
24. Hage CA, Knox KS, Wheat LJ. Endemic mycoses: overlooked causes of community acquired pneumonia. Respir Med. 2012 Jun;106(6):769-76.

25. Weiner LM, Webb AK, Limbago B, Dudeck MA, Patel J, Kallen AJ, Edwards JR, Sievert DM. Antimicrobial-Resistant Pathogens Associated With Healthcare-Associated Infections: Summary of Data Reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2011-2014. Infect Control Hosp Epidemiol. 2016 Nov;37(11):1288-1301.
26. Jones RN. Microbial etiologies of hospital-acquired bacterial pneumonia and ventilator-associated bacterial pneumonia. Clin Infect Dis. 2010 Aug 01;51 Suppl 1:S81-7.
27. Torres A, Niederman MS, Chastre J, Ewig S, Fernandez-Vandellos P, Hanberger H, Kollef M, Li Bassi G, Luna CM, Martin-Loeches I, Paiva JA, Read RC, Rigau D, Timsit JF, Welte T, Wunderink R. International ERS/ESICM/ESCMID/ALAT guidelines for the management of hospital-acquired pneumonia and ventilator-associated pneumonia: Guidelines for the management of hospital-acquired pneumonia (HAP)/ventilator-associated pneumonia (VAP) of the European Respiratory Society (ERS), European Society of Intensive Care Medicine (ESICM), European Society of Clinical Microbiology and Infectious Diseases (ESCMID) and Asociación Latinoamericana del Tórax (ALAT). Eur Respir J. 2017 Sep;50(3)
28. Mbata GC, Chukwuka CJ, Onyedum CC, Onwubere BJ. The CURB-65 scoring system in severity assessment of Eastern Nigerian patients with community-acquired pneumonia: a prospective observational study. Prim Care Respir J. 2013 Jun;22(2):175-80.
29. Castro-Guardiola A, Armengou-Arxé A, Viejo-Rodríguez A, Peñarroja-Matutano G, Garcia-Bragado F. Differential diagnosis between community-acquired pneumonia and non-pneumonia diseases of the chest in the emergency ward. Eur J Intern Med. 2000 Dec 20;11(6):334-339.

30. Milas GP, Issaris V, Papavasileiou V. Blood urea nitrogen to albumin ratio as a predictive factor for pneumonia: A meta-analysis. Respir Med Res. 2022 May;81:100886.
31. Jyothi RS, Basavaraj B, Gurupadappa K. The prognostic implication of serum albumin and BUN/Albumin ratio in assessing severity and mortality in community acquired pneumonia (CAP). Int J Clin Biochem Res 2019;6(1):79-81.
32. Ugajin M, Yamaki K, Iwamura N, Yagi T, Asano. Blood urea nitrogen to serum albumin ratio independently predicts mortality and severity of community-acquired pneumonia. Int J Gen Med. 2012;5:583-589.
33. Agarwal M, Joshi M, Gupta M, Bharti N, Chakraborti A, Sonigra M. Role of blood urea nitrogen and serum albumin ratio in predicting severity of community acquired pneumonia (CAP). Monaldi Arch Chest Dis. 2021 Dec 3;92(3).
34. Hung K-C, Li Y-Y, Huang Y-T, Liu P-H, Hsu C-W, Ho C-N, Hung I-Y, Chang F-S, Sun C-K. Efficacy of blood urea nitrogen-to-albumin ratio for predicting prognostic outcomes of inpatients with COVID-19: A meta-analysis. Medicine 2023;102:7(e33007).
35. Feng DY, Zhou YQ, Zou XL, Zhou M, Yang HL, Chen XX, Zhang TT. Elevated Blood Urea Nitrogen-to-Serum Albumin Ratio as a Factor That Negatively Affects the Mortality of Patients with Hospital-Acquired Pneumonia. Can J Infect Dis Med Microbiol. 2019 Jun 16;2019:1547405.
36. Özdemir, Aksel & Yuksel, Melih & Ay, Mehmet & Kaya, Halil & Doğru, Ümran & Bulut, Mehtap. (2022). Investigation of the Relationship between Blood Urea Nitrogen / Serum Albumin Ratio and Clinical Course in Patients with COVID-19 Pneumonia. Kocaeli Medical Journal. 11. 157-171. 10.5505/ktd.2022.48742.
37. Zeng Z, Ke X, Gong S, Huang X, Liu Q, Huang X, Cheng J, Li Y, Wei L. Blood urea nitrogen to serum albumin ratio: a good predictor of in-hospital and 90-day

all-cause mortality in patients with acute exacerbations of chronic obstructive pulmonary disease. BMC Pulm Med. 2022 Dec 15;22(1):476.

38. Xiao Q, Zhou Q, Shen W, Dong S, Tan Y, Zhang X, Yao L, Li Q, Qin Z, Wang T. Blood urea nitrogento-albumin ratio independently predicts 30-day mortality in acute respiratory failure patients: a retrospective cohort study. J Thorac Dis 2024;16(8):4892-4903.
39. Tingting Xia, Shu Lei. Blood Urea Nitrogen to Serum Albumin Ratio in critically ill patients with aspiration pneumonia : A retrospective cohort study. Research square.2024.

ANNEXURE – I - INFORMED CONSENT FORM

KAHERs JNMC
BELAGAVI
INFORMED CONSENT FORM

" A study of blood urea nitrogen and serum albumin ratio in patients of pneumonia at a tertiary care hospital, Belagavi "

Name of Student/Principal Investigator:

Name of Guide/Co Investigators:

MD (GENERAL MEDICINE)

PROFESSOR AND UNIT CHEIF

OF GENERAL MEDICINE
J.N.MEDICAL COLLEGE, BELAGAVI

- **Introduction:**

Pneumonia is a pathological process of interstitial lung tissue and distal airway and alveolar infection and infiltratio.Its clinical definition is a group of symptoms, including tachypnea, increased sputum production, productive cough, chills, increased bronchial lung sounds, fever, or pleuritic chest discomfort, all of which are followed by chest X-ray infiltration (CXR).The incidence of pneumonia is 20% to 30% in low- and middle-income countries while in developed countries, its incidence is 3% to 4% It is one of the most common causes of mortality and morbidity. Based on studies, it is one of the top five causes of death in old age people.

The American Thoracic Society/ Infectious Diseases Society of America has established some scoring methods to determine the disease progression of pneumonia.CURB-65 (confusion, urea nitrogen, respiratory rate, blood pressue, ≥ 65 years) and Pneumonia Severity Index (PSI) are commonly used scoring methods to determine the disease complication. But, these scoring methods are affected by subjective decision of individual clinicians. So to determine the need of ICU requirement in these patients is a real challenge for clinicians. So, clinicians are in need of simple blood parameters to take crucial decision on requirement of ICU in these patients during the course of treatment.

In recent years many studies have undertaken on the use of certain serum biomarkers in pneumonia patients.The levels of these inflammatory markers correlated with mortality and severity of pneumonia.Blood urea and serum albumin are among the routinely analyzed laboratory biomarkers which are implicated in the disease progression of pneumonia. Many studies have shown that the patients who ended up with complications had lower serum albumin levels than the patients who were successfully treated.The present study is under

taken to evaluate the role of BUN and albumin in assessing the requirement of ICU and death within one month of admission in these patients.Of the commonly used laboratory biomarkers, earlier studies showed that nonsurvivors of cap had higher blood urea nitrogen levels and lower serum albumin levels than survivors.Therefore, we hypothesized that the blood urea nitrogen to serum albumin (b/a) ratio may be elevated in critically ill patients with cap and be correlated with mortality or severity of pneumonia. In this single-center, prospective, observational study, we investigated the relationship between commonly used laboratory markers, especially the b/a ratio, and the clinical outcomes of pneumonia.

- **Explanation of procedure:** Patient will be selected according to clinical and radiological features of Pneumonia and blood sample will be drawn for determination of serum blood urea nitrogen and serum albumin within first 24 hours of admission in medicine wards/ ICU. This blood investigation will be done in routine complete count investigation.

Withdrawal from participation in the study: Participation in this study in voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will get any benefits by participating in this study. As early diagnosis will be helpful to determine further course of treatment. The data gathered will help population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person to identify you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Cost of investigations done during the course of study will be paid by the principal investigator. (Strike out which is not applicable)

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purpose and or presented to scientific groups. However, your identity will never be revealed.

Questions: In case of any questions with regard to this study, you are free to contact:

If you have any question or complaints with regard to your right as study participant you may contact Dr Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights

CONSENT STATEMENT

I am making a voluntary decision to participate in the study **" A study of blood urea nitrogen and serum albumin ratio in patients of pneumonia at a tertiary care hospital,Belagavi"** My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE – II - PROFORMA

PROFORMA

CASE NO	
NAME	
IP NO	
AGE	YEARS
SEX	MALE FEMALE
ADDRESS	
OCCUPATION	

Complaints at presentation	
Past history	
Family history	

Personal history	
Treatment history	

Vitals :

Temperature	
Pulse	
Respiratory rate	
Blood pressure	

PHYSICAL EXAMINATION:

	Yes	No
Pallor		
Icterus		
Lymphadenopathy		
Cyanosis		
Clubbing		
Edema		

SYSTEMIC EXAMINATION:

C.V.S	
R.S.	
C.N.S	
PER ABDOMEN	

INVESTIGATIONS:

Hemoglobin		ALP		Na^+	
Total Count		Total Bilirubin		K^+	
Neutrophils		Direct Bilirubin		Sr. Creatinine	
Lymphocytes		Total Protein		BUN	
Eosinophils		Albumin		Chest xray	

Monocytes		A/G ratio			
Basophils		SGOT			
ESR		SGPT			
RBS					

ANNEXURE – III

MASTER CHART

IP NO	SEX	AGE	DATE OF ADMISSION	DATE OF DISCHARGE	Comorbidities	HEART RATE	RESPIRATORY RATE	Bp	Temperature	Fever	Cough with or without expectoration	Chest pain	Breathlesness	Spo2	Icu admission	NIV	Intubation	Inotropic support	In hospital mortality	Serum bun	Albumin	BUN/ALBUMIN	Creat	TLC	Curb 65
10075376	F	30	11 July 2024	23 July 2024	Hypertension	120	30	140	40	TRUE	TRUE	TRUE	FALSE	94	YES	YES	NO	NO	NO	6.2	3	2.07	0.44	6800	1
10064066	F	62	27 May 2024	3 June 2024	Diabetes	72	28	100	39.9	TRUE	TRUE	TRUE	TRUE	94	NO	NO	NO	NO	NO	17.52	4.7	3.73	0.96	26200	0
10070315	F	30	21 June 2024	28 June 2024	Diabetes,hypertension	100	36	110	39.8	FALSE	FALSE	FALSE	TRUE	70	YES	NO	YES	YES	YES	12.2	2.6	4.69	0.77	22600	2
10081054	M	55	3 August 2024	3 August 2024	Diabetes	68	20	110	39.8	TRUE	FALSE	FALSE	FALSE	96	NO	NO	NO	NO	NO	7.2	3	2.40	0.92	8600	0
10064454	F	50	29 May 2024	5 June 2024		130	30	110	39.6	TRUE	TRUE	FALSE	TRUE	92	YES	NO	NO	YES	NO	48.42	2.8	17.29	0.79	30500	4
10000593	F	51	16 August 2024	30 August 2024		88	18	110	39.5	TRUE	TRUE	TRUE	FALSE	98	NOI	NO	NO	NO	NO	64.02	2.4	26.68	7.38	9000	1
10075921	F	70	13 July 2024	24 July 2024	Hypertension	84	16	100	39.4	TRUE	TRUE	TRUE	FALSE	78	YES	YES	YES	YES	NO	28.88	3.3	8.75	3.28	17100	3
10024496	F	38	3 December 2023	7 December 2023	Diabetes,hypertension	56	23	130	39.4	TRUE	TRUE	TRUE	FALSE	94	NO	NO	NO	NO	NO	13.18	4.4	3.00	0.73	10000	0
10070785	M	49	23 June 2024	3 July 2024	Diabetes,hypertension	77	16	110	39.4	TRUE	FALSE	FALSE	FALSE	92	NO	NO	NO	NO	NO	5.09	2.7	1.89	0.54	13400	1
10091165	M	58	15 September 2024	27 September 2024	Diabetes,hypertension	90	16	180	39.3	TRUE	FALSE	FALSE	FALSE	94	NO	NO	NO	NO	NO	7.34	3.1	2.37	0.77	11000	0
10024538	M	42	3 December 2023	19 December 2023	Diabetes	99	40	100	39.3	TRUE	TRUE	FALSE	FALSE	88	YES	NO	YES	NO	YES	3.41	3.5	0.97	0.34	10200	1
10072876	F	66	2 July 2024	15 July 2024	Diabetes,hypertension	86	16	140	39.3	TRUE	TRUE	TRUE	FALSE	94	NO	YES	NO	NO	NO	11.4	1.7	6.71	0.42	14000	1
10080640	M	60	1 August 2024	8 August 2024	Diabetes	88	20	130	39.3	TRUE	FALSE	FALSE	FALSE	98	NO	NO	NO	NO	NO	8.41	4.1	2.05	0.70	5400	0
10091353	F	56	16 September 2024	1 October 2024	Diabetes,hypertension	70	14	120	39.2	TRUE	TRUE	TRUE	TRUE	92	NO	NO	NO	NO	NO	16.68	4.1	4.07	0.69	6400	0
10065959	M	45	4 June 2024	8 June 2024	Diabetes	90	30	150	39.2	TRUE	FALSE	FALSE	FALSE	92	YES	YES	YES	YES	YES	60.06	3	20.02	0.9	26000	3
10077578	M	26	20 July 2024	22 August 2024	Hypertension	97	28	120	39.2	TRUE	TRUE	TRUE	FALSE	80	YES	NO	YES	YES	NO	25.84	3.6	7.18	8	7300	1
10072209	M	86	28 June 2024	27 July 2024		100	26	100	39.2	FALSE	FALSE	FALSE	FALSE	86	YES	YES	YES	YES	NO	51.92	3.8	13.66	2.48	13800	2
10022112	M	33	18 February 2024	18 July 2024	Diabetes,hypertension	78	18	130	39.1	TRUE	FALSE	FALSE	TRUE	88	NO	NO	NO	NO	NO	12.29	4.2	2.93	1.21	14200	0
10080385	M	49	31 July 2024	5 August 2024	Diabetes	69	16	130	39.1	TRUE	TRUE	FALSE	FALSE	94	NO	NO	NO	NO	NO	10.28	2.6	3.95	0.79	9100	0
10090072	F	52	10 September 2024	20 September 2024	Diabetes,hypertension	89	26	120	39	TRUE	TRUE	TRUE	FALSE	72	NO	NO	NO	NO	NO	25.93	3.4	7.63	2.71	2400	1
10080084	F	32	30 July 2024	20 August 2024	Diabetes	90	35	90	39	TRUE	TRUE	TRUE	FALSE	92	YES	NO	YES	YES	YES	16.36	2.8	5.84	1.15	12500	3
10021007	M	32	17 November 2023	18 November 2023	Hypertension	72	28	90	38.9	TRUE	TRUE	TRUE	FALSE	88	YES	NO	YES	YES	YES	102.80	3.3	31.15	9.28	14200	3
10072937	M	60	2 July 2024	29 July 2024	Diabetes	130	16	140	38.9	TRUE	TRUE	TRUE	FALSE	94	YES	YES	YES	YES	YES	23.83	3.2	7.45	0.75	12300	1
10074214	F	48	6 July 2024	30 July 2024		90	29	120	38.9	TRUE	FALSE	FALSE	FALSE	94	NO	NO	NO	NO	NO	14.86	3.2	4.64	0.44	25900	0
10090351	M	60	11 September 2024	16 September 2024	Hypertension	72	16	90	38.8	TRUE	TRUE	TRUE	FALSE	96	NO	NO	NO	NO	NO	25.14	3.2	7.86	1.42	7600	1
10093356	M	20	24 September 2024	3 October 2024	Diabetes,hypertension	72	18	120	38.8	TRUE	TRUE	TRUE	TRUE	96	NO	NO	NO	NO	NO	15.75	2.5	6.30	0.82	8900	0
10069243	M	49	25 January 2024		Diabetes,hypertension	89	30	140	38.8	TRUE	TRUE	FALSE	FALSE	88	YES	YES	NO	YES	NO	62.61	3	20.87	1	10000	2
10021502	F	64	20 November 2023	30 November 2023	Hypertension	76	21	130	38.8	TRUE	FALSE	FALSE	TRUE	92	NO	NO	NO	NO	NO	9.49	4.2	2.26	0.72	17800	0
10023498	M	83	28 November 2023	5 December 2023	Hypertension	90	35	110	38.7	TRUE	FALSE	FALSE	FALSE	90	YES	YES	NO	NO	NO	18.64	4.3	4.33	1.25	12400	2
10080104	M	76	30 July 2024	8 August 2024	Diabetes	97	28	100	38.7	TRUE	FALSE	FALSE	FALSE	90	YES	NO	YES	YES	YES	66.82	3.1	21.55	5.79	9200	2
10035589	M	66	23 January 2024	31 January 2024		78	24	140	38.7	TRUE	TRUE	TRUE	TRUE	94	NO	NO	NO	NO	NO	11.68	4.2	2.78	0.85	6200	1
10073963	M	65	5 July 2024	29 July 2024		76	18	130	38.7	TRUE	FALSE	FALSE	FALSE	94	NO	NO	NO	NO	NO	13.46	2.8	4.81	0.73	14000	1
10093488	M	71	24 September 2024	1 October 2024	Diabetes,hypertension	77	16	120	38.6	TRUE	TRUE	TRUE	FALSE	96	NO	NO	NO	NO	NO	40.19	3	13.40	1.37	18700	2
10077809	F	47	21 July 2024	1 August 2024	Diabetes,hypertension	100	32	120	38.6	TRUE	TRUE	TRUE	TRUE	92	YES	NO	YES	YES	NO	13.69	3.5	3.91	0.40	7000	1
10074226	F	62	6 July 2024	26 July 2024	Diabetes,hypertension	78	16	150	38.6	TRUE	TRUE	TRUE	TRUE	96	NO	NO	NO	NO	NO	8.13	3.1	2.62	0.93	6800	0
10013585	F	79	12 October 2023	2 November 2023		89	18	110	38.6	TRUE	FALSE	FALSE	FALSE	92	NO	NO	NO	NO	NO	14.63	3.3	4.43	0.65	8700	1
10064327	M	75	28 May 2024	25 June 2024	Hypertension	78	28	140	38.5	TRUE	FALSE	FALSE	FALSE	88	YES	YES	NO	NO	NO	58.46	2.9	20.16	2.1	12400	3
10090446	M	64	12 September 2024	24 September 2024	Diabetes,hypertension	130	36	120	38.5	TRUE	FALSE	FALSE	TRUE	90	YES	NO	YES	YES	YES	23.83	3.6	6.62	1.32	11900	3
10088931	M	60	5 September 2024	16 September 2024	Diabetes,hypertension	80	18	110	38.4	TRUE	FALSE	FALSE	TRUE	97	NO	NO	NO	NO	NO	20.75	3.7	5.61	0.92	7700	0
10069601	M	54	18 June 2024	1 August 2024	Hypertension	114	17	110	38.4	TRUE	FALSE	FALSE	FALSE	96	YES	NO	YES	NO	YES	49.21	2.4	20.50	2.88	22500	2
10073455	M	57	3 July 2024	17 July 2024	Hypertension	110	23	130	38.4	TRUE	FALSE	FALSE	FALSE	98	YES	NO	YES	YES	YES	74.9	4.4	17.02	0.94	18000	2
10030468	M	26	30 December 2023	6 January 2024		84	28	110	38.4	TRUE	TRUE	TRUE	FALSE	94	NO	NO	NO	NO	NO	15.05	2.8	5.38	0.73	15900	0
10089528	M	75	9 September 2024	14 September 2024		76	18	140	38.3	TRUE	FALSE	FALSE	FALSE	87	NO	NO	NO	NO	NO	12.90	3.5	3.69	0.99	5900	1
10074662	M	38	8 July 2024	12 July 2024		69	16	110	38.3	TRUE	TRUE	TRUE	FALSE	86	YES	YES	NO	NO	NO	20.98	4	5.25	0.82	12700	1
10038498	F	65	5 February 2024	13 February 2024		98	26	120	38.3	TRUE	FALSE	FALSE	FALSE	94	NO	NO	NO	NO	NO	7.85	3.1	2.53	0.85	10600	1
10075179	F	38	29 April 2024	1 May 2024	Diabetes,hypertension	96	28	160	38.2	TRUE	TRUE	FALSE	FALSE	88	YES	NO	YES	YES	YES	36.68	2.8	13.10	0.88	6300	1
10091238	M	64	16 September 2024	28 October 2024	Diabetes,hypertension	100	30	110	38.2	TRUE	FALSE	FALSE	TRUE	88	YES	NO	YES	NO	YES	14.02	3.2	4.38	1.28	17600	3
10038050	M	39	3 February 2024	4 February 2024		70	28	130	38.2	TRUE	TRUE	FALSE	FALSE	96	NO	NO	NO	NO	NO	64.8	3.6	18.00	1	9400	1
10069948	M	35	19 June 2024	29 June 2024	Diabetes,hypertension	81	26	100	38.1	TRUE	FALSE	FALSE	TRUE	86	YES	YES	YES	YES	NO	18.60	3.9	4.77	1.05	21600	1
10081918	F	62	19 February 2024	19 July 2024	Diabetes,hypertension	106	40	130	38.1	TRUE	TRUE	FALSE	TRUE	84	YES	YES	NO	YES	NO	52.8	3.2	16.50	2.70	19100	2
10080418	M	48	1 August 2024	7 August 2024	Diabetes,hypertension	104	16	140	37.9	FALSE	FALSE	FALSE	TRUE	100	NO	NO	NO	NO	NO	7.76	3.2	2.43	0.53	10100	0
10038940	F	43	7 February 2024	14 February 2024	Hypertension	76	29	110	37.8	FALSE	TRUE	TRUE	TRUE	96	NO	YES	NO	NO	NO	53.74	2.5	21.50	1.96	26600	1
10046627	M	48	12 March 2024	10 April 2024	Hypertension	106	32	130	37.8	FALSE	TRUE	TRUE	TRUE	92	NO	NO	NO	NO	NO	13.46	2.8	4.81	0.73	4800	1
10085834	M	31	23 August 2024	3 September 2024	Diabetes,hypertension	85	22	130	37.8	TRUE	TRUE	TRUE	FALSE	96	NO	NO	NO	NO	NO	7.66	4.2	1.82	0.80	18200	0
10020489	F	70	15 November 2023	22 November 2023	Hypertension	106	33	100	37.6	FALSE	TRUE	FALSE	FALSE	90	YES	YES	NO	NO	NO	7.10	3.6	1.97	0.67	9700	2
10064031	F	53	27 May 2024	1 June 2024	Diabetes,hypertension	80	22	110	37.5	TRUE	TRUE	TRUE	FALSE	96	NO	NO	NO	NO	NO	10.89	3.1	3.51	0.66	11900	0
10081550	F	45	5 August 2024	22 August 2024		68	16	110	37.5	TRUE	TRUE	FALSE	FALSE	98	NO	NO	NO	NO	NO	16.4	3.3	4.97	0.96	3800	0
10035592	M	45	23 January 2024	22 February 2024	Diabetes	142	30	160	37.4	FALSE	TRUE	TRUE	TRUE	92	NO	NO	NO	NO	NO	62.62	3.5	17.89	1.3	20000	2
10063504	F	67	24 May 2024	30 May 2024	Diabetes,hypertension	84	23	150	37.4	TRUE	TRUE	TRUE	FALSE	98	NO	NO	NO	NO	NO	87.85	3	29.28	0.49	10400	2
10042391	M	51	22 February 2024	1 March 2024	Diabetes	122	40	120	37.4	TRUE	TRUE	FALSE	TRUE	84	YES	YES	NO	NO	NO	7.01	4.2	1.67	0.72	11200	1
10052583	M	81	8 April 2024	22 April 2024	Diabetes,hypertension	120	35	120	37.3	FALSE	FALSE	FALSE	TRUE	86	YES	YES	YES	YES	YES	54.21	4.3	12.61	1.94	8800	2
10023861	F	52	30 November 2023	7 December 2023	Diabetes	110	26	110	37.2	FALSE	TRUE	TRUE	TRUE	94	NO	NO	NO	NO	NO	14.07	4.1	3.43	0.65	5700	0
10053980	M	40	15 April 2024	6 May 2024	Diabetes	73	50	120	37.2	TRUE	TRUE	FALSE	FALSE	92	NO	NO	NO	NO	NO	36.82	3.4	10.83	0.7	8700	2
10081112	M	34	3 August 2024	10 August 2024	Diabetes	70	16	110	37.2	TRUE	FALSE	FALSE	TRUE	94	NO	NO	NO	NO	NO	6.17	4.2	1.47	0.87	5600	0
10035911	M	85	26 January 2024		Diabetes,hypertension	100	28	120	37.1	FALSE	FALSE	FALSE	TRUE	88	YES	YES	YES	YES	NO	13.38	2.9	4.61	1.26	11800	1
10038003	M	66	2 February 2024	5 February 2024		126	38	120	37.1	TRUE	FALSE	FALSE	FALSE	94	YES	YES	NO	NO	NO	6.50	3.7	1.76	0.74	7500	2

10049276	M	44	23 March 2024	27 March 2024	Diabetes,hypertension	80	16	200	37	TRUE	TRUE	FALSE	FALSE	92	NO	NO	NO	NO	NO	38.64	3.8	10.17	8.61	3700	1
10041354	M	78	17 February 2024	27 February 2024		110	32	100	36.9	TRUE	FALSE	FALSE	FALSE	90	NO	NO	NO	NO	NO	21.03	3.4	6.19	1.04	18700	3
10023012	M	70	26 November 2023	10 December 2023	Diabetes,hypertension	96	33	100	36.9	FALSE	FALSE	FALSE	TRUE	70	YES	YES	NO	YES	NO	37.85	3.4	11.13	1.52	11300	3
10021118	F	64	18 November 2023	23 November 2023		90	20	120	36.8	FALSE	TRUE	FALSE	FALSE	94	NO	NO	NO	NO	NO	19.21	3.4	5.65	0.76	10100	0
10092559	M	62	20 September 2024	26 September 2024	Diabetes	78	18	120	36.8	FALSE	TRUE	FALSE	FALSE	96	NO	NO	NO	NO	NO	29.02	3.6	8.06	2.37	10200	1
10076120	M	62	14 July 2024	24 July 2024		80	17	120	36.8	TRUE	TRUE	TRUE	TRUE	92	NO	NO	NO	NO	NO	62.64	2.6	24.09	0.46	10600	2
10021801	M	63	26 February 2024	26 July 2024		112	30	100	36.7	FALSE	FALSE	FALSE	TRUE	76	YES	NO	YES	NO	NO	45.61	3.7	12.33	3.81	22400	0
10081811	M	51	6 August 2024	9 August 2024		52	15	120	36.6	TRUE	TRUE	FALSE	TRUE	96	NO	NIO	NO	NO	NO	29.53	3.5	8.44	0.94	12300	1
10074983	M	50	10 July 2024	16 July 2024		77	28	130	36.5	TRUE	TRUE	FALSE	FALSE	94	NO	NO	NO	NO	NO	10.51	4	2.63	1.14	24000	0
10075534	F	63	11 July 2024	30 July 2024	Diabetes,hypertension	74	21	100	36.5	TRUE	FALSE	FALSE	TRUE	98	NO	NO	NO	NO	NO	10.51	2.3	4.57	0.62	13400	0
10080331	M	71	31 July 2024	5 August 2024	Diabetes,hypertension	60	18	130	36.5	TRUE	TRUE	TRUE	FALSE	96	NO	NO	NO	NO	NO	12.52	4	3.13	0.90	11700	1
10071259	M	41	25 June 2024	24 July 2024	Hypertension	104	28	110	36.5	TRUE	TRUE	FALSE	FALSE	92	YES	NO	NO	YES	NO	6.40	4.2	1.52	0.81	6900	0
10020152	F	51	13 November 2023	17 November 2023	Diabetes,hypertension	60	20	110	36.3	FALSE	FALSE	FALSE	TRUE	98	NO	NO	NO	NO	NO	16.36	3.9	4.19	1.28	13600	0
10090598	M	65	14 March 2024	12 August 2024	Diabetes	95	26	80	36.3	FALSE	FALSE	FALSE	TRUE	89	NO	NO	NO	NO	NO	7.24	2.8	2.59	1.12	14000	1
10079411	F	48	27 July 2024	8 August 2024	Hypertension	120	26	110	36.3	TRUE	TRUE	FALSE	TRUE	94	NO	NO	NO	NO	NO	56.54	2.4	23.56	3.42	21600	1
10065581	M	41	2 June 2024	12 July 2024	Diabetes,hypertension	136	40	90	35.4	FALSE	TRUE	TRUE	TRUE	84	YES	NO	YES	YES	NO	12.06	3.2	3.77	0.77	13700	2
10067290	M	28	9 June 2024	5 July 2024	Diabetes,hypertension	101	22	160	35.8	FALSE	TRUE	TRUE	TRUE	94	YES	NO	YES	YES	YES	62.63	2.8	22.37	1.32	21500	1
10072876	F	76	7 June 2024	12 June 2024	Hypertension	105	32	90	35.8	FALSE	FALSE	FALSE	FALSE	88	YES	YES	NO	NO	NO	15.33	1.7	9.02	1	14000	3
10074935	M	84	9 July 2024	19 July 2024	Diabetes,hypertension	88	18	150	35.8	FALSE	FALSE	FALSE	TRUE	90	YES	YES	NO	YES	NO	45.65	4	11.41	5.22	14100	2
10078735	F	58	24 July 2024	10 August 2024	Hypertension	109	28	130	35.8	FALSE	TRUE	FALSE	FALSE	88	YES	YES	NO	NO	NO	35.42	2.9	12.21	4.99	15200	1
10079824	F	27	29 July 2024	9 August 2024	Diabetes	120	28	110	35.9	FALSE	FALSE	FALSE	TRUE	88	YES	YES	NO	YES	YES	67.99	2.8	24.28	3.14	4100	2
10081893	M	39	7 August 2024	9 August 2024	Diabetes	100	21	130	35.9	FALSE	TRUE	TRUE	TRUE	90	YES	YES	NO	NO	NO	20.61	4.6	4.48	1.05	10000	1
10087889	F	86	21 August 2024	10 September 2024		106	20	160	35.9	FALSE	FALSE	FALSE	FALSE	92	YES	NO	NO	NO	NO	16.78	3.1	5.41	1.11	23600	1
10093585	M	24	24 September 2024	4 October 2024		90	22	170	37.4	FALSE	FALSE	FALSE	FALSE	90	YES	NO	NO	NO	NO	16.50	4.1	4.02	0.57	2900	0
10020493	F	57	15 November 2023	18 November 2023		70	21	120	37.6	TRUE	FALSE	FALSE	FALSE	92	YES	YES	NO	NO	NO	8.64	3.6	2.40	0.71	12300	0
10033572	M	94	13 January 2024	6 February 2024	Diabetes,hypertension	86	18	160	36.7	TRUE	TRUE	FALSE	TRUE	92	YES	YES	NO	NO	NO	62.62	2.7	23.19	1.11	10500	2
10072150	M	42	28 June 2024	4 July 2024	Diabetes,hypertension	126	30	140	36.5	TRUE	TRUE	FALSE	FALSE	88	YES	YES	YES	YES	YES	76.24	3.1	24.59	0.96	10800	3
10072167	M	75	28 June 2024	13 July 2024	Hypertension	87	30	120	36.3	TRUE	FALSE	FALSE	FALSE	96	YES	YES	NO	YES	NO	46.82	4.1	11.42	1.88	14000	4
10075992	F	48	13 July 2024	19 July 2024		124	26	120	35.9	TRUE	FALSE	FALSE	FALSE	88	YES	YES	NO	NO	NO	22.2	3	7.40	0.97	5800	0
10076009	M	73	13 July 2024	1 August 2024	Diabetes	74	18	110	35.9	TRUE	TRUE	TRUE	FALSE	96	YES	NO	NO	NO	NO	62.15	2.7	23.02	1.54	17000	2
10076471	F	57	15 July 2024	23 July 2024	Diabetes	110	36	130	35.6	TRUE	FALSE	FALSE	FALSE	88	YES	YES	NO	NO	NO	16.03	3.6	4.45	0.85	3400	1
10076727	M	55	16 July 2024	31 July 2024	Diabetes	130	34	90	35.6	TRUE	FALSE	FALSE	FALSE	86	YES	YES	YES	YES	YES	40.37	2.6	15.53	1.38	7600	3