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ORIGINAL RESEARCH INTENSIVE CARE

Prevalence and predictors of mortality in patients with severe community-acquired pneumonia in the intensive care unit

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ABSTRACT

Background & objective: Community-acquired pneumonia (CAP) stands as one of the most widespread infections globally, often leading to hospital admissions. This study aims to assess the proportion and mortality rate of severe CAP patients admitted to the Intensive Care Unit (ICU) and to identify the significant predictor factors contributing to mortality.

Methods: The study was conducted as a retrospective cohort study of severe CAP patients admitted to the mixed ICU and surgical ICU of Hospital Pakar University Sains Malaysia (HPUSM) during two years from January 1, 2021, to December 31, 2022. Eligible participants were adults aged 18 years and older diagnosed with severe CAP, with demographic, clinical, laboratory, and outcome data retrospectively collected from records and registries.

Results: A total of 203 severe CAP patients out of 788 were admitted to the ICU, indicating a prevalence of 25.8%, with a mortality rate of 25.6%. The mean age was 54.66 years. Multiple logistic regression analysis revealed that the independent risk factors significantly associated with mortality were an APACHE II score exceeding 23 (adjusted Odd Ratio OR = 7.89; 95% CI: 2.88, 21.61; $P < 0.001$). And plasma albumin level (adjusted OR = 0.92; 95% CI: 0.86, 0.99; $P = 0.025$).

Conclusion: The prevalence of severe CAP in the ICU at HPUSM was 25.8%, with a mortality rate of 25.6%. Higher APACHE II scores were associated with mortality, while elevated plasma albumin levels were associated with lower mortality in ICU.

Abbreviations: CAP: Community-acquired pneumonia, DM: Diabetes mellitus, DNR: do-not-resuscitate, GCS: Glasgow Coma Scale. ICU: Intensive Care Unit, PSI: Pneumonia Severity Index, MRIC: Malaysian Registry of Intensive Care, SICU: Surgical Intensive Care Unit

Keywords: Community-acquired pneumonia; CAP; intensive care; prevalence; mortality risk factors; mortality; predictor risk factors

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1. INTRODUCTION

Community-acquired pneumonia (CAP) ranks as the fourth leading cause of death worldwide, often in conjunction with lower respiratory tract infections.[1] It frequently leads to sepsis,[2] and is linked to substantial mortality.[3] CAP is characterized as an acute infection affecting the lung parenchyma, with symptoms emerging within the community.[4] Severe CAP is defined as pneumonia necessitating supportive therapy in a critical care setting, carrying a significant burden of morbidity and mortality.[4]

The diagnosis of severe CAP can be established through the British Thoracic Society (BTS) CURB-65 severity score. A score of 3 or more confirms the diagnosis, taking into account factors such as confusion, blood urea levels exceeding 7 mmol/L, a respiratory rate surpassing 30 breaths/min, blood pressure with a diastolic reading above 60 mmHg or systolic below 90 mmHg, or an age of 65 years or older.[5] In 2007 and 2019 Infectious Diseases Society of America/American Thoracic Society 2025 defined severe CAP as pneumonia that presents with either septic shock requiring vasopressors, respiratory failure requiring mechanical ventilation, or at least three minor criteria such as high respiratory rate, low oxygenation, multilobar infiltrates, confusion, uremia, leukopenia, thrombocytopenia, hypothermia, or hypotension requiring aggressive fluids.[6]

Among CAP patients, about 10–20% would require admission to the Intensive Care Unit (ICU), and the mortality rates may be as high as 11–56%.[7] According to the 2017 Malaysian Registry of Intensive Care (MRIC) report, severe CAP ranked among the top 10 (6.1%) common causes of ICU admission.[8] The overall ICU mortality rate in 2017 reported in MRIC is 18.3%, with severe CAP contributing to a specific mortality rate of 35.2%.[8] Severe CAP patients may have multiple comorbidities and impaired host defences that potentially worsen the outcome of therapy.[9]

As severe CAP is potentially severe, identifying the predictors of mortality may be important in improving the outcome of treatment, via focused efforts at severe CAP patients with poorer predictors of mortality. Over the years, there has been a plethora of studies into the prognostic factors of mortality with regard to severe CAP and guidelines for the optimal management of patients with CAP have been proposed by several medical authorities in the world.[10-18]

There is currently a lack of comprehensive data on severe community-acquired pneumonia (CAP) cases and their mortality rates within Malaysian ICU settings. Such information is essential for benchmarking, enhancing quality improvement initiatives, and optimizing patient outcomes nationwide. Accurate data can guide clinical decision-making, inform resource allocation, and contribute to the development of future clinical protocols in Malaysia. To address this evidence gap, the present study aims to determine both the proportion and mortality rate of severe CAP cases admitted to the intensive care unit at Hospital Pakar Universiti Sains Malaysia (HPUSM) over two years from 2021 to 2022. In addition, the study will identify significant predictors of mortality among these patients. Factors to be evaluated include age (≥ 65 years), diabetes mellitus (DM), hypertension, end-stage renal failure, malignancy, cerebrovascular accident (CVA), acute kidney injury (AKI), positive pneumonia cultures, septic shock, high APACHE II scores (above 23) [19], chronic heart failure, chronic obstructive pulmonary disease (COPD), and low plasma albumin levels.

2. METHODOLOGY

This study employed a retrospective record review, encompassing all patients admitted to the ICU of HPUSM from January 1, 2021, to December 31, 2022. Patient records, specifically the bed head tickets (BHT), for the two years were systematically traced through the hospital's medical record system, online laboratory results, Lifeline online HPUSM, and the ICU registry. The study received ethical approval from the Human Research and Ethics Committee of University Sains Malaysia (JEPeM Code: USM/JEPeM/22070484).

Eligibility included adult patients aged ≥18 years, diagnosed with CAP, and admitted to the common ICU or surgical intensive care unit (SICU) of HPUSM. Exclusion criteria were palliative care, do-not-resuscitate (DNR) status, pregnancy, and incomplete medical records.

Severe CAP was defined as pneumonia requiring supportive treatment in a critical care setting,[4] or according to the criteria outlined by the American Thoracic Society 2025.[6]

It incorporates an augmented capability for monitoring, as well as a range of physiologic organ support modalities designed to sustain life during instances of acute organ system insufficiency.[20]

2.1. Sample size calculation

The sample size requirement was calculated using the standard formula for calculation of single proportion sample size, $n = Z^2(1-\alpha/2)p(1-p)/d^2$, where $Z^2(1-\alpha/2)$ is the reliability coefficient, p is the proportion, and d is the precision.[15] This calculation assumes an infinite population. The calculated sample size was 196 patients, with an estimation to 95% level of confidence, a precision of 5%, and a proportion of 15%. Two previous studies by Espinoza et al. (from South America) and Ferrer et al. (from Europe) reported severe CAP proportions of 10% and 18% respectively; therefore, a middle ground of 15% was selected for this study's proportion.[12,14] Consecutive sampling was applied, with eligible patients enrolled until the required sample size was achieved.

2.2. Data collection method

A data collection sheet was utilized to collect the data required for this study, which includes the study identification, age, date of admission / discharge / death, site of admission, relevant comorbidities (DM, hypertension, end-stage renal failure, malignancy, CVA, chronic heart failure (CHF), liver cirrhosis), relevant biochemical data (C-reactive protein (CRP), lactate, albumin), chest X-ray (CXR) findings, positive culture (and organisms), septic shock (and number of inotropes), presence of AKI (and if renal replacement therapy need / dialysis dependent), and Acute Physiology and Chronic Health Evaluation (APACHE) II score.

2.3. Statistical analysis

Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 27 (IBM Corp., Armonk, NY, US). Continuous data presented as mean and SD for normally distributed data, and median and interquartile range for not normally distributed data, while category data presented as frequency and percentage. To ascertain the proportion of severe CAP, the number of patients meeting the criteria for severe CAP was divided by the total ICU admissions over the two-year period, multiplied by 100 to express the result as a percentage. To calculate the proportion of severe CAP patients who succumbed in the ICU, the number of deaths among severe CAP cases was divided by the total number of severe CAP cases (including both survivors and non-survivors). For the analysis of predictor factors influencing mortality among severe CAP cases in the ICU, both simple logistic regression (univariable analysis) and multiple logistic regression (multivariable analysis) were employed to predict death using the studied independent variables. Only records with complete data for all variables of interest are analyzed, while those with missing values are excluded from the analysis.

Variables with $P < 0.25$ in simple logistic regression were included for variable selection in multiple logistic regression analysis. Interaction and multicollinearity between variables were assessed before evaluation of model fitness (area under receiver operating (ROC) curve and Hosmer-Lemeshow test). Results were presented as crude odds ratio (OR), 95% confidence interval of crude OR, and P-value for simple logistic regression. For multiple logistic regression, adjusted OR, 95% confidence interval of OR and P-value were presented.

Table 1: Characteristics of patients with severe CAP (n = 203)

Parameter	N (%)
Age (years)[a]	55 (16)
Gender (male)	109 (53.7)
Comorbidities	155 (76.4)
CHF	2 (1.0)
COPD	8 (3.9)
CVA	10 (4.9)
Diabetes Mellitus	69 (34.0)
ESRF	6 (3.0)
Hypertension	93 (45.8)
Malignancy	5 (2.5)
Others	109 (53.7)
Mechanical ventilation	168 (82)
APACHE II score[a]	20 (9)
APACHE II score more than 23	83 (40.9)
GCS[a]	7 (5)
Temperature (°C) [a]	36.7 (0.8)
Heart rate (beats per minute) [a]	95 (21)
Urea (mmol/L) [a]	13.0 (13.5)
Creatinine (µmol/L) [a]	231 (314)
Albumin (g/L) [a]	30 (6)
WCC ($x10^9$/L) [a]	15.6 (10.2)
pH[a]	7.33 (0.11)
GCS[a]	7 (5)
Glucose (mmol/L) [a]	8.7 (3.7)
Septic shock	105 (51.7)
Positive blood culture	35 (17)
RRT	47 (23)

APACHE II = acute physiological and chronic health evaluation, CAP = community-acquired pneumonia, CHF = chronic heart failure, COPD = chronic obstructive pulmonary disease, CVA = cerebrovascular accident, ESRF = end-stage renal failure, GCS = Glasgow coma scale, ICU = intensive care unit, RRT = renal replacement therapy, SD = standard deviation, WCC = white cell count

4. RESULTS

Among the 788 patients diagnosed with CAP, a total of 203 were admitted to the ICU during the study period. Table 1 summarizes the baseline demographic, clinical, and laboratory characteristics, while Table 2 summarizes the outcomes of these 203 patients with severe CAP. Patient ages ranged from 18 to 85 years, with a mean of 54.66 ± 15.53 years. Many of the patients were male (n = 109, 53.7%), and all cases of severe CAP were exclusively admitted to the mixed ICU of HPUSM. (n = 203, 100.0%). The two most prevalent comorbidities among these patients were hypertension (n = 93, 45.8%) and DM (n = 69, 34.0%).

In terms of disease severity, the mean Acute Physiology and Chronic Health Evaluation (APACHE) II score for these patients was 19.84 ± 9.14. The heart rate of these individuals remained within the upper limit of the normal range, with a mean baseline of 94.69 ± 21.32 beats/minute, and their baseline temperature was also within the normal range at 36.67 ± 0.83. Conversely, a notable proportion of patients exhibited impaired consciousness, as reflected by a mean baseline Glasgow Coma Scale (GCS) of 7.35 ± 5.25.

Table 2: Clinical outcomes for patients with severe CAP at ICU admission

Variables	n (%)
Antibiotic within 24H	203 (100.0)
• Meropenem	76 (37.4)
• Tazosin	81 (39.9)
• Ceftriaxone	14 (6.9)
• Ceftazidime	15 (7.4)
Length of ICU stay (days)[a]	9 (10)
Length of hospital stay (days)[a]	22 (21)
Mortality	52 (25.6)

CAP = community-acquired pneumonia, ICU = intensive care unit

Many patients received mechanical ventilation (168 (82.8%), and inotropic or vasopressor support was administered to 105 individuals (51.7%), while nearly one-quarter of the cases required renal replacement therapy (n = 47, 23.2%). Regarding laboratory characteristics, patients exhibited impaired urea levels (mean urea 12.99 ± 13.46 mmol/L) and elevated creatinine levels (mean creatinine 230.68 ± 314.33. Leucocytosis was observed with a mean total White Cell Count (WCC) of 15.56 ± 10.24 x 10^9/L, hypoalbuminemia was present with a mean albumin of 29.88 ± 5.70) g/dL, and acidaemia was noted with a mean pH of 7.33 ± 0.11. Plasma glucose levels remained within the normal range, with a mean glucose of 8.74 ± 3.72 mmol/L. Notably, blood culture was positive in only 17.2% of patients (n = 35).

All patients (n = 203, 100.0%) received antibiotics within the first 24 hours of admission to the ICU. The two most used antibiotics in the treatment of severe CAP were Tazosin (Piperacillin/Tazobactam) (n = 81, 39.9%) and Meropenem (n = 76, 37.4%). In contrast, Ceftriaxone was utilized in only 6.9% of cases (n = 14), and Ceftazidime in only 7.4% of cases (n = 15). The mean length of ICU stay was 9.14 ± 10.24 days, and the mean length of hospitalization was 21.60 ± 20.80 days.

To determine the prevalence of severe CAP in ICU

$$\frac{Number\ of\ patients\ with\ severe\ CAP}{Number\ of\ patients\ treated\ in\ ICU}\ x\ 100$$

$$\frac{203}{788}\ x\ 100 = 25.7\%$$

What is the proportion of death among severe CAP admitted to ICU?

$$\frac{Number\ of\ death\ patients\ with\ severe\ CAP}{Number\ of\ patients\ with\ severe\ CAP}$$

$$\frac{52}{203} = 0.256$$

To determine the predictor factors of mortality among severe CAP in ICU

Both Simple Logistic Regression Analysis (univariable analysis) and Multiple Logistic Regression Analysis (multivariable analysis) were performed to identify the associated factors of mortality among severe CAP patients in ICU. In this study the considered associated factors were age, DM, hypertension, end-stage renal failure (ESRF), malignancy, CVA, AKI, pneumonia with positive culture, septic shock, APACHE II score, CHF, COPD and albumin. The outcome of these analysis is summarized in Table 3.

Simple Logistic Regression analysis is a univariable analysis that gives a preliminary idea of which variables were identified as potentially significant associated factors. In this study, a cut-off point of 0.25 is set for variable selection in Simple Logistic Regression to be included in further Multiple Logistic Regression (multivariable analysis). This is supported by many articles[21] as individual variables that are weakly

Table 3: Factors of severe CAP mortality (n = 203)

Factors	Crude OR (95% CI)	P-value[a]	Adjusted OR (95% CI)	P-value[b]
Age (years): less than 65 versus 65 and above	1.23 (0.62, 2.46)	0.552		
Diabetes Mellitus: No versus Yes	0.64 (0.32, 1.29)	0.214	0.51 (0.23, 1.12)	0.095
Hypertension: No versus Yes	0.74 (0.39, 1.41)	0.363		
ESRF: No versus Yes	1.47 (0.26, 8.27)	0.662		
Malignancy: No versus Yes	0.72 (0.08, 6.60)	0.772		
CVA: No versus Yes	0.31 (0.04, 2.50)	0.271		
AKI: No versus Yes	1.68 (0.89, 3.16)	0.111	0.43 (0.17, 1.13)	0.086
Pneumonia with positive culture: No versus Yes	2.28 (1.06, 4.91)	0.035	1.32 (0.34, 3.24)	0.542
Septic shock: No versus Yes	3.40 (1.70, 6.80)	0.001	1.64 (0.74, 3.62)	0.222
APACHE II score more than 23: No versus Yes	6.39 (3.16, 12.94)	<0.001	7.89 (2.88, 21.61)	< 0.001
CHF: No versus Yes	2.94 (0.18, 47.88)	0.449		
COPD: No versus Yes	0.40 (0.05, 3.36)	0.401		
Albumin	0.90 (0.85, 0.96)	0.001	0.92 (0.86, 0.99)	0.025

*[a]Simple Logistic Regression, [b]Multiple Logistic Regression. * P < 0.05 indicates a statistically significant difference, AKI = acute kidney injury, APACHE II = acute physiological and chronic health evaluation, CAP = community-acquired pneumonia, CHF = chronic heart failure, CI = confidence interval, COPD = chronic obstructive pulmonary disease, CVA = cerebrovascular accident, ESRF = end-stage renal failure, OR = odds ratio,*

correlated with the outcome during univariable analysis might contribute significantly when combined in multivariable analysis. The traditional cut-point of 0.05 for variable selection may result in important variables being removed from the model.[22,23]

Following Simple Logistic Regression, six variables (DM, AKI, pneumonia with positive blood culture, septic shock, APACHE II score, and plasma albumin level) were identified as potentially significant, indicated by a P-value less than 0.25. Subsequently, these variables were included in a Multiple Logistic Regression Analysis. From the Multiple Logistic Regression analysis, two variables emerged as significantly associated factors with mortality among severe CAP patients in the ICU, with a P less than 0.05. These variables were APACHE II score (P < 0.001) and albumin (P = 0.025).

The Multiple Logistic result showed that the model explained 29.1% (Nagelkerke R^2) of the variance in mortality among severe CAP patients in the ICU and correctly classified 76.4% of cases. The Hosmer-Lemeshow demonstrated a non-significant result (P = 0.808), which indicates that the model adequately fits the data and the predicted results are reliable.

The APACHE II score was identified as a significant associated factor with mortality among severe CAP patients in the ICU. Patients with severe CAP and an APACHE II score exceeding 23 had 7.89 times higher odds of mortality in the ICU compared to those with an APACHE II score of 23 and below. This association remained significant after adjusting for other relevant factors (P < 0.001, OR 7.89, 95% CI: 2.88, 21.61).

The plasma albumin level was identified as a significant associated factor with mortality among severe CAP patients in the ICU. For each one-unit increase in the albumin score among severe CAP patients, the odds of mortality in the ICU decreased by 8% after adjusting for other associated factors (P = 0.025, OR 0.92, 95% CI: 0.86, 0.99).

4. DISCUSSION

CAP remains a prevalent illness, and despite advancements in antibiotics leading to improved outcomes, it continues to stand as one of the foremost causes of hospitalization, morbidity, and mortality globally.[24,25] This study aims to delineate the characteristics of patients, mortality percentages, and

predictor factors associated with mortality among individuals with severe CAP admitted to the ICU.

From our study, the prevalence of severe CAP in the ICU of HPUSM was 25.7%, surpassing the 6.1% reported in the MRIC 2017, while the mortality rate was 25.6%, which is lower than the MRIC 2017 8 In a 2014 European epidemiological survey by Walden AP et al, the reported ICU admission rate for CAP ranged from 1.2% to 10%, with mortality rates in the range of 17% to 28.8% 26. Similarly in Germany, the study reveals the mortality rates for hospitalized CAP were 18.5% in-hospital, 22.9% at 30 days, and 44.5% at one year, with older adults (≥60 years) experiencing roughly double the mortality at each time point compared to younger patients.[27] Furthermore, a 2015 report from Egypt by Alotair HA et al cited a mortality rate for severe CAP in the ICU at 24.4%, a figure consistent with our findings.[28]

Previous research has identified various definitive risk factors for CAP, including age, smoking, environmental exposures, malnutrition, previous CAP, chronic bronchitis/chronic obstructive pulmonary disease, asthma, functional impairment, poor dental health, immunosuppressive therapy, oral steroids, and treatment with gastric acid-suppressive drugs.[29] In our study, the mean age of severe CAP patients was 54.66, indicating a skew towards the older age group. Many patients were male (53.7%), although gender's role as a risk factor remains inconclusive according to the same study.[29] The two most prevalent comorbidities noted were hypertension (45.8%) and DM (34.0%), though both conditions also lack conclusive evidence as risk factors in the same study.[29]

In our study, the two independent risk factors significantly associated with mortality among severe CAP patients in the ICU were an APACHE II score exceeding 23 and lower plasma albumin levels. Patients with higher APACHE II scores demonstrated elevated odds for mortality in the ICU, while those with higher plasma albumin levels exhibited lower odds for mortality in the ICU. These findings resonate with a study by Sirvent JM et al in 2013, which identified an APACHE II score exceeding 24 as a significant independent risk factor for mortality in severe CAP ICU patients.[16] A retrospective cohort study across 361 ICUs in 20 countries found APACHE II scores predict mortality in severe CAP patients 30. Another study in South Africa also reveals APACHE II ≥ 25 for predicting 28-day severe CAP.[31]

Damayanti N et al. (2013) revealed that severe hypoalbuminemia is associated with higher mortality risk in CAP patients,[32] reinforcing our results. Another study in Turkey also reveals hypoalbuminemia in severe CAP associated with mortality.[33] In data collected from West Peninsular Malaysia between 2016 and 2018, hypoalbuminemia was identified as an independent risk factor for multidrug-resistant healthcare-associated pneumonia, with an odds ratio of 3.43 (95% CI: 1.08–10.87).[34]

Additionally, our study identified other potentially significant factors during univariable analysis, including DM, AKI (AKI), pneumonia with positive blood culture, and septic shock. These factors find resonance in previous research. For instance, a study by Sirvent JM et al in 2013 identified CAP with shock and AKI as independent risk factors 16. Espinoza R et al. study in 2019 and Aziz AOA et al's study in 2016 similarly found septic shock to be an independent risk factor.[12,13]

Moreover, a study by Huang D et al. (2021) reported an association between severe CAP patients with type 2 DM and poorer outcomes.[35] Only 17.2% of severe CAP patients had positive blood cultures in our centre. However, the data does not include viral microorganism testing, which was not performed as a routine during the study period. A review published in JAMA reveals that in hospitalized CAP cases, a pathogen is identified in just 38% of patients, with viruses accounting for up to 40% of these detections and Streptococcus pneumoniae representing the leading bacterial cause, found in around 15%.[36]

5. LIMITATIONS

The retrospective design may introduce biases, such as information bias from inconsistent records and unmeasured confounders, including socioeconomic factors, comorbidity severity, and treatment details, which could affect mortality outcomes. This study's limitations include being conducted at a tertiary teaching hospital, which may limit generalizability, and lacking independent monitoring of study processes. To enhance validity, data were cross-checked at multiple intervals. Additionally, CAP data were only collected from closed ICUs, excluding HDUs primarily managed by physicians. Therefore, findings should be interpreted cautiously, and prospective studies are needed for further validation.

6. STRENGTHS

The strength of this study is that this was the first study to determine the mortality rate of severe CAP and its predictive mortality risk factors in the ICU of HPUSM, which may contribute to the epidemiology database of severe CAP among the critical care units in Malaysia, which may then serve to improve the outcome of severe CAP in the ICU.

7. CONCLUSION

In conclusion, our study revealed a prevalence of 25.8% for severe CAP in the ICU with a mortality rate of 25.6%. Higher APACHE II scores were associated with increased odds of mortality in the ICU, while higher plasma albumin levels were linked to reduced odds of mortality in the ICU.

8. Data availability

The numerical data generated during this research are available from the authors.

9. Conflict of interest

All authors declare that there was no conflict of interest.

10. Funding

The study utilized the hospital resources only, and no external or industry funding was involved.

11. Authors' contribution

GS: conduction of the study work, write manuscript

SH, WM, NA, NY: manuscript editing

MZ: Concept, conduction of the study work, write, manuscript editing

12. REFERENCES

1. GBD 2016 Causes of Death Collaborators. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet 2017 Sep 16;390(10100):1151-1210. [PubMed] DOI: 10.1016/S0140-6736(17)32152-9
2. Prina E, Ranzani OT, Torres A. Community-acquired pneumonia. Lancet 2015 Sep 12;386(9998):1097-108. [PubMed] DOI: 10.1016/S0140-6736(15)60733-4
3. Marshall DC, Goodson RJ, Xu YW, Komorowski M, Shalhoub J, Maruthappu M et al. Trends in mortality from pneumonia in the Europe union: a temporal analysis of the European detailed mortality database between 2001 and 2014. Respir Res 2018 May 4;19(1):81.[PubMed] DOI: 10.1186/s12931-018-0781-4
4. Morgan AJ, Glossop AJ. Severe community-acquired pneumonia. BJA Education 2016;16(5):167–172. [PubMed] DOI: 10.1093/bjaed/mkv052
5. Abdulla AT. Assessment of severe community acquired pneumonia by CURB-65. Int. J. Adv. Res. Biol. Sci 2019;6(1):135-141. [FullText]
6. Jones BE, Ramirez JA, Oren E, Soni NJ, Sullivan LR, Restrepo MI, Musher DM, Erstad BL, Pickens C, Vaughn VM, Helgeson SA. Diagnosis and Management of Community-acquired Pneumonia. An Official American Thoracic Society Clinical Practice Guideline. American Journal of Respiratory and Critical Care Medicine. 2025 Jul 21(ja).[PubMed] DOI: 10.1164/rccm.202507-1692ST
7. Sligl WI, Marrie TJ. Severe community-acquired pneumonia. Crit Care Clin 2013 Jul;29(3):563-601. [PubMed] DOI: 10.1016/j.ccc.2013.03.009
8. Tai LL, Lim CH, Nor MRM, Ismail NI, Ismail WNW. Malaysia Registry of Intensive Care report 2017. Malaysia Registry of Intensive Care, Clinical Research Centre, Ministry of Health Malaysia, September 2018. [FullText]
9. Kruckow KL, Zhao K, Bowdish DME, Orihuela CJ. Acute organ injury and long-term sequelae of severe pneumococcal infections. Pneumonia (Nathan) 2023;15:5.. [PubMed] DOI: 10.1186/s41479-023-00110-y
10. Nair GB, Niederman MS. Updates on community acquired pneumonia management in the ICU. Pharmacol Ther 2021 Jan;217:107663. [PubMed] DOI: 10.1016/j.pharmthera.2020.107663
11. Phua J, Dean NC, Guo Q, Kuan WS, Lim HF, Lim TK. Severe community-acquired pneumonia: timely management measures in the first 24 hours. Crit Care 2016;20:237. . [PubMed] DOI: 10.1186/s13054-016-1414-2
12. Espinoza R, Silva JRL, Bergmann A, Melo UO, Calil FE, Santos RC at al. Factors associated with mortality in severe community-acquired pneumonia: a multicenter cohort study. J Crit Care 2019 Apr;50:82–86. [PubMed] DOI: 10.1016/j.jcrc.2018.11.024
13. Aziz AOA, Fattah MTA, Mohamed AH, Aziz MOA, Mohammed MS. Mortality predictors in patients with severe community-acquired pneumonia requiring ICU admission. Egypt J Bronchol 2016;10:155-161. [FullText]
14. Ferrer M, Travierso C, Cilloniz C, Gabarrus A, Ranzani OT, Polverino E, et al. Severe community-acquired pneumonia: Characteristics and prognostic factors in ventilated and non-ventilated patients. PLoS One 2018;13(1):e0191721. [PubMed] DOI: 10.1371/journal.pone.0191721
15. Zhang ZXZ, Yong Y, Tan WC, Shen L, Ng HS, Fong KY. Prognostic factors for mortality due to pneumonia among adults from different age groups in Singapore and mortality predictions based on PSI and CURB-65. Singapore Med J 2018;59(4):190-198. [PubMed] DOI: 10.11622/smedj.2017079
16. Sirvent JM, Torre MC, Lorencio C, Taché A, Ferri C, Garcia-Gil J et al. Predictive factors of mortality in severe;37(5):308-315. [PubMed] DOI: 10.1016/j.medin.2013.03.003
17. Spasovska K, Grozdanovski K, Milenkovic Z, Bosilkovski M, Cvetanovska M, Kuzmanovski N, et al. Evaluation of community-acquired pneumonia: A model with data on the first 24H of ICU admission. Med Intensiva 2013severity scoring systems in patients with severe community acquired pneumonia. Rom J Intern

Med 2021 Nov 20;59(4):394-402. [PubMed] DOI:10.2478/rjim-2021-0025

18. Póvoa P, Nseir S, Salluh J. Severe community-acquired pneumonia: in search of the guiding star. Intensive Care Med 2023 Jun;49(6):656-658. [PubMed] DOI: 10.1007/s00134-023-07063-2\

19. Godinjak A, Inglica A, Rama A, Tančica I, Jusufović S, Ajanović A et al. Predictive value of SAPS II and APACHE II scoring systems for patient outcome in a medical intensive care unit. Acta Med Acad 2016 Nov;45(2):97–103. [PubMed] DOI: 10.5644/ama2006-124.165

20. Marshall JC, Bosco L, Adhikari NK, Conolly B, Diaz JV, Dorman T, et al. What is an intensive care unit? A report of the task force of the World Federation of Societies of Intensive and Critical Care Medicine. J Crit Care 2017 Feb;37:270-276 [PubMed] DOI: 10.1016/j.jcrc.2016.07.015

21. Zhang ZH. Model building strategy for logistic regression: purposeful selection. Ann Transl Med 2016 Mar;4(6):111. [PubMed] DOI: 10.21037/atm.2016.02.15

22. Hosmer Jr DW, Lemmeshow S, Sturdivant RX. Applied logistic regression, 3rd ed. John Wiley & Sons: 2013;10:398.[FullText]

23. Chowdhury MZI, Turin TC. Variable selection strategies and its importance in clinical prediction modelling. Fam Med Community Health 2020 Feb 16;8(1):e000262. [PubMed] DOI: 10.1136/fmch-2019-000262

24. Wunderink RG, Waterer GW. Clinical practice. Community-acquired pneumonia. N Engl J Med 2014;370:543–51. [PubMed] DOI: 10.1056/NEJMcp1214869

25. Quan TP, Fawcett NJ, Wrightson JM, Finney J, Wyllie D, Jeffery K, et al. Increasing burden of community-acquired pneumonia leading to hospitalisation, 1998-2014. Thorax 2016;71:535–42[PubMed] DOI: 10.1136/thoraxjnl-2015-207688

26. Walden AP, Clarke GM, McKechnie S, Hutton P, Gordon AC, Rello J, et al. Patients with community acquired pneumonia admitted to European intensive care units: an epidemiological survey of the GenOSept cohort. Crit Care 2014 Apr 1;18(2):R58. [PubMed] DOI: 10.1186/cc13812

27. Theilacker C, Sprenger R, Leverkus F, et al. Population-based incidence and mortality of community-acquired pneumonia in Germany. PLoS One. 2021;16(6):e0253118. [PubMed] DOI: 10.1371/journal.pone.0253118

28. Alotair HA, Hussein MA, Elhoseny MA, Alzeer AH, Khan MF. Severe pneumonia requiring ICU admission: revisited. J Taibah Uni Med Sci 2015;2925:1–7. [FullText]

29. Almirall J, Serra-Prat M, Bolíbar I, Balasso V. Risk factors for community-acquired pneumonia in adults: a systematic review of observational studies. Respiration 2017;94(3):299-311. [PubMed] DOI: 10.1159/000479089

30. Tejerina E, Frutos-Vivar F, Restrepo MI, Anzueto A, Palizas F, González M, Apezteguía C, Abroug F, Matamis D, Bugedo G, Esteban A. Prognosis factors and outcome of community-acquired pneumonia needing mechanical ventilation. Journal of critical care. 2005 Sep 1;20(3):230-8. [PubMed] DOI: 10.1016/j.jcrc.2005.05.010

31. Richards G, Levy H, Laterre PF, Feldman C, Woodward B, Bates BM, et al. CURB-65, PSI, and APACHE II to assess mortality risk in patients with severe sepsis and community acquired pneumonia in PROWESS. J Intensive Care Med. 2011 Jan-Feb;26(1):34-40. [PubMed] DOI: 10.1177/0885066610383949

32. Damayanti N, Abidin A, Keliat EN. The correlation between albumin levels with 30 days mortality in community acquired pneumonia patients. IOP Conf. Series: Earth and Environmental Science 2018;125(1):012141[FullText]

33. Hoşgün D, Gülensoy ES, Akpınar E, Ogan N, Ateş C, Aydemir S. Serum albumin and C-reactive protein/albumin ratio in community-acquired pneumonia. Journal of Medicine and Palliative Care. 2022;3(2):111-6. [FullText]

34. Woei IL, Islahudin F, Bahari N, Sen TJ. Hypoalbuminemia and Central Venous Catheter as Risk Factors for Multidrug-resistant Healthcare-associated Pneumonia in an Intensive Care Setting. IMSEAR. 2020. ID: sea-215800[FullText]

35. Huang D, He DX, Gong LJ, Wang W, Yang L, Zhang ZW, et al. Clinical characteristics and risk factors associated with mortality in patients with severe community-acquired pneumonia and type 2 diabetes mellitus. Crit Care 2021 Dec 7;25(1):419. [PubMed] DOI: 10.1186/s13054-021-03841-w

36. Vaughn VM, Dickson RP, Horowitz JK, Flanders SA. Community-Acquired Pneumonia: A Review. JAMA. 2024;332(15):1282–1295. [PubMed] DOI: 10.1001/jama.2024.14796

