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A-DROP Scoring System in Predicting Mortality within 30 Days of Hospitalization in Community-acquired Pneumonia Patients at H. Adam Malik General Hospital Medan

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Abstract

BACKGROUND: Community-acquired pneumonia (CAP) is the leading cause of death among infectious diseases, contributing significantly to patient morbidity and mortality. Therefore, an accurate initial assessment of CAP severity should be performed immediately to determine the prognosis before starting the management. A-DROP scoring system is one of the initial assessments.

AIM: This study aimed to determine the accuracy of the A-DROP scoring system in predicting mortality within 30 days of hospitalization at H. Adam Malik General Hospital Medan.

METHODS: This is an observational study with a retrospective and cohort study. Data were obtained from the medical records of 76 CAP patients hospitalized from January 2018 to December 2018. Each patient was assessed with an A-DROP scoring system and the presence or absence of mortality within 30 days of hospitalization. The data were processed using statistical analysis to calculate the area under curve (AUC) on the receiver operating characteristic (ROC) curve. The optimal cutoff point is also analyzed using the Youden index.

RESULT: The ROC curve analysis showed that the AUC was 0.772 (95% CI: 0.666–0.978, $p < 0.001$). The accuracy of A-DROP scoring system is good (AUC:0.7−0.8). The optimal of the Youden index is 0.428 at the cutoff point A-DROP score >1.5, so that the optimal cutoff point is A-DROP score ≥2.

CONCLUSION: The A-DROP scoring system has good accuracy in predicting mortality within 30 days of hospitalized CAP patients. The A-DROP scoring system has an accuracy similar to the PSI (Pneumonia Severity Index) and the CURB-65 scoring system.

Introduction

Community-acquired pneumonia (CAP) is the leading cause of death among infectious diseases, a common cause of hospital admission that makes a significant contribution to patient morbidity and mortality. It also plays a role in increasing health-care costs. In addition, the mortality of CAP patients is higher in patients with severe disease, respiratory failure, shock, and the elderly [1], [2]. The incidence of CAP worldwide varies from 1.5 to 14 cases per 1000 people per year, and it is affected by geography, season, and population characteristics. In the United States, the annual incidence rate is 24.8 cases per 10,000 adults, increasing with age. The mortality rate for CAP patients is 23% for patients admitted to the intensive care unit (ICU) [3]. In Indonesia, CAP is in the top 10 inpatients in hospitals [4].

The clinical manifestations of CAP are classified into respiratory and non-respiratory symptoms. Respiratory symptoms consist of cough (66−84%), sputum production (53−55%), chest pain (17−45%), coughing up blood (3−13%), and shortness of breath (70−80%). Non-respiratory symptoms consist of chills (23−51%), sweating (45−55%), weakness (84−88%), abdominal pain (18%), anorexia (57−64), changes in mental status (11−45%), and malaise (8−23%). Some clinical findings on physical examination of CAP are fever (40−78%), tachypnea (65−68%), tachycardia (37−40%), and crackles on auscultation (77−84%) [5].

An accurate initial assessment of the severity of CAP should be performed immediately before starting the management of CAP patients. Assessment of the severity of CAP can determine the prognosis of CAP patients since entering the Emergency Room (ER) so that optimal initial treatment can be given as soon as possible [6].

Based on the Indonesian Society of Respirology (ISR), a definite diagnosis of CAP is confirmed if there is an infiltrate/air bronchogram on the chest X-ray with any of the following symptoms or signs: Cough, change in sputum/purulent characteristics, body temperature ≥38°C (axillary)/history of fever, chest pain, and shortness of breath, on physical examination, there

may be signs of consolidation, bronchial breath sounds, and crackles, and leukocytes ≥10,000 or ≤ 4500 [4].

The A-DROP scoring system is a simplified version of the CURB-65 recommended by the Japan Respiratory Society (JRS) with a ROC curve for A-DROP similar to CURB-65 [7], [8]. A-DROP is also a more simple clinical score than the pneumonia severity index (PSI) because it only uses five components of the A-DROP scoring system variable: Age, dehydration, and respiratory failure, orientation disturbance, and blood pressure, compared to PSI which has 20 variables. For each component of the A-DROP scoring system variable, it is shown in Table 1 [9]. CURB-65 and PSI are recommended by the American Thoracic Society (ATS) to assess the severity of CAP before starting initial treatment. However, PSI is more effective than CURB-65 because it uses 20 specific variables and CURB-65 is simpler to use because it only uses five variables [10].

Table 1: Components of A-DROP Score [9]

Characteristics	Score
Age (Men ≥ 70 years, Women ≥ 75 years)	1
Dehidration (Blood Urea Nitrogen (BUN) ≥21 mg/dL)	1
Respiratory Failure (arterial oxygen saturation ≤ 90% or arterial oxygen pressure ≤ 60 mmHg)	1
Orientation disturbance (confusion)	1
Blood pressure (systolic blood pressure ≤ 90 mmHg)	1

Prognosis in CAP patients was assessed using a short-term mortality rate. This short-term mortality rate is defined as deaths that occur within 30 days after admission to the hospital. The short-term risk of death increases significantly as the number of A-DROP scores increases. The prognosis is related to several risk factors such as age, gender, and comorbid diseases that can significantly increase short-term mortality [11]. This study aimed to determine the accuracy of the A-DROP scoring system in predicting mortality within 30 days of hospitalization at H. Adam Malik General Hospital Medan.

Methods

Study design

This study is an observational study with a retrospective and cohort study. Data were taken from patient's medical records diagnosed with CAP hospitalized at the H. Adam Malik General Hospital from January 2018 to December 2018. The patient's medical record used is a medical record that contains a diagnosis of CAP as a primary diagnosis or a secondary diagnosis on a medical resume at the time of discharge/death. The subjects of this study were patients who met the inclusion criteria and exclusion criteria. The inclusion criteria in this study met: Age over 18 years, admitted to the H. Adam Malik General Hospital from the emergency room (ER) and hospitalized in an inpatient room or ICU room, diagnosed with CAP by a pulmonologist. Exclusion criteria in this study were patients with a diagnosis of aspiration pneumonia, patients with a diagnosis of pulmonary tuberculosis, and patients who had been previously hospitalized with a length of stay of more than 48 h before readmission to the ER.

A definite diagnosis of CAP is confirmed if there is an infiltrate/air bronchogram on the chest X-ray with any of the following symptoms or signs: Cough, change in sputum/purulent characteristics, body temperature ≥38°C (axillary)/history of fever, chest pain, and shortness of breath, on physical examination, there may be signs of consolidation, bronchial breath sounds, and crackles, and leukocytes ≥10,000 or ≤ 4500.

Subject data in the medical records of patients diagnosed with CAP were examined starting from the initial admission to the ER, that is, age, gender, history, vital signs: consciousness, blood pressure, pulse, respiratory rate, body temperature, oxygen saturation, and chest X-ray within 24 h of admission to the ER confirmed by a radiologist and met as a description of pneumonia, arterial blood gas analysis (ABG), blood urea nitrogen (BUN), and patient outcome within 30 days of hospitalization. The number of subjects who met the inclusion criteria and exclusion criteria in this study was 76 patients. Each patient was calculated A-DROP score when admitted to the ED and whether there was death within 30 days of hospitalization.

A-DROP scoring system

A-DROP score data taken from medical records, that is, age, dehydration, respiratory failure, disorientation disorders, and systolic blood pressure. The components of the A-DROP scoring system variable:

- Age (men ≥70 years, women ≥75 years),
- Dehydration (blood urea nitrogen (BUN) ≥21 mg/dL),
- Respiratory failure (arterial oxygen saturation ≤90% or paO_2 ≤60 mm Hg),
- Orientation disturbance (disorientation to person, time, and place),
- Blood pressure (systolic blood pressure ≤90 mmHg).

A-DROP scores are calculated based on the number that meets the variable components of the A-DROP scoring system.

Outcome

The outcome of this study was whether there was death within 30 days of hospitalization at H. Adam Malik General Hospital, Medan. Outcomes in this study were taken from the patient's medical record resume when the patient was discharged/died.

Statistical analysis

A-DROP scores data were collected and tabulated into a 2x2 table. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were measured for each cutoff point A-DROP score. The correlation between A-DROP scores with the incidence of death within 30 days of hospitalization was also statistically analyzed. The receiver operating characteristic (ROC) curve and the area under curve (AUC) A-DROP scoring systems were also calculated to assess the accuracy of the A-DROP score in predicting mortality within 30 days of hospitalization. The classification of AUC is as follows: 0.90–1 = excellent, 0.80–0.90 = very good, 0.70–0.80 = good, 0.60–0.70 = sufficient, and 0.50–0.6 = bad. The Youden index is calculated to find the optimal cutoff point. Statistical analysis in this study used SPSS statistical software version 20.

The Ethics Committee of the Faculty of Medicine, Universitas Sumatera Utara, Medan, has approved this research.

Results

This study involved 76 patients who met the inclusion and exclusion criteria. Statistical analysis showed that 55.3% of patients were male and 44.7% were female. The mean age was 54.6 ± 16.2 years. The mortality rate within 30 days of hospitalization encountered was 51.3%. The characteristics of research subjects and the A-DROP scoring system variable, respectively, are shown in Table 2.

Table 2: Subjects characteristics

Subjects characteristics	Total N = 76	%
Sex		
Male	42	55.3
Female	34	44.7
Age		
Mean (± SD years)	54.6 ± 16.2 (years)	
Components of A-DROP		
Age (Men≥70 years, Women≥75 years)	11	14.5
Dehydration (Blood Urea Nitrogen (BUN) ≥21 mg/dL)	40	52.6
Respiratory Failure (arterial oxygen saturation ≤ 90% or arterial oxygen pressure ≤ 60 mmHg)	3	3.9
Orientation disturbance (confusion)	27	35.5
Blood Pressure (systolic blood pressure ≤ 90 mmHg)	8	10.5
Outcome		
Mortality within 30 Days of Hospitalization	39	51.3

In this study, patients with a total A-DROP score of 0 are 24 of the total 76 patients, five patients died, and 19 patients survive. Patients with a total score of A-DROP 1 are 23 of the total 76 patients, 11 patients died, and 12 patients survive. Patients with a total score of A-DROP 2 are 21 of the total 76 patients, 16 patients died, and five patients did not die. Patients with a total A-DROP 3 score are 8 of the total 76 patients, seven patients died, and one patient survive. There were no patients with a total A-DROP score of 4 or 5. From the statistical analysis, we can see a relationship between an increase in the A-DROP score and mortality within 30 days of hospitalization with $p < 0.001$. The distribution of mortality within 30 days of hospitalization for each A-DROP score and its correlation with death within 30 days of hospitalization is shown in Table 3.

Table 3: Distribution and correlation of A-DROP scores with mortality within 30 days of hospitalization

Score	All	Mortality within 30 days of hospitalization		p-value
		Yes	No	
	n (%)	n (%)	n (%)	
A-DROP				
5	0 (0)	0 (0)	0 (0)	<0.001
4	0 (0)	0 (0)	0 (0)	
3	8 (10.5)	7 (17.9)	1 (10.8)	
2	21 (27.6)	16 (16.2)	5 (21.6)	
1	23 (30.3)	11 (28.2)	12 (29.7)	
0	24 (31.6)	5 (12.8)	19 (37.8)	
Total	76 (100.0)	39 (100.0)	37 (100.0)	

The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for the A-DROP score ≥3 were 17.9%, 97.3%, 87.5%, and 52.9%. The sensitivity, specificity, PPV, and NPV for the A-DROP score ≥2 were 59.0%, 86.5%, 82.1%, and 66.7%. As for the A-DROP score ≥1, the sensitivity, specificity, PPV, and NPV were 87.2%, 51.4%, 73.9%, and 79.1%. For each sensitivity, specificity, PPV, and NPV, the A-DROP score is shown in Table 4.

Table 4: Sensitivity, Spesificity, PPV, and NPV A-DROP score in predicting mortality within 30 days of hospitalization in this study

Score	Sensitivity %	Sensitivity %	PPV %	NPV %
A-DROP				
A-DROP≥3	17.9	97.3	87.5	52.9
A-DROP≥2	59.0	86.5	82.1	66.7
A-DROP≥1	87.2	51.4	73.9	79.1

In this study, statistical analysis was carried out with the receiver operating characteristic (ROC) curve, as shown in Figure 1. The results of the ROC

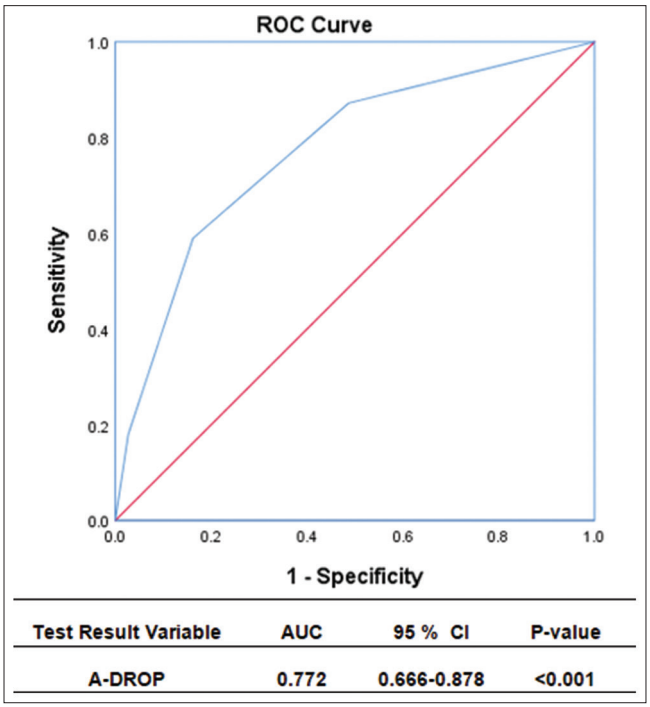

Figure 1: A-DROP scoring system ROC curve in predicting mortality within 30 days of hospitalization

curve analysis obtained the area under curve (AUC) are 0.772 (95% CI: 0.666−0.978) with a p < 0.001. The AUC of 0.772 means that the A-DROP score has good accuracy in predicting death within 30 days of hospitalization.

The optimal cutoff point in this study was calculated using the Youden index, as shown in Table 5. The optimal Youden index was 0.428 at the cutoff point A-DROP score >1.5. With these calculations, the optimal cutoff point in this study was A-DROP score 2, so that patients with A-DROP score ≥2 had a poor prognosis and a tendency to die in hospitalization for 30 days.

Table 5: Youden index for the optimal cut-off point

Severity score	Sensitivity	Specificity	Youden Index
0.5	0.872	0.514	0.386
1.5	0.590	0.838	0.428
2.5	0.179	0.973	0.152

Discussion

The study found that men were more likely to suffer from CAP, with the percentages of men and women are 55.3% and 44.7%, respectively. This study is not much different from the research conducted by Nagano *et al*. in 2019, with the respective percentages of men and women being 56.7% and 43.3% [12]. The mean age of subjects was 54.6 ± 16.2 years. The mean age of this study is very different from the study conducted by Shindo *et al*. in Japan, which found that the mean age of hospitalized CAP patients was 75.0 ± 15.6 years [13]. Another study conducted by Nagano *et al*. in Japan found that the median age of hospitalized community CAP patients was 81.0 (71.0-87.0) [12]. Research by Ahn and Choi in South Korea found that the average age of hospitalized patients with CAP was 69.2 ± 14.3 years [6]. The mean/median age of the study conducted by Shindo *et al*., Nagano *et al*., Ahn, and Choi was higher than in this study because patients who came to the hospital for hospitalization in Japan and South Korea were more often elderly. Meanwhile, in this study, patients came with fewer elderly people [6], [12], [13]. The higher mean/median age of those studies is related to life expectancy in South Korea and Japan, which are higher when compared to life expectancy in Indonesia so that patients who come to the hospital are often elderly. According to the Indonesia Central Bureau of Statistics, life expectancy in South Korea, Japan, and Indonesia is 81.4 years, 83.5 years, and 70.1 years [14].

The mortality percentage of 30-day hospitalized patients with CAP in this study was 51.3%. This study is different from Teixeira-Lopes *et al*. in Portugal and Nagano *et al*. in Japan, which found mortality rates of 20.4% and 9.3%, respectively. This difference is due to the more significant number of research samples of Teixeira-Lopes *et al*. and Nagano *et al*., which will represent the state of the population [12], [15].

The area under curve (AUC) on the receiver operating characteristic (ROC) A-DROP scoring system curve in this study was 0.772 (95% CI: 0.666−0.878). This means that the A-DROP score can be used adequately in predicting the mortality of CAP patients within 30 days of hospitalization (AUC: 0.7−0.8) [10]. In a study conducted by Shindo *et al*., the AUC of A-DROP score was 0.846 (95% CI: 0.790–0.903) [13]. The AUC of the A-DROP score in Shindo *et al*. was higher when compared to this study. In the study by Ahn and Choi, the AUC score of the A-DROP score was 0.730 (95% CI: 0.678–0.782) [6]. The AUC of the A-DROP score in the study by Ahn and Choi was slightly lower when compared to this study. This study is still within the range of AUC variations of the previous studies that have been carried out. The AUC of the ROC PSI (Pneumonia Severity Index) and CURB-65 scores in the study by Ahn and Choi was 0.735 (95% CI: 0.686–0.784) and 0.701 (95% CI: 0.648–0.754), respectively [6]. The AUC of the ROC A-DROP score in this study was slightly higher than the AUC of the ROC PSI (Pneumonia Severity Index) and CURB-65 scores in the study by Ahn and Choi. In another study conducted by Shehata, Sileem, and Shahien, the AUC for PSI scores and CURB-65 scores was 0.740 (p < 0.0001) and 0.706 (p-value = 0.0005), respectively [11]. This means that the accuracy of the A-DROP score is slightly higher than the accuracy of the CURB-65 score and PSI score in both studies. In a study conducted by Zhang *et al*., the AUC of the ROC PSI and CURB-65 score was 0.82 (95% CI: 0.80–0.84) and 0.71 (95% CI: 0.68–0.74) [16]. Compared with the AUC conducted by Zhang *et al*., the accuracy of the A-DROP score is higher than the CURB-65 score but slightly lower accuracy compared to PSI. Hence, it can be said that based on those studies, the A-DROP score can be used to predict mortality within 30 days of hospitalization of patients with CAP with good accuracy.

The optimal of the Youden index is 0.428 at the cutoff point A-DROP score >1.5, so that the optimal cutoff point in this study is A-DROP score ≥2. This means that patients who are admitted with an A-DROP score ≥2 have a poor prognosis. The sensitivity, specificity, PPV, and NPV of the A-DROP scores ≥2 in this study were 59.0, 86.5, 82.1, and 66.7, respectively.

There were no hospitalized patients with an A-DROP score of 4 or 5 in this study. This is because only three patients were admitted with respiratory failure (arterial oxygen saturation 90% or arterial oxygen pressure 60 mmHg), and there were only 11 patients who came with age (male ≥70 years and Female ≥75 years).

This study has limitations. This study is a retrospective and cohort design so that there may be bias in the information obtained from the patient's

medical record. In addition, patients discharged from inpatient treatment in this study were not followed up again, so there was still the possibility of readmission for hospitalization.

Conclusion

The A-DROP scoring system has good accuracy in predicting mortality within 30 days of hospitalized CAP patients. The A-DROP scoring system has an accuracy similar to the PSI (Pneumonia Severity Index) and the CURB-65 scoring system. This study shows that the higher the A-DROP score, the higher the mortality rate. The optimal cutoff point in this study is the A-DROP ≥2, meaning that if the patient came to the ER with the A-DROP ≥2, the patient had a poor prognosis.

Patients Consent Statement

The first author stated that the patients' consent to enroll in the study was not required because the data in this study were taken from the patient's medical records.

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