The prognostic models for predicting the survival probability of septic patients: A cohort study in Vietnam

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Summary

Objective: To predict the survival probability of septic patients over time, integrating the Sequential Organ Failure Assessment (SOFA) score with other key clinical features. *Subject and method:* Using stepwise and exhaustive search techniques, we analyzed time-dependent data from 125 patients in the Intensive Care Unit of the 108 Military Central Hospital, collected during a cohort study conducted between December 2019 and February 2021. *Result:* We identified 11 prognostic factors related to vital signs, onset symptoms, blood investigations, and severity of illness scores that significantly influence the mortality rate as well as the survival probability at the specified time. A proposed model incorporating four key factors - SOFA score, shivering, hemoglobin and septic shock - demonstrated superior performance compared to a univariate Cox model based solely on SOFA. This improvement was evidenced by better quality metrics, such as the Akaike Information Criterion (AIC) and enhanced calibration plots. Additionally, we introduce a user-friendly nomogram to estimate 7-day, 14-day, and 30-day mortality risks for septic patients using the identified significant factors. *Conclusion:* This study provides valuable insights into the survival probabilities of septic patients and offers a practical prognostic tool for clinical application. With further validation and refinement, the findings could make a significant contribution to improving sepsis management and patient outcomes in diverse healthcare settings.

Keywords: Sepsis, SOFA, Cox PH model.

I. BACKGROUND

Sepsis is the body's extreme and life-threatening reaction to infection, characterized by organ dysfunction resulting from a dysregulated host immune response. Without prompt treatment, sepsis can lead to organ failure, tissue damage, and death. Despite advances in diagnostics, monitoring, and treatment, sepsis remains a major global health challenge with high incidence and mortality rates. In 2017 alone, an estimated 11 million deaths occurred from 49 million global cases of sepsis[1]. It is also the leading cause of death in intensive care units (ICUs), with approximately 250,000 annual deaths reported in the U.S. alone[2]. In Vietnam, a 2021 cross-sectional study across 15 ICUs reported 101 deaths among 252 sepsis patients[3].

The diagnosis of sepsis involves a combination of clinical assessments, laboratory tests, imaging studies, and scoring systems. Key tools include the Sequential Organ Failure Assessment (SOFA) score, Quick SOFA (qSOFA), Systemic Inflammatory Response Syndrome (SIRS) criteria, APACHE II, and Point-of-Care testing methods such as bedside ultrasound and lactate monitoring. Among these, the SOFA score is the most widely used to evaluate organ dysfunction. According to the Third

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International Consensus Definitions for Sepsis, a SOFA score ≥ 2 alongside evidence of infection confirms a sepsis diagnosis. However, the SOFA score has limitations, including its complexity and dependence on comprehensive data.

Sepsis treatment strategies are typically guided by clinical protocols and physician judgment. Delays in recognizing and treating sepsis can lead to worse outcomes and higher mortality rates. While management guidelines and training programs have been implemented globally, resource constraints in many settings hinder timely interventions[3]. Identifying prognostic factors can assist clinicians in decision-making and treatment planning. Recent studies have highlighted several factors influencing sepsis outcomes, including age, underlying diseases, pathogens, timely antibiotic treatment, and septic shock. These factors have been incorporated into statistical models for predicting survival probabilities and mortality rates. For instance, the logistic regression models are commonly employed to estimate mortality rates of sepsis patients using cross-sectional data (see Do et al. 2023). For time-dependent data, the Cox proportional hazards model is preferred to predict 30-, 60-, and 90-day survival risks (see Hui Liu et al. 2021).

The SOFA score is consistently identified as a key prognostic factor for sepsis mortality, alongside APACHE II, age, immunosuppression, Glasgow Coma Scale (GCS), body temperature, C-reactive protein, and bilirubin[2, 4]. Studies, such as Hui Liu et al. (2021), combined SOFA with other variables, including lactate, albumin, and RDW, to enhance predictive accuracy for 30-, 60-, and 90-day survival risks. Evidence also suggests that mortality rates outside ICUs are higher than those inside ICUs[5, 6]. In Vietnam, few studies, including those by Do et al. (2023), have evaluated SOFA's role in predicting sepsis outcomes, showing that while SOFA is useful, APACHE II may be too complex for routine use in resource-limited settings[7].

This study presents the first cohort analysis of sepsis patients at 108 Military Central Hospital, aiming to identify prognostic factors and propose a simple, efficient tool to support clinical decisions. Using a nomogram-based approach, the study predicts 7-day, 14-day, and 30-day survival risks on a 100-point scale. Eleven variables influencing mortality and survival probability were identified, and their combined effects on SOFA scores were analyzed over time. Models incorporating these predictors were compared to a simpler model based solely on SOFA scores. This research underscores the need for practical and adaptable tools to improve sepsis management, especially in resource-constrained environments.

II. SUBJECT AND METHOD

Study design and population

Adult patients diagnosed with sepsis and treated at the 108 Military Central Hospital from December 2019 to February 2021 were screened for inclusion. The diagnosis of sepsis was based on the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3), defined as life-threatening organ dysfunction caused by a dysregulated host response to infection. Organ dysfunction was identified by an increase of 2 or more points in the Sequential [Sepsis-related] Organ Failure Assessment (SOFA) score. In this study, the SOFA score that defined as the combination of PaO_2/FiO_2, platelets, bilirubin, cardiovascular, Glassgow Coma Scale score, creatinine and urine output, by Singer (2016)[8] was recorded at admission and up to 24 hours post-infection onset.

Exclusion criteria included:

Pregnant or lactating patients.

Patients with HIV or those receiving immunosuppressive therapy.

Patients with decompensated cirrhosis, chronic renal failure requiring hemodialysis, or a history of blood transfusion.

Patients with shock due to non-infectious causes, such as cardiogenic shock or anaphylaxis.

Patients deceased from causes clearly unrelated to infection.

All patients included in the study provided informed consent. For patients unable to consent, the next of kin was informed and provided the necessary consent.

Data collection

During the hospital stay, data were collected on the following:

Baseline characteristics: Vital signs at admission, presenting symptoms, and laboratory parameters.

Clinical information: Sources of infection, identified pathogens, treatment duration, and life-sustaining interventions.

Sample size

The sample size for this study was calculated as n = 125, based on the minimum total sample size required, which depends on the event rate P_e, and is derived from the formula = E/P_e. Here, E represents the minimum number of events needed to detect a significant hazard ratio (HR), as determined by Schoenfeld's formula (1981)[9]:

$$E = \frac{(Z_\alpha + Z_\beta)^2}{\ln(HR)^2}$$

Where Z_α and Z_β are the critical values for the significance level α and the statistical power (1-β), respectively.

For this cohort study, the following values were used: $Z_\alpha = Z_{0.05} = 1.645$, $Z_\beta = 0.84$ (corresponding to 80% power), HR = 1.5 and the death event rate P_e = 0.4 based on findings from a previous cross-sectional study by Do et al (2021).

Ethical approval

This study was approved by the Scientific and Ethics Committee of the 108 Institute of Clinical Medical and Pharmaceutical Sciences on September 20, 2019 (approval number: 5191/HĐĐĐ).

Statistical analysis

All statistical analyses were performed using the R programming language. Descriptive statistics were employed to summarize categorical variables (frequencies and percentages) and continuous variables (medians and interquartile ranges or means and standard deviations). Inferential statistics, such as Chi-square tests, Fisher's exact tests, or Mann-Whitney U tests, were used to compare survival and mortality groups. Receiver Operating Characteristic (ROC) curve analysis was conducted to determine the optimal cut-off thresholds for quantitative variables. Cox Proportional Hazards Regression was applied to identify factors influencing survival probability over time with the hazard rate function:

$$h(t|x) = h_0(t)e^{-(b_0+b_1x_1+\cdots+b_kx_k)}$$

Where $h_0(t)$ is the baseline hazard rate, $x_1,\ldots, x_k$ represent the clinical feature predictors, and $b_0,\ldots, b_k$ are the estimated parameters. The survival probability is defined by the cumulative hazard function, whose density is the hazard rate.

For each clinical feature predictor, the univariate Cox proportional hazards models (i.e. *k=1)* was developed to predict survival probabilities over time. To assess the combined impact of these variables and the SOFA score to the survival probability, the multivariate Cox proportional hazards regression models were constructed and selected from the significant models containing SOFA by using stepwise selection and exhaustive search methods with R software support. The goodness of significant models that found by likelihood ratio test was compared by using Akaike Information Criterion (AIC) metrics, the existence of statistically significant SOFA, and the calibration plot with smallest error. The final Cox model was used to predict survival probabilities at different time points, and the results were visualized through user-friendly nomograms. A p-value of less than 0.05 was considered statistically significant for all analyses.

III. RESULT

3.1. Clinical characteristics

A summary of the clinical characteristics of the study cohort is presented in Table 1. It includes descriptive statistics for two patient groups, along with their comparison tests. The groups were distributed in a ratio of 72.8% to 27.2%, with no statistically significant differences in demographics, comorbidities, or most blood investigations.

Table 1. Baseline characteristics and treatments

Variables	All cases	Survived	Died	p value
	n = 125	n = 91 (72.8%)	n = 34 (27.2%)	
Demographics				
Age (years), median (IQR)	65 (56 - 74)	65 (57 - 63)	61 (55 - 76)	0.514[c]
Sex (male), no. (%)	84 (67)	60 (66)	24 (71)	0.780[a]
Documented comorbidities				
Cancer, no. (%)	2 (1.6)	2 (2.2)	0 (0)	0.999[b]
Brain stroke, no. (%)	12 (9.6)	7 (7.7)	5 (15)	0.399[a]
Chronic renal disease, no. (%)	4 (3.2)	3 (3.3)	1 (2.9)	0.999[b]
Chronic respiratory disease, no. (%)	11 (8.8)	8 (8.8)	3 (8.8)	0.999[b]
Chronic cardiology disease, no. (%)	57 (46)	42 (46)	15 (44)	0.999[a]
Chronic liver disease, no. (%)	23 (18)	15 (16)	8 (24)	0.519[a]
Diabetes, no. (%)	52 (42)	35 (38)	17 (50)	0.337[a]
Other diseases, no. (%)	7 (5.6)	7 (7.7)	0 (0)	0.188[b]
Vital signs				
Respiratory rate, median (IQR)	20 (19 - 22)	20 (19 - 22)	22 (20 - 25)	0.006[c]
Heart rate, mean (SD)	106 (19)	103 (18)	115 (18)	< 0.001[c]
Systolic blood pressure, mean (SD)	116 (23)	117 (23)	114 (26)	0.491[c]
Diastolic blood pressure, median (IQR)	70 (60 - 78)	70 (60 - 79)	66 (56 - 77)	0.267[c]
Glasgow, median (IQR)	15 (13 - 15)	15 (14 - 15)	13 (9 - 15)	< 0.001[c]
Onset symptoms				
Shivering state, no. (%)	69 (55)	57 (63)	12 (35)	0.011[a]
Urinary tract onset				0.931[a]
1 symptom, no. (%)	32 (26)	24 (26)	8 (24)	
2 symptoms, no. (%)	8 (6.4)	6 (6.6)	2 (5.9)	
Respiratory onset				0.020[a]
1 symptom, no. (%)	50 (40)	37 (41)	13 (38)	
2 symptoms, no. (%)	15 (12)	7 (7.7)	8 (24)	
3 symptoms, no. (%)	8 (6.4)	4 (4.4)	4 (12)	
Abdominal				0.063[a]
1 symptom, no. (%)	47 (38)	37 (41)	10 (29)	
2 symptoms, no. (%)	13 (10)	12 (13)	1 (2.9)	
Headache, no. (%)	25 (20)	19 (21)	6 (18)	0.880[a]
Other symptoms, no. (%)	22 (18)	15 (16)	7 (21)	0.785[a]
Blood investigations				
FiO_2, median (IQR)	0.36 (0.21 - 0.50)	0.32 (0.21 - 0.40)	0.58 (0.40 - 0.80)	< 0.001[c]

Variables	All cases	Survived	Died	p value
	n = 125	n = 91 (72.8%)	n = 34 (27.2%)	
BC, median (IQR)	16 (10 - 21)	16 (10 - 22)	15 (9 - 19)	0.208[c]
Neu, median (IQR)	89 (82 - 92)	89 (83 - 92)	89 (81 - 93)	0.870[c]
HC, median (IQR)	4.22 (3.80 - 4.73)	4.24 (3.96 - 4.68)	3.98 (3.41 - 4.78)	0.080[c]
HGB, mean (SD)	126 (21)	129 (19)	119 (23)	0.023[c]
HCT, mean (SD)	0.39 (0.06)	0.39 (0.06)	0.38 (0.08)	0.206[c]
TC, median (IQR)	147 (81 -242)	139 (84 - 249)	164 (75 -242)	0.807[c]
SGOT, median (IQR)	67 (34 - 146)	64 (33 - 121)	104 (47 - 202)	0.043[c]
SGPT, median (IQR)	45 (29 - 82)	39 (27 - 75)	57 (35 - 105)	0.075[c]
Na, mean (SD)	134 (6)	134 (5)	135 (7)	0.817[c]
K, median (IQR)	3.80 (3.40 - 4.10)	3.70 (3.35 - 4.05)	4.00 (3.40 - 4.50)	0.046[c]
Creatinine, median (IQR)	126 (93 - 192)	121 (86 - 181)	132 (110 - 221)	0.147[c]
Severity of illness score				
SOFA, median (IQR)	7 (4 - 10)	6 (4 - 9)	10 (7 - 13)	< 0.001[c]
Septic shock, no. (%)	73 (58)	42 (46)	31 (91)	< 0.001[a]

[a]Comparison between the patients who survived and died using χ^2 test, [b]Fisher's exact test, [c]Mann-Whitney U test

Table 2. Baseline characteristics and treatments (continued)

Variables	All cases	Survived	Died	p value
	n = 125	n = 91 (72.8%)	n = 34 (27.2%)	
Source of infection				
Primary source of infection				
Gastrointestinal infection, no. (%)	36 (28.8)	29 (31.9)	7 (20.6)	0.309[a]
Urinary tract infection, no. (%)	27 (21.6)	23 (25.3)	4 (11.8)	0.270[b]
Pneumonia, no. (%)	25 (20)	15 (16.5)	10 (29.4)	0.175[a]
Central nervous infection, no. (%)	11 (8.8)	6 (6.6)	5 (14.7)	0.285[a]
Soft tissue infection, no. (%)	21 (16.8)	13 (14.3)	8 (23.5)	0.336[a]
Unknown, no. (%)	5 (4)	5 (5.5)	0 (0)	0.322[b]
Second source of infection, no. (%)	24 (19)	15 (16)	9 (26)	0.314[a]
Pathogen, no. (%)	78 (62)	56 (62)	22 (65)	0.906[a]
Life-sustaining treatments				
Mechanical ventilation, no. (%)	48 (38)	16 (18)	32 (94)	< 0.001[a]
Oxygen therapy, no. (%)	87 (70)	55 (60)	32 (94)	< 0.001[a]

[a] Comparison between the patients who survived and died using χ^2 test, [b] Fisher's exact test, [c] Mann-Whitney U test

In the overall cohort, the median SOFA score at hospital admission was 7 (IQR: 4–10), and 58% (73/125) of the patients were diagnosed with septic shock. Table 1 also highlight the most common

comorbidities: Chronic cardiovascular disease (46.0%; 57/125), diabetes (42%; 52/125), and chronic liver disease (18%; 23/125). The primary sources of infection were gastrointestinal (28.8%; 36/125), urinary tract infections (21.6%; 27/125), pneumonia (20%; 25/125), and soft tissue infections (16.8%; 21/125). Regarding treatment, 70% (87/125) of the patients received oxygen therapy, and 38% (48/125) required mechanical ventilation. The median treatment duration was 14 days (IQR: 10–18), while the median survival time within 30 days of treatment initiation was 30 days (IQR: 15–30).

Significant differences between the two patient groups were observed in specific parameters, including: Vital signs (Respiratory rate, heart rate, Glasgow Coma Scale); Onset symptoms (Shivering state, respiratory onset); Blood investigations (FiO_2, HGB, K^+); Severity scores (SOFA score, septic shock); Life-sustaining treatments (Mechanical ventilation, oxygen therapy); Treatment duration.

Prognostic prediction models

Moreover, the effect of the above factors on the mortality rate is also investigated from the univariate Cox regression analyses. This approach identified 11 factors significantly associated with survival or mortality, as shown in Table 2. These factors included heart rate, Glasgow Coma Scale, FiO_2, HGB, K^+, SOFA score, treatment duration, shivering state, septic shock, oxygen therapy, and mechanical ventilation.

Cut-off values of certain quantitative variables that could act as potential biomarkers for survival prediction. For example:

SOFA score: 8.5

Heart rate: 109.5

Glasgow Coma Scale: 13.5

FiO_2: 0.445

Hemoglobin: 118.5

K^+: 3.85

Treatment duration: 8.5

The ROC curve analysis is shown in Figure 3 of the Appendix, demonstrating the ability of each variable to discriminate between survival and mortality outcomes.

Multivariate Cox Regression Modeling

Two final Cox models, that found by exhaustive search and stepwise technique respectively, were identified:

Model 1: Selected through exhaustive search, including SOFA score, shivering state, HGB, and septic shock.

Model 2: Generated through stepwise selection, consisting of SOFA score, Shivering state, HGB, K^+, treatment duration, and mechanical ventilation.

The estimated parameters of these models, along with those of the SOFA-only model (denoted as Model 0), are summarized in Table 2. Model 1 emerged as the preferred choice over Model 0, offering significant improvements in predictive performance. Although Model 2 demonstrated better AIC values, it lacked statistical significance for the SOFA factor, with only shivering state, treatment duration, and mechanical ventilation showing significance (p-value < 0.05) and potassium (K) with significant p-value < 0.1.

Table 2. The prognostic variables of survival probability in the Cox models

Variables	Univariate Cox models			Multivariate Cox models					
				Model 1: Exhausted searching			Model 2: Stepwise both		
	HR	95% CI	p-value	HR	95% CI	p-value	HR	95% CI	p-value
Heart rate	1.031	1.012-1.049	0.001**						
Glasgow	0.793	0.715-0.879	<0.001***						
FiO_2	100.474	26.108-386.671	<0.001***						
HGB	0.979	0.963-0.996	0.017*	0.982	0.967-0.998	0.025*	0.985	0.966-1.003	0.102
K^+	1.904	1.247-2.907	0.003**				1.498	0.956-2.349	0.078
SOFA Score	1.250	1.145-1.365	<0.001***	1.118	1.014-1.233	0.025*	0.979	0.858-1.117	0.753
Treatment duration	0.584	0.502-0.680	<0.001***				0.564	0.456-0.698	<0.001***
Shivering state *(Yes)*	0.377	0.186-0.762	0.007**	0.364	0.178-0.746	0.006**	0.416	0.173-0.998	0.049*
Septic shock *(Yes)*	9.231	2.820-30.216	<0.001***	4.963	1.347-18.292	0.016*			
Oxygen therapy (Yes)	8.401	2.012-35.073	0.004**						
Mechanical ventilation *(Yes)*	40.517	9.677-169.650	<0.001***				68.140	12.430-373.538	<0.001***
AIC	295.297 (SOFA)			283.332			167.943		
Likelihood ratio test	< 0.001***			< 0.001***			< 0.001***		

In contrast, Model 1 retained the SOFA factor as statistically significant while also yielding lower standard errors for its parameter estimates, particularly for the SOFA score. Calibration plots comparing the predicted 30-day survival probabilities of the models against observed outcomes (Figure 1) further validate the superior predictive accuracy of Model 1 over both Model 0 and Model 2. Figure 1 highlights that Model 1 exhibits the smallest mean absolute error, with its observed survival probabilities (black line) aligning most closely with the ideal diagonal line (gray line).

Based on these findings, Model 1 is recommended as the final model, as it not only improves upon Model 0 but also preserves the inclusion of the significant SOFA factor, ensuring clinical relevance and robust predictive performance.

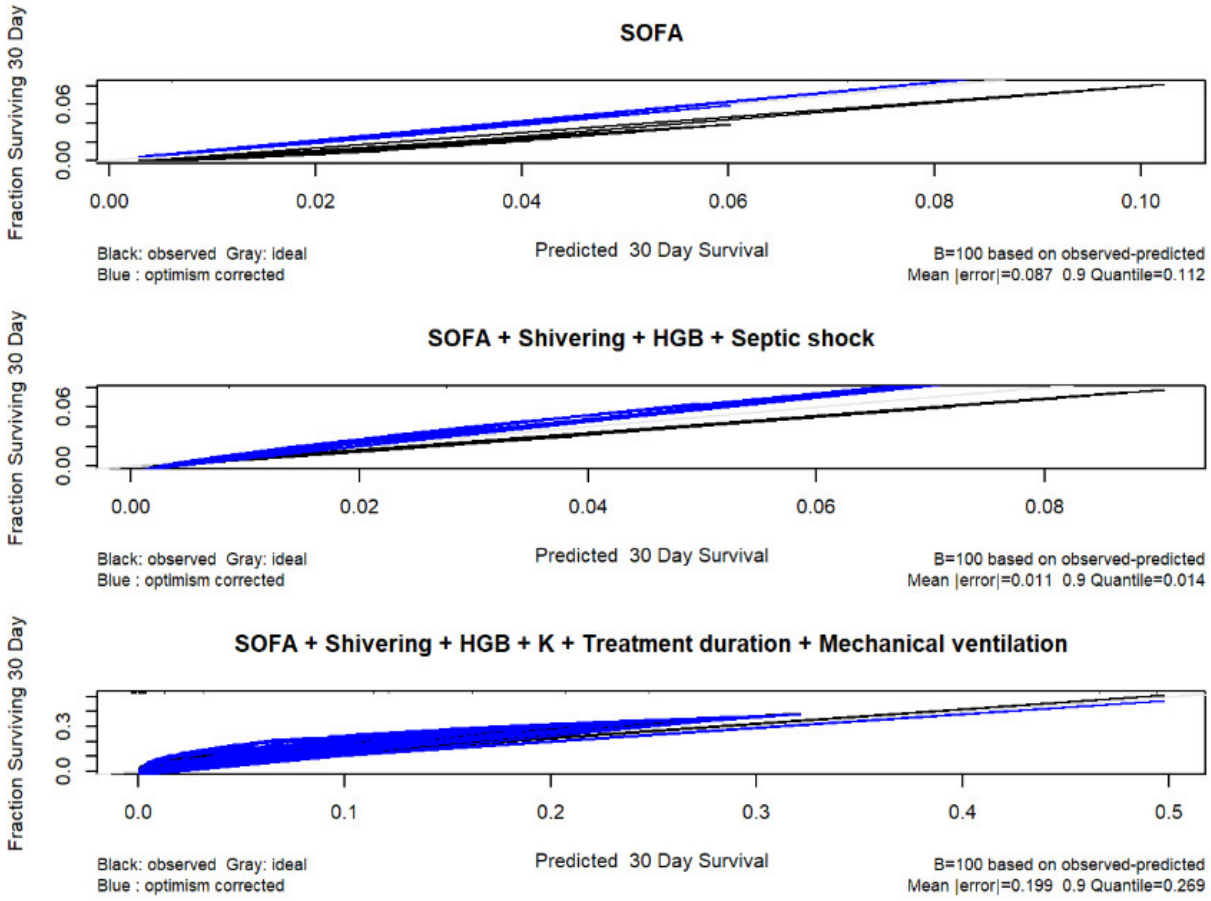

Figure 1. Calibration Plots for model 0 (only SOFA), model 1 (SOFA + Shivering + HGB + Septic shock) and model 2 (SOFA + Shivering + HGB + K + Treatment duration + Mechanical ventilation) evaluate the agreement between the predicted survival probabilities and the observed survival outcomes.

Nomograms

A user-friendly nomogram for Cox Model 1 (see more in Harrell, 2001; Hui et al., 2021 and Balachandran et al., 2015) was built up to predict survival probabilities at 7, 14, and 30 days (Figure 2). The nomogram incorporates four variables: SOFA score, shivering state, HGB, and septic shock. Each variable is assigned a corresponding point value on the top line of the nomogram. By summing these points, the total score aligns with the predicted survival probabilities on the bottom lines of the chart.

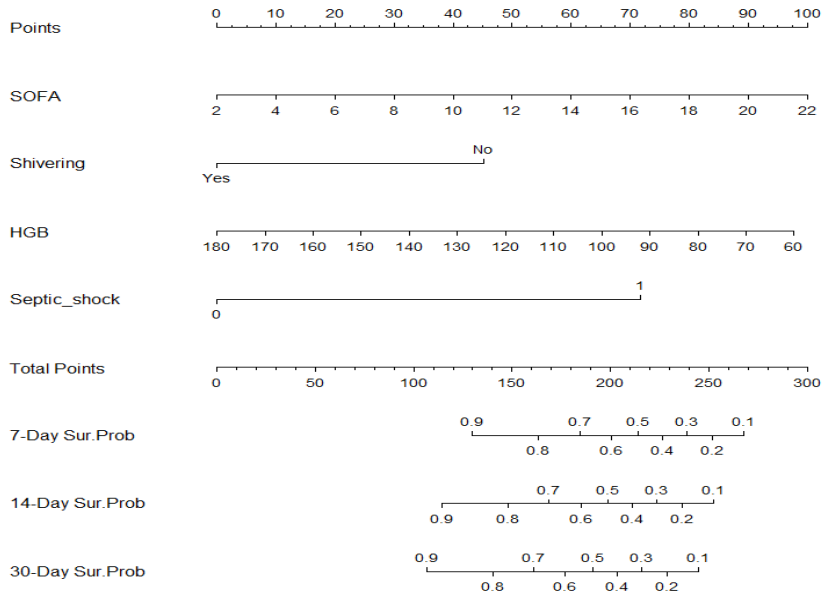

Figure 2. Nomograms for prediction of 7-day, 14-day and 30-day survival probability of septic patients using Cox model.

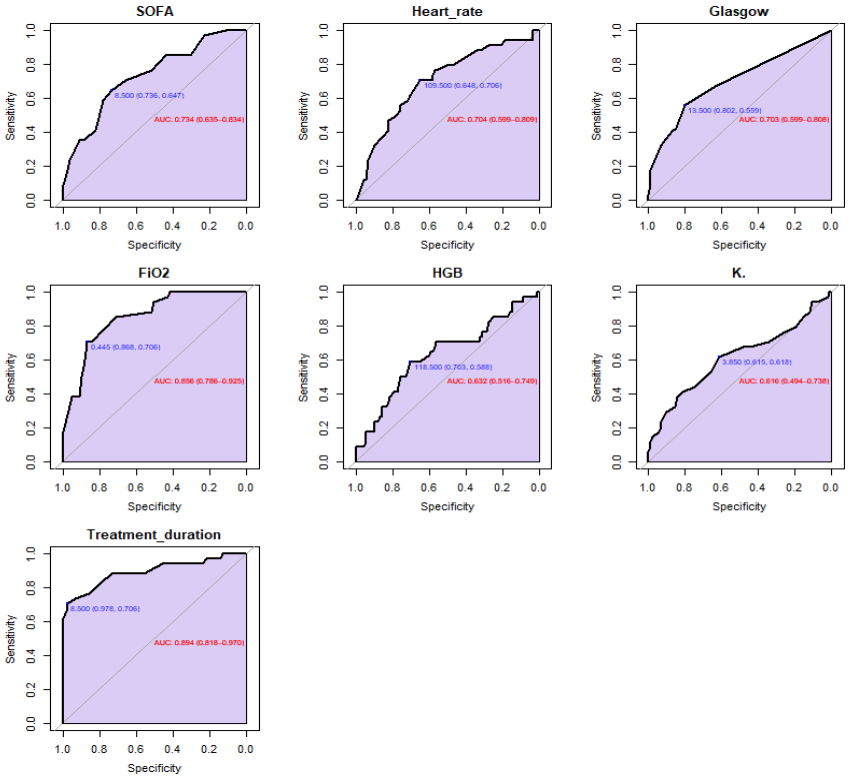

Figure 3. The ROC curve for certain quantitative variables.

For example, a patient with a SOFA score of 2, exhibiting shivering, a Hemoglobin (HGB) level of 180, and without septic shock would have a total nomogram score of 0. This corresponds to predicted survival probabilities of over 90% at 7, 14, and 30 days. Conversely, a patient with a SOFA score of 14, no shivering, a hemoglobin (HGB) level of 60, and experiencing septic shock would accumulate a total

nomogram score of approximately 275. This translates to predicted survival probabilities of less than 10% at 7, 14, and 30 days.

IV. DISCUSSION

Developing sepsis prognostic models to identify factors associated with survival risk over time in sepsis patients is crucial for enabling timely monitoring, guiding interventions, improving treatment outcomes, and reducing sepsis-related mortality. In this study, we analyzed a cohort of 125 septic patients over 15 months at the 108 Military Central Hospital in Vietnam. Our analysis identified 11 key prognostic factors spanning vital signs, onset symptoms, blood investigations, and severity of illness scores. These factors were found to significantly influence both the mortality rate and survival probabilities at specific time points, providing valuable insights for enhancing clinical decision-making and patient care.

For predicting patient mortality according to each prognostic features, threshold values in ROC curves for these features were determined, providing potential biomarkers. The hazard ratio in the univariate Cox model suggests the prognostic factors influencing the survival probability of septic patients where the higher ratios to 1, the greater the risk. Among these, FiO_2 and mechanical ventilation showed high hazard ratios of 100 and 40, respectively, while septic shock and oxygen therapy had hazard ratios around 10. The SOFA, K^+, and heart rate factors had hazard ratios greater than 1 and the remaining factors had hazard ratios less than 1.

A multivariate Cox regression model incorporating four key factors - SOFA score, shivering, HGB, and septic shock - demonstrated superior predictive performance compared to the existing SOFA-only model. This improvement highlights the importance of evaluating multiple prognostic features simultaneously to achieve more accurate risk stratification. The proposed model was further optimized by using an exhaustive search method, which improved the Akaike Information Criterion (AIC) value without excluding significant factors. This approach outperformed the traditional stepwise method, which focuses solely on optimizing AIC, particularly in the context of a small sample size.

The user-friendly nomogram derived from this model provides clinicians with a practical tool for rapidly estimating survival probabilities for septic patients at 7, 14, and 30 days. As illustrated in Figure 2, factors such as HGB, SOFA score, carry significant weight in predicting the patient risk at these time points, underscoring their critical role in the management and prognosis of sepsis.

In analyzing the combined effects of the four significant factors, two distinct trends were identified: (i) higher SOFA scores, and occurring Septic shock were associated with an increased hazard (higher risk of death), indicating greater disease severity and systemic compromise; and (ii) higher hemoglobin (HGB) levels and exhibiting Shivering were associated with a reduced hazard, reflecting better physiological resilience and neurological function.

These findings align with current clinical understanding of sepsis management. Elevated SOFA scores and occurrence of Septic shock are often associated with an increased risk of death, necessitating aggressive intervention[10, 11]. Conversely, higher HGB level suggests improved oxygen transport capacity, critical for maintaining tissue perfusion, while appearance of Shivering state indicates preserved neurological integrity and lower disease severity[12, 13].

These results emphasize the critical role of early, accurate risk stratification in sepsis care. Identifying and addressing these prognostic factors promptly can help guide treatment decisions, optimize resource allocation, and ultimately improve survival outcomes in septic patients.

This is the first cohort study conducted at a frontline Vietnamese hospital, and its findings have potential applicability across lower-level hospitals due to the simplicity of the prognostic scoring system. The research shows another aspect of the previous work, such as Do et al. (2023), by extending the understanding of survival probabilities for septic patients at time based on the time dependent data.

Despite these achievements, the study has limitations. Only four significant features were identified in the multivariate Cox model, potentially due to the limited dataset and the study's restriction to

a single hospital's ICU. Furthermore, the study cohort primarily consisted of older patients, limiting its generalizability to younger populations. Future studies should address these limitations by expanding the sample size, including data from multiple ICUs, and incorporating a more diverse age range. Collaborative efforts with other hospitals and organizations will be crucial for achieving these goals.

V. CONCLUSION

In summary, this study provides valuable insights into the survival probabilities of septic patients and offers a practical prognostic tool for clinical application. With further validation and refinement, the findings could contribute significantly to improving sepsis management and patient outcomes in diverse healthcare settings.

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