Comparison of CRB/CRB-65, qSOFA, and SIRS for Risk Prediction in Patients with Urinary Tract Infection

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Abstract

Background: Early recognition of sepsis is critical for improving patient outcomes. In approximately 20%-30% of patients, sepsis resulted from urinary tract infection (UTI). This study aimed to investigate the effectiveness of CRB (confusion, respiratory rate, blood pressure), CRB-65, and quick sequential organ failure assessment (qSOFA) in predicting intensive care unit (ICU) admission and in-hospital mortality of patients with UTI and compare them with Systemic Inflammatory Response Syndrome (SIRS).

Methods: This retrospective cohort study included patients with UTI who visited the emergency department of a single medical center between February 2018 and March 2020. Baseline characteristic data were obtained and compared with the prevalence of ICU admission and in-hospital mortality. The effectiveness of CRB, CRB-65, qSOFA, and SIRS as indicators of ICU admission and in-hospital mortality was evaluated using the area under the receiver operating characteristic (AUROC) curve.

Results: Overall, 1151 patients were included in this study, of whom 132 (11.5%) were admitted to the ICU and 30 (2.6%) succumbed to in-hospital mortality. AUROC values of CRB, CRB-65, and qSOFA as predictors of ICU admission and in-hospital mortality were similar. The CRB score of ≥1 had a sensitivity and specificity of 71.3% and 73.5%, respectively, for ICU admission and 66.7% and 69.2%, respectively, for in-hospital mortality. The CRB-65 score of ≥2 had a sensitivity and specificity of 61.2% and 80.9%, respectively, for ICU admissions and 60% and 76.9%, respectively, for in-hospital mortality. The qSOFA score of ≥1 had a sensitivity and specificity of 71.3% and 79.6%, respectively, for ICU admission and 66.7% and 74.8%, respectively, for in-hospital mortality.

Conclusion: CRB, CRB-65, and qSOFA were more effective predictors than SIRS for patients with UTI. CRB, CRB-65, and qSOFA had similar general values for predicting outcomes in patients with UTI in the emergency department.

Background

A systematic response to infection is termed sepsis, which can lead to life-threatening organ dysfunction [1, 2]. In 1992, the American College of Chest Physicians/Society of critical Care Medicine (ACCP/SCCM) gave recommendations to better define sepsis [3]. This definition was revised and expanded in 2001, and the most recent update was made by the Sepsis-3 task force in 2016 [4, 5]. The task force proposed the use of sequential (sepsis-related) organ failure assessment (Sequential Organ Failure Assessment, SOFA) score as a measure of organ dysfunction. In addition, they proposed the quick SOFA, which is a simplified version of the SOFA that comprises only three variants (altered mental status, systolic blood pressure of 100 mmHg or less, and respiratory rate of 22/min or greater) [5, 6]. In addition, many severity scoring systems have been developed to identify critically ill patients, such as the Acute Physiology and Chronic Health Evaluation (APACHE) and the Multiple Organ Dysfunction Score (MODS) [7]. However, these scoring systems are difficult to apply in the early phase of treatment in the emergency department (ED) because the results of some parameters are based on laboratory tests. For this reason, we decided to investigate the effectiveness of CRB and CRB-65 scoring systems, which were designed primarily to

predict mortality in patients with pneumonia as a simplified system of CURB-65 (confusion, urea > 7 mmol/L, respiratory rate ≥ 30/minute, low systolic [< 90 mmHg] or diastolic [≤ 60 mmHg] blood pressure, age ≥ 65 years). The CRB scoring criteria are similar to those of qSOFA and include only clinical features available from a clinical assessment without laboratory tests [8]. Moreover, qSOFA is used as a tool for screening organ dysfunction and has recently been used to assess disease severity in patients with other diseases such as pneumonia and liver cirrhosis [9, 10].

In approximately 20%-30% of patients, sepsis resulted from urinary tract infection (UTI) [11]. Due to the anatomical, clinical, and pathophysiological differences of infectious causes, effectiveness of scoring systems in predicting disease severity may differ depending on the disease. Previous studies on this subject have primarily focused on patients suspected with infection [12, 13]. In this study, we, therefore, investigated the performance of CRB, CRB-65, and qSOFA to predict intensive care unit (ICU) admission and in-hospital mortality of patients with UTI and compared it with Systemic Inflammatory Response Syndrome (SIRS).

Methods

Study design

This was a single-center retrospective study performed using the electronic medical records (EMRs) of patients who visited the emergency department (ED). The study design was approved by the Institutional Review Board, and the requirement for written informed consent was waived.

Study setting and population

This study included patients who visited an urban, tertiary, academic hospital with 65,000 annual emergency visits between February 2018 and March 2020. The inclusion criteria were (1) an age of 18 years or more, (2) ED diagnosis of urinary tract infection, based on international classification of diseases (ICD) -10. Patients who visited for non-medical purposes and who had missing data, including vital sign and laboratory test results, were excluded.

Data collection and outcome measurement

First, two board-certified emergency physicians selected all ED patients with ED diagnosis of urinary tract infection based on ICD-10. We collected data from each patient’s EMR. The collected data were (1) patient demographics, including sex and age; (2) initial vital signs in the ED, including systolic blood pressure, diastolic blood pressure, pulse rate, respiratory rate, body temperature, and mental status; (3) clinical details, including laboratory findings, such as white blood cell (WBC) count, neutrophil count, lymphocyte count, platelet count, levels of c-reactive protein (CRP), serum blood urea nitrogen (BUN), and serum creatinine; (4) The ED treatment results, which could be hospital discharge, general ward (GW) admission, or ICU admission. The primary outcome was ICU admission. The secondary outcome was in-hospital mortality.

Statistical analysis

In this study, the ICU positive group (ICU [+] group) consisted of patients who were admitted to the ICU and the ICU negative group (ICU [-] group) consisted of those who were discharged and then admitted to the GW. The mortality positive group (mortality [+] group) comprised patients who died in the hospital, and the mortality negative group (mortality [-] group) comprised those who survived and were discharged. Differences in the baseline characteristics were summarized using the independent *t*-test performed for continuous variables and Pearson's chi-squared test performed for categorical variables. Continuous variables are presented as means with standard deviations (SD) and ranges, while categorical variables are presented as count (percent).

The predictive accuracy of CRB, CRB-65, qSOFA, and SIRS for ICU admission and in-hospital mortality was evaluated using the area under the receiver operating characteristic (AUROC) curve. AUROC curve between 0.8–0.9 is described as "good", between 0.7–0.8 is described as "adequate", and between 0.6–0.7 is described as "poor" performance [14]. The optimal cut-off values of each scoring system were determined by the Youden index of ROC curves [15]. Additionally, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and positive and negative likelihood ratios with 95% CI were used to estimate the prognostic accuracy of each criterion for the proposed cut-off points. The significance level was considered as p value < 0.05. Statistical analyses were performed using SPSS 26.0 (SPSS Inc., Chicago, IL). The ROC curve analysis was performed using the MedCalc Statistical Software version 19 (MedCalc Software bvba, Ostend, Belgium).

Results

Patient characteristics of study population

A total of 1151 patients were enrolled for the study. The baseline characteristics are presented in Table 1. The mean age of all the patients was 63.2 years (SD: 19.6), and 24.3% were male. Of all the patients, 132 (11.5%) were admitted to the ICU and 30 (2.6%) succumbed to in-hospital mortality. The ICU [+] group had significantly lower systolic and diastolic blood pressures (SBP and DBP), higher pulse rate (PR), and respiratory rate (RR) than the ICU [-] group. The ICU [+] group had significantly higher WBC count, neutrophil count, BUN, creatinine, CRP, lower lymphocyte count, and platelet count than the ICU [-] group.

Table 1
General characteristics of patients in the study cohort

Variable	Total (n = 1,151)	ICU admission Negative (n = 1019)	ICU admission Positive (n = 132)	P-value	In-hospital mortality Negative (n = 1121)	In-hospital mortality Positive (n = 30)	P-value
Age (years)	63.2 ± 19.6	61.7 ± 20.0	74.5 ± 11.4	< 0.001	62.8 ± 19.6	80.3 ± 11.0	< 0.001
Sex				0.981			0.989
Male	280 (24.3)	248 (24.3)	32 (24.8)		273 (24.4)	7 (23.3)	
Female	868 (75.7)	771 (75.7)	100 (75.8)		848 (75.6)	23 (76.7)	
Vital sign							
Systolic blood pressure (mmHg)	126.2 ± 24.5	129.0 ± 22.4	104.1 ± 28.4	< 0.001	126.6 ± 24.0	110.9 ± 34.1	0.018
Diastolic blood pressure (mmHg)	69.3 ± 15.3	70.7 ± 14.3	58.4 ± 17.7	< 0.001	69.6 ± 15.2	58.7 ± 15.5	< 0.001
Heart rate(/min)	98.7 ± 18.8	98.0 ± 18.1	103.4 ± 23.1	0.011	98.5 ± 18.7	106.2 ± 19.7	0.025
Respiratory rate(/min)	20.2 ± 1.9	20.1 ± 1.7	21.0 ± 2.9	0.002	20.2 ± 1.8	22.0 ± 3.6	0.009
Body temperature (ºC)	37.9 ± 1.1	38.0 ± 1.1	37.8 ± 1.2	0.119	38.0 ± 1.1	37.2 ± 1.0	0.001
Mental status				< 0,001			< 0.001
Alert	1,084 (94.2)	982 (96.4)	102 (77.3)		1,062 (94.7)	22(73.3)	
Verbal response	41 (3.6)	22 (2.2)	19 (14.4)		37 (3.3)	4 (13.3)	
Painful response	26 (2.3)	15 (1.5)	11 (8.3%)		22 (2.0)	4 (13.3)	
Unresponsive	0	0	0		0	0	
Laboratory finding							

The values are given as mean ± standard deviation or number (%).

Variable	Total (n = 1,151)	ICU admission		P-value	In-hospital mortality		P-value
		Negative (n = 1019)	Positive (n = 132)		Negative (n = 1121)	Positive (n = 30)	
WBC (x10^3/□)	12.1 ± 6.1	11.7 ± 5.2	15.1 ± 10.1	< 0.001	12.0 ± 5.8	17.3 ± 11.9	0.020
Neutrophil (x10^3/□)	10.0 ± 5.7	9.6 ± 4.8	13.3 ± 9.7	< 0.001	9.9 ± 5.5	14.2 ± 9.4	0.019
Lymphocyte (x10^3/□)	1.2 ± 0.7	1.2 ± 0.7	1.0 ± 0.7	< 0.001	1.2 ± 0.7	1.0 ± 0.7	0.177
Platelet (x10^3/□)	221.6 ± 92.9	227.2 ± 91.5	177.6 ± 92.6	< 0.001	222.8 ± 91.9	176.7 ± 120.2	0.046
BUN (mg/dL)	21.8 ± 17.5	19.6 ± 14.7	38.0 ± 26.2	< 0.001	21.2 ± 16.8	42.2 ± 28.4	< 0.001
Creatinine (mg/dL)	1.2 ± 1.0	1.1 ± 0.8	2.0 ± 1.6	< 0.001	1.2 ± 0.9	2.0 ± 1.9	0.018
C-reactive protein (mg/dL)	10.0 ± 8.9	9.2 ± 8.5	16.3 ± 9.8	< 0.001	9.9 ± 8.9	15.7 ± 8.8	< 0.001
The values are given as mean ± standard deviation or number (%).							

The mortality [+] group had lower SBP, DBP, body temperature, and higher PR and RR than the mortality [-] group. The mortality [+] group had higher WBC count, neutrophil count, BUN, creatinine, CRP, and lower platelet count than the mortality [-] group.

Score distribution of CRB, CRB-65, qSOFA, and SIRS according to ICU admission and in-hospital mortality

The number of patients with ICU admission and in-hospital mortality, according to the CRB, CRB-65, qSOFA, and SIRS scores, are shown in Table 2. CRB, CRB-65, qSOFA, and SIRS showed significant differences in score distribution with respect to ICU admission. In case of CRB and qSOFA, the ratio of 0 points in the ICU [-] group and the ratio of 1,2,3 points in the ICU [+] group were relatively high. In the case of CRB-65 and SIRS, the ratio of 0,1 point in ICU [-] and 2,3,4 point in ICU [+] group were relatively high. For mortality, CRB, CRB-65, and qSOFA score distributions were significantly different, and their results were the same as those for ICU admission. In the case of SIRS, there was no significant difference in score distribution (p = 0.126).

Table 2
Score distribution of CRB, CRB-65, qSOFA and SIRD according to ICU admission and in-hospital mortality

Variable	Total	ICU admission		*p*-value	In-hospital mortality		*p*-value
		(-)	(+)		(-)	(+)	
	(n = 1,151)	(n = 1,019)	(n = 132)		(n = 1,121)	(n = 30)	
CRB				< 0.001			< 0.001
0	786 (68.3)	749 (73.5)	37 (28.0)		776 (69.2)	10 (33.3)	
1	330 (28.7)	255 (25.0)	75 (56.8)		316 (28.2)	14 (46.7)	
2	31 (2.7)	12 (1.2)	19 (14.4)		26 (2.3)	5 (16.7)	
3	4 (0.3)	3 (0.3)	1 (0.8)		3 (0.3)	1 (3.3)	
CRB-65				< 0.001			< 0.001
0	431 (37.4)	420 (41.2)	11 (8.3)		430 (38.4)	1 (3.3)	
1	443 (38.5)	404 (39.6)	39 (29.5)		432 (38.5)	11 (36.7)	
2	247 (21.5)	180 (17.7)	67 (50.8)		234 (20.9)	13 (43.3)	
3	26 (2.3)	12 (1.2)	14 (10.6)		22 (2.0)	4 (13.3)	
4	4 (0.3)	3 (0.3)	1 (0.8)		3 (0.3)	1 (3.3)	
qSOFA				< 0.001			< 0.001
0	848 (73.7)	811 (79.6)	37 (28.0)		838 (74.8)	10 (33.3)	
1	242 (21.0)	179 (17.6)	63 (47.7)		233 (20.8)	9 (30.0)	
2	54 (4.7)	26 (2.6)	28 (21.2)		46 (4.1)	8 (26.7)	
3	7 (0.6)	3 (0.3)	4 (3.0)		4 (0.4)	3 (10.0)	
SIRS				0.022			0.126
0	193 (16.8)	182 (17.9)	11 (8.3)		192 (17.1)	1 (3.3)	
1	292 (25.4)	262 (25.7)	30 (22.7)		287 (25.6)	5 (16.7)	
2	394 (34.2)	344 (33.8)	50 (37.9)		379 (33.8)	15 (50.0)	
3	251 (21.8)	212 (20.8)	39 (29.5)		243 (21.7)	8 (26.7)	
4	21 (1.8)	19 (1.9)	2 (1.5)		20 (1.8)	1 (3.3)	

The values are given as number (%).

Validation of CRB, CRB-65, qSOFA, and SIRS for ICU admission and in-hospital mortality

The ROC curves of CRB, CRB-65, qSOFA, and SIRS are depicted in Fig. 1. For predicting ICU admission, the AUROCs of CRB, CRB-65, qSOFA, and SIRS were 0.742 (95% CI 0.716–0.767), 0.765 (95% CI 0.740–0.790), 0.772 (95% CI 0.747–0.796), and 0.580 (95% CI 0.551–0.609), respectively. AUROCs in each criteria were statistically significant, but when compared between the two criteria, CRB vs SIRS (0.162 [95% CI, 0.097–0.226]), CRB-65 vs SIRS (0.185 [95% CI, 0.125–0.245]), and qSOFA vs SIRS (0.192 [95% CI, 0.133–0.251]), were significantly different ($p < 0.001$) (Fig. 1A). For in-hospital mortality, the AUROCs of CRB, CRB-65, qSOFA and SIRS were 0.702 (95% CI 0.674–0.728), 0.761 (95% CI 0.735–0.785), 0.740 (95% CI 0.714–0.765), and 0.617 (95% CI 0.588–0.645), respectively. All of these were also statistically significant ($p < 0.001$). When comparison was made between the two criteria for in-hospital mortality, CRB vs CRB-65 (0.059 [95% CI, 0.009–0.110]), CRB-65 vs SIRS (0.147 [95% CI, 0.037–0.257]), and qSOFA vs SIRS (0.126 [95% CI, 0.05–0.248]), were significantly different (p values were 0.04, 0.02 and < 0.01) (Fig. 1B).

The cut-off values and the sensitivity and specificity of each criterion are shown in Table 3. The CRB score of ≥ 1 had a sensitivity and specificity of 71.3% (95% CI 62.7–78.9) and 73.5% (95% CI 70.7–76.2), respectively, for ICU admission and 66.7% (95% CI 47.2–82.7) and 69.2% (95% CI 66.4–71.9), respectively, for in-hospital mortality. The CRB-65 score of ≥ 2 had a sensitivity and specificity of 61.2% (95% CI 52.3–69.7) and 80.9% (95% CI 78.3–83.2), respectively, for ICU admissions and 60% (95% CI 40.6–77.3) and 76.9% (95% CI 74.3–79.3), respectively, for in-hospital mortality. The cut-off values for qSOFA score of ≥ 1 had a sensitivity and specificity of 71.3% (95% CI 62.7–78.9) and 79.6% (95% CI 77.0–82.0), respectively, for ICU admission and 66.7% (95% CI 47.2–82.7) and 74.8% (95% CI 72.1–77.3), respectively, for in-hospital mortality.

Table 3
AUROC, cut-off value, sensitivity and specificity for ICU admission and in-hospital mortality

	Cut-off value	AUROC (95% CI)		Sensitivity, % (95% CI)		Specificity, % (95% CI)		+LR (95%CI)		-LR (95%CI)	
ICU admission											
CRB	1	0.742	(0.716–0.767)	71.3	(62.7–78.9)	73.5	(70.7–76.2)	2.7	(2.3–3.1)	0.4	0.3–0.5)
CRB-65	2	0.765	(0.740–0.790)	61.2	(52.3–69.7)	80.9	(78.3–83.2)	3.2	(2.7–3.9)	0.5	(0.4–0.6)
qSOFA	1	0.772	(0.747–0.796)	71.3	(62.7–78.9)	79.6	(77.0–82.0)	3.5	(3.0–4.1)	0.4	(0.3–0.5)
SIRS	2	0.580	(0.551–0.609)	68.2	(59.4–76.1)	43.6	(40.5–46.7)	1.2	(1.1–1.4)	0.7	(0.6–0.9)
In-hospital mortality											
CRB	1	0.702	(0.674–0.728)	66.7	(47.2–82.7)	69.2	(66.4–71.9)	2.2	(1.7–2.8)	0.5	(0.3–0.8)
CRB-65	2	0.761	(0.735–0.785)	60.0	(40.6–77.3)	76.9	(74.3–79.3)	2.6	(1.9–3.5)	0.5	(0.3–0.8)
qSOFA	1	0.740	(0.714–0.765)	66.7	(47.2–82.7)	74.8	(72.1–77.3)	2.6	(2.0–3.5)	0.5	(0.3–0.7)
SIRS	2	0.617	(0.588–0.645)	80.0	(61.4–92.3)	42.7	(39.8–45.7)	1.4	(1.2–1.7)	0.5	(0.2–1.0)

Discussion

Sepsis-3 task force emphasized that sepsis was the primary cause of death from infection, especially if not recognized and treated early. Thus, its identification requires urgent attention [5]. According to the degree of priority assigned during triage, continued monitoring can rapidly identify sepsis [16]. Furthermore, attempts to identify patients with sepsis at the triage had continued [17]. Hayden et al. evaluated the efficacy of a sepsis work-up and treatment (SWAT) protocol for rapid identification of sepsis during triage [18]. Although the qSOFA score was recommended by the Sepsis-3 task, its usefulness has remained debatable. Previously, several studies compared the accuracy of different scoring systems, such as qSOFA, SIRS, and SOFA. Raith et al. reported that an increase in SOFA score of 2 or more points indicated greater prognostic accuracy for in-hospital mortality than SIRS or qSOFA [19]. On the other hand, Park et al. found that qSOFA is more effective than SIRS in predicting the occurrence of organ failure in patients with suspected infection [20].

In the investigation of pneumonia, CRB and CRB-65 scoring systems are easy to use, especially in those cases where laboratory result of blood, urea, and nitrogen is unavailable [21, 22]. These systems were

proven highly effective in predicting the prognosis and were used widely for several years [23]. In previous studies for pneumonia, CRB and CRB-65 were similar and did not provide additional predictive performance compared with qSOFA [9, 24]. Both CRB and qSOFA had three identical vital signs as criteria: respiratory rate, mental status, and blood pressure. Although CRB and qSOFA used the same vital signs as mentioned above, the thresholds for respiratory rate and blood pressure were stricter for CRB than for qSOFA (CRB: respiratory rate > 30, systolic blood pressure < 90 or diastolic blood pressure ≤ 60; qSOFA: respiratory rate ≥ 22, systolic blood pressure ≤ 100). Therefore, CRB was expected to be more effective in predicting outcomes than qSOFA. CRB-65 used an added parameter of age ≥ 65 years, so it was expected to provide additional predictive performance. However, in this study, the AUROCs of CRB, CRB-65, and qSOFA revealed similar effectiveness in prediction of outcomes. In addition, the differences were not statistically significant, but compared with SIRS, CRB and CRB-65 were significantly more effective in predicting ICU admission. AUROC value of SIRS for predicting ICU admission was < 0.6, which indicated its poor effectiveness. On the other hand, AUROC values of CRB and CRB-65 were between 0.7 and 0.8, which is described as "adequate". For predicting in-hospital mortality, only CRB-65 provided better predictive performance than SIRS. AUROC values of CRB-65 were between 0.7 and 0.8, which was quite accurate. In the comparison between CRB and CRB-65, despite the addition of age as a parameter, CRB-65 was statistically superior only in predicting in-hospital mortality ($p = 0.02$). In previous studies that compared the effectiveness of prediction by qSOFA and SIRS in UTI patients, qSOFA had a higher predictive accuracy for in-hospital mortality and ICU admissions than SIRS [25, 26]. Likewise, in our study, the ability of qSOFA to identify the requirement of ICU admission and in-hospital mortality in patients with UTI was better than that of SIRS.

There are several limitations to this study. First, this was a single-center, retrospective study. Thus, selection bias may exist because of the limited sample size available from a single institute. Therefore, caution should be used in generalizing our results, and further studies are required with multi-center, prospective designs for generalization. Second, patients with UTI, especially the elderly, tended to have co-morbidities. Thus, multiple organ dysfunction syndrome may have affected the prognosis. Third, being a large tertiary academic hospital, our institution receives patients transferred from smaller hospitals and primary healthcare institutions who are already in a poor condition. Thus, their mortality is generally higher than normal, which may result in inaccurate study results.

Conclusions

CRB, CRB-65, and qSOFA have better predictive performance than SIRS with regard to the initial assessment of patients with UTI. CRB, CRB-65, and qSOFA have similar general values for predicting mortality and assessment of clinical care in patients with UTI in the ED.

Abbreviations

ACCP/SCCM

the American College of Chest Physicians/Society of critical Care Medicine; SOFA:Sequential Organ Failure Assessment; qSOFA:quick SOFA; APACHE:the Acute Physiology and Chronic Health Evaluation; MODS:Multiple Organ Dysfunction Score; ED:emergency department; CRB:confusion, respiratory rate ≥ 30/minute, low systolic [< 90 mmHg] or diastolic [≤ 60 mmHg] blood pressure; CRB-65:CRB and age ≥ 65 years); CURB-65:confusion, urea > 7 mmol/L, respiratory rate ≥ 30/minute, low systolic [< 90 mmHg] or diastolic [≤ 60 mmHg] blood pressure, age ≥ 65 years; UTI:urinary tract infection; ICU:intensive care unit; SIRS:Systemic Inflammatory Response Syndrome; EMR:electronic medical records; ICD:international classification of diseases; WBC:white blood cell; CRP:c-reactive protein; BUN:blood urea nitrogen; GW:general ward; SD:standard deviations; AUROC:area under the receiver operating characteristic; CI:confidence interval; SBP:systolic blood pressure; DBP:diastolic blood pressure; PR:pulse rate; RR:respiratory rate; SWAT:sepsis work-up and treatment

Declarations

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None.

Authors’ contributions

Conception and design: Y H Choi. Acquisition, analysis, and interpretation of data: S J Bae: J H Lee. Drafting the manuscript for intellectual content: S J Bae: J H Lee. Statistical analysis: S J Bae: J H Lee. All authors reviewed: revised: and approved the manuscript for submissions. Study supervision: Y H Choi.

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Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by the institutional review board of EwhaWomans University Mokdong Hospital, and the requirement for written informed consent was waived. (IRB No. 2020-06-043)

Consent for publication

Not applicable.

Conflicts of Interest

The authors declare that they have no competing interests.

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Figures

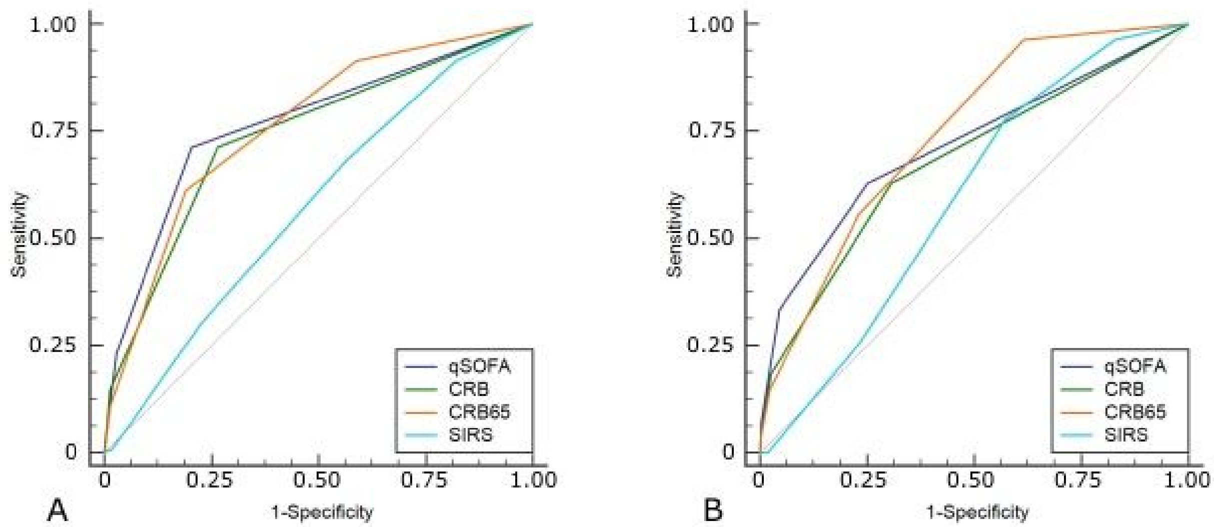

Figure 1

ICU admission (A) and In-hospital mortality (B) receiver operating characteristic curve for qSOFA, CRB, CRB-65, and SIRS