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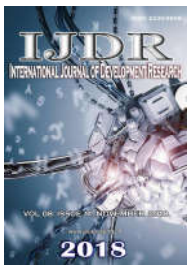

ORIGINAL RESEARCH ARTICLE OPEN ACCESS

COMPARISON BETWEEN QUICK SOFA AND SIRS CRITERIA IN TRIAGE AND AS A SEVERITY AND MORTALITY PREDICTOR IN PATIENTS WITH SEPSIS

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ABSTRACT

Background: Sepsis is a major cause of morbidity and mortality worldwide, and it is very important to establish a simple clinical evaluation method that can identify patients with signs of organic dysfunction who may be progressing to sepsis. The study objective was to compare the qSOFA and SIRS criteria as triage tools and severity and mortality predictors in patients with sepsis at the emergency sector of a University Hospital in the Midwest of the State of Santa Catarina, Brazil. **Methods:** A descriptive, longitudinal and prospective field research was undertaken between February and August 2017. **Results:** Ninety sepsis triage protocols were found. Eight patients were excluded, and 69 of the remaining 82 received the diagnosis and treatment for sepsis. During the triage, 46.4% of the patients obtained positive criteria for both scores, 47.8% were only identified through the SIRS, while 5.8% only presented a positive score on the qSOFA. In-hospital mortality corresponded to 31.9%. A relationship was found between the mean number of positive qSOFA, but not SIRS criteria, and mortality. **Conclusion:** The SIRS criteria showed better performance to detect sepsis in patient triage, while the number of positive qSOFA criteria demonstrated a directly proportional relation with severity and the mortality rate.

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INTRODUCTION

Sepsis is a potentially severe clinical condition, historically recognized for its lethality, with increasing incidence due to the growth of the elderly population, chronic conditions and immunosuppressed patients (Instituto Latino Americano Para Estudos da Sepse, 2015; Dellinger *et al.,* 2012). Its true incidence is unknown, but it is estimated that sepsis is a major cause of morbidity and mortality worldwide, leading to the death of one in every four patients (Singer *et al.,* 2016; Dellinger *et al.,* 2012). The burden of treating sepsis patients reached US$ 24.3 billion in 2007 (Lagu *et al.,* 2007). After the first Sepsis Consensus Conference in 1991, sepsis was defined as a suspected or proven infection, associated with the presence of two or more Systemic Inflammatory Response Syndrome (SIRS) criteria (Bone *et al.,* 1992). Kaukonen *et al.* (2015) and Singer *et al.* (2016) demonstrated that these criteria were not as sensitive as they were supposed to be though, and also lacked specificity for the detection of sepsis in the first hours. Seymour *et al.* (2016), organized into a task force that gave rise to Sepsis-3, suggested replacing the old concepts and testing new diagnostic scores. Sepsis has been defined as a life-threatening organic dysfunction due to a deregulated host response to an infection. Its main novelties include the quick Sequential Organ Failure Assessment (qSOFA), a simple clinical evaluation method that can be used at the bedside for rapid evaluation of patients with signs of organic dysfunction who may be progressing to sepsis. The sudden increase by two or more points in the patient's baseline Sequential Organ Failure Assessment (SOFA) started to characterize organ dysfunction and, in turn, diagnose sepsis (Seymour *et al.,* 2016). Treatment should be established immediately to reduce mortality, hence the importance of appropriate screening and early diagnosis. The aim in this study was to compare the qSOFA and SIRS criteria as screening tools and as predictors of severity and mortality in patients with sepsis in the emergency department of a university hospital.

METHODS

This was a descriptive, longitudinal and prospective study, carried out in the Emergency Department of the Santa Terezinha University Hospital, Joaçaba, Santa Catarina, Brazil,

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between February and August 2017, after approval by the Research Ethics Committee UNOESC / HUST, CAAE No. 60913916.9.0000.5367. The consent was waived by IRB (Comitê de Ética em Pesquisa Unoesc/HUST), because the data was collected from medical records. Before the beginning of the data collection, a multiprofessional training was carried out, especially of the medical and nursing staff of different sectors of the institution, when the screening protocol of patients with sepsis in the emergency department was presented, as well as the research objectives. The professionals were advised on the use of the protocol according to the new and old screening criteria for sepsis.

Clinical and demographic data were collected through an instrument entitled "Screening Protocol for Patients with Sepsis", which consisted of an adaptation of the models proposed by ILAS (Instituto Latino Americano Para Estudos da Sepse, 2015), and the model used by Westphal *et al.* (2009), in addition to the new recommendations of the Sepsis-3 consensus (Singer *et al.,* 2016). A pre-test of the instrument was carried out and the necessary adjustments were made. The study included adult patients (≥18 years old), attended in the public health network, admitted to the emergency department and who presented two or more positive criteria for qSOFA and / or SIRS during the initial screening. Patients who were diagnosed or treated for sepsis coming from other sectors or institutions were excluded, as well as patients who were not treated in the public health network. The qSOFA criteria were: respiratory rate ≥ 22 rpm, systolic blood pressure ≤ 100 mmHg, and Glasgow Coma Scale <15 (3).

Criteria for SIRS were: body temperature> 38ºC or <36ºC; heart rate> 90 bpm; respiratory rate> 20 rpm; leukocytes> 12,000 cells / mm^3 or <4,000 cells / mm^3, or the presence of> 10% of young forms (rods) (Levy *et al.,* 2003). Data were collected by the researchers and entered in Microsoft Excel 2007. Statistical analysis was performed using IBM SPSS Statistics, version 22.0 (IBM Corporation, Armonk, NY, USA). The statistical tests used were Student's t test for independent samples and the Levene test for analysis of variances, as well as Pearson's chi-square test. Statistical significance was set at $p < 0.05$. Data were presented in absolute or relative frequency distribution for categorical variables and mean ± standard deviation (SD) for continuous variables.

RESULTS

In total, 90 sepsis triage protocols were opened, 02 (1.8%) of which were excluded because the patients had not been attended in the public health network, 02 (1.8%) because they were already under treatment for sepsis and 04 (3.6%) due to lack of access to the patient history data. Among the 82 remaining protocols opened due to suspected sepsis, 13 (15.9%) did not present conditions compatible with sepsis or septic shock. The majority of the population was female 43 (52.4%) and the mean age of the patients was 66.4 ± 19.4 years. The sample of patients who were screened and effectively diagnosed and treated as sepsis or septic shock totaled 69 patients within a six-month study period. The main infectious focus suspected at the time of admission was pulmonary, 58%, followed by urinary focus with 14.5%. The mean time elapsed between the initial screening and the collection of laboratory tests was 51.86 ± 49.8 minutes, while the time interval between the screening and the administration of the first antibiotic was 118.68 ± 137.1 minutes. Mortality during hospitalization of patients screened by the protocol as having sepsis or septic shock totaled 22 individuals (31.9%) (Table 1). Upon the patients' arrival to the emergency department, 33 (47.8%) of those with sepsis were identified because they presented only positive SIRS criteria, 4 (5.8%) because they presented only positive qSOFA and 32 (46.4%) because they presented positive SIRS and qSOFA criteria.

Added to these data, SIRS identified 94.2% of patients with sepsis, while qSOFA recognized 52.2% of them (Table 2). Of the 22 patients who died, 19 (86.4%) had 2 or more SIRS criteria present upon arrival at the emergency room, while 17 (77.3%) of them presented positive qSOFA as well. Even among the patients who died, 3 (13.6%) did not present sufficient criteria for SIRS, while 5 (22.7%) did not present positive criteria for qSOFA. The mean qSOFA score upon admission was 1.91 for those who died and 1.19 points for the survivors, showing a statistically significant difference between these groups ($p = 0.002$), while for SIRS, the mean points for those who died corresponded to 2.45 and 2.64 for the survivors, without a difference between the mean scores of these two groups ($p = 0.184$) (Table 3). The in-hospital mortality of patients with none, one, two or three qSOFA criteria was 14.3%, 15.8%, 41.4% and 71.4%, respectively ($p = 0.015$). In the meantime, no relationship was found between the number of SIRS criteria and in-hospital mortality ($p=0.101$) (Table 4).

Table 1. Demographic and clinical characteristics of study subjects

Characteristic	n (%)
Sex	
Female	43 (52.4)
Male	39 (47.6)
Age (mean age in years ± SD)	
66.4 ± 19.4	
Diagnosis	
Sepsis	69 (84.1)
No sepsis	13 (15.9)
Infectious focus	
Pulmonary	40 (58.0)
Urinary	10 (14.5)
Undetermined	5 (7.2)
Neutropenia	5 (7.2)
Abdominal	4 (5.8)
Skin/ soft tissues	2 (2.9)
Operative site	2 (2.9)
Catheter-related	1 (1.4)
Δt-LAB (in minutes ± SD)	
51.86 ± 49.8	
Δt-ATB (in minutes ± SD)	
118.68 ± 137.1	22 (31.9)
Mortality of patients with sepsis	

Δt-LAB – time between initial screening and collection of laboratory tests; Δt-ATB – time between initial screening and administration of first antibiotic; Results expressed as mean ± standard deviation or n (%).

Table 1. Capacity of SIRS and qSOFA criteria to identify patients with sepsis

	Patients identified n(%)
Positive only for SIRS	33 (47.8)
Positive only for qSOFA	4 (5.8)
Positive for SIRS and qSOFA	32 (46.4)

SIRS – Systemic Inflammatory Response Syndrome; qSOFA – Quick Sequential Organ Failure Assessment. Patients who upon admission presented ≥2 or more criteria were considered positive for SIRS. Patients who upon admission presented ≥2 or more criteria were considered positive for qSOFA. Patients who upon admission presented ≥2 or more criteria of both scores were considered positive for SIRS and qSOFA.

Table 3. Number of qSOFA and SIRS criteria and their relation with mortality

	n (%)	qSOFA (mean)	P value	SIRS (mean score)	P value
Death					
Yes	22 (31.9)	1.91	0.002	2.45	0.184
No	47 (68.1)	1.19		2.64	

qSOFA – Quick Sequential Organ Failure Assessment.
Student's t test for independent samples and Levene test for equality of variance. Statistical significance was set at $p<0.05$.

Table 4. Number of positive criteria for SIRS or qSOFA and their relation with mortality

	SIRS 0	1	2	3	≥4	qSOFA 0	1	2	3
Death (%)									
Yes	1(50,0)	2 (100)	9 (33,3)	6 (20,0)	4(50,0)	2 (14,3)	3 (15,8)	12(41,4)	5 (71,4)
No	1(50,0)	0 (0,0)	18 (66,7)	24(80,0)	4(50,0)	12 (85,7)	16(84,2)	17(58,6)	2(28,6)
					p=0,101				p=0,015

SIRS – Systemic Inflammatory Response Syndrome; qSOFA – Quick Sequential Organ Failure Assessment. Results expressed in n (%).
The p value was calculated using Pearson's Chi-squared test, and statistical significance was set at $p<0.05$.

DISCUSSION

The findings of this prospective study demonstrate that qSOFA is less able than SIRS to detect patients with sepsis upon arrival to the Emergency department. Successful treatment of sepsis is essentially linked to early diagnosis and early antibiotics therapy (Rivers *et al.,* 2001; Dellinger *et al.,* 2012). To systematize the early recognition of sepsis patients or those at risk of developing sepsis, organizations such as ILAS and the Sepsis Survival Campaign (CSS) guidelines formally advise that all health institutions develop early detection strategies, and also establish programs to improve the quality of care (Dellinger *et al.,* 2012; Instituto Latino Americano Para Estudos da Sepse, 2015). After the Consensus Guideline Sepse-3, we tried to create a screening instrument that used qSOFA and SOFA, and also maintained the SIRS criteria to be able to compare the tools within the present hospital reality. In this study, the in-hospital mortality of patients screened for sepsis or septic shock was 31.9%. This figure is considerably lower than that reported by ILAS, when in 2015 the mortality of patients with severe sepsis and septic shock attended in emergency departments of Brazilian public hospitals was 52.7% (Instituto Latino Americano Para Estudos da Sepse, 2016). In the sample of 69 patients, the ability to identify those with sepsis for presenting positive SIRS criteria was 47.8%, compared to 5.8% for those who were positive only for qSOFA and 46.4% for those who presented both positive criteria. This information is in line with the results of Haydar *et al.* (2017).

In a retrospective study that evaluated electronic records of 200 patients treated for suspected sepsis in the emergency department of a university hospital, qSOFA as a screening tool showed 58.3% of sensitivity, against 94.5% for SIRS. In another observational cohort study conducted in the emergency department of a university hospital in Norway, the sensitivity of qSOFA was only 30.6% to identify patients with sepsis (Askim *et al.,* 2017). On the other hand, in this study, the use of the SIRS score without leukocytes showed a sensitivity of 74.1%, considerably higher than the qSOFA. In another similar study, medical records were evaluated related to prehospital care and the emergency department of a university hospital, showing that, although qSOFA was very specific 97.3%, it presented a low prehospital sensitivity of 16.3%, which increased to 28% upon the arrival to the emergency department (Dorsett *et al.,* 2017). In the study by Kaukonen *et al.* (2015), which questioned the sensitivity of SIRS because one out of every eight patients in the study did not present two or more positive criteria, even though they were diagnosed with severe sepsis, the reported sensitivity of SIRS was 87.9%. These data lead us to consider that, based on current recommendations for the use of qSOFA as an alert system for probable sepsis patients, around half of the patients in this study could not be identified nor even raised suspicion of sepsis on arrival at the emergency room. Singer *et al.* (2016) were cautious in considering that organ dysfunction induced by sepsis may be an initially hidden event. Therefore, even if there are no specific results on the available screening and diagnosis scores, organ dysfunction can be considered as probable in patients with infectious conditions, in which case the clinical judgment of the attending physician prevails (Dellinger *et al.,* 2013). Early identification being a priority in sepsis treatment, it seems consistent to agree with Dorsett *et al.* (Dorsett *et al.,* 2017) in that sensitivity is more important than specificity in the detection of possible sepsis patients, so perhaps qSOFA is not yet the most appropriate triage tool. The recommendation of the Sepsis-3 Consensus for the use of qSOFA beyond the ICU is based on its good predictive validity for in-hospital mortality, showing a 3 to 14 fold increase in the death rate for patients with two or more qSOFA criteria, and 70% of the deceased scoring 2 or 3 points in this score (Seymour *et al.,* 2016). In this study, 77.3% of patients who died due to sepsis presented 2 or more points for qSOFA. The variations found in the mean qSOFA score, being 1.19 for the survivors and 1.91 for the deaths, showed statistical significance (Table 3). Although these data favor the quality of qSOFA in predicting in-hospital mortality, 22.7% of the patients who died in this study had a qSOFA score lower than 2 upon arrival to the emergency sector. Recent publications agree that qSOFA is more accurate than the SIRS criteria in predicting in-hospital mortality (Haydar *et al.,* 2017; Finkelsztein *et al.,* 2017; Park *et al.,* 2017). In a prospective cohort conducted in emergency departments in France, Spain, Belgium and Switzerland, the predictive capacity of the new Sepsis-3 criteria was also assessed. For Freund *et al.* (2017), the best prediction of in-hospital mortality was qSOFA, SOFA and SIRS, with AUROC of 0.80, 0.77 and 0.65, respectively. Regarding the number of positive criteria for SIRS and qSOFA and their relation with in-hospital mortality, statistical significance was found with p-value 0.015 for the linear increase in the number of qSOFA criteria and a higher mortality rate. Although 86.4% of the deceased patients presented positive SIRS, the same relation between the number of criteria and the increase in mortality was not found (Table

4). In the study by Freund *et al*. (18), the relationship between the number of qSOFA criteria and higher mortality rates was also evident: patients with 0 or 1 point had a 3% mortality rate, compared to 24% for those with 2 or more positive criteria. Kaukonen *et al.* (2015), unlike the present study, demonstrated that for each additional SIRS criterion, there was a linear increase in the patients' risk of death.

Conclusion

Although, after the publication of Sepsis-3, there exists a formal recommendation to use the qSOFA criteria as an alert tool for possible sepsis patients, in this prospective study, these criteria demonstrated poor performance to identify these patients when compared to the SIRS criteria. When the same criteria are evaluated as predictors of severity and in-hospital mortality, qSOFA proved to be an effective tool, with a linear increase in patient mortality as the number of positive qSOFA criteria increased.

Abbreviations list:

bpm: Beats per minute
IRB: Institutional Review Board
qSOFA: Quick Sequential Organ Failure Assessment
rpm: respirations per minute
SIRS: Systemic Inflammatory Response Syndrome
SOFA: Sequential Organ Failure Assessment
SD: standard deviation

Declaration

Ethical Approval/Consent: This study have been approved by the ethics committee (Comitê de Ética em Pesquisa Unoesc/HUST): CAAE No. 60913916.9.0000.5367. The consent was waived by IRB (Comitê de Ética em Pesquisa Unoesc/HUST), because the data was collected from medical records.

Consent for publication: Not applicable.

Availability of data and material: The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request, because the row data is still been analyzed to generate another manuscript.

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