

Balancing Precision and Practicality: SOFA vs. qSOFA in the Diagnosis and Management of Sepsis

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ABSTRACT

Sepsis is a complex and multifaceted condition that remains a leading cause of morbidity and mortality worldwide. The sequential organ failure assessment (SOFA) and quick sequential organ failure assessment (qSOFA) scores are widely used to predict sepsis outcomes, but their utility varies depending on the clinical setting. This narrative review compares the predictive validity, sensitivity and specificity of SOFA and qSOFA, as well as other markers such as serum lactate and SIRS, across different healthcare environments. We conducted a comprehensive literature search of articles published over the last 10 years, focusing on studies that provided full-text access. Our analysis highlights the superior predictive performance of SOFA within intensive care units and the practical advantages of qSOFA in emergency departments. Additionally, this study examines the limitations of these scores and discusses the impact of the 2016 Sepsis-3 definition changes. By synthesizing data from diverse studies, we aimed to provide a thorough understanding of the current landscape of sepsis diagnosis and management, offering insights into how these tools can be optimized to improve patient outcomes.

Keywords: sepsis, SOFA score, qSOFA score.

INTRODUCTION

The sequential organ failure assessment (SOFA) score, created in 1994 and published in 1996, evaluates the severity of organ dysfunction in the respiratory, hepatic, cardiovascular, renal, central nervous and coagulation systems. This score was used to objectively assess organ impairment in critically ill patients (1).

In 2016, the Society of Critical Care Medicine and the European Society of Intensive Care Medicine convened experts to revise the definitions of sepsis and septic shock, resulting in The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). A new score, quick sequential organ failure assessment (qSOFA), was introduced. Unlike the SOFA score, qSOFA can be used at the bedside as it utilizes only clinical parameters: respiratory rate greater than or equal

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Parameter	SOFA (sequential organ failure assessment)	qSOFA (quick sequential organ failure assessment)
Respiratory	PaO ₂ /FiO ₂ ratio	Respiratory rate $\geq$ 22/minute
Coagulation	Platelet count	Not included
Liver function	Bilirubin level	Not included
Cardiovascular	Mean arterial pressure (MAP) or use of vasopressors	Systolic blood pressure $\leq$ 100 mm Hg
Central nervous system	Glasgow coma scale	Altered mental status (Glasgow coma scale)
Renal function	Serum creatinine or urine output	Not included

TABLE 1. Comparative analysis of parameters used in SOFA and qSOFA scores

to 22 breaths/minute, altered mental status and systolic blood pressure <100 mm Hg. This score is proposed for assessing organ dysfunction in adult patients with suspected infection but is not diagnostic (2) (Table 1).

According to the revised definitions in 2016, sepsis is defined as an increase in the SOFA score by two or more points, correlating with an in-hospital mortality rate of $>10\%$. Although the pathophysiological mechanism of sepsis is not yet fully understood, it is thought to result from an exaggerated host response to infection or injury that progresses to shock and subsequent death (2, 3). Septic shock, in the absence of hypovolemia, is characterized by the need for vasopressor therapy to maintain a mean arterial pressure of 65 mm Hg or greater and a serum lactate level of >2 mmol/L or >18 mg/dL (2, 4). Early recognition and prompt initiation of treatment are essential for a favorable prognosis (5).

The aim of this narrative review is to present a thorough synthesis of existing knowledge, highlight areas of consensus and controversy, and identify gaps in current research that could be addressed in future studies. $\square$

MATERIAL AND METHODS

For this narrative review, we conducted a comprehensive literature search using the following formulas: (SOFA OR Sequential Organ Failure Assessment) AND (qSOFA OR quick SOFA) AND (Sepsis OR Septic Shock). The search was performed using three major databases: PubMed, Web of Science and ScienceDirect.

We focused on articles published in the last 10 years to ensure the relevance and currency of the information, except for the seminal 1996 article that first introduced the SOFA score. Only articles in which the full text was accessible were included.

The selection process involved several stages as mentioned below.

1. Initial search and screening – The initial search yielded many articles, which were subsequently screened based on their titles and abstracts to assess their relevance to the topic. Duplicate articles were excluded during this stage.

2. Eligibility assessment – Full texts of the remaining articles were retrieved and assessed for eligibility based on predefined inclusion criteria, and studies had to be directly related to the SOFA or qSOFA scores, sepsis, or septic shock. The exclusion criteria comprised articles not available in English, conference abstracts and studies that did not provide significant data related to the focus of the review.

3. Quality appraisal – The selected articles were subjected to a quality appraisal process to ensure the inclusion of high-quality studies. This involved evaluating methodological rigor, sample size and relevance of the findings to clinical practice.

4. Data extraction and synthesis – Data from the final set of selected articles were extracted and synthesized. Key information, such as study design, sample characteristics, main findings and conclusions, were summarized and integrated to provide a comprehensive overview of the current knowledge on SOFA and qSOFA scores in the context of sepsis and septic shock.

A total of 15 articles were considered to be the most relevant and were included in the final review. These articles provide a broad and detailed understanding of the application and implications of the SOFA and qSOFA scores in assessing organ dysfunction and guiding the management of patients with sepsis and septic shock. $\square$

RESULTS AND DISCUSSIONS

The analysis of diagnostic tools for sepsis has evolved significantly over the past decades, reflecting the complexity and variability of this life-threatening condition. As sepsis encompasses a spectrum of physiological and biochemical disturbances, the development and refinement of pre-

dictive scores such as SOFA, qSOFA and SIRS have been critical for improving early diagnosis, risk stratification, and clinical decision-making. Each of these tools has unique strengths and limitations, depending on the clinical setting and patient population. This review synthesizes findings from various studies to provide a comprehensive evaluation of these diagnostic approaches, focusing on their sensitivity, specificity and utility in different healthcare environments. By integrating insights from multiple research contexts, the analysis aims to clarify the comparative performance of these scores and their implications for sepsis management.

However, the pathophysiology of sepsis remains unclear. Physiological and biochemical changes resulting from infection lead to the abnormal functioning of multiple organs. This complex process, once thought to be solely an inflammatory pathology, now includes imbalances between proinflammatory and anti-inflammatory factors, microcirculatory impairment, mitochondrial damage leading to cytopathic ischemia, endoplasmic reticulum stress, and autophagy. Although these aspects have been studied, they have yet to provide a complete picture (6, 7).

In our study, the SOFA and qSOFA scores were compared in terms of sensitivity and specificity, considering the advantages and limitations of each within different clinical contexts: intensive care units versus other hospital settings, such as emergency departments and general wards. Both scores were compared with each other and with other predictive markers for sepsis, such as serum lactate and other utilized scores, including the systemic inflammatory response syndrome (SIRS) and logistic organ dysfunction score (LODS), to obtain a comprehensive overview.

In 2016, a new definition of sepsis was introduced, which is defined as an increase of two or more points in the SOFA score. In addition, a new qSOFA score was introduced, which utilizes only the clinical criteria. Simultaneously, SIRS criteria were removed from the definition of sepsis. A positive SIRS score is defined as the presence of two or more of the following criteria: temperature above 38°C or below 36°C, heart rate above 90/min, respiratory rate above 20/min or $\text{PaCO}_2 < 32$ mm Hg, white blood cell count $> 12,000/\text{mm}^3$ or below $4,000/\text{mm}^3$, or more than 10% immature forms in peripheral blood (2). The SIRS score was excluded owing to its low specificity.

Seymour *et al* compared the predictive validity of SOFA, qSOFA, LODS and SIRS scores both within intensive care units (ICUs) and outside of them. Diagnosing sepsis in the ICU is challenging due to the supportive treatments that patients receive, which can mask diagnostic criteria and potential pre-existing organ dysfunction in critically ill patients. This study demonstrated that the SOFA score had good predictive validity, as it includes many variables independent of hospital supportive treatments, unlike qSOFA, whose criteria are more easily influenced.

Outside the ICU, such as in emergency departments, a score like SOFA is time-consuming because it requires paraclinical investigation. Under these conditions, qSOFA has higher predictive validity, as it relies solely on clinical criteria that can be easily obtained at the patient's bedside. However, there are limitations since qSOFA is used only in patients already suspected or diagnosed with an infection. Additionally, the evaluation of mental status considers general mental alterations but not deviations from the patient's baseline. For instance, as highlighted in the article, patients with Alzheimer's disease may initially have a qSOFA score of 1, not due to sepsis-induced mental status changes but due to their pre-existing neurodegenerative condition (8).

Raith *et al* conducted a retrospective cohort study comparing the discriminative ability of SOFA, SIRS and qSOFA scores in critically ill patients, considering two criteria: in-hospital mortality as the primary criterion and in-hospital mortality combined with ICU admission for three or more days as the secondary criterion. A SOFA score of ≥ 2 predicted both in-hospital mortality and the combined criterion of in-hospital mortality and ICU admission for three or more days more accurately than SIRS or qSOFA scores. The cohort used in Raith *et al*'s study was independent of the previous study, but had similar characteristics in terms of sex, age, and prognosis, and employed the same methodology. However, the study by Raith *et al* was 11 times larger, involving data from 184,875 patients collected over the past 16 years from Australia and New Zealand. Nevertheless, the data were collected only within the first 24 hours of ICU admission, limiting the discussion on the utility of these scores for infections that occur later during hospitalization. Additionally, the data were collected exclusively from ICUs, so the utility of qSOFA and the advan-

tage of exclusively using clinical criteria outside the ICU were not determined in this study (9).

In an ICU from a middle-income country, SOFA has demonstrated superiority over qSOFA and SIRS in predicting mortality and organ failure. This retrospective cohort study analyzed 10 years of data from a university hospital in Thailand. Of the 2,350 patients who met the Sepsis-2 criteria, 95.6% met the Sepsis-3 criteria. The analysis showed that SOFA had the highest ability to predict both mortality and organ failure, followed by qSOFA and SIRS. Notably, in the study with a SOFA score below 2 all patients with sepsis survived and did not develop organ failure. The mortality rates in this study were higher than those reported by Seymour *et al* and Raith *et al* (8, 9). SOFA, qSOFA, and SIRS demonstrated better predictive performance for mortality than other studies, suggesting that these scores might better predict outcomes for more severely ill patients. However, the study's limitations include data from a single hospital and the consideration of score values only within the first 24 hours (10, 18).

Another retrospective study analyzed data from 1,865 ICU patients to compare the predictive validity of serum lactate, SOFA and qSOFA (12). Lactate levels rise in both tissue hypoxia and hyperdynamic states due to beta-2 adrenergic sympathetic stimulation, which increases carbohydrate metabolism, exceeds pyruvate dehydrogenase capacity, and converts pyruvate to lactate. Both causes of hyperlactatemia are observed in sepsis (13, 14). Patient data on serum lactate values within the first 24 hours of presentation were collected, and the highest values of the scores calculated within the first 24 hours were used to predict short-term and long-term prognoses. The study results showed that qSOFA had lower sensitivity but comparable specificity to SOFA and serum lactate levels, which had similar values. However, this study has limitations due to the retrospective nature of data collection, the diversity of treatments and procedures that can influence SOFA and qSOFA scores, and the timing differences in serum lactate collection, all of which could affect the analysis results (12, 15).

In the context of the emergency department, a rapid score that does not require additional investigations, such as qSOFA, can be advantageous. Freund *et al* conducted a prospective cohort study analyzing 879 patients in emergency units across four European countries: France, Switzerland,

Spain and Belgium. This study aimed to prospectively validate Sepsis-3 proposals regarding the introduction of the qSOFA score as a diagnostic tool outside the ICU. The Sepsis-3 criteria were compared with the previous diagnostic criteria: SIRS and criteria for severe sepsis (combination of two or more positive SIRS criteria and serum lactate levels > 2 mmol/L). Notably, one-third of patients with two or more positive SIRS criteria lacked data on serum lactate levels. The qSOFA demonstrated superior discriminatory value over both previous criteria for all outcomes: mortality, ICU admission and ICU stay longer than 72 hours. The results of the study suggest that patients in the emergency department suspected of infection with a qSOFA score of ≥ 2 should be considered for a possible sepsis diagnosis even if the SOFA score is < 2 . Additionally, more than 70% of patients with a qSOFA score of ≥ 2 had a SOFA score of ≥ 2 , although 250 subjects had missing data necessary for calculating the latter score. Thus, it is possible that the SOFA score was superior to the qSOFA score. However, the authors suggested that the qSOFA was more suitable outside the ICU. The study added to the Sepsis-3 recommendations, as the data were collected prospectively and from emergency departments. Among the limitations mentioned in the article are the consideration of only the highest qSOFA values and the tracking of patients only for in-hospital mortality, thus not determining the ability of the score to predict long-term mortality or outcomes (16).

A complementary study by Hwang *et al* analyzed the ability of scores evaluated within the first 24 hours to accurately predict 28-day mortality. This retrospective study included data from 1,395 patients who presented to the emergency department and met the criteria for severe sepsis and septic shock. One limitation of this study is the use of the term "severe sepsis", which was withdrawn in 2016 (2). The authors stated that most patients met the updated sepsis criteria but chose to use this term to reduce nomenclature confusion as it was accepted during the data collection period (August 2008 – September 2014). Severe sepsis is defined as sepsis associated with acute organ failure. The results showed a low sensitivity of qSOFA in predicting 28-day mortality, with a substantial number of patients not meeting the qSOFA criteria. The lowest sensitivity was observed upon presentation to the emergency de-

partment; however, it gradually increased over the 24-hour period, raising questions about the utility of the score as a screening tool, since early therapeutic intervention is crucial for septic patients (5). The study suggests that serial evaluation of scores could compensate for low sensitivity and that using the highest score value could improve predictability. A particular category of patients mentioned in the study comprises those with cryptic shock, a severe form of sepsis where patients have normal blood pressure but organ dysfunction or elevated serum lactate levels. This hemodynamic normality limits the use of qSOFA in these patients because one of the three criteria is a blood pressure below 100 mmHg. The retrospective nature of the study is a limitation owing to missing mental status data for some patients. Other limitations include data from critically ill patients, some of whom were admitted to the ICU, and from a single hospital (17).

Simpson argued against the 2016 change in sepsis definition based on the SOFA score. The current ICU diagnostic criteria based on SOFA require pathological progression, meaning that the score does not recognize early signs for detection, potentially delaying therapeutic intervention (18). For patients, a good prognosis comes from the rapid recognition of sepsis and aggressive early treatment when it is most effective (5).

The complexity of the pathophysiology of sepsis, which involves physiological and biochemical changes, makes it challenging to diagnose and treat effectively. While SOFA and qSOFA scores offer valuable tools for predicting outcomes, their utility varies depending on the clinical setting. This retrospective cohort study in Thailand highlights SOFA's superiority of SOFA in predicting mortality and organ failure within the ICU, suggesting its robustness in settings where patients receive extensive supportive treatments. Conversely, qSOFA's simplicity and reliance on readily available clinical parameters make it more suitable for rapid assessment in emergency departments, where time and resources are limited (8, 9, 15, 19).

Freund *et al* further validated the practical application of qSOFA in emergency departments across multiple European countries. These findings support the Sepsis-3 recommendations, indicating that the qSOFA can effectively identify patients at risk of sepsis outside the ICU. The ability to quickly screen patients can facilitate timely

intervention and potentially improve outcomes. However, the study also noted the limitations of qSOFA, particularly its lower sensitivity compared to SOFA and the potential for missing early signs of deterioration (16).

Hwang *et al*'s study underscores the importance of serial evaluations, suggesting that repeated assessments of qSOFA scores could enhance its predictive accuracy. The challenges posed by cryptic shock, where normal blood pressure masks severe sepsis, highlight the need for comprehensive evaluation strategies that go beyond single-time-point assessments (17). This approach could help bridge the gap between the rapid screening capabilities of qSOFA and the detailed diagnostic insights provided by SOFA.

In 2019, Mak *et al* conducted a prospective study validating the Sepsis-3 guidelines in acute hepatobiliary infections, comparing the sensitivity and specificity of the qSOFA and SIRS criteria. The study revealed that while SIRS criteria exhibited higher sensitivity, the qSOFA score demonstrated greater specificity in predicting ICU admission and morbidity. These findings suggest that a combined use of both scores may optimize the identification of high-risk patients in this specific context (20). Similarly, in a 2017 study, Tugul and colleagues examined the performance of qSOFA and SIRS in prehospital and emergency department triage settings. Their findings highlighted the low sensitivity of both criteria in detecting at-risk patients, underscoring the need for more effective early screening tools for infectious complications (21).

The debate surrounding the 2016 Sepsis-3 definition changes, particularly the exclusion of SIRS and reliance on SOFA, reflects the ongoing challenges in sepsis diagnosis. Although SOFA offers a detailed assessment of organ dysfunction, its requirement for extensive clinical data can delay diagnosis and treatment. Simpson's critique emphasizes the need for diagnostic criteria that can identify sepsis early to enable prompt intervention, which is crucial for improving patient outcomes (18).

Overall, the combination of SOFA and qSOFA scores, along with other markers such as serum lactate, offers a multifaceted approach to sepsis diagnosis and management. Evidence suggests that while SOFA provides a comprehensive assessment within the ICU, qSOFA's ease of use makes it invaluable for initial screening in emer-

Criteria	SOFA (sequential organ failure assessment)	qSOFA (quick sequential organ failure assessment)
Purpose	Assess the severity of organ dysfunction in critically ill patients	Provide a quick bedside assessment for sepsis risk
Parameters	Respiratory (PaO ₂ /FiO ₂), coagulation (platelets), liver (bilirubin), cardiovascular (MAP or use of vasopressors), central nervous system (Glasgow coma scale), renal (creatinine or urine output)	Respiratory rate ≥ 22 /min, altered mental status (Glasgow coma scale), systolic blood pressure ≤ 100 mm Hg
Clinical setting	Primarily used in ICU settings where comprehensive data is available	Designed for use in emergency departments and other settings outside the ICU
Data requirements	Requires laboratory results and clinical data from multiple organ systems	Requires only clinical observation, no laboratory tests needed
Time to administer	Time-consuming due to the need for various clinical and laboratory data	Quick and easy to administer at the bedside
Predictive validity	High predictive validity for mortality and organ failure in ICU settings	Good predictive validity for identifying high-risk sepsis patients outside ICU settings
Sensitivity	Higher sensitivity in ICU settings for detecting sepsis-related mortality and organ dysfunction	Lower sensitivity compared to SOFA but still useful for initial assessment
Specificity	High specificity, particularly useful for severe sepsis cases	High specificity in emergency settings, less influenced by supportive treatments
Advantages	Comprehensive assessment of organ dysfunction; can guide intensive care treatment	Rapid, easy to use, no additional tests required; suitable for quick screening
Limitations	Requires extensive data collection; may delay diagnosis and treatment	Less comprehensive; may miss early signs of sepsis, not suitable for all patient types
Impact of Sepsis-3	Integral part of the updated sepsis definition (increase in SOFA score by 2 or more points)	Introduced as a quick assessment tool under Sepsis-3 criteria

TABLE 2. Comparative analysis of SOFA and qSOFA scores

gency settings. Future research should focus on refining these tools, exploring serial assessments, and integrating additional biomarkers to enhance the accuracy and timeliness of sepsis diagnoses across different clinical environments (22, 23) (Table 2).

This review has several limitations that must be acknowledged. First, the included studies employed varying methodologies, ranging from prospective to retrospective designs. This heterogeneity introduces potential biases and limits the generalizability of findings, as the differences in study design can affect the interpretation of results. Additionally, the studies were conducted in diverse clinical settings, including ICUs, emergency departments and prehospital environments, each characterized by distinct patient populations, resources and diagnostic challenges. These contextual differences may contribute to variability in the predictive performance of the SOFA, qSOFA and SIRS scores, making it challenging to draw universal conclusions.

Furthermore, many of the explored studies focused on short-term outcomes, such as in-hospital or 28-day mortality, without considering long-term patient prognoses or quality of life following sepsis. This narrow focus limits the understanding of the broader implications of sepsis and its manage-

ment. Retrospective studies, in particular, were prone to missing critical data, such as baseline mental status, lactate levels, or other clinical variables, which could impact the evaluation of the diagnostic tools. Moreover, specific patient populations, including those with cryptic shock or pre-existing conditions like neurodegenerative diseases, were either underrepresented or difficult to evaluate accurately using the studied scores. Lastly, the geographic scope of the studies was often limited to specific regions or institutions, which may restrict the applicability of findings to other healthcare systems or demographic groups, underscoring the need for more inclusive and geographically diverse research. □

CONCLUSIONS

This review highlights the strengths and weaknesses of commonly used sepsis diagnostic tools, including SOFA, qSOFA and SIRS. The data suggest that SOFA is highly reliable in predicting mortality and organ dysfunction in ICU settings, where comprehensive clinical and laboratory data are available. In contrast, qSOFA is better suited for rapid screening in emergency and prehospital environments due to its reliance on easily measurable clinical parameters. However, both scores

have limitations, particularly in their sensitivity to early-stage sepsis or atypical presentations, such as cryptic shock.

The exclusion of SIRS criteria in the Sepsis-3 guidelines has been met with both support and criticism, underscoring the need for a balanced approach that incorporates the strengths of multiple diagnostic tools. Future research should focus on integrating biomarkers, serial assessments, and advanced predictive models to enhance diagno-

stic accuracy. Additionally, efforts should be made to address gaps in the existing literature, including long-term patient outcomes and the evaluation of score performance across diverse healthcare settings. These advancements could improve the early detection and management of sepsis, ultimately reducing morbidity and mortality. ▣

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