

# Assessment of early sepsis recognition scores: experience from a quaternary hospital in Brazil

*Avaliação de escores de reconhecimento precoce da sepse: experiência de um hospital quaternário do Brasil*

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## ABSTRACT

**Objective:** To analyze the effectiveness of screening tools for the early detection of sepsis. **Methods:** A prospective study that included 443 sepsis protocols from a quaternary hospital in Rio de Janeiro between January and August 2023. The sensitivity and specificity of three tools were compared: Systemic Inflammatory Response Syndrome (SIRS), quick Sepsis Related Organ Failure Assessment (qSOFA), and National Early Warning Score (NEWS). **Results:** Among patients with septic shock, 88% had a NEWS score > 4, while 74% of sepsis cases also had this score. NEWS stood out with a sensitivity of 87% for septic shock and 74% for sepsis, outperforming the other tools in both cases. Additionally, qSOFA was more specific, with 89% specificity for sepsis. Most patients were elderly and female, with initial screening indicating a high level of risk. **Conclusion:** The study underscores the importance of early identification of sepsis, recommending the use of NEWS as the primary tool in emergency services. Although conducted at a single center, the findings encourage the adoption of NEWS-based protocols to improve outcomes in sepsis management.

**Keyword:** Sepsis; Systemic inflammatory response syndrome; Shock, septic

## RESUMO

**Objetivo:** Analisar a eficácia de ferramentas de triagem para a detecção precoce de sepse. **Métodos:** Estudo prospectivo, que abrangeu 443 protocolos de sepse de um hospital quaternário no Rio de Janeiro entre janeiro e agosto de 2023. Foram comparadas a sensibilidade e a especificidade de três ferramentas: síndrome da resposta inflamatória sistêmica, *quick Sepsis Related Organ Failure Assessment* (qSOFA) e *National Early Warning Score* (NEWS). **Resultados:** Dentre os pacientes com choque séptico, 88% apresentaram NEWS > 4, enquanto 74% dos casos de sepse também tiveram essa pontuação. O NEWS se destacou com uma sensibilidade de 87% para choque séptico e uma sensibilidade de 74% para sepse, superando as outras ferramentas em ambos os casos. Além disso, o qSOFA foi mais específico, com 89% de especificidade para sepse. A maioria dos pacientes era idosa e do sexo feminino, com a triagem inicial indicando alto nível de risco. **Conclusão:** O estudo sublinha a importância da identificação precoce da sepse, recomendando o uso do NEWS como ferramenta primária em serviços de emergência. Embora realizado em um único centro, os achados incentivam a adoção de protocolos baseados no NEWS para melhorar os resultados no manejo da sepse.

**Descritor:** Sepse; Síndrome de resposta inflamatória sistêmica; Choque séptico

Received on: May 30, 2024 • Accepted on: Oct 23, 2024

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Source of financing: none.

Conflicts of interest: there are no conflicts of interest.

How to cite this article: Figueiredo GF, Silva MF, Japiassu AM, Freitas AA, Gomes GF, Damasceno MP, et al. Assessment of early sepsis recognition scores: experience from a quaternary hospital in Brazil. JBMEDE. 2024;4(3):e24024.

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DOI: 10.54143/jbmede.v4i3.204

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## INTRODUCTION

World Sepsis Day, celebrated annually on September 13, was proposed in 2012 by the Global Sepsis Alliance to raise awareness about the issue worldwide.<sup>1</sup> It is estimated that there are around 49 million annual cases globally, with 11 million deaths.<sup>2</sup>

Sepsis is defined as a dysregulated and potentially fatal response to an infection, which can lead to tissue damage, organ failure, and death.<sup>1</sup> The management of sepsis is time-dependent, and the first contact for septic patients typically occurs in the Emergency Department. Therefore, there is a need for early recognition and risk stratification to identify prognostic markers that can help emergency physicians implement more aggressive and effective management.<sup>3</sup>

The main available tools include the Systemic Inflammatory Response Syndrome (SIRS), the quick Sepsis Related Organ Failure Assessment (qSOFA), and the National Early Warning Score (NEWS). The use of these scores is straightforward, allowing for early recognition of clinical deterioration signs through easily collectible variables. This facilitates decision-making and reduces unfavorable outcomes, such as decreasing in-hospital mortality from sepsis.<sup>4</sup> Thus, this study aimed to compare the sensitivity and specificity of sepsis screening tools in a quaternary hospital.

## METHODS

This is a prospective cohort study of patients diagnosed with sepsis or septic shock, treated at a quaternary teaching hospital in Rio de Janeiro. The study was conducted from January to August 2023. The sepsis protocol was initiated for adult patients over 18 years of age who presented at least two signs: hyperthermia  $> 37.8^{\circ}\text{C}$  or hypothermia  $< 35^{\circ}\text{C}$ , tachycardia  $> 90$  bpm, tachypnea  $> 20$  breaths per minute, leukocytosis  $> 12,000$  or leukopenia  $< 4,000$ , or one of the criteria for organ dysfunction: oliguria (less than 400 mL per day), altered level of consciousness, desaturation ( $< 94\%$ ), or hypotension (systolic blood pressure  $< 90$  mmHg or mean arterial pressure  $< 65$  mmHg).

Data from the sepsis forms, medical records, laboratory tests, and outcomes were recorded in an Excel spreadsheet. The final diagnosis was determined by the physician managing the sepsis protocol in the hospital unit. Patients without sufficient data for statistical analysis or who did not meet the criteria for sepsis/septic shock were excluded.

The sample size calculation, considering a prevalence of sepsis of 30% in Brazilian and international studies,<sup>5,6</sup> a power of 95%, and a significance level of 5%, indicated that 50 patients constituted a sufficient sample to detect as significant an area under the Receiver Operating Characteristic (ROC) curve of 0.7, with qSOFA as a predictor for the diagnosis of sepsis and a clinically useful test for early identification.

The collected data were organized and compiled in Excel and subsequently analyzed using the Statistical Package for the Social Sciences (SPSS), version 20.0, and the statistical software R, version 3.5.2. A multivariable analysis was conducted using the Poisson regression method with robust variance to estimate the effect of predictor factors on the occurrence of the studied outcomes. Associations with a p-value  $< 0.05$  were considered significant. The tools were evaluated for sensitivity and specificity, and confidence intervals were calculated at a 95% confidence level.

The qSOFA is considered positive for possible diagnosis of sepsis when the patient meets two or more assessment criteria: respiratory rate  $\geq 22$  breaths per minute, systolic blood pressure (SBP)  $\leq 100$  mmHg, and altered level of consciousness, as assessed using the Glasgow Coma Scale.<sup>7</sup>

The NEWS is defined by the sum of the scores achieved in the assessment of consciousness level, temperature, heart rate, systolic blood pressure (SBP), respiratory rate, peripheral oxygen saturation, and oxygen supplementation. The higher the score attained in the physiological parameters, the higher the overall score achieved on the scale.<sup>8</sup>

SIRS is an exaggerated defensive response of the body to a harmful stressor (such as infection, trauma, surgery, acute inflammation, ischemia or

reperfusion, or malignancy, among others) aimed at locating and then eliminating the endogenous or exogenous source of the insult. Objectively, SIRS is defined by the fulfillment of any two of the following criteria: body temperature  $< 38^{\circ}\text{C}$  or  $> 36^{\circ}\text{C}$ , heart rate  $> 90$  bpm, respiratory rate  $> 20$  breaths per minute, or partial pressure of carbon dioxide  $< 32$  mmHg; leukocyte count  $> 12,000$  or  $< 4,000/\mu\text{L}$ ; or more than 10% of immature forms or bands.<sup>9</sup>

Sepsis is defined as a life-threatening organ dysfunction caused by a dysregulated host response to an infection. Septic shock is defined as sepsis that presents with circulatory, cellular, and metabolic abnormalities, associated with a higher risk of mortality than sepsis alone.<sup>5</sup>

The research was submitted and approved by the institution's Ethics and Research Committee, with the Certificate of Presentation for Ethical Appreciation (CAAE) 47504821.0.0000.5455.

## RESULTS

During the study period, 443 sepsis protocols were opened for 251 female patients. The mean age was 76.5 years, with approximately 30% of individuals over 80 years old. At the time of hospital admission, most of the 345 patients were triaged as red (emergency) and 54 as yellow (urgent). About 37% of the sepsis protocols were initiated within 11 to 30 minutes of arrival at the hospital. Upon analyzing the protocols, 40 patients met the criteria for septic shock, 180 for sepsis, 182 for infection, and 40 were excluded for not having an infection. Patients with sepsis and septic shock had a median NEWS score of 7 and 8 points, respectively. The data are presented below in **table 1**.

When stratified according to the screening tool, 88% of patients with septic shock had NEWS  $> 4$ , 29% had qSOFA  $> 2$ , and 66% had SIRS  $> 2$ , while 74% of those included with sepsis had NEWS  $> 4$ . Analyzing sensitivity and specificity, NEWS was the most sensitive for screening in patients with septic shock (sensitivity of 87%;  $p$  value  $< 0.001$ ), while qSOFA was more specific

**Table 1.** Epidemiological characteristics of patients included in the sepsis protocol at a hospital unit in Rio de Janeiro

| Characteristics                        | Total, n= 443 |
|--|---------------|
| Gender                                 |               |
| Female                                 | 251(56)       |
| Male                                   | 192(43)       |
| Median age                             | 76.5          |
| Triagem classification                 |               |
| Red                                    | 345 (78)      |
| Yellow                                 | 54 (12)       |
| Blue                                   | 37 (8)        |
| Green                                  | 7 (2)         |
| Time to Open Sepsis Protocol (minutes) |               |
| 0-10                                   | 107 (24)      |
| 11-30                                  | 164 (37)      |
| 31-60                                  | 76 (17)       |
| > 60                                   | 96 (21)       |
| Protocol classification                |               |
| Sepsis                                 | 180 (41)      |
| Septic shock                           | 41 (9)        |
| Infection                              | 182 (42)      |
| Not infection                          | 40 (8)        |

Results expressed as n (%).

in patients with sepsis (specificity 89%,  $p$  value  $< 0.001$ ). The NEWS tool demonstrated superiority over qSOFA and SIRS in detecting sepsis and septic shock, regardless of the screening category (**Table 2**).

## DISCUSSION

Screening tools are designed to promote the early identification of sepsis and thereby improve patient care processes and safety. This study highlights that NEWS was more accurate compared to SIRS and qSOFA for detecting sepsis and septic shock in an emergency care setting.

Most patients treated for suspected or confirmed sepsis in the hospital unit were women and elderly. These data are consistent with information in the literature. A study conducted by Lohn et al. indicates that 55% of patients treated in an emergency setting for sepsis were female and elderly.<sup>10</sup>

Regarding risk classification, most patients were classified as red (78%) or yellow (12%). These

**Tabela 2.** Sensitivity and specificity of screening tools

| Characteristics | Total (n=443)<br>n (%) | OR   | IC 95%    | p-value | Sensitivity | Specificity |
|-----------------|------------------------|------|-----------|---------|-------------|-------------|
| Sepsis          |                        |      |           |         |             |             |
| NEWS > 4        | 134 (30)               | 2,5  | 2,4-5,24  | < 0,001 | 0,74        | 0,55        |
| qSOFA > 2       | 46 (10)                | 2,96 | 2,96-4,66 | < 0,001 | 0,25        | 0,89        |
| SIRS > 2        | 125 (28)               | 2,54 | 2,5-5,3   | < 0,001 | 0,69        | 0,61        |
| Septic Shock    |                        |      |           |         |             |             |
| NEWS > 4        | 36 (0,08)              | 8,25 | 8,20-3,16 | < 0,001 | 0,87        | 0,53        |
| qSOFA > 2       | 12 (0,02)              | 0,9  | -         | 0,08    | 0,29        | 0,81        |
| SIRS > 2        | 27 (0,06)              | 0,6  | -         | 0,48    | 0,65        | 0,39        |

Poisson regression. SIRS: systemic inflammatory response syndrome; qSOFA: quick Sepsis Related Organ Failure Assessment; NEWS: National Early Warning Score

findings highlight the importance, challenges, and effectiveness of nurses in risk classification. According to a publication by the Latin American Sepsis Institute, early identification of sepsis through Manchester protocol flowcharts links common complaints with discriminators that may be associated with signs and symptoms of sepsis.<sup>11</sup>

A large portion of patients was managed under the sepsis protocol within 1 hour. In the presence of dysfunctions and a presumed infectious focus, the diagnosis of sepsis should be initiated immediately.<sup>12</sup> These findings are superior to those previously published. A Canadian cohort study conducted to evaluate adherence to antibiotic therapy in sepsis found an average time from sepsis recognition to the start of antimicrobial therapy of 4 hours.<sup>13</sup>

Previous studies assessed NEWS cutoff points of  $\geq 4$  and  $\geq 8$  for moderate and high risk categories of sepsis, with a sensitivity of 84% and specificity of 85%.<sup>11</sup> The NEWS showed greater sensitivity. When the goal is to rule out a diagnosis of sepsis, it is important for the best tool to have high sensitivity, as this will significantly affect the negative predictive value; in other words, if the test result is negative, it is highly unlikely that the person actually has sepsis.<sup>14</sup> This study reinforces the recommendation of international guidelines for the management of sepsis and septic shock to avoid using qSOFA in isolation.

Although conducted at a single center, the results of this study should encourage emergency services

to implement sepsis management protocols based on the use of NEWS for early recognition, treatment, and training of involved professionals.

## ACKNOWLEDGEMENTS

To the entire care team that provided treatment and managed the sepsis cases.

## REFERENCES

1. Brasil. Ministério da Saúde. Biblioteca Virtual da Saúde. 13/9 – Dia Mundial da Sepse. [citado 2024 Ago 5]. Disponível em: <https://bvsms.saude.gov.br/13-9-dia-mundial-da-sepse-3/>
2. Rudd KE, Johnson SC, Agesa KM, Shackelford KA, Tsoi D, Kievlan DR, et al. Global, regional, and national sepsis incidence and mortality, 1990-2017: analysis for the Global Burden of Disease Study. *Lancet*. 2020;395(10219):200-211.
3. Gavelli F, Castello LM, Avanzi GC. Management of sepsis and septic shock in the emergency department. *Intern Emerg Med*. 2021;16(6):1649-61.
4. Sousa AS, Soares GR, Severo LT, Oliveira AP, Santarém MD, Caregnato RC. Escores utilizados em suspeita/diagnóstico de sepse. *Rev Enferm UERJ*. 2022;30:e67662.
5. Brasil. Ministério da Educação. Empresa Brasileira de Serviços Hospitalares. Escore para alerta precoce. Brasília, DF: Ministério da Educação; 2020 [citado 2024 Ago 5]. Disponível em: <https://www.gov.br/ebserh/pt-br/hospitais-universitarios/regiao-sudeste/hu-ufjf/saude/escore-para-alerta-precoce-1/escore-para-alerta-precoce>
6. Lohn A, Martins MS, Câmara LT, Malfussi LB, Lazzari DD, Nascimento ER, et al. Perfil epidemiológico e clínico de pacientes com suspeita de sepse e choque séptico em emergência hospitalar. *Reme: Rev Min Enferm*. 2021;25:e-1415.
7. Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA*. 2016;315(8):801-10.
8. Usman OA, Usman AA, Ward MA. Comparison of SIRS, qSOFA, and NEWS for the early identification of sepsis in the Emergency Department. *Am J Emerg Med*. 2019;37(8):1490-7.
9. Chakraborty RK, Burns B. Systemic Inflammatory Response Syndrome. [Updated 2023 May 29]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-.
10. Lohn A, Martins MS, Câmara LT, Malfussi LB, Lazzari DD, Nascimento ER, et al. Perfil epidemiológico e clínico de pacientes

com suspeita de sepse e choque séptico em emergência hospitalar. *Rev Min Enferm.* 2021;25:e-1415.

11. Latin American Sepsis Institute. Grupo Brasileiro de Avaliação de Risco. Associação entre Sistema Manchester de Classificação de Risco e Protocolo de Sepse. [citado 2024 Ago 5]. Disponível em: <https://ilas.org.br/wp-content/uploads/2022/07/nota-tecnica01-2017.pdf>
12. Instituto Latino Americano de Sepse. Implementação de protocolo gerenciado de sepse protocolo clínico. [citado 2024 Ago 5]. Disponível em: <https://ilas.org.br/wp-content/uploads/2022/02/protocolo-de-tratamento.pdf>
13. Mok K, Christian MD, Nelson S, Burry L. Time to Administration of Antibiotics among Inpatients with Severe Sepsis or Septic Shock. *Can J Hosp Pharm.* 2014;67(3):213-9.
14. Artigos sobre testes diagnósticos. [citado 2024 Out 1]. Disponível em: [https://www.sboc.org.br/app/webroot/leitura-critica/LEITURA-CRITICA\\_C5.pdf](https://www.sboc.org.br/app/webroot/leitura-critica/LEITURA-CRITICA_C5.pdf)