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Association between admission NEWS2 categories and in-hospital mortality among adults with sepsis in the Brazilian Amazon: a retrospective cohort study

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Research Article

Keywords: NEWS2, sepsis, emergency department, mortality, risk stratification, retrospective cohort, Brazilian Amazon

Posted Date: November 18th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11364359/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

Accurate early risk stratification is important in sepsis, but the prognostic performance of the National Early Warning Score 2 (NEWS2) may vary across populations and care pathways. We evaluated the association between NEWS2 at emergency department admission and in-hospital outcomes among adults with sepsis in a general hospital in the Brazilian Amazon.

Methods

We conducted a single-center retrospective cohort study of consecutive adults with physician-confirmed sepsis admitted between January 2, 2022 and July 8, 2024. Sepsis was defined according to the institutional protocol as a suspected infectious focus plus at least two systemic inflammatory response syndrome criteria. At emergency department admission, trained nursing technicians entered vital signs into the electronic medical record, which automatically generated NEWS2. The primary outcome was in-hospital mortality. Associations between NEWS2 categories and in-hospital mortality were examined using chi-square tests and logistic regression, with adjustment for age and the presence of comorbidities. Kaplan–Meier survival analysis was also performed.

Results

The cohort included 246 patients (mean age 63.75 years, SD 21.37; 56.1% women); 75.2% had comorbidities. Forty-two patients died in hospital (17.1%). Mortality was 7.1% among patients with NEWS2 0–2, 4.5% for NEWS2 3–4, 36.7% for NEWS2 5–6, and 36.4% for NEWS2 ≥ 7 ($p < 0.001$). Using NEWS2 0–2 as the reference category, the unadjusted odds of death were higher for NEWS2 5–6 (OR 7.53, 95% CI 2.08–27.24) and NEWS2 ≥ 7 (OR 7.43, 95% CI 1.88–29.29). After adjustment for age and comorbidities, NEWS2 scores of 5–6 (aOR 6.04, 95% CI 1.63–22.41) and ≥ 7 (aOR 6.90, 95% CI 1.72–27.71) remained associated with in-hospital mortality. Survival differed across NEWS2 categories (log-rank $p < 0.001$). Mean hospital length of stay was 17.17 days (SD 8.77).

Conclusions

Higher NEWS2 categories at emergency department admission were associated with increased in-hospital mortality among adults with sepsis in the Brazilian Amazon, including after adjustment for age and comorbidity status. These findings support the potential use of NEWS2 for risk stratification in emergency care. Further studies in larger, multicenter cohorts are needed to assess its prognostic performance across different clinical settings.

Background

Sepsis is a life-threatening syndrome characterized by organ dysfunction arising from a dysregulated host response to infection and remains a major cause of global mortality (1, 2). In 2017, approximately 85% of incident sepsis cases occurred in countries with low, low-middle, or middle sociodemographic index (2). Access to critical care resources is also unevenly distributed, with substantial limitations in the availability of intensive care services in low- and middle-income countries (3). A systematic review and meta-analysis of hospital-treated sepsis found a high incidence across all regions, with approximately one in four patients dying during their hospital stay and highlighted persistent gaps in data from low- and middle-income countries (4).

In Brazil, an analysis of hospitalizations for sepsis in the Unified Health System (SUS) between 2010 and 2019 showed regional differences in mortality rates and an overall increasing trend (5). In a nationally representative study of Brazilian intensive care units (ICU), sepsis was identified in approximately 30% of ICU beds, with an in-hospital mortality of 55.7% among patients with sepsis (6). Differences between public and private institutions have also been reported. In a multicenter cohort of ICU patients with sepsis, admission to a public hospital was independently associated with higher mortality (7).

Physiological deterioration may precede critical events, and early warning scores were developed to standardize the recognition of acute illness severity (8). The original National Early Warning Score (NEWS), recommended by the Royal College of Physicians for routine assessment of adult patients, showed excellent discrimination for mortality within 24 hours (AUROC 0.894) in a large hospital-based study (9). In 2017, the Royal College of Physicians introduced NEWS2, which incorporates respiratory rate, oxygen saturation, supplemental oxygen, systolic blood pressure, pulse, temperature, and level of consciousness into a standardized score linked to escalation of clinical response (10). The NEWS2 has also been translated and culturally adapted for Brazilian Portuguese (11).

Early warning scores have been evaluated for predicting clinical deterioration and mortality in hospitalized adults, although differences in study populations, outcomes, and methods limit comparisons across studies (8). In patients with suspected or confirmed sepsis, NEWS2 has been evaluated for the prediction of organ dysfunction and adverse clinical outcomes. Mellhammar et al. reported better discrimination with NEWS2 than with qSOFA for a composite outcome involving organ dysfunction, infection-related mortality, or intensive care admission (12). Moreno-Torres et al. reported better discrimination for in-hospital mortality with NEWS2 than with qSOFA, although its discriminatory performance was modest (13). In contrast, Sivayoham et al. found that the REDS score had better discrimination for mortality than NEWS2 in patients with suspected sepsis (14). Hsieh et al. reported lower in-hospital mortality among patients whose NEWS2 decreased during emergency department care (15).

In a meta-analysis of 26 studies involving 62,338 patients with suspected sepsis, NEWS showed a pooled sensitivity of 0.73 and specificity of 0.52 for mortality, while qSOFA had higher overall prognostic accuracy (16). More recently, Rhee et al. investigated the use of NEWS2 to stratify the urgency of

antibiotic treatment in patients with suspected sepsis, extending its potential application beyond mortality prediction alone (17).

The available literature, however, is dominated by studies from Europe, North America, and Asia (18, 19). Evidence from Brazilian emergency departments, particularly in the Amazon region, remains limited (20). Moreover, a locally implemented electronic workflow in which NEWS2 is automatically generated from admission vital signs may differ from manually calculated research scores (21). We therefore evaluated the prognostic association between admission NEWS2 categories and in-hospital mortality among adults with sepsis treated in a general emergency department in Manaus, Amazonas.

Methods

Study design and setting

This retrospective observational cohort study was conducted in the emergency department of Hospital Adventista de Manaus, a private general hospital located in Manaus, Amazonas, in the Brazilian Amazon (Fig. 1).

The hospital provides emergency care for adult patients and implemented the National Early Warning Score 2 (NEWS2) as part of its institutional clinical care protocol in December 2021. NEWS2 was integrated into the SOU MV electronic medical record system, enabling automatic calculation of the score from physiological parameters recorded during routine clinical assessment. The study included eligible patients admitted between January 2, 2022, and July 8, 2024. The study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (22).

Participants and eligibility

The source population comprised adults aged 18 years or older presenting to the emergency department with physician-confirmed sepsis and an indication for hospital admission. Sepsis was identified according to the institutional protocol in use during the study period, based on suspected infection and at least two systemic inflammatory response syndrome (SIRS) criteria, supported by clinical assessment and laboratory findings (23). This operational definition reflects the institutional protocol used for case ascertainment and differs from the contemporary Sepsis-3 definition (1).

Eligible patients were required to have a NEWS2 assessment documented during the initial emergency department evaluation. Patients presenting with septic shock were excluded. The final analytical cohort comprised 246 patients, all with documented NEWS2 categories and hospital outcomes. The numbers of patients initially screened and excluded could not be reliably reconstructed from the available records.

NEWS2 measurement and data collection

NEWS2 was incorporated into the emergency service's care routine via the hospital's institutional standard operating procedure (SOP) in January 2022, marking the start of retrospective data collection. During the initial clinical assessment, physiological parameters were entered into the SOU MV electronic medical record system, which automatically calculated the NEWS2 score.

According to the institutional SOP, NEWS2 assessment was mandatory before the initiation of antibiotic therapy, intravenous fluid administration, or supplemental oxygen therapy. The resulting score was used to guide subsequent clinical management, including the level of monitoring, clinical reassessment, and escalation of care according to the institutional protocol.

For this retrospective study, the NEWS2 category recorded during the initial emergency department assessment was extracted from the electronic medical record. All included patients had a documented NEWS2 assessment.

Data were retrospectively extracted from the SOU MV system by a trained research team using predefined variables and outcomes. Patients were followed through the electronic record from emergency department admission until hospital discharge or in-hospital death.

Variables and outcomes

The primary outcome was all-cause in-hospital mortality.

Secondary descriptive variables included age, sex, comorbidities, suspected infection focus, clinical deterioration documented at admission, urgent medical assessment, ICU admission after initial hospitalization, and hospital length of stay. Comorbidity status was defined as a binary variable indicating the presence of at least one documented comorbidity (yes vs. no), regardless of the number or severity of coexisting conditions.

Clinical deterioration at admission was identified from clinical worsening documented in the electronic record. Recorded manifestations included oxygen desaturation, hypotension, respiratory distress, fever, tachycardia, and other respiratory or hemodynamic abnormalities.

The original data-collection instrument did not specify a single prospective physiological threshold or composite rule for this variable; it was therefore treated as a documented clinical-record variable rather than an independently adjudicated outcome.

For the original analysis, NEWS2 was categorized into four groups: 0–2 (n = 42), 3–4 (n = 111), 5–6 (n = 60), and ≥ 7 (n = 33). These categories were those recorded in the historical study database and were retained to preserve consistency with the original analysis. They should not be interpreted as replacements for the clinical response thresholds recommended by the Royal College of Physicians (10).

Bias

Several strategies were used to reduce potential bias. Predefined eligibility criteria were applied to the available retrospective records. Although the study sought to include consecutive eligible patients, the absence of a complete screening log prevented independent verification of the total number of potentially eligible patients and assessment of the magnitude of selection bias. Information and measurement bias were reduced through use of a standardized electronic medical record, predefined study variables, trained data extractors, and automatic NEWS2 generation from routinely recorded physiological parameters. To limit temporal bias, the NEWS2 value considered for analysis was the admission score documented before critical escalation of care. Hospital outcome was available for all participants. Residual bias related to retrospective data quality, unmeasured confounding, and the single-center design could not be eliminated.

Study size

The original protocol estimated approximately 180 eligible patients per year and specified alpha = 0.05, beta = 0.20, 80% power, and an anticipated 20% loss, yielding a target of 111 participants per year. All consecutive eligible patients were included during the study period, resulting in 246 participants.

Missing data

Age, sex, confirmed sepsis diagnosis, NEWS2 category, clinical deterioration at admission, comorbidity status, ICU admission, and final hospital outcome were complete for all 246 participants. Information on NEWS2-linked clinical action was available for 243 participants, and urgent medical assessment was available for 244. Missing data were handled using an available-case approach: participants with missing information for a specific variable were excluded only from analyses involving that variable and remained eligible for all other analyses. No data imputation was performed.

Statistical analysis

Continuous variables were summarized using mean and standard deviation and, where informative, median and range. Categorical variables were summarized as counts and percentages. Associations between NEWS2 category and categorical outcomes were evaluated using Pearson's chi-square test or Fisher's exact test as appropriate.

The association between NEWS2 category and in-hospital mortality was evaluated using unadjusted binary logistic regression. Odds ratios (ORs) with 95% confidence intervals (CIs) are reported. The lowest NEWS2 category was used as the reference group in the regression model. A separate crude pairwise comparison between NEWS2 ≥ 7 and NEWS2 3–4 was retained because it was a prespecified comparison in the original analysis.

A multivariable logistic regression model was fitted to investigate the association between NEWS2 categories at admission and in-hospital mortality, adjusting for age (per 10-year increase) and the

presence of comorbidities. Adjusted odds ratios (aORs) and their corresponding 95% confidence intervals (CIs) were estimated. The lowest NEWS2 category (≤ 2) was used as the reference group. Given the limited number of deaths, a parsimonious model was specified to reduce the risk of overfitting.

Kaplan-Meier methods were used to compare survival experience across NEWS2 categories, and the log-rank test was used for the primary comparison of survival curves. No formal subgroup or interaction analyses were performed. No sensitivity analyses were performed. Analyses were conducted in Stata version 14 (StataCorp, College Station, TX, USA), using a two-sided significance level of 0.05.

Ethics approval

The study was approved by the Research Ethics Committee of the Federal University of Amazonas (CEP-UFAM; CAAE 77115023.40000.5020). Given the retrospective medical-record design, the requirement for individual informed consent was waived by the Research Ethics Committee. All data were handled confidentially and analyzed without disclosure of participant-identifying information.

Results

Participant characteristics

The analytical cohort included 246 adults with sepsis (Figure 2; Table 1). Mean age was 63.75 years (SD 21.37), median age was 68 years, and the age range was 19-101 years. Women comprised 138 participants (56.1%), and 185 (75.2%) had at least one comorbidity. The most frequent comorbidities were hypertension (42.7%), diabetes mellitus (28.5%), oncologic disease (13.8%), cardiovascular disease (8.5%), chronic obstructive pulmonary disease (7.7%), and renal insufficiency (7.7%).

Pulmonary infection was the most frequently recorded focus (41.1%), followed by urinary (32.1%) and abdominal (17.5%) foci.

Hospital outcome was available for all 246 participants: 204 (82.9%) were discharged alive and 42 (17.1%) died in hospital. Time from admission to death was recorded for 40 of the 42 patients who died, with a median of 15 days (range, 1–109 days). Fourteen patients (5.7%) required ICU admission after initial hospitalization.

Table 1. General characteristics of the study population (N = 246)

Variable	Result
Mean age	63.75 ± 21.37 years
Median age	68 years
Female sex	138 (56.1%)
Male sex	108 (43.9%)
Presence of comorbidities	185 (75.2%)
Clinical deterioration at admission	220 (89.4%)
Hospital discharge alive	204 (82.9%)
In-hospital death	42 (17.1%)
Need for ICU after admission	14 (5.7%)
Time from admission to death, days, median (IQR; range)	15 (7–31; 1–109)

Notes. Values are presented as n (%) unless otherwise specified. Age is presented as mean ± standard deviation (SD) and median. Time from admission to death is presented as median (interquartile range [IQR]; minimum–maximum) and refers only to patients who died during hospitalization. NEWS2, National Early Warning Score 2; ICU, intensive care unit.

NEWS2, clinical deterioration, and urgent assessment

NEWS2 scores of 0–2 were recorded in 42 patients (17.1%), scores of 3–4 in 111 (45.1%), scores of 5–6 in 60 (24.4%), and scores ≥7 in 33 (13.4%). Clinical deterioration at admission was documented in 220 patients (89.4%). The most frequent recorded manifestations were oxygen desaturation (34.5%), hypotension (33.6%), respiratory distress (31.8%), fever (22.7%), and tachycardia (18.2%).

Urgent medical assessment was documented for 226 of 244 patients with available information (92.6%). Information on NEWS2-linked clinical actions was available for 243 patients; because these fields represented recorded care responses rather than independently adjudicated outcomes, they were not used to infer treatment effectiveness.

NEWS2 and in-hospital mortality

Hospital mortality differed significantly across NEWS2 categories ($p<0.001$) (Table 2). Mortality was 3/42 (7.1%) in the lowest-score category, 5/111 (4.5%) in the 3-4 category, 22/60 (36.7%) in the 5-6 category, and 12/33 (36.4%) in the ≥7 category.

Table 2. Hospital outcome according to NEWS2 category

NEWS 2 category	Discharged alive	In-hospital death	Crude OR vs. 0–2	Total
0-2	39 (92.9%)	3 (7.1%)	1.00	42
3-4	106 (95.5%)	5 (4.5%)	0.61	111
5-6	38 (63.3%)	22 (36.7%)	7.53	60
≥7	21 (63.6%)	12 (36.4%)	7.43	33
Total	204 (82.9%)	42 (17.1%)	-	246

Notes. Values are presented as n (row percentage), except in the Total row, in which percentages refer to the overall study population. Percentages within each NEWS2 category were calculated using the total number of patients in that category as the denominator. NEWS2, National Early Warning Score 2.

In unadjusted logistic regression using the lowest-score category as reference, NEWS2 3-4 was not associated with higher mortality (OR 0.61, 95% CI 0.14-2.69) (Table 3). In contrast, NEWS2 5-6 was associated with substantially higher odds of death (OR 7.53, 95% CI 2.08-27.24), as was NEWS2 ≥7 (OR 7.43, 95% CI 1.88-29.29). In the separate crude pairwise comparison, NEWS2 ≥7 was associated with 12.11-fold higher odds of death than NEWS2 3-4 (95% CI 3.86-38.01).

In the multivariable logistic regression analysis, admission NEWS2 categories of 5–6 and ≥7 remained associated with higher odds of in-hospital mortality after adjustment for age and comorbidity status (Table 3). Compared with patients in the NEWS2 0–2 category, those with NEWS2 5–6 had higher odds of in-hospital death (aOR 6.04, 95% CI 1.63–22.41; p=0.007), as did those with NEWS2 ≥7 (aOR 6.90, 95% CI 1.72–27.71; p=0.006). The presence of at least one comorbidity was also associated with higher odds of mortality (aOR 6.05, 95% CI 1.34–27.23; p=0.019). Age, expressed per 10-year increase, was not significantly associated with in-hospital mortality after adjustment (aOR 1.038, 95% CI 0.974–1.107; p=0.248).

Table 3. Unadjusted and multivariable-adjusted associations of NEWS2 categories, age, and comorbidity status with in-hospital mortality among adults with sepsis (N = 246)

Predictor	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
NEWS2 category				
0–2	1.00 (reference)	-	1.00 (reference)	-
3–4	0.61 (0.14–2.69)	0.517	0.51 (0.11–2.33)	0.387
5–6	7.53 (2.08–27.24)	0.002	6.04 (1.63–22.41)	0.007
≥7	7.43 (1.88–29.29)	0.004	6.90 (1.72–27.71)	0.006
Age (per 10-year increase)	1.036 (0.975–1.100)	0.257	1.038 (0.974–1.107)	0.248
Presence of comorbidities (yes vs. no)	8.14 (1.91–34.76)	0.005	6.05 (1.34–27.23)	0.019

Notes. OR, odds ratio; aOR, adjusted odds ratio; CI, confidence interval; NEWS2, National Early Warning Score 2. The outcome was all-cause in-hospital mortality (42 deaths among 246 patients). NEWS2 0–2 was the reference category. Unadjusted ORs were estimated using separate binary logistic regression models. The multivariable logistic regression model included NEWS2 category, age (per 10-year increase), and presence of comorbidities (yes vs. no).

Survival analysis

Survival differed across NEWS2 categories (log-rank chi-square=37.3, df=3, p<0.001). The highest NEWS2 category showed the least favorable survival pattern, whereas the lowest-score category showed the most favorable pattern. These survival findings were directionally consistent with the mortality proportions and unadjusted logistic regression.

Discussion

In this retrospective cohort of adults with sepsis admitted to an emergency department in Manaus, in-hospital mortality was higher among patients with admission NEWS2 scores of 5–6 and ≥ 7. The associations remained after adjustment for age and comorbidities, although the wide confidence intervals indicate limited precision. These results suggest that NEWS2 may contribute to the identification of patients at higher risk of in-hospital death. However, our study did not assess whether NEWS2-guided clinical decisions improve patient outcomes. Patients with at least one documented comorbidity had higher odds of in-hospital death in the adjusted analysis. However, comorbidities were recorded only as present or absent, preventing an assessment of whether mortality differed according to the number or severity of coexisting conditions. A systematic review of 20 studies reported an association between NEWS/NEWS2 implementation and lower in-hospital mortality, but the certainty of the evidence was low because of methodological limitations and risk of bias (24).

An important contribution of this study is the investigation of the association between routinely documented NEWS2 categories and in-hospital mortality among adults with sepsis in an emergency department in the Brazilian Amazon, a region that remains underrepresented in the literature on early warning scores. Unlike studies in which NEWS2 is calculated retrospectively for research purposes, NEWS2 was already integrated into routine clinical care at our institution through an electronic medical record system and a standardized clinical protocol. The institutional procedure required NEWS2 assessment before the initiation of antibiotic therapy, intravenous fluid administration, or supplemental oxygen therapy, and the score informed subsequent clinical management. This context strengthens the clinical relevance of the observed associations under routine care conditions. However, the observational design does not allow conclusions about the effectiveness of NEWS2 implementation or the causal impact of NEWS2-guided interventions on patient outcomes.

Previous studies have examined NEWS2 in patients with suspected or confirmed sepsis. Mellhammar et al. found that NEWS2 performed better than qSOFA in identifying sepsis with organ dysfunction in the emergency department (12). Moreno-Torres et al. assessed NEWS2 alongside other severity scores in patients with sepsis (13), while Sivayoham et al. compared several risk-stratification tools in patients with suspected sepsis (14). Hsieh et al. investigated NEWS2 in emergency department sepsis management (15). Differences in study populations, outcomes, and assessment methods limit direct comparisons with our findings, particularly the adjusted associations with in-hospital mortality.

Few Brazilian studies have evaluated NEWS2 in patients with sepsis in emergency departments. Sousa et al. conducted a prospective study involving 295 adults in a public hospital in southern Brazil (20). NEWS2 showed an AUC of 0.770 for in-hospital mortality when measured at the last assessment before transfer, whereas the AUC at initial risk classification was 0.703 for clinical deterioration. These estimates refer to different outcomes and assessment times and should not be directly compared. Our study was conducted in a private hospital in the Brazilian Amazon and used NEWS2 scores automatically generated from vital signs recorded at admission. Although automated calculation may reduce scoring errors, it does not prevent errors in the measurement or recording of physiological variables. Differences in patient populations, timing of assessment, and methods of score calculation should be considered when interpreting the findings of both studies.

Our results should also be interpreted in light of the way sepsis was identified. The institutional protocol used a suspected infectious focus plus at least two SIRS criteria. Contemporary international definitions instead conceptualize sepsis as infection-associated organ dysfunction (1). The study therefore reflects real-world case ascertainment under the local protocol rather than a Sepsis-3-defined cohort. This may have broadened the included population and limits direct comparison with studies using SOFA-based definitions. However, SIRS-based criteria have also been used for patient identification in studies evaluating sepsis-related diagnostic and prognostic scores in low- and middle-income countries (25, 26). A prospective study from India using the same inclusion criteria found that NEWS2 discriminated in-hospital mortality better than qSOFA (AUC 0.781 vs 0.729), supporting the prognostic value of NEWS2 in populations identified this way (26).

The very high frequency of documented clinical deterioration at admission (89.4%) also requires cautious interpretation. This variable was recorded from the clinical chart and was not defined by a prospectively standardized composite threshold. It should therefore be viewed as a descriptive marker of clinical instability rather than a validated endpoint. Moreover, because NEWS2 and clinical deterioration were both assessed at or around admission, these data do not establish temporal 'early detection' of subsequent deterioration. This is a central reason for framing the present analysis around prognostic value rather than effectiveness.

In a multicenter study, Rhee et al. examined NEWS2 as a tool for stratifying the urgency of antibiotic treatment among patients with suspected sepsis (17). Delays in antibiotic administration were associated with increased mortality in patients classified as high risk by NEWS2, including some without septic shock. Although that study addressed a different clinical question, it illustrates the potential relevance of NEWS2 for identifying patients who may require prompt clinical assessment. The interpretation of NEWS2 should therefore consider the population, the timing of measurement, and the outcome of interest (17, 27).

Strengths and limitations

This study has several strengths. It was conducted under routine emergency care conditions in a hospital located in the Brazilian Amazon, providing evidence from a relatively underrepresented clinical setting. NEWS2 had been incorporated into the institutional clinical workflow before the study period and was automatically calculated through the electronic medical record system. Furthermore, NEWS2 categories and hospital outcomes were available for all 246 included patients, reducing the likelihood of missing-data bias for these variables.

Several limitations should be acknowledged. First, the retrospective, single-center design limits causal inference and generalizability, particularly to public hospitals and institutions with different patient populations, resources, and clinical protocols. Second, participants were identified using the institutional sepsis protocol in effect during the study period, which required suspected infection and at least two systemic inflammatory response syndrome (SIRS) criteria, together with physician confirmation. Consequently, the cohort was not defined according to Sepsis-3 criteria, and infection-associated organ dysfunction could not be retrospectively confirmed in every participant. This may have introduced heterogeneity in disease severity and limits comparability with cohorts defined using contemporary sepsis criteria. Third, patients presenting septic shock were excluded, restricting the applicability of the findings to the full spectrum of sepsis severity. Fourth, the relatively small number of in-hospital deaths (n = 42) limited the precision of the regression estimates, as reflected by the wide confidence intervals, and increased the potential for model instability. Comorbidity status was recorded only as a binary variable, without accounting for the number or severity of coexisting conditions, and residual confounding cannot be excluded. Finally, although NEWS2 categories were associated with in-hospital mortality, formal measures of discrimination and calibration were not assessed. Therefore, the findings

should not be interpreted as establishing the predictive accuracy, clinical utility, or effectiveness of NEWS2-guided interventions.

Conclusions

In this retrospective cohort of adults with physician-confirmed sepsis admitted through an emergency department in the Brazilian Amazon, higher NEWS2 categories recorded during the initial clinical assessment were associated with increased odds of in-hospital mortality, after adjustment for age and comorbidity status. NEWS2 was routinely incorporated into the institutional clinical workflow and automatically calculated through the electronic medical record system. These findings support the prognostic relevance of routinely documented NEWS2 categories in this setting. Further multicenter studies are needed to evaluate predictive performance, clinical utility, and generalizability across different healthcare settings and sepsis populations.

Abbreviations

CI: confidence interval; ED: emergency department; ICU: intensive care unit; NEWS2: National Early Warning Score 2; OR: odds ratio; RCP: Royal College of Physicians; SIRS: systemic inflammatory response syndrome; STROBE: Strengthening the Reporting of Observational Studies in Epidemiology.

Declarations

Ethics approval and consent to participate

The study was approved by the Research Ethics Committee of the Federal University of Amazonas (CEP-UFAM; CAAE 77115023.40000.5020) and was conducted in accordance with the principles of the Declaration of Helsinki and Brazilian National Health Council Resolution No. 466/2012. Because this was a retrospective study based exclusively on the review of electronic medical records, the requirement for individual informed consent was waived by the Research Ethics Committee. Participant confidentiality and anonymity were preserved throughout data collection, analysis, and reporting.

Consent for publication

Not applicable.

Availability of data and materials

The dataset analysed during the current study is not publicly available because it contains clinical information derived from institutional medical records, but de-identified data may be available from the corresponding author on reasonable request and subject to ethics and institutional approval.

Competing interests

The authors declare that they have no competing interests.

Funding

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001. The article processing charges were funded by the Faculty of Medical Sciences (FCM), National Autonomous University of Honduras (UNAH) (budget code 2-03-01-01; award to Dr. LIZ). The funders had no role in the design of the study, data collection, analysis, interpretation of data, or writing of the manuscript.

Authors' contributions

ÉCC and KFLD contributed to the investigation, data collection, data curation, formal analysis, and methodology, and wrote the original draft. LSN, ASM, and AMAT contributed to data collection and data curation. DATM contributed to the expansion of the background, methods, and discussion, preparation of the flow diagram, and drafting of the manuscript. LIZ contributed to the investigation, data curation, formal analysis, and methodology. RLG conceptualized and supervised the study, acquired funding, administered the project, contributed to data curation, formal analysis, and methodology, and reviewed and edited the manuscript. All authors read and approved the final manuscript.

Acknowledgements

The authors gratefully acknowledge the Universidade Federal do Amazonas (UFAM) and the Graduate Program in Health Sciences (Programa de Pós-Graduação em Ciências da Saúde – PPGCIS) for their academic and institutional support. We also thank Hospital Adventista de Manaus, Manaus, Amazonas, Brazil, and its Teaching and Research Management team for their support and collaboration throughout the study. We extend our sincere appreciation to Dr. Luiz Rocha, whose institutional support and encouragement were important to the development of this research. We are especially grateful to the patients whose clinical data made this study possible, and to all healthcare professionals, researchers, and collaboratorswho contributed directly or indirectly to the conduct of the study.

References

1. Singer M, Deutschman CS, Seymour CW, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA. 2016;315(8):801–10. 10.1001/jama.2016.0287.
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):200–11. https://doi.org/10.1016/S0140-6736(19)32989-7.
3. Adhikari NKJ, Fowler RA, Bhagwanjee S, Rubenfeld GD. Critical care and the global burden of critical illness in adults. Lancet. 2010;376(9749):1339–46. https://doi.org/10.1016/S0140-6736(10)60446-1.

4. Fleischmann-Struzek C, Mellhammar L, Rose N, Cassini A, Rudd KE, Schlattmann P, et al. Incidence and mortality of hospital- and ICU-treated sepsis: results from an updated and expanded systematic review and meta-analysis. Intensive Care Med. 2020;46(8):1552–62. https://doi.org/10.1007/s00134-020-06151-x.
5. Almeida NRC, Pontes GF, Jacob FL, Deprá JVS, Porto JPP, Lima FR, et al. Analysis of trends in sepsis mortality in Brazil and by regions from 2010 to 2019. Rev Saude Publica. 2022;56:25. https://doi.org/10.11606/s1518-8787.2022056003789.
6. Machado FR, Cavalcanti AB, Bozza FA, Ferreira EM, Angotti Carrara FS, Sousa JL, et al. The epidemiology of sepsis in Brazilian intensive care units (the Sepsis PREvalence Assessment Database, SPREAD): an observational study. Lancet Infect Dis. 2017;17(11):1180–9. https://doi.org/10.1016/S1473-3099(17)30322-5.
7. Conde KAP, Silva E, Silva CO, Ferreira E, Freitas FGR, Castro I, et al. Differences in sepsis treatment and outcomes between public and private hospitals in Brazil: a multicenter observational study. PLoS ONE. 2013;8(6). https://doi.org/10.1371/journal.pone.0064790.
8. Gerry S, Bonnici T, Birks J, Kirtley S, Virdee PS, Watkinson PJ, et al. Early warning scores for detecting deterioration in adult hospital patients: systematic review and critical appraisal of methodology. BMJ. 2020;369. https://doi.org/10.1136/bmj.m1501.
9. Smith GB, Prytherch DR, Meredith P, Schmidt PE, Featherstone PI. The ability of the National Early Warning Score (NEWS) to discriminate patients at risk of early cardiac arrest, unanticipated intensive care unit admission, and death. Resuscitation. 2013;84(4):465–70. https://doi.org/10.1016/j.resuscitation.2012.12.016.
10. Royal College of Physicians. National Early Warning Score (NEWS) 2: Standardising the assessment of acute-illness severity in the NHS. Updated report of a working party. London: Royal College of Physicians. 2017. Available from: https://rcp.ac.uk/resources/national-early-warning-score-news-2/
11. Oliveira APA, Urbanetto JS, Caregnato RCA. National Early Warning Score 2: transcultural adaptation to Brazilian Portuguese. Rev Gaucha Enferm. 2020;41. https://doi.org/10.1590/1983-1447.2020.20190424.
12. Mellhammar L, Linder A, Tverring J, Christensson B, Boyd JH, Sendi P, et al. NEWS2 is superior to qSOFA in detecting sepsis with organ dysfunction in the emergency department. J Clin Med. 2019;8(8):1128. https://doi.org/10.3390/jcm8081128.
13. Moreno-Torres V, Royuela A, Múñez E, Ortega A, Gutierrez Á, Mills P, et al. Mejor capacidad pronóstica de NEWS2, SOFA y SAPS-II en pacientes con sepsis. Med Clin (Barc). 2022;159(5):224–9. https://doi.org/10.1016/j.medcli.2021.10.021.
14. Sivayoham N, Hussain AN, Shabbo L, Christie D. An observational cohort study of the performance of the REDS score compared to the SIRS criteria, NEWS2, CURB65, SOFA, MEDS and PIRO scores to risk-stratify emergency department suspected sepsis. Ann Med. 2021;53(1):1863–74. https://doi.org/10.1080/07853890.2021.1992495.

15. Hsieh MS, Chiu KC, Chattopadhyay A, Lu TP, Liao SH, Chang CM, et al. Utilizing the National Early Warning Score 2 (NEWS2) to confirm the impact of emergency department management in sepsis patients: a cohort study from taiwan 1998–2020. Int J Emerg Med. 2024;17(1):42. https://doi.org/10.1186/s12245-024-00614-4.
16. Wang C, Xu R, Zeng Y, Zhao Y, Hu X. A comparison of qSOFA, SIRS and NEWS in predicting the accuracy of mortality in patients with suspected sepsis: a meta-analysis. PLoS ONE. 2022;17(4). https://doi.org/10.1371/journal.pone.0266755.
17. Rhee C, Singer M, Pak TR, McKenna CS, Agan A, DelloStritto L, et al. NEWS2 versus shock status to stratify antibiotic urgency in patients with suspected sepsis: a retrospective, multicentre cohort study. Lancet Respir Med. 2026;14(10):849–58. https://doi.org/10.1016/S2213-2600(26)00187-6.
18. Tomás E, Ulica E, Alves C, Pascoal C, Jeremias A, Escoval A, et al. Effectiveness of early warning scores in predicting in-hospital mortality and adverse events in adult general-ward patients in low- and middle-income countries: a systematic review. Afr J Emerg Med. 2026;16(1):100943. https://doi.org/10.1016/j.afjem.2026.100943.
19. Tran TH, Nguyen HTT, Tran TH. Accuracy of prognostic scoring tools for ICU triage and mortality among patients in low- and middle-income countries: a systematic review and meta-analysis. BMJ Open Respir Res. 2026;13(1). https://doi.org/10.1136/bmjresp-2026-004244.
20. Sousa AS, Soares GR, Costa JP, Rocha CR, Azzolin KO, Urbanetto JS, et al. Predictive performance of the National Early Warning Score 2- Brazilian Version for septic patients. Rev Gaucha Enferm. 2025;46. https://doi.org/10.1590/1983-1447.2025.20240233.en.
21. Prytherch DR, Smith GB, Schmidt P, Featherstone PI, Stewart K, Knight D, et al. Calculating early warning scores–a classroom comparison of pen and paper and hand-held computer methods. Resuscitation. 2006;70(2):173–8. https://doi.org/10.1016/j.resuscitation.2005.12.002.
22. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol. 2008;61(4):344–9. https://doi.org/10.1016/j.jclinepi.2007.11.008.
23. Bone RC, Balk RA, Cerra FB, Dellinger RP, Fein AM, Knaus WA et al. Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. The ACCP/SCCM Consensus Conference Committee. American College of Chest Physicians/Society of Critical Care Medicine. Chest. 1992;101(6):1644–1655. https://doi.org/10.1378/chest.101.6.1644
24. Scott LJ, Jackson J, Dawson S, Knight T, Savović J. Does the use of National Early Warning Scores (NEWS or NEWS2) in healthcare settings improve patient outcomes: a systematic review. Syst Rev. 2026;15(1):73. https://doi.org/10.1186/s13643-026-03088-y.
25. Adegbite BR, Edoa JR, Ndzebe Ndoumba WF, Dimessa Mbadinga LB, Mombo-Ngoma G, Jacob ST, et al. A comparison of different scores for diagnosis and mortality prediction of adults with sepsis in Low-and-Middle-Income Countries: a systematic review and meta-analysis. EClinicalMedicine. 2021;42:101184. https://doi.org/10.1016/j.eclinm.2021.101184.

26. Verma A, Farooq A, Jaiswal S, Haldar M, Sheikh WR, Khanna P, et al. National Early Warning Score 2 is superior to quick Sequential Organ Failure Assessment in predicting mortality in sepsis patients presenting to the emergency department in India: a prospective observational study. Int J Crit Illn Inj Sci. 2023;13(1):26–31. https://doi.org/10.4103/ijciis.ijciis_41_22.
27. Permpatdechakul S, Tangsuwanaruk T, Wittayachamnankul B, Laohakul P, Changratanakorn C, Chenthanakij B. Limitations of NEWS2 for predicting 48-hour emergency department revisits: a real-world retrospective cohort study. Int J Emerg Med. 2026. https://doi.org/10.1186/s12245-026-01325-8.

Figures



Figure 1

Location of the study site. (A) Brazil, with the state of Amazonas highlighted. (B) State of Amazonas, showing the location of Manaus. (C) City of Manaus, showing the location of Hospital Adventista de Manaus, where the study was conducted. The figure was prepared by the authors using AI-assisted cartographic design, based on geographic data from the Brazilian Institute of Geography and Statistics (IBGE).

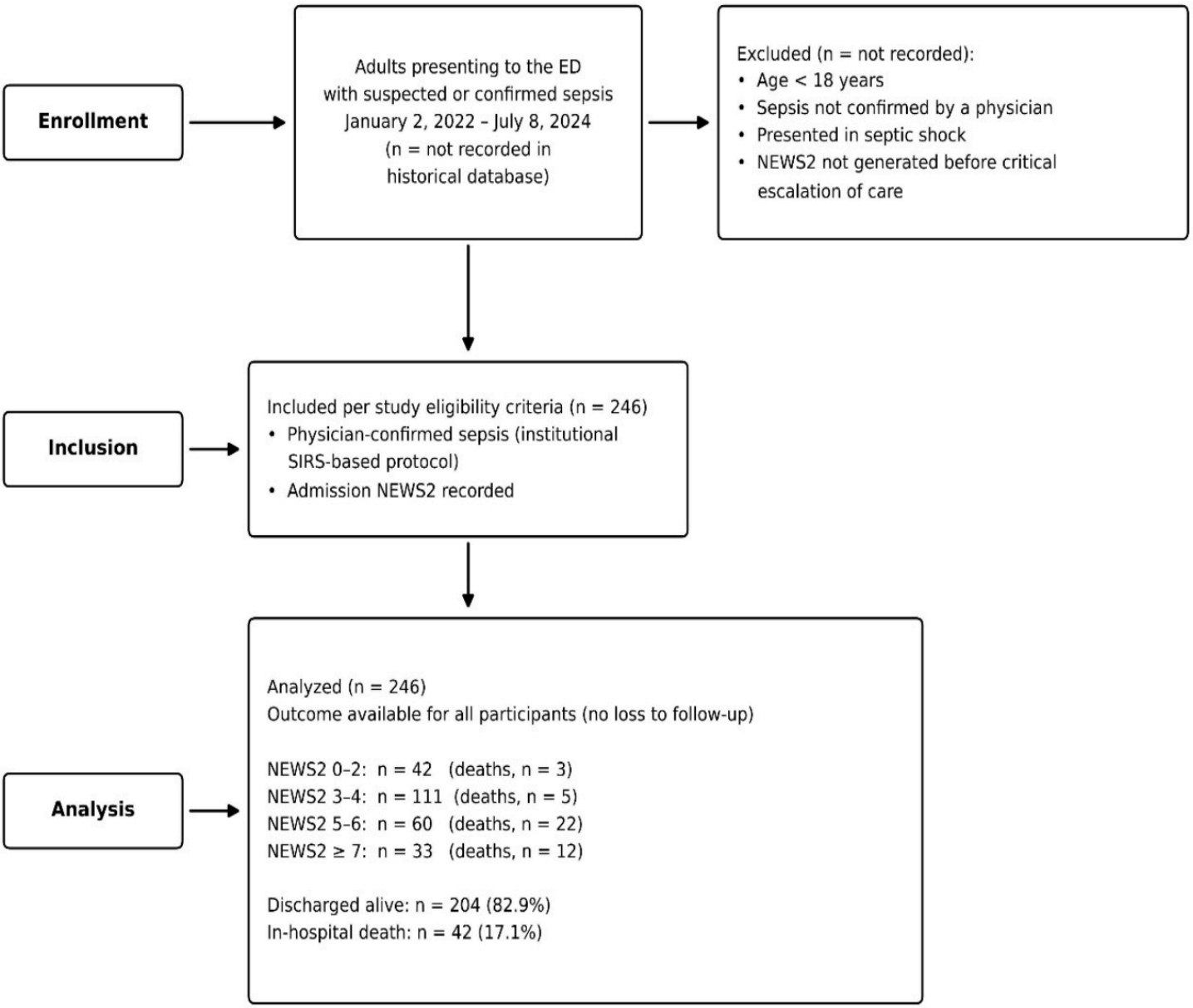


Figure 2

Flow diagram of participant selection and hospital outcomes