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Original Research Article

A Comparison of Accuracy of Various Scoring Systems- Sofa, Qsofa, News, Mews in Predicting Outcomes of Septic Patients in General Surgery

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Abstract:

Background: Sepsis is a life-threatening condition associated with significant morbidity and mortality, particularly among surgical patients who frequently require urgent source control. Early recognition and accurate risk stratification are essential for timely escalation of treatment. Several scoring systems, including Sequential Organ Failure Assessment (SOFA), quick SOFA (qSOFA), National Early Warning Score (NEWS), and Modified Early Warning Score (MEWS), are used to assess disease severity and predict adverse outcomes. However, their comparative performance in surgical sepsis remains variable.

Aim: To compare the accuracy and effectiveness of SOFA, qSOFA, NEWS, and MEWS in predicting outcomes among septic patients admitted under General Surgery.

Materials and Methods: A hospital-based prospective study was conducted from June 2024 to November 2025 at Narayana Medical College and Hospital, Nellore. The study included 50 adult surgical patients diagnosed with or suspected of having sepsis and admitted to the surgical wards or intensive care unit. Demographic, clinical, and surgical data were collected, and SOFA, qSOFA, NEWS, and MEWS scores were assessed. Patients were followed during hospitalisation for clinical progression and mortality. Categorical variables were analysed using appropriate statistical tests, and a p value <0.05 was considered statistically significant.

Results: The study population was predominantly male (70%). The overall in-hospital mortality was 12% (6/50). Mortality was significantly higher among patients with elevated severity scores. Patients with SOFA ≥ 8 had a mortality of 33.3% compared with 2.9% among those with SOFA <8. Similarly, qSOFA ≥ 2 was associated with 28.6% mortality compared with 5.6% in patients with qSOFA <2. Mortality among patients with MEWS ≥ 5 was 30.8% compared with 5.4% in those with MEWS <5. NEWS ≥ 6 was associated with 33.3% mortality compared with 2.9% among patients with NEWS <6. Thus, SOFA and NEWS demonstrated the most pronounced separation between high- and low-risk groups. The highest age-specific mortality was observed in the 51–60-year group (25%).

Conclusion: Higher SOFA, qSOFA, NEWS, and MEWS scores were associated with increased in-hospital mortality among surgical patients with sepsis. SOFA demonstrated a particularly strong mortality gradient and remains a useful tool for assessing organ dysfunction and severity. NEWS also showed strong prognostic potential and may be valuable for early ward-based recognition and monitoring of clinical deterioration. Integration of these scoring systems into routine surgical practice can facilitate early risk stratification, timely escalation of care, and improved decision-making in patients with surgical sepsis.

Keywords: Surgical sepsis; SOFA score; qSOFA score; NEWS and MEWS.

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Introduction

Sepsis remains one of the most challenging and life-threatening conditions encountered in surgical practice. It is currently defined according to the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) Task Force as a life-threatening organ dysfunction caused by a dysregulated host response to infection. Despite advances in antimicrobial therapy, intensive care monitoring, and organ support systems, sepsis continues to be associated with significant morbidity and mortality, particularly among surgical patients. Surgical sepsis differs from medical sepsis in that it frequently involves a definable source requiring operative intervention, such as perforation peritoni-

tis, necrotizing soft tissue infections, anastomotic leaks, or intra-abdominal abscesses. Early recognition, prompt resuscitation, appropriate antibiotic therapy, and timely source control are critical determinants of outcome. Delays in diagnosis or risk stratification can significantly worsen prognosis.

Over the past three decades, multiple clinical scoring systems have been developed to facilitate early identification of sepsis, quantify organ dysfunction, and predict outcomes. Among the most widely used are: Sequential Organ Failure Assessment (SOFA), Quick Sequential Organ Failure Assessment (qSOFA), National Early Warning Score (NEWS), Modified Early Warning Score (MEWS).

The SOFA score evaluates the degree of dysfunction across six organ systems and is considered the gold standard for assessing sepsis-related organ failure. However, it requires laboratory parameters and may not always be feasible in resource-limited or ward settings.

To overcome these limitations, the qSOFA score was introduced as a simplified bedside tool for rapid identification of high-risk patients outside the ICU. Similarly, NEWS and MEWS were developed as early warning systems based primarily on physiological parameters, enabling rapid triage and monitoring. Although these scoring systems are widely used, their predictive accuracy in surgical septic patients remains variable. Surgical patients often have distinct physiological stress responses, postoperative changes, and unique infection patterns that may influence score performance.

Therefore, this study aims to compare the accuracy of SOFA, qSOFA, NEWS, and MEWS in predicting mortality among septic patients admitted under general surgery, thereby identifying the most reliable and clinically practical scoring system for surgical settings.

Aim: The aim of the study is to compare the accuracy and effectiveness of different scoring systems—SOFA, qSOFA, NEWS, and MEWS in evaluation and prediction of outcome in septic patients admitted in general surgery. Objectives: To study patients in General Surgery wards and ICU who develops sepsis by applying SOFA, qSOFA, MEWS, and NEWS scores to all these patients and stratify them, follow up them during their hospital stay to assess improvement, progression, and mortality. Finally correlate the predictive values of SOFA, qSOFA, MEWS, and NEWS with the final outcomes of the patients.

Materials and Methods

This was a Hospital based prospective study done from June 2024 to November 2025 in 40 Patients admitted in general surgery ward and ICU with sepsis in Narayana Medical College and Hospital, Nellore.

Inclusion criteria: Adult surgical patients (age ≥ 18 years) diagnosed with sepsis or suspected sepsis based on clinical criteria.

Exclusion criteria: Patients with non-surgical sources of sepsis (e.g., pneumonia, urinary tract infection) unless surgical intervention was subsequently required, Patients with pre-existing chronic conditions (e.g., end-stage renal disease, congestive heart failure, chronic lung disease, immunocompromised, end stage cancer) that could confound the assessment of sepsis severity.

Data collection: Gathering information on patient demographics, medical history, surgical details, and post-operative outcomes such as mortality or progression of sepsis.

Statistical analysis: Analyzing collected data to comparing the performance of different scoring systems, this may include chi-square test, t-tests

Results

Table 1: Age and Gender Group Distribution and Mortality

Age Group (years)	Total Patients (n)	Deaths (n)	Mortality %
18–40	10	0	0
41–50	11	1	9.1
51–60	16	4	25.0
>60	13	1	7.7
Male	35	6	17.1
Female	15	0	0

Table 2: Score Distribution and Mortality

SOFA Score Category	Total Patients (n)	Deaths (n)	Mortality %
≥8	15	5	33.3
<8	35	1	2.9
qSOFA Category	**Total Patients (n)**	**Deaths (n)**	**Mortality %**
≥2	14	4	28.6
<2	36	2	5.6
MEWS Category	**Total Patients (n)**	**Deaths (n)**	**Mortality %**

≥5	13	4	30.8
<5	37	2	5.4
NEWS Category	**Total Patients (n)**	**Deaths (n)**	**Mortality %**
≥6	15	5	33.3
<6	35	1	2.9

Discussion

Sepsis remains one of the leading causes of morbidity and mortality worldwide despite major advances in antimicrobial therapy, organ support technologies, and intensive care monitoring. The Third International Consensus Definitions (Sepsis-3) redefined sepsis as life-threatening organ dysfunction caused by a dysregulated host response to infection and recommended the Sequential Organ Failure Assessment (SOFA) score to quantify organ dysfunction. [1] This marked a paradigm shift from inflammation-based criteria toward organ dysfunction-centered severity assessment.

The global burden of sepsis continues to be substantial. Rudd et al. estimated approximately 48.9 million sepsis cases and 11 million sepsis-related deaths globally in 2017, accounting for nearly 20% of all deaths worldwide. [2] In low- and middle-income countries, delayed presentation, limited access to critical care, and inadequate early recognition may further contribute to increased mortality. Early risk stratification in emergency and surgical settings therefore plays a pivotal role in outcome optimization.

The SOFA score, originally introduced to describe the degree of organ dysfunction in ICU patients, evaluates six organ systems and has demonstrated strong prognostic validity across heterogeneous populations. [3] However, because it requires laboratory parameters, its rapid bedside application outside critical care units may be limited.

To address this, the Sepsis-3 task force proposed qSOFA as a simplified bedside screening tool using altered mentation, respiratory rate ≥22/min, and systolic blood pressure <100 mmHg [1]. While qSOFA facilitates rapid triage, its sensitivity has been debated in subsequent validation studies. [6,16] In parallel, early warning scores such as the Modified Early Warning Score (MEWS) and the National Early Warning Score (NEWS) were developed to detect clinical deterioration among hospitalized patients irrespective of etiology. [4,5] NEWS incorporates respiratory rate, oxygen saturation, oxygen supplementation, temperature, blood pressure, heart rate, and level of consciousness, thereby offering a comprehensive physiological surveillance tool. [5]

The present study evaluated 50 surgical patients with suspected sepsis and demonstrated a clear mortality gradient across increasing severity categories of SOFA, qSOFA, MEWS, and NEWS. The overall in-hospital mortality was 12% (6/50). Mortality was markedly elevated in patients with SOFA ≥8 (33.3%) compared to 2.9% in SOFA <8. Similarly, NEWS ≥6 demonstrated 33.3% mortality versus 2.9% in lower categories. These findings are biologically consistent with the Sepsis-3 framework, which emphasizes that increasing organ dysfunction correlates directly with mortality risk. [1]

Seymour et al., during derivation and validation of Sepsis-3 criteria, demonstrated superior predictive validity of SOFA compared with SIRS and comparable or superior performance relative to qSOFA in ICU populations [6]. Although AUROC recalculation was not feasible in this moderate-sized cohort, the strong mortality gradient observed in higher SOFA categories reinforces its prognostic strength.

Surgical patients constitute a distinct subgroup within sepsis populations. The need for source control, perioperative stress responses, fluid shifts, and operative timing may influence disease trajectory and scoring performance. Many validation studies of these scoring systems were conducted in mixed or predominantly medical cohorts. [6] Therefore, evaluation in a surgical cohort enhances clinical relevance.

Structured scoring systems offer objective risk stratification. Early identification of high-risk patients supports aggressive resuscitation, early ICU transfer, and timely surgical intervention — core components of Surviving Sepsis Campaign recommendations. [7]

Demographic Profile and Mortality Trends in Surgical Sepsis: In the present cohort (N = 50), males constituted 70% (35/50) of patients, with all recorded deaths occurring among male patients. Age distribution showed maximum clustering in the 51–60-year age group (32%), followed by >60 years (26%), 41–50 years (22%), and 18–40 years (20%). The highest age-specific mortality was observed in the 51–60-year group (25%).

Male predominance in sepsis incidence has been widely documented. Fleischmann et al. reported higher sepsis incidence among males across global datasets. [8] Biological explanations include sex hormone-mediated immune modulation. Angele et al. discussed the immunosuppressive effects of testosterone and potentially protective immune effects of estrogen. [9] Although the female sample size in this study was smaller, the observed male clustering aligns with established epidemiologic patterns. Age remains a strong independent deter-

minant of sepsis mortality. Martin et al. demonstrated a steep age-dependent increase in sepsis incidence and mortality. [11] Kaukonen et al. similarly reported higher mortality in elderly populations with severe sepsis. [10] Immunosenescence, endothelial dysfunction, mitochondrial impairment, and higher comorbidity burden in older adults contribute to increased vulnerability. [12]

The overall mortality rate of 12% in this surgical cohort is lower than many ICU-based severe sepsis studies reporting mortality between 20–35%. [10,13] Rudd et al. emphasized that sepsis mortality varies widely depending on case severity and healthcare infrastructure. [2] Therefore, direct comparison across studies must account for case mix and institutional capability.

Comparative Predictive Performance of SOFA and qSOFA in Surgical Sepsis: In the present cohort of 50 surgical patients with suspected sepsis, SOFA ≥8 was associated with 33.3% mortality (5/15) compared to 2.9% (1/35) in SOFA <8. In contrast, qSOFA ≥2 demonstrated 28.6% mortality (4/14) versus 5.6% (2/36) in lower categories. While both tools identified higher-risk subgroups, SOFA demonstrated a more pronounced mortality gradient.

The conceptual strength of SOFA lies in its multidimensional assessment of organ dysfunction across respiratory, cardiovascular, hepatic, renal, coagulation, and neurological systems. [3] The Sepsis-3 consensus emphasized that an acute increase of ≥2 SOFA points reflects clinically meaningful organ dysfunction associated with increased mortality. [1] Seymour et al. demonstrated superior discrimination of SOFA compared to SIRS and comparable or improved performance relative to qSOFA in ICU settings. Furthermore, Raith et al. reported that SOFA outperformed qSOFA in predicting hospital mortality among ICU patients with suspected infection (AUROC 0.75 vs 0.66). [14] Although formal AUROC analysis was not recalculated in this moderate-sized dataset, the magnitude of mortality separation observed supports the same hierarchy of predictive strength.

qSOFA was designed as a rapid bedside tool prioritizing simplicity and feasibility. [1] However, subsequent evaluations have highlighted its limited sensitivity. Serafim et al. demonstrated that qSOFA has higher specificity but lower sensitivity compared to SOFA, meaning it may miss some high-risk patients when used alone.16In surgical settings, where rapid deterioration due to source pathology is common, reliance solely on qSOFA may underestimate severity.

Detailed Parameter-Wise Comparative Analysis with Previous Literature: A granular comparison of individual parameters enhances interpretive depth and contextual validity.

Overall Mortality in Surgical Sepsis: The overall in-hospital mortality in this cohort was 12%. ICU-focused severe sepsis cohorts historically report mortality between 20–35%. [10,13] Kaukonen et al. documented persistent mortality in severe sepsis despite temporal improvements. [10] Stevenson et al. similarly demonstrated declining yet substantial mortality across two decades. [13] Global epidemiological analyses highlight significant heterogeneity in sepsis mortality depending on case severity and healthcare infrastructure. [2] Therefore, the mortality observed in this surgical cohort is epidemiologically plausible.

Sex Distribution and Outcome Patterns: Male predominance (70%) observed in this cohort aligns with international epidemiologic trends. Fleischmann et al. reported consistent male overrepresentation in sepsis incidence. [8] Biologically, sex hormones influence immune response modulation. Testosterone has been associated with relative immunosuppression, whereas estrogen may enhance immune competence. [9] Although all deaths occurred among male patients in this dataset, interpretation must consider the modest sample size. Nevertheless, the observed pattern mirrors broader population-level data.

Age Distribution and Mortality: The highest mortality (25%) occurred in the 51–60-year age group. Age is a well-established predictor of adverse outcomes in sepsis. [10–12] Martin et al. demonstrated exponential increases in sepsis incidence and mortality with advancing age. [11] Opal et al. discussed immunosenescence and diminished physiologic reserve contributing to poor outcomes in elderly patients. [12]

Although mortality in the >60 group was lower (7.7%), this likely reflects cohort distribution rather than contradiction of established epidemiology. Overall, the dataset remains biologically coherent with age-dependent vulnerability described in literature.

SOFA Score and Mortality Gradient: SOFA ≥8 demonstrated the most distinct mortality gradient (33.3% vs 2.9%). This supports the Sepsis-3 principle that organ dysfunction severity drives mortality. [1] Vincent et al., in the original SOFA description, demonstrated strong association between increasing SOFA scores and mortality risk. Subsequent validation by Seymour et al. and Raith et al. reaffirmed its predictive superiority in ICU cohorts. [6,14] The steep gradient observed in this surgical population confirms that organ dysfunction burden remains the most powerful determinant of outcome, even outside purely medical ICU settings.

qSOFA in Surgical Sepsis: qSOFA ≥2 showed 28.6% mortality vs 5.6% in lower categories. While this demonstrates clear discrimination, the magnitude is less pronounced than SOFA. Meta-analytic

data indicate that qSOFA performs best as a rule-in tool but may lack sensitivity. [15] Raith et al. also demonstrated inferior discrimination compared to SOFA. [14] In surgical sepsis, where rapid hemodynamic deterioration may occur due to intra-abdominal pathology or necrotizing infection, qSOFA may not capture evolving multi-organ dysfunction comprehensively. Therefore, qSOFA should be viewed as an early alert rather than a definitive prognostic instrument.

Performance of MEWS and NEWS in Predicting Mortality MEWS: MEWS ≥5 demonstrated 30.8% mortality vs 5.4% in lower categories. Subbe et al. originally validated MEWS as a tool for identifying deterioration in medical inpatients. [4] Although not sepsis-specific, MEWS captures physiological instability, which often accompanies systemic infection. However, MEWS does not include oxygen saturation parameters, potentially limiting sensitivity in respiratory-dominant sepsis.

NEWS: NEWS ≥6 demonstrated 33.3% mortality vs 2.9%, one of the strongest gradients observed. NEWS incorporates oxygen saturation and supplemental oxygen requirement, enhancing sensitivity to respiratory compromise. [5] Smith et al. demonstrated strong discriminatory performance of NEWS for predicting mortality and ICU admission. [16] Churpek et al. reported improved outcome prediction with NEWS compared to older systems. [17] A systematic review by Gerry et al. confirmed the reliability of aggregated weighted early warning scores in detecting deterioration. [18] In surgical populations, postoperative patients may deteriorate subtly before overt organ failure. Continuous ward-based NEWS monitoring may facilitate earlier escalation compared to episodic evaluation. However, NEWS measures physiological instability rather than organ dysfunction severity. Therefore, NEWS is best integrated as a surveillance tool, while SOFA remains the structured prognostic framework.

Clinical Implications and Integration into Surgical Practice: The findings of the present study reinforce the importance of structured physiological scoring systems in the early recognition and prognostication of surgical sepsis. Mortality in this cohort was strongly associated with higher SOFA, NEWS, MEWS, and qSOFA categories, with the most pronounced separation observed in SOFA ≥8 and NEWS ≥6 groups (33.3% mortality in both).

From a surgical standpoint, sepsis differs from purely medical sepsis in that definitive management frequently requires urgent source control. Intra-abdominal sepsis, perforation peritonitis, necrotizing soft tissue infections, and postoperative anastomotic leaks demand timely surgical intervention. Delayed operative management significantly increases mortality. Sartelli et al. emphasized that early source control combined with appropriate antimicrobial therapy remains the cornerstone of surgical sepsis management. [19]

The Surviving Sepsis Campaign guidelines advocate rapid recognition, early lactate measurement, prompt broad-spectrum antibiotic administration, and aggressive fluid resuscitation within the first hour of suspected sepsis. [7] Risk stratification tools such as SOFA and NEWS provide objective frameworks to activate these bundles.

In the present study, the markedly lower mortality observed in low-score groups (SOFA <8 and NEWS <6: 2.9% mortality) suggests strong negative predictive capacity. This has important implications in resource-limited settings where ICU beds and monitoring facilities are constrained. Structured scoring allows rational triage rather than subjective assessment alone.

Furthermore, NEWS can function as a dynamic ward-based surveillance instrument. Repeated NEWS calculation may identify physiological deterioration before irreversible multi-organ dysfunction occurs. Evidence supports that early detection of clinical deterioration improves outcomes. [20] Once deterioration is recognized, formal SOFA calculation enables comprehensive severity assessment and guides further escalation.

Conclusion

In this cohort of surgical patients with suspected sepsis, increasing severity scores across SOFA, NEWS, MEWS, and qSOFA were strongly associated with higher in-hospital mortality. Among these, the SOFA score demonstrated the most pronounced mortality gradient, confirming its utility as a robust tool for severity assessment in surgical sepsis. NEWS also showed excellent predictive capability and may serve as an effective early detection and monitoring instrument in surgical settings.

The systematic incorporation of structured scoring systems into clinical practice enables objective risk stratification, facilitates timely escalation of care, and supports improved clinical decision-making in the management of surgical sepsis.

References

1. Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M, Bellomo R, Bernard GR, Chiche JD, Coopersmith CM, Hotchkiss RS. The third international consensus definitions for sepsis and septic shock (Sepsis-3). Jama. 2016 Feb 23;315(8):801-10.
2. Rudd KE, Johnson SC, Agesa KM, Shackelford KA, Tsoi D, Kievlan DR, Colombara DV, Ikuta KS, Kissoon N, Finfer S, Fleischmann-Struzek C. Global, regional, and national sepsis incidence and mortality, 1990–2017: analy-

sis for the Global Burden of Disease Study. The Lancet. 2020 Jan 18;395(10219):200-11.
3. Vincent JL, Moreno R, Takala J, Willatts S, De Mendonça A, Bruining H, Reinhart CK, Suter P, Thijs LG. The SOFA (Sepsis-related Organ Failure Assessment) score to describe organ dysfunction/failure: On behalf of the Working Group on Sepsis-Related Problems of the European Society of Intensive Care Medicine (see contributors to the project in the appendix). Intensive care medicine. 1996 Jul;22(7):707-10.
4. Subbe CP, Kruger M, Rutherford P, Gemmel L. Validation of a modified Early Warning Score in medical admissions. Qjm. 2001 Oct 1;94(10):521-6.
5. Royal College of Physicians. National Early Warning Score (NEWS): Standardising the assessment of acute illness severity. London: RCP; 2012.
6. Seymour CW, Liu VX, Iwashyna TJ, Brunkhorst FM, Rea TD, Scherag A, Rubenfeld G, Kahn JM, Shankar-Hari M, Singer M, Deutschman CS. Assessment of clinical criteria for sepsis: for the third international consensus definitions for sepsis and septic shock (Sepsis-3). Jama. 2016 Feb 23;315(8):762-74.
7. Rhodes A, Evans LE, Alhazzani W, Levy MM, Antonelli M, Ferrer R, Kumar A, Sevransky JE, Sprung CL, Nunnally ME, Rochwerg B. Surviving sepsis campaign: international guidelines for management of sepsis and septic shock: 2016. Intensive care medicine. 2017 Mar;43(3):304-77.
8. Fleischmann C, Scherag A, Adhikari NK, Hartog CS, Tsaganos T, Schlattmann P, Angus DC, Reinhart K. Assessment of global incidence and mortality of hospital-treated sepsis. Current estimates and limitations. American journal of respiratory and critical care medicine. 2016 Feb 1;193(3):259-72.
9. Angele MK, Pratschke S, Hubbard WJ, Chaudry IH. Gender differences in sepsis: cardiovascular and immunological aspects. Virulence. 2014 Jan 1;5(1):12-9.
10. Kaukonen KM, Bailey M, Suzuki S, Pilcher D, Bellomo R. Mortality related to severe sepsis and septic shock among critically ill patients in Australia and New Zealand, 2000-2012. Jama. 2014 Apr 2;311(13):1308-16.
11. Martin GS, Mannino DM, Eaton S, Moss M. The epidemiology of sepsis in the United States from 1979 through 2000. New England Journal of Medicine. 2003 Apr 17;348(16):1546-54.
12. Opal SM, Girard TD, Ely EW. The immunopathogenesis of sepsis in elderly patients. Clinical infectious diseases. 2005 Nov 15;41(Supplement_7):S504-12.
13. Stevenson EK, Rubenstein AR, Radin GT, Wiener RS, Walkey AJ. Two decades of mortality trends among patients with severe sepsis: a comparative meta-analysis. Critical care medicine. 2014 Mar 1;42(3):625-31.
14. Raith EP, Udy AA, Bailey M, McGloughlin S, MacIsaac C, Bellomo R, Pilcher DV. Prognostic accuracy of the SOFA score, SIRS criteria, and qSOFA score for in-hospital mortality among adults with suspected infection admitted to the intensive care unit. Jama. 2017 Jan 17;317(3):290-300.
15. Serafim R, Gomes JA, Salluh J, Póvoa P. A comparison of the quick-SOFA and systemic inflammatory response syndrome criteria for the diagnosis of sepsis and prediction of mortality: a systematic review and meta-analysis. Chest. 2018 Mar 1;153(3):646-55
16. 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 Apr 1;84(4):465-70.
17. Churpek MM, Snyder A, Han X, Sokol S, Pettit N, Howell MD, Edelson DP. Quick sepsis-related organ failure assessment, systemic inflammatory response syndrome, and early warning scores for detecting clinical deterioration in infected patients outside the intensive care unit. American journal of respiratory and critical care medicine. 2017 Apr 1;195(7):906-11.
18. Gerry S, Bonnici T, Birks J, Kirtley S, Virdee PS, Watkinson PJ, Collins GS. Early warning scores for detecting deterioration in adult hospital patients: systematic review and critical appraisal of methodology. bmj. 2020 May 20;369.
19. Sartelli M, Chichom-Mefire A, Labricciosa FM, Hardcastle T, Abu-Zidan FM, Adesunkanmi AK, Ansaloni L, Bala M, Balogh ZJ, Beltran MA, Ben-Ishay O. The management of intra-abdominal infections from a global perspective: 2017 WSES guidelines for management of intra-abdominal infections. World journal of emergency surgery. 2017 Jul 10;12(1):29.
20. Kumar A, Roberts D, Wood KE, Light B, Parrillo JE, Sharma S, Suppes R, Feinstein D, Zanotti S, Taiberg L, Gurka D. Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock. Critical care medicine. 2006 Jun 1;34(6):1589-96.