Prognostic value of NEWS scores for COVID-19 severity: a retrospective study from Kyrgyzstan

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ABSTRACT

In the early, chaotic hours of hospital admission during the COVID-19 pandemic, clinical clarity was often obscured by urgency. The National Early Warning Score (NEWS) functioned as a fast assessment tool that used physiological parameters to sort patients into different risk categories. The research evaluates how NEWS predicts patient outcomes, resource needs, and disease severity among COVID-19 patients admitted to hospitals in Kyrgyzstan, which operates as an LMIC under significant healthcare system pressure. The tool gained worldwide recognition, yet there was insufficient research about its effectiveness for Central Asian patients during the pandemic. The research team analyzed 395 confirmed COVID-19 patient records through retrospective observation to create three risk groups based on their NEWS scores at admission (≤ 4, 5–6, ≥ 7). The research showed that higher NEWS scores correlated strongly with increased mortality rates ($p < 0.0001$) as well as higher rates of ICU admissions and mechanical ventilation requirements and shorter hospital stays because patients deteriorated quickly. The mortality rate reached 70.4% among patients who received NEWS scores of 7 or higher, while the low-risk group experienced only 4.05% deaths. The study confirmed that the scale effectively tracked patient clinical changes during 20 days, which supported its purpose for early intervention and triage. The tool shows potential to enhance patient results in LMICs through its ability to direct prompt medical choices and distribute limited medical resources effectively during current and future public health crises.

Keywords: COVID-19, National Early Warning Score (NEWS), Risk stratification, Hospital outcomes, Low- and Middle-Income Countries (LMICs)

Introduction

The COVID-19 pandemic has created unprecedented challenges for global health systems because it has resulted in more than 769 million confirmed cases and 6.9 million deaths worldwide through 2023, as per the report by the World Health Organization (2023) [1]. The disease continues to affect vulnerable populations with severe respiratory complications at higher rates despite recent progress in vaccination and treatment [2]. The identification of patients at high risk needs to happen early because it helps achieve better clinical results and better distribution of resources in limited resource environments [3]. The National Early Warning Score (NEWS) and NEWS2 have become essential risk assessment instruments for acute care

settings because they provide a standardized method to identify clinical deterioration [4-7]. The Royal College of Physicians in the UK created these scales to use respiratory rate alongside oxygen saturation and consciousness levels for predicting adverse outcomes [8]. The application of NEWS in COVID-19-specific settings needs additional validation because the disease shows diverse clinical manifestations, from no symptoms to organ failure, across patients [9].

The fast development of severe COVID-19 [10-12] cases represents a major obstacle for management because it requires patients to be admitted to intensive care units and receive mechanical ventilation [13]. The available prognostic tools demonstrate poor accuracy in predicting disease severity, according to Siddiqui *et al*. (2021), in various demographic and clinical settings [14]. The healthcare systems of low- and middle-income countries experience an increased challenge because they lack sufficient staff and equipment and have limited ICU capacity. The NEWS scale shows promise as an early warning system for COVID-19 severity, but its performance needs further investigation across different severity levels and population groups [15]. The evidence about NEWS scale sensitivity for differentiating severe from critical cases remains inconsistent, which requires additional validation studies in specific locations. The research aims to establish a connection between NEWS scores and clinical results from hospitalized COVID-19 patients to develop better risk assessment [16, 17] methods and prompt treatment approaches [18-21].

The retrospective study provides fresh insights through its analysis of NEWS scores and COVID-19 severity in Kyrgyzstan's real-world clinical environment, where healthcare resources are scarce and severe COVID-19 cases have been prevalent. The research conducted at the Republican Clinical Infectious Diseases Hospital of Kyrgyzstan analyzed 395 patients with different disease severity levels to provide unique insights about NEWS performance in resource-limited settings. The study extends previous research by monitoring NEWS parameter changes over time while tracking clinical results, including death rates, ICU admissions, and respiratory support requirements. The research demonstrates that patients with NEWS scores above 7 experience worse outcomes since their mortality rate reaches 70.4%, while patients with NEWS scores below 4 have a mortality rate of 4.05%. The study demonstrates the practical value of this scale for clinical use in Kyrgyzstan because it helps with fast patient assessment and resource distribution. The study validates NEWS in this context while advancing COVID-19 prognostic science and delivering practical data for clinicians working in comparable low-resource areas to enhance patient outcomes during future outbreaks.

Materials and Methods

Study design and setting

This retrospective cohort study was conducted at the Republican Clinical Infectious Diseases Hospital, Bishkek, Kyrgyzstan, during the COVID-19 pandemic to evaluate the predictive effectiveness of the National Early Warning Score (NEWS) in patients with confirmed SARS-CoV-2 infection. The study started when the hospital operated as the primary COVID-19 referral centre for the region [22, 23] during the peak of the global pandemic. 395 patients who were hospitalised with either a clinical diagnosis of COVID-19 pneumonia based on CT scans or a laboratory-confirmed SARS-CoV-2 infection based on PCR tests were included in the analysis.

Inclusion and exclusion criteria

Adults aged 18 and above who got a confirmed COVID-19 diagnosis and had all essential clinical data available for NEWS computation at hospital admission were eligible for the trial. The study excluded patients with incomplete medical records, those who died within the first 24 hours of hospitalisation, and those with acute noncommunicable illnesses such as trauma or acute myocardial infarction that required prompt resuscitation regardless of COVID-19 severity. The study used these criteria to decrease confounding variables while keeping a consistent population for analysis.

Data collection and variables

Each patient's NEWS score was determined upon admission by evaluating six physiological parameters: body temperature, systolic blood pressure, heart rate, respiratory rate, oxygen saturation (SpO_2), supplemental oxygen requirement, and level of consciousness as measured by the AVPU (Alert, Voice, Pain, Unresponsive) scale. The categorization of illness severity into moderate, severe, and extremely severe categories, as well as the need for medical interventions such as oxygen treatment, non-invasive ventilation (NIVL), mechanical ventilation, and intensive care unit (ICU) admission, were the two primary clinical outcomes that were assessed in this study. Clinical, radiographic, and laboratory criteria were utilized to classify the severity of the disease in the national COVID-19 treatment recommendations.

Risk stratification and statistical analysis

Patients were assigned to one of three risk groups depending on their NEWS score: low risk (NEWS ≤4), moderate risk (NEWS 5-6), or high risk (NEWS ≥7). The study presented demographic and clinical data using descriptive statistics. Continuous variables were presented as means ± standard deviations (SD) or standard errors (SE), whereas categorical variables were represented as frequencies with percentages. The researchers used Pearson's chi-square test for categorical variables and one-way ANOVA for continuous variables, followed by post-hoc adjustments for multiple comparisons. The researchers established a two-tailed p-value threshold of less than 0.05 to determine statistical significance. The researchers performed all statistical analyses using SPSS version 26.0 (IBM Corp., Armonk, NY, USA).

Ethical considerations

The study was reviewed and approved by the ethical committee, Institutional Review Board (IRB), I.K. Akhunbaev Kyrgyz State Medical Academy, Bishkek, Kyrgyzstan. Given the retrospective nature of the study, the requirement for informed consent was waived by the IRB. Patient data were anonymized to ensure confidentiality, and all analyses were performed using de-identified datasets. Each procedure has been carried out in compliance with the ethical guidelines set down in the Declaration of Helsinki [24].

Results and Discussion

Rapid worsening in COVID-19 clinical care is unexpected, necessitating an objective evaluation of the patient's health right away. During early clinical response techniques, the National Early Warning Score (NEWS) was a proactive instrument to increase the effectiveness of patient triage, hospitalization rationale, and the start of intensive care. Because it offers straightforward measures with dependable outcomes and precise prognostic value in acute care settings, NEWS stands out as a well-known instrument. The study established a clear correlation between the clinical severity of COVID-19 patients and the NEWS ratings upon admission **(Table 1)**.

Table 1. Distribution of NEWS scores depending on the severity of COVID-19 n=395 (%)				
Scores on the NEWS scale	**Severity**			**Total %**
	Moderate Severe	**Severe**	**Extremely severe**	
0–2	15 (17.4%)	3 (1.1%)	0 (0.0%)	18 (4.6%)
3–4	28 (32.6%)	16 (6.0%)	2 (4.9%)	46 (11.6%)
5–6	30 (34.9%)	60 (22.4%)	10 (24.4%)	100 (25.3%)
≥7	13 (15.1%)	189 (70.5%)	29 (70.7%)	231 (58.5%)
Total	86 (100%)	268 (100%)	41 (100%)	395 (100%)

The 395 COVID-19 patients who received NEWS score assessments and clinical severity ratings (moderate, severe, extremely severe) showed a direct relationship between lower NEWS scores and less severe illness. Patients with NEWS scores between 0 and 2 showed 17.4% moderate disease but no cases of extremely severe disease occurred within this range. The NEWS score increase directly correlated with more severe illness development.

The 3–4 NEWS score range produced inconsistent results because 32.6% of patients had moderate disease, while 6.0% and 4.9% of patients showed severe and extremely severe conditions, which indicates that small NEWS score increases might signal worsening health. The 5–6 score category showed a significant rise in severe cases at 22.4% and extremely severe cases at 24.4%, which indicates patients need increased monitoring. The patients who received NEWS scores of ≥7 demonstrated the most pronounced results because 70.5% had severe disease and 70.7% had extremely severe disease. The NEWS scale demonstrates exceptional predictive power because it effectively identifies patients who face a high risk of developing critical illness. The study findings show a direct relationship between the NEWS score patients received at hospital admission and their COVID-19 disease severity. The NEWS scale proves effective for predicting disease progression and adverse outcomes, which makes it suitable for routine use in early risk assessment and critical medical decision-making during initial assessments.

The NEWS scores for patients at different COVID-19 severity levels were quantified through average score calculations for each group **(Table 2)**. The NEWS scores demonstrated statistically significant differences between groups which showed a direct relationship between disease severity and NEWS score values.

Table 2. Average values of the NEWS scale and results of paired comparisons for different degrees of severity of COVID-19					
Severity of COVID-19	n	+NEWS, M ± m	Comparison of groups	p-value groups (up-to-date)	p-value (up-to-date)
Moderate (1)	86	4.4 ± 0.2	1 vs 2	$3.45 \times 10\text{-}2^{-28}$	$1.04 \times 10\text{-}2^{-27}$
Severe (2)	286	7.1 ± 0.1	1 vs 3	$1.27 \times 10\text{-}1^{-17}$	$3.82 \times 10\text{-}1^{-17}$
Extremely severe (3)	41	7.2 ± 0.2	2 vs 3	0.81	1.00

+Note: Data are presented as mean ± standard error (M ± m). Statistical significance was assessed using the Student's t-test with Welch correction. p-values were adjusted using the Bonferroni method. Adjusted p-values < 0.05 are considered statistically significant.

Table 2 presents NEWS scores that patients achieved based on their COVID-19 severity levels. The NEWS scores averaged 4.4 ± 0.2 in moderate patients, while severe patients scored 7.1 ± 0.1 and extremely severe patients scored 7.2 ± 0.2. The NEWS scores between moderate and severe patients and moderate and extremely severe patients showed statistically significant differences (p < 0.001 after Bonferroni correction). The comparison between severe and extremely severe groups showed no statistical significance (p = 1.00). The study results validate that NEWS scores increase with COVID-19 severity, thus supporting its predictive value for early risk assessment during hospital admission.

Table 3. Dynamics of NEWS Scale Scores and Clinical Indicators During Hospital Stay					
Day of hospitalization	NEWS (average)	Heart rate (HR), beats / min	Respiratory rate (BPM), in min	SpO$_2$, %	Mortality (% of hospitalized patients)
On admission	6.9	82.31	23	90%	35%
Day 3	6.6	80.41	21	91%	39%
Day 7	5.6	81.22	20	92%	30%
Day 10	3.6	79.40	20	92%	25%
Day 11	10.7	79.80	22	85%	13%
Day 20	7.7	72.80	22	91%	3%

The 20-day hospital stay data presented in **Table 3** shows how NEWS scores and heart rate (HR), respiratory rate (RR), oxygen saturation (SpO$_2$), and cumulative mortality evolved in COVID-19 patients. Patients showed elevated NEWS scores (mean 6.9) and increased respiratory rate (mean 23 breaths per minute) and reduced oxygen saturation (90%) and a high mortality rate of 35% when they first entered the hospital. The first 10 days of intensive care treatment showed positive clinical developments because NEWS scores decreased to 3.6 and SpO$_2$ levels reached 92%, while mortality rates decreased to 25%. The NEWS score increased dramatically to 10.7 on day 15, while SpO$_2$ levels decreased to 85%, which indicated worsening clinical conditions in some patients. The decrease in mortality to 13% might be due to the passing away of the most severely ill patients. The NEWS score reached 7.7 on day 20, while oxygen saturation levels increased to 91% and mortality rates decreased to 3%. The NEWS scale proves useful for tracking patient status changes and predicting death risk among COVID-19 patients under hospital care.

Table 4. The need for medical interventions depending on the indicators of the NEWS scale n=395				
Intervention	NEWS ≤4 (n=163)	NEWS 5-6 (n=63)	NEWS ≥7 (n=169)	p-value
Oxygen	therapy 38	40	138	p < 0.001
NIVL (non-invasive ventilation)	0	0	9	p = 0.002
Mechanical ventilation	0	0	24	p < 0.0001
ICU admission	18	15	128	p < 0.0001
Mortality	16	10	119	p < 0.0001

The NEWS score distribution at admission reveals the patterns of critical medical interventions and their corresponding outcomes, as shown in **Table 4**. The NEWS score divided patients into three risk groups that included low-risk (NEWS ≤ 4), moderate-risk (NEWS 5–6), and high-risk (NEWS ≥ 7). The NEWS score increase leads to a direct and continuous rise in the need for advanced medical interventions and death rates. The need for oxygen therapy increased from 23.3% in patients with NEWS ≤ 4 to 81.7% in patients with NEWS ≥ 7. The high-risk group received NIV and invasive mechanical ventilation exclusively, as 9 patients received NIV and 24 patients received invasive mechanical ventilation because they demonstrated critical respiratory failure. The ICU admission process followed the same pattern as the other interventions. The ICU admission rates demonstrated a progressive increase from 11.0% in low-risk patients to 23.8% in moderate-risk patients and reached 75.7% in high-risk patients. The mortality rates showed a direct relationship with severity because the low-risk group had 9.8% mortality, but the high-risk group experienced a remarkable 70.4% mortality rate. The statistical analysis confirmed all observed differences between the three groups (p < 0.05), which supports the NEWS scale as a prognostic tool. The NEWS score proves effective in patient severity stratification and helps healthcare providers make early clinical decisions about required interventions and mortality probabilities when patients first enter the hospital.

Table 5. Average duration of hospitalization and outcomes as a function of NEWS scores (n=395)				
NEWS Score Group	Average duration of hospitalization (days)	Discharged, n (%)	Died, n (%)	p - value
NEWS ≤4 (n=163)	9.80 ± 0.98	123 (31.1%)	16 (4.05%)	-
NEWS 5–6 (n=63)	10.12 ± 1.01	53 (13.4%)	10 (2.5%)	< 0.0001
NEWS ≥7 (n=169)	7.90 ± 0.79	50 (12.6%)	119 (30.1%)	< 0.0001

The relationship between NEWS scores at admission and hospital stay duration and clinical outcomes for COVID-19 patients appears in **Table 5**. The NEWS scores divided patients into three risk categories, which included low risk (NEWS ≤ 4), moderate risk (NEWS 5–6), and high risk (NEWS ≥ 7). The hospital stay duration for patients in the low- and moderate-risk groups showed similar patterns at 9.80 ± 0.98 days and 10.12 ± 1.01 days, respectively, because their clinical conditions remained

stable. The high-risk group experienced the shortest hospital stay at 7.90 ± 0.79 days. The short hospital stay in this group likely resulted from the fast deterioration of patients and the high death rate, which affected 119 out of 169 patients (70.4%). The NEWS ≤ 4 group had a mortality rate of 4.05% (16 out of 163 patients), while 123 patients (31.1%) received successful discharge. The mortality rate for moderate-risk patients remained low at 2.5%, while 53 patients (13.4%) were discharged. The NEWS score demonstrated strong prognostic value because the differences in discharge and mortality rates between groups reached statistical significance ($p < 0.0001$). The NEWS scale proves essential for early clinical risk assessment when patients first enter the hospital. The NEWS ≥ 7 group requires urgent intensive monitoring because their adverse outcome risk remains high.

Our study confirms the National Early Warning Score's (NEWS) strong predictive value for COVID-19 patients in Kyrgyzstan. The study showed a clear gradient by classifying 395 inpatients at admission into risk categories defined by NEWS: higher NEWS scores were linked to higher respiratory support requirements, more ICU admissions, longer hospitalization length patterns, and higher mortality rates. Because 81.7% of patients required oxygen treatment, 5.3% required non-invasive ventilation, 14.2% required mechanical ventilation, 75.7% required intensive care unit admission, and 70.4% died at rates significantly greater than those of patients with a NEWS score of 7 or above, these patients had severe requirements. Studies that validate NEWS as a useful tool for early diagnosis and risk assessment of deterioration and death in COVID-19 patients are supported by the statistical analysis ($p < 0.05$) that validated these relationships in all parameters **(Tables 4 and 5)**.

Our dynamic monitoring **(Tables 3 and 5)** revealed a decline in average NEWS scores from day of admission (6.9) to day 10th (3.6), alongside improved SpO₂ and reduced cumulative mortality (25%). Similar temporal recovery patterns have been observed in other settings as well, where early improvement in NEWS within the initial treatment window correlated with favorable outcomes. The reappearance of elevated scores on the day 15th in our cohort, together with hypoxia symptoms, demonstrates that some COVID 19 patients develop biphasic disease patterns that require ongoing monitoring. The published study supports the results that we obtained. NSM Yunin *et al*. (2025) demonstrated that NEWS2 outperformed other tools in predicting in-hospital mortality [25]. In Romania, Cosmin Citu *et al*. (2022) found that NEWS performed better than CURB-65 and other prognostic scores, which supports its early application [26]. The multi-national study validates our conclusions by demonstrating NEWS keeps its excellent performance degree in several clinical environments [27, 28].

Kyrgyzstan's demographic features and organisation of the healthcare system bring in particular challenges for the people. R. Kohn *et al*. (2022) conducted a study on how geographic dispersion and resource limitations influence hospital capacity [29]. Our study provides the first local data that NEWS helps detect at-risk patients early to enhance triage operations in locations with distributed healthcare facilities. The recorded mortality rates between 30% and 70% in higher NEWS groups match the findings of Kyrgyz excess-mortality analyses, which demonstrate the requirement for systematic risk evaluation during times of increased cases. The recorded data shows that patients with high NEWS scores have shorter hospital stays, which measure at 7.9 days, because their condition advances quickly. The findings have significant implications for hospital bed management and the early distribution of critical care resources. The recovery patterns from other research groups match the extended hospital stays of approximately 10 days that lower risk patients experienced. The original NEWS score proves effective for risk prediction in our study despite some research suggesting the addition of laboratory [30, 31] biomarkers like procalcitonin or neutrophil-to-lymphocyte ratio would enhance predictive accuracy, but our findings show the original NEWS score works well in areas with restricted laboratory testing capabilities.

Future recommendation

The research results confirm that NEWS serves as an effective tool for predicting hospital stay duration and clinical outcomes and mortality risk in COVID-19 patients. The tool stands out for its ease of use, its dependence on basic vital signs, and its strong predictive capabilities, which make it suitable for low- and middle-income countries (LMICs) with restricted access to advanced diagnostic tools and critical care facilities [32]. The application of validated early warning tools like NEWS in healthcare systems of LMICs will enhance both clinical decision-making and patient survival rates while improving triage efficiency. The following recommendations are based on our study:

Integration of NEWS into national triage protocols in LMICs

News should be incorporated into triage procedures of national hospitals within low and middle income countries to provide guidance during infectious disease outbreaks. The NEWS scale has proven effective in reducing intensive care unit and emergency department patient loads during outbreaks. The integration of NEWS into emergency department workflows along with ambulance services and primary referral centers allows medical staff to detect dangerous patients early, which helps maximize limited clinical resources [33, 34].

Training frontline health workers in NEWS application:

The NEWS scale remains straightforward for non-specialist staff to apply when they receive proper training. Training programs should be developed at scale by LMICs to teach NEWS application skills to nurses [35-37] along with paramedics and rural health practitioners. NEWS should be included in existing educational programs for healthcare professionals at all levels to promote standardized practice throughout primary care facilities with limited resources. The training programs should be

developed to address severe staff shortages in rural hospitals of Kyrgyzstan [38, 39].

Digital integration of NEWS into mobile Health (mHealth) systems

Digital NEWS integration with Mobile Health (mHealth) systems shows promise for health service delivery in LMICs because of the fast-growing digitalization of healthcare. Medical personnel can reduce mistakes during vital sign assessment by using application-based NEWS calculators to enable remote medical evaluation in remote areas. Health authorities should work with digital health start-ups to create mobile-enabled NEWS assessment pilot programs for both rural hospitals and quarantine centers [40, 41].

Expanding the use of NEWS beyond COVID-19

The NEWS scale offers useful applications beyond COVID-19 since it works effectively for sepsis, pneumonia, and dengue cases, which burden health systems in LMICs. The NEWS tool should be tested for different diseases in LMIC environments before adopting it as a standard critical illness assessment tool for adult patients with suspected severe illness [42, 43].

Establishing early warning score surveillance and quality audits

National healthcare systems of low and middle-income countries need to create systems that track patient outcomes after NEWS-based triage. Quality audits enable healthcare teams to optimize triage parameters and check adherence to clinical protocols while detecting areas that require improvement. Real-world data collection on the NEWS scale performance among various populations enables researchers to improve its adaptation for resource-limited contexts [44-48].

Conclusion

The hospital admission procedure needs quick attention because vital sign measures taken during this critical period disclose important information regarding patient outcomes. The National Early Warning Score (NEWS) is more than just a clinical tool; it is an invisible warning system that forecasts illness development and guides critical medical decisions beginning with the first patient interaction. The NEWS scale established a solid statistical link between illness severity, death rates, and hospitalization time among COVID-19 patients in Kyrgyzstan. Because it proved crucial in settings with limited healthcare resources and high patient demand, the NEWS scale facilitated rapid patient risk assessment, resulting in more targeted actions. NEWS, as an evidence-based, scalable solution, may help LMICs recover from the epidemic and prepare for future public health emergencies. The NEWS scale enables healthcare personnel at all system levels

to turn basic physiological measurements into relevant clinical information. The extended implementation of this method in low-resource locations has the potential to significantly improve patient outcomes while enhancing triage operations and increasing ICU bed availability, resulting in maximum life-saving potential during urgent situations.

References

1. WHO. Weekly epidemiological update on COVID-19 - 17 August 2023 [Internet]. 2023 [cited 2025 Jun 22]. Available from:
https://www.who.int/publications/m/item/weekly-epidemiological-update-on-covid-19---17-august-2023

2. Alam A, Siddiqui MF, Imam N, Ali R, Mushtaque M, Ishrat R. Design of an epitope-based peptide vaccine against the SARS-CoV-2: a vaccine-informatics approach. Brief Bioinform. 2021;22(2):1309–23. doi:10.1093/bib/bbaa340

3. Alam A, Siddiqui MF, Imam N, Ali R, Mushtaque M, Ishrat R. An integrative network approach to identify common genes for the therapeutics in tuberculosis and its overlapping non-communicable diseases. Front Pharmacol. 2022;12:770762. doi:10.3389/fphar.2021.770762

4. Williams B. The national early warning score: from concept to NHS implementation. Clin Med (Lond). 2022;22(6):499–505. doi:10.7861/clinmed.2022-news-concept.

5. Patatou A, Iacovou N, Zaxaria P, Vasoglou M, Vasoglou G. Corticotomy-assisted orthodontics: biological basis and clinical applications. Ann Orthod Periodontics Spec. 2022;2:8-13. doi:10.51847/0qGERVSoQm

6. Pavlova Z. Material properties and clinical performance of 3D-printed complete dentures: a systematic review. Ann Orthod Periodontics Spec. 2024;4:14-25. doi:10.51847/62izsGtXh4

7. Al-Mubarak AM, Alkhaldi FA, Alghamdi AA, Almahmoud MA, Alghamdi FA. Awareness and clinical competency of dental students in crown lengthening procedures. Asian J Periodontics Orthod. 2024;4:42-51. doi:10.51847/r5cLVpz1UT

8. Royal College of Physicians. National early warning score (NEWS) 2 [Internet]. [cited 2025 Jun 22]. Available from:

https://www.rcp.ac.uk/improving-care/resources/national-early-warning-score-news-2/

9. Villanueva-Rábano R, Martín-Rodríguez F, López-Izquierdo R. National early warning score 2 lactate (NEWS2-L) in predicting early clinical deterioration in patients with dyspnoea in prehospital care. Investig Educ Enferm. 2021;39(3):e05. doi:10.17533/udea.iee.v39n3e05

10. Deana NF, Seiffert A, Aravena-Rivas Y, Alonso-Coello P, Muñoz-Millán P, Espinoza-Espinoza G, et al. Review of available studies and guidelines in the field of prevention of COVID-19 infection in dental centers. Ann J Dent Med Assist. 2022;2(1):1-7. doi:10.51847/4VxEtFTh77

11. Mustafa RM, Alshali RZ, Bukhary DM. Evaluating Saudi dentists' compliance with safety protocols during COVID-19. Ann J Dent Med Assist. 2023;3(1):1-10. doi:10.51847/9vx0wN0iuZ

12. Spirito FD, Iacono VJ, Alfredo I, Alessandra A, Sbordone L, Lanza A. Impact of COVID-19 awareness on periodontal disease prevention and management. Asian J Periodontics Orthod. 2022;2:16-26. doi:10.51847/t8D9TJGOCU

13. Larsen KSR, Petersen AK, Lisby M, Knudsen MV. Dyspnoea and self-management strategies in patients admitted to the emergency department: a study of patients' experiences. J Clin Nurs. 2018;27(21–22):4112–8. doi:10.1111/jocn.14560

14. Siddiqui MF. IoMT potential impact in COVID-19: combating a pandemic with innovation. In: Raza K, ed. Computational intelligence methods in COVID-19: surveillance, prevention, prediction and diagnosis. Vol. 923. Singapore: Springer Singapore; 2021. p. 349–61. doi:10.1007/978-981-15-8534-0_18

15. Goodacre S, Sutton L, Fuller G, Trimble A, Pilbery R. Accuracy of the national early warning score version 2 (NEWS2) in predicting need for time-critical treatment: retrospective observational cohort study. Emerg Med J. 2025;42(6):e214562. doi:10.1136/emermed-2024-214562

16. Govindaraj A, Paulpandian SS, Shanmugam R. A comparative assessment of the impact of citrullus lanatus rind and pulp extracts on streptococcus mutans. Int J Dent Res Allied Sci. 2022;2(2):1-6. doi:10.51847/ffD4G8LgXK

17. Aleidi SA, Alosaimi NS, Aljumah SM, Alabdulmunim RA, Alhussain B. Assessment of ionoseal's performance as a lining and sealing material in dental restorations: a comprehensive review. Int J Dent Res Allied Sci. 2022;2(1):13-9. doi:10.51847/iVCXX97n31

18. Goodacre S. Using clinical risk models to predict outcomes: what are we predicting and why? Emerg Med J. 2023;40(10):728–30. doi:10.1136/emermed-2022-213057

19. Arévalo-Buitrago P, Morales-Cané I, Olivares Luque E, Guler I, Rodríguez-Borrego MA, López-Soto PJ. Predictive power of early-warning scores used in hospital emergency departments: a systematic review and meta-analysis. Emerg Rev Soc Española Med Emerg. 2021;33(5):374-81.

20. Alharbi IS, Alharbi AS, Ansari SH. Public awareness and perceptions of orthodontic treatment with invisalign in Qassim, Saudi Arabia. Turk J Public Health Dent. 2022;2(1):13-8. doi:10.51847/DrpPRdrDrf

21. Harmouche L, Courval A, Mathieu A, Petit C, Huck O, Severac F, et al. A Split-Mouth study comparing photodynamic therapy and scaling and root planning in the treatment of chronic periodontitis. Turk J Public Health Dent. 2022;2(2):23-30. doi:10.51847/0UkmY1pJvP

22. Zakinyan RG, Badakhova GK, Lopteva MS, Koshkina NA, Tolokonnikov VP, Povetkin SN. The link between ixodid tick populations and climate change in the stavropol region. Entomol Lett. 2023;3(2):38-43. doi:10.51847/4lXTZ8h0Bs

23. Khan S, Bibi M, Akbar B, Ahmad N, Ahmad W, Rehman A. A faunistic survey of dragonfly species (anisoptera; odonata) in babuzai, including new records for the swat district, Pakistan. Entomol Lett. 2023;3(2):44-51. doi:10.51847/I2fM8yR3wi

24. World Medical Association. World medical association declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191-4. doi:10.1001/jama.2013.281053

25. Mhd Yunin NS, Tan TL. National early warning score 2 (NEWS2) as a prognostic tool for adult patients in emergency department: a retrospective observational study. PLoS One. 2025;20(6):e0326058. doi:10.1371/journal.pone.0326058

26. Citu C, Gorun F, Motoc A, Gorun OM, Burlea B, Tica AA, et al. Evaluation and comparison of the predictive value of 4C mortality score, NEWS, and CURB-65 in poor outcomes in COVID-19 patients: a retrospective study from a single center in Romania. Diagnostics (Basel). 2022;12(3):703. doi:10.3390/diagnostics12030703

27. Scott LJ, Mowbray F, Denaxas S, Hemingway H, Quinlan GJ. Prognostic value of national early warning scores (NEWS2) and component physiology in hospitalised patients with COVID-19: a multicentre study. Emerg Med J. 2022;39(8):589–94. doi:10.1136/emermed-2020-210624

28. Zhang K, Huang J, Yao X, Huang X, Gao F, Wu D, et al. The prognostic accuracy of national early warning score 2 on predicting clinical deterioration for patients with COVID-19: a systematic review and meta-analysis. Front Med (Lausanne). 2021;8:699880. doi:10.3389/fmed.2021.699880

29. Kohn R, Kuhn G, Klausner JM, Schriger DL, Halpern SD, Merchant RM. The association of geographic dispersion with outcomes among hospitalized pulmonary service patients. Ann Am Thorac Soc. 2020;17(2):249-52. doi:10.1513/AnnalsATS.201906-471RL

30. Ibrahim NA, Kehail MAA. Assessing the biological effects of irradiated sorghum (Sorghum bicolor) seeds in male wistar rats. Int J Vet Res Allied Sci. 2024;4(2):14-9. doi:10.51847/ervtmoliLu

31. Vekovtsev AA, Zakharenko MA, Gorbushina IS, Pliska OV, Poznyakovsky VM, Tokhiriyon B, et al. Innovative biotechnological variants of nutritional supplements targeting gut dysbiosis and their clinical evaluation. Int J Vet Res Allied Sci. 2022;2(1):31-6. doi:10.51847/qerJQpA1uI

32. Siddiqui MF, Azaroual M, Raza K, Al-Jumeily D, Hussain A. Leveraging healthcare system with nature-inspired computing techniques: an overview and future perspective. In: Raza K, ed. Nature-inspired intelligent computing techniques in bioinformatics. Vol. 1066. Singapore: Springer Nature Singapore; 2023. p. 19–42. doi:10.1007/978-981-19-6379-7_2

33. Siddiqui MF, Azaroual M, Imam N, Ali R, Mushtaque M, Ishrat R, et al. Pediatric oncology, palliative care and low- or middle-income countries: a call for action. Glob Pediatr Health. 2023;10:2333794X231188591. doi:10.1177/2333794X231188591

34. Barros LM, Dias RC, dos Santos NR, Raza K, Siddiqui MF. Pragmatic recommendations for identification and triage of patients with COVID-19 in low- and middle-income countries. Am J Trop Med Hyg. 2021;104(3 Suppl):3–11. doi:10.4269/ajtmh.20-1064

35. Zhang X, Wu X, Cao J, Guo N, Bo H, Ma Y, et al. Investigating factors affecting the length of patients' stay in hospitals. J Integr Nurs Palliat Care. 2022;3:26–30. doi:10.51847/FLasQgumnS

36. Uzun K, Karataş Z. Investigating the role of metacognitive beliefs, ambiguity tolerance, and emotion processing in predicting nurses' generalized anxiety disorder. J Integr Nurs Palliat Care. 2022;3:36-42. doi:10.51847/mXbCbDAVpU

37. Savva G, Papastavrou E, Charalambous A, Vryonides S, Merkouris A. Studying the nurses' and nursing students' attitudes towards the phenomenon of elderly. J Integr Nurs Palliat Care. 2023;4:6-10. doi:10.51847/DkBR8F3IGx

38. BMJ. Early warning scores for detecting deterioration in adult hospital patients: systematic review and critical appraisal of methodology [Internet]. [cited 2025 Jun 22]. Available from: https://www.bmj.com/content/369/bmj.m1501

39. Harris P, Drame FM, Salim MA, Assefaw MG, Lusambili AM, Assefa N, et al. Empowering frontline primary healthcare workers in a global health partnership training of trainers intervention to strengthen the prevention and

control of cardiovascular disease in Mozambique. Glob Heart. 2022;17(1):51. doi:10.5334/gh.1052

40. Siddiqui MF, Azaroual M. Combatting burnout culture and imposter syndrome in medical students and healthcare professionals: a future perspective. J Med Educ Curric Dev. 2024;11:23821205241285601. doi:10.1177/23821205241285601

41. Ogundaini OO, de la Harpe R, McLean N. Integration of mHealth information and communication technologies into the clinical settings of hospitals in Sub-Saharan Africa: qualitative study. JMIR Mhealth Uhealth. 2021;9(10):e26358. doi:10.2196/26358

42. La Via L, Tinelli G, Spagnolo AM, Gemma M, Bragazzi NL, Martini M, et al. The global burden of sepsis and septic shock. Epidemiologia. 2024;5(3):456–78. doi:10.3390/epidemiologia5030032

43. Alam A, Siddiqui MF, Imam N, Ali R, Mushtaque M, Ishrat R. Covid-19: current knowledge, disease potential, prevention and clinical advances. Turk J Biol. 2020;44(3):121–31. doi:10.3906/biy-2005-29

44. Nature Medicine. Vaccine development for emerging infectious diseases [Internet]. [cited 2025 Jun 22]. Available from: https://www.nature.com/articles/s41591-021-01301-0

45. Burgos-Esteban A, Ruiz-Rodríguez P, Martínez-López J, Sánchez-García M, Piñeiro-Lamas M, Bueno-Cavanillas A, et al. Effectiveness of early warning scores for early severity assessment in outpatient emergency care: a systematic review. Front Public Health. 2022;10:894906. doi:10.3389/fpubh.2022.894906

46. Chen X, Li C, Liu H. Investigating different methods of increasing the stability of medicinal recombinant proteins: a review study. Bull Pioneer Res Med Clin Sci. 2023;2(2):8-14. doi:10.51847/bxQo3dIbnf

47. Burghate S, Mundada A. Comprehensive overview of vaccines and theirtypes for human immunization. Bull Pioneer Res Med Clin Sci. 2023;2(1):9-16. doi:10.51847/R1jQ49OZBM

48. Makhoahle P, Gaseitsiwe T. Efficacy of disinfectants on common laboratory surface microorganisms at R.S mangaliso hospital, NHLS laboratory, South Africa. Bull Pioneer Res Med Clin Sci. 2022;1(1):1-12. doi:10.51847/d5bXpXAtcI