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**Research Article**

# Role of Modified Early Warning Score in Early Detection of Post-Operative Morbidity and Mortality

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**ABSTRACT**

**Background:** Postoperative clinical deterioration remains a major contributor to preventable morbidity and mortality in surgical patients. Early identification of physiological instability is essential to enable timely intervention. The Modified Early Warning Score (MEWS) is a bedside scoring system based on routinely measured vital parameters designed to detect early deterioration. However, data evaluating its predictive role in general surgical patients in Indian tertiary care settings remain limited.

**Aim**: To assess the efficacy of MEWS score in predicting post-operative decline in general surgical patients.

**Methods:** This cross-section study was conducted over a two-year period (June 2023–May 2025) in the Department of General Surgery at NRI General Hospital, Chinnakakani, Guntur. A total of 100 adult patients undergoing major surgical procedures under general or regional anaesthesia were enrolled. Postoperative physiological parameters — including pulse rate, respiratory rate, systolic blood pressure, temperature, urine output, and level of consciousness (AVPU scale)—were recorded, and MEWS was calculated. The highest MEWS score documented prior to clinical stabilization or deterioration was analysed. Primary outcome was in-hospital mortality. Secondary outcomes included ICU admission and duration of hospital stay.

**Results**: Fifty-three patients (53%) required postoperative ICU admission, while 47 (47%) were managed in the ward. The mean MEWS score was significantly higher in ICU patients compared to ward patients (4.32 ± 1.50 vs. 1.97 ± 0.94; $p < 0.001$). Significant associations were observed between ICU admission and abnormal pulse rate ($p < 0.001$), respiratory rate ($p < 0.001$), temperature ($p < 0.001$), urine output ($p = 0.0017$), and altered level of consciousness ($p < 0.001$). Systolic blood pressure did not show significant association ($p = 0.494$). Overall mortality was 8%, with all deaths occurring in the ICU group ($p = 0.017$). The mean MEWS score among deceased patients was 6.37, significantly higher than among survivors.

**Conclusion**: Elevated MEWS scores were strongly associated with postoperative ICU admission and in-hospital mortality. MEWS serves as a simple, cost-effective, and reliable bedside tool for early detection of physiological deterioration in surgical patients. Routine implementation of MEWS in postoperative monitoring protocols may facilitate timely escalation of care, optimize ICU utilization, and potentially reduce preventable postoperative mortality.

**Keywords**: Modified Early Warning Score (MEWS), Postoperative Morbidity, Postoperative Mortality, ICU Admission, Early Warning Systems, Surgical Outcomes.

## INTRODUCTION

Clinical deterioration causing death or intensive care unit (ICU) transfer affects around 3% to 5% of patients hospitalized outside the ICU. This is associated with increased morbidity and mortality. [1,2] These increased risks are more commonly seen among patients with serious infection or sepsis, leading to 50% or more of hospital deaths. [3] Previous studies showed that many patients showed signs of increased risk hours before deterioration. These early signals can be captured by clinical data like vital signs or laboratory test results. [1,2,4]. This finding made researchers, and health systems to develop and implement risk scores within early warning systems. These can alert clinicians to intervene in patients at risk for impending deterioration. [1,2,5,6].

Several groups like Joint Commission, the Centers for Medicare and Medic-aid Services promoted certain regulations that focused on leveraging risk scores to enhance the identification and treatment of patients with deteriorating status.[7-10] The Modified Early Warning Score (MEWS) was proposed to warn healthcare providers about development of serious adverse effects.[11-16] MEWS consists of bedside measurements of heart rate(HR), respiratory rate(RR), systolic blood pressure(SBP), temperature, and level of consciousness.[16,17] These measurements are scored and ranked, and management is initiated once threshold scores are exceeded.[16,17] Previous studies suggested that using MEWS, might be beneficial in decreasing mortality among hospitalized patient .[18,19]

**Aims & Objectives**

**MATERIALS & METHODS**

Patients undergoing major surgical procedures are identified. After taking consent, they are included in the study. Serial assessment of patient's condition and vital data is done in the immediate post-operative period. Calculation of MEWS score and identification of highest score before shifting up to ICU or shifting down to general ward. Trends in vital parameters and MEWS scores are identified and the role of score is validated for prediction of outcome.

**Source of Data**: A cross-section study was conducted in the Department of GENERAL SURGERY, NRI, MEDICAL COLLEGE, CHINAKAKANI, Andhra Pradesh, India involving 100 patients from April 2021 to 2022.

**Inclusion Criteria**

Patients undergoing surgical procedures requiring Spinal or General anesthesia.

**Exclusion Criteria**

Patients below 18 years of age

Pregnant women

Parameters assessed are age, gender, admission in intensive care unit or ward, duration of admission, co-morbidities, anaesthesia, pulse rate, systolic blood pressure, respiratory rate, temperature, urine output, level of consciousness, mortality and MEWS Score.

Modified Early Warning Score (MEWS) is a tool developed to monitor vital signs among acutely ill patients, mainly after surgery. The goal is to identify patients at risk of deterioration, enabling early intervention to prevent adverse outcome.[20,21.] (Table 1).

**Statistical Analysis:**

Frequencies and percentages were used for demographic variables. Mean and standard deviation were used for continuous variables. Statistical analysis was done using Epi Info Software version 7.2.5 and Microsoft Excel. Association between categorical parameters was done by chi-square test/Fischer exact test. P- value below 0.05 is significant.

**RESULTS**

A total of 100 patients were enrolled in the study. Of these, 53 patients (53%) required postoperative admission to the Intensive Care Unit (ICU), while 47 patients (47%) were managed in the surgical ward. The mean age of patients admitted to the ICU was 59.74 ± 12.74 years, whereas the mean age of patients managed in the ward was 61.64 ± 12.22 years. The men age in comparable in both the groups ($p = 0.759$), indicating that age distribution was comparable across ICU and ward populations. Among females, 28 were admitted to ICU and 15 to ward, while among males, 25 were admitted to ICU and 32 to the ward. The Pearson chi-square test showed a statistically significant association between gender and patient group ($x2=4.446$, $p=0.035$), indicating that females were more frequently admitted to ICU, whereas males were more commonly managed in ward. Co-morbidities were present in 66 patients (66%) of the total study population. Among these, 38 patients belonged to the ICU group and 28 to the ward group. In contrast, among the 34 patients without co-morbidites, 12 required ICU admission and 22 were managed in the ward. The association between presence co-morbidities and ICU admission was statistically significant (Chi-square = 8.716, $p = 0.003$), suggesting that patients with underlying systemic illnesses were more likely to require higher-level postoperative monitoring. In total, 53 patients received general anesthesia (GA) and 47 patients underwent surgery under regional anesthesia (RA). Of those who received GA, 49 patients (92.5%) required ICU admission, while only 4 patients (7.5%) were managed in the ward. Conversely, among those who received RA, 4 patients (8.5%) required ICU admission and 43 patients (91.5%) were managed in the ward. This difference was highly statistically significant (Chi-square = 70.463, $p < 0.001$), indicating a strong association between type of anesthesia and postoperative ICU requirement. Analysis of postoperative physiological parameters revealed significant differences between ICU and ward groups. Pulse rate (PR) distribution varied significantly (Chi-square = 38.071, $p < 0.001$). Higher PR ranges (111–129

beats per minute) were observed exclusively in ICU patients (20 cases), and bradycardia (41–50 beats per minute) was also confined to the ICU group (10 cases). In contrast, PR within 51–100 beats per minute were more frequently observed among ward patients. Systolic blood pressure (SBP) distribution did not show a statistically significant difference between the two groups (Chi-square = 1.411, p = 0.494). Most patients in both groups had SBP values between 100 and 199 mmHg, suggesting that isolated SBP variation did not independently differentiate ICU from ward patients in this cohort. Respiratory rate (RR) distribution demonstrated a statistically significant difference (Chi-square = 19.048, p < 0.001) in two group of patients. Abnormal RR (9–14 cycles\min and <8 cycles per minute) were predominantly observed among ICU patients, whereas the majority of ward patients had rate within the normal range of 15–20 cycles\min. This highlights the importance of RR as a sensitive indicator of postoperative deterioration. Body temperature also differed significantly between the two groups (Chi-square = 39.84, p < 0.001). Fever (38.1–38.5°C) was observed exclusively in ICU patients (25 cases), while all ward patients had temperatures within the 36.1–38°C range. Hypothermia (35.1–36°C) was noted in 6 ICU patients and none in the ward group. These findings reflect greater systemic inflammatory or infectious processes among ICU patients. Urine output showed significant association with ICU admission (Chi-square = 9.85, p = 0.0017). Reduced urine output (<0.5 ml/kg/hour) was observed in 10 ICU patients and none in the ward group, indicating compromised renal perfusion or systemic instability in the ICU cohort. Level of consciousness demonstrated a highly significant difference between groups (Chi-square = 80.989, p < 0.001). Among ICU patients, 50 were responsive only to voice, while only 3 were fully alert. In contrast, 45 ward patients were fully alert and only 2 responded to voice. This marked difference underscores neurological status as a strong discriminator between stable and unstable postoperative patients. The mean Modified Early Warning Score (MEWS) among ICU patients was 4.32 ± 1.50, compared to 1.97 ± 0.94 among ward patients. The difference in mean MEWS scores was highly statistically significant (t = 9.19, p < 0.001). This indicates that patients requiring ICU admission had substantially higher physiological derangement as quantified by MEWS. Overall, in-hospital mortality was 8% (8 patients). All deaths occurred in the ICU group, while no mortality was recorded in the ward group. The association between ICU admission and mortality was statistically significant (Chi-square = 5.660, p = 0.017). The mean MEWS score among deceased patients was 6.37, which was markedly higher than that of survivors, demonstrating a strong correlation between elevated MEWS scores and mortality risk. (Table 2).

## DISCUSSION

Annanditha Kumaret al.,[23] evaluated unplanned escalation of care and its association with surgical patients with a sample of 263, with a mean age of 61, contrastingly this study on comparing ICU and ward patients with respect to MEWS scores, physiological parameters, comorbidity, and mortality outcomes with a sample size of 100, with a mean age of 60.69. Male predominance was observed in both studies. Annanditha Kumar et al.[23]reported 144 males (55%), while the current study included 57 male patients. With regard to comorbidities, Annanditha Kumaret al.[23] reported a high prevalence of systemic hypertension, coronary artery disease, diabetes mellitus, chronic renal insufficiency, and COPD among surgical patients, which was also similar to our study. Out of 34 patients with comorbidities, 25 belonged to the ICU group, indicating associated medical illnesses were frequently linked with ICU admission and higher severity of illness. Similarly, Wu et al.,[25] reported an older patient population, with a mean age of 75 years and 78 years among the non-survivors. In contrast, our study population were younger, with mean ages of 61.64 years in ward patients and 59.74 years in ICU patients. Both studies showed male predominance, with 69% and 57% respectively. Wu et al.[25] also observed a high prevalence of comorbidities such as hypertension, diabetes mellitus, chronic renal disease, cirrhosis, and COPD consistent with our results. Among the 34 patients with comorbidities in our study 25 were admitted to the ICU, while only 9 were managed in the ward. Indicating that multiple comorbid conditions may contribute to increased disease severity and the need for intensive care management. Our study demonstrated a significant difference in the duration of hospital stay between ICU and ward patients, highlighting the greater health care burden associated with critically ill patients. Umesh Raj

et al[26]. Suggested that patients with higher MEWS score (7-8) required longer SICU stays. Our study found a significant difference in MEWS scores between ICU and ward patients, with mean scores of 4.32 and 1.97, respectively. Higher MEWS scores were significantly associated with mortality, with expired patients showing a mean score of 6.37. These findings indicate that elevated MEWS scores are linked to greater clinical deterioration, increased ICU requirement, and poorer outcomes. Similar findings have been reported in previous studies. Khan et al[27]. Found that higher MEWS values predicted severe disease progression in acute pancreatitis, while Kumar et al.[23]reported a positive association between MEWS scores and mortality in surgical patients, although with some limitations in predictive accuracy. Selda Mart et al.[28]reported that the use of the MEWS in postoperative patients enabled early detection of clinical deterioration, reducing ICU admissions and postoperative complications. Their findings demonstrated that MEWS improves patient monitoring and clinical outcome. Similarly, Umesh Raj et al.[26]found that higher MEWS scores correlated with increased mortality, supporting the findings of the present study that elevated MEWS scores are strongly associated with adverse patient outcomes. MEWS Scores and Clinical Outcomes. Higher MEWS scores were significantly associated with ICU admission and mortality. ICU patients had a mean MEWS score of 7.0 compared to 3.65 in ward patients. All six deaths occurred in the ICU group and were linked to higher MEWS scores, highlighting its value in identifying high-risk surgical patients. These findings are consistent with studies by Selda Mart et al[28]. and Umesh Raj et al.[26], which reported that elevated MEWS scores were associated with clinical deterioration, ICU admission, and mortality. While Kumaretal.[23]also observed a positive association with mortality, they reported lower predictive accuracy. Comparison with Wu et al[25], abnormal pulse rate, respiratory rate, and impaired consciousness were associated with poorer outcomes. However, unlike their study, no significant difference in systolic blood pressure was observed. Reduced urine output and temperature abnormalities were also more frequent among ICU patients, supporting their value as indicators of clinical deterioration. (Table 3).

**Limitations**

- The sample size of 100 patients may not be large enough to generalize the findings to the broader population.
- Single centre study, so limited validity.
- The study may be subject to selection bias, as participants were taken only from General surgical dept. and allied specialties, without including other surgical departments.
- Important confounding factors such as pre-existing medical conditions have not been fully considered.
- The observational nature of the study limits the ability to establish causal relationships between pre-operative condition and outcomes.

## CONCLUSION

This study on 100 patients showed significant differences between ICU and ward admissions. More than half (53%) of the patients were admitted to the ICU. The duration of monitored hospital stays varied significantly between two groups, and 20 patients stayed for just one day in PACU, while 9 patients required 6 days of ICU stay. Comorbidities were more prevalent in the ICU group, 66% patients had comorbidities. Anaesthesia type also showed a significant difference, with 53% patients receiving General Anaesthesia, potentially affecting the outcomes, and needing ICU stay. Main physiological parameters like pulse rate, respiratory rate, body temperature, urine output, and consciousness levels differed between groups, and ICU patients showed more severe deviations. Significant association was seen between more MEWS score and increased mortality. MEWS is a robust predictor of post-operative morbidity (ICU admission) and mortality. Patients with MEWS ≥4 had significantly higher ICU admission rates, and MEWS=8 was a critical threshold for mortality. Components of MEWS (e.g., pulse rate, RR, temperature, consciousness) showed strong associations with adverse outcomes, validating its clinical utility. The findings underline the importance of monitoring vital signs and comorbid conditions in hospitalized patients.

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Table 1 Modified Early Warning Score (MEWS):[22]

| Physiological Parameter | 3 Points | 2 Points | 1 Point | 0 Points (Normal) | 1 Point | 2 Points | 3 Points |
|---|---|---|---|---|---|---|---|
| **Systolic BP (mmHg)** | ≤ 70 | 71–80 | 81–100 | 101–199 | — | ≥ 200 | — |
| **Heart Rate (bpm)** | — | < 40 | 41–50 | 51–100 | 101–110 | 111–129 | ≥ 130 |
| **Respiratory Rate (rpm)** | — | < 9 | — | 9–14 | 15–20 | 21–29 | ≥ 30 |
| **Temperature (°C)** | — | < 35.0 | — | 35.0–38.4 | — | ≥ 38.5 | — |
| **Mental Status (AVPU)** | — | — | — | Alert | Voice | Pain | Unresponsive |

Table 2

| Variable | ICU (n=53) | Ward (n=47) | P value |
|---|---|---|---|
| **Mean age (years)** | 59.74 | 61.64 | 0.759 |
| **Gender** | | | |
| Female | 28 | 15 | 0.035 |
| Male | 25 | 32 | |
| **Comorbidities** | | | |
| Hypertension | 9 | 6 | 0.003 |

| | | | |
|---|---|---|---|
| Hypertension + coronary artery disease | 8 | 7 | |
| coronary artery disease | 6 | 3 | |
| Diabetes + Hypertension | 4 | 4 | |
| Diabetes | 11 | 8 | |
| None | 15 | 19 | |
| **Type of anaesthesia** | | | |
| General | 49 | 4 | <0.001 |
| Regional | 4 | 43 | |
| **Pulse rate distribution (beats/ min)** | | | |
| 51–100 | 9 | 20 | <0.001 |
| 101–110 | 14 | 27 | |
| 111–129 | 20 | 0 | |
| 41–50 | 10 | 0 | |
| **SBP distribution (mmHg)** | | | |
| 100–199 | 40 | 36 | 0.494 |
| >200 | 11 | 7 | |
| 81–100 | 2 | 4 | |
| **Respiratory rate (Cycles/ min)** | | | |
| 15–20 | 33 | 46 | <0.001 |
| 9–14 | 19 | 1 | |
| <8 | 1 | 0 | |
| **Temperature** | | | |
| 35.1–36°C | 6 | 0 | <0.001 |
| 36.1–38°C | 22 | 47 | |
| 38.1–38.5°C | 25 | 0 | |
| **Urine output (ml/kg/hr)** | | | |
| >0.5 | 43 | 47 | 0.0017 |
| <0.5 | 10 | 0 | |
| **Level of consciousness** | | | |
| Alert | 3 | 45 | <0.001 |
| Voice | 50 | 2 | |
| **Mortality** | | | |
| Yes | 8 | 0 | 0.017 |
| No | 42 | 50 | |
| **MEWS score** | 4.32 ± 1.50 | 1.98 ± 0.94 | <0.001 |

Table 3

| Parameter | Our Study | Somasundaram et al. (2018) [24] | Khan et al. (2021)[27] | Wu et al. (2023)[25] | Kumar A. et al. (2020)[23] |
|---|---|---|---|---|---|
| Study Design | Cross-sectional observational | Prospective cohort | Observational | Retrospective | Retrospective |
| Sample Size | 100 | 150 | 200 | 336 | 263 |
| Mean Age | 60.69 | 41.31 | 37 | 75 | 61 |
| Male | 57 | 76 | 120 | 205 | 144 |
| Female | 43 | 74 | 80 | 91 | 119 |
| Hypertension | 15 | NOT | NOT | 194 | 103 |
| CAD | 9 | NOT | NOT | 49 | 44 |
| Diabetes | 19 | NOT | NOT | 120 | 65 |
| No Comorbidity | 34 | 122 | NOT | NOT | NOT |
| General Anaesthesia | 53 | 64 | NOT | NOT | NOT |

| | | | | | |
|---|---|---|---|---|---|
| Regional Anaesthesia | 47 | 86 | NOT | NOT | NOT |
| Mortality | 8 | 7 | 2 | 40 | 77 |
| ICU/SICU Admission | 53 ICU | 33 SICU | 25 ICU | NOT | All admitted to SICU |
| MEWS Threshold Mean | 4.32 | 7–8 | hMEWS>2; mMEWS>1.2 | 5.0 | 3 |
| Main Conclusion | Higher MEWS associated with ICU admission and mortality | Effective SICU predictor | Predicts severe AP | Best predictor among six scores | Poor mortality discriminator |