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Research Article

# ROLE OF MODIFIED EARLY WARNING SCORE IN EVALUATING MORTALITY IN POST-OPERATIVE PERIOD

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**ABSTRACT**

**Objectives:** The intent of the study is to analyze the role of modified early warning score (MEWS) in the assessment of the need of early intervention and surgical intensive care unit (SICU) admission in patients undergoing elective and emergency major surgical procedures.

**Methods:** This prospective study incorporated 150 patients who underwent emergency or elective major surgical procedures, with monitoring of physiological parameters in the post-operative period with implementation of MEWS. The MEWS score of 1–3: Escalation of monitoring done. MEWS of 4–5: Escalation of monitoring, urgent assessment by the surgical team, shift of patient to intensive care unit (ICU) if required. MEWS of ≥6: Shift of patient to ICU with emergency assessment by the surgical/medical/ICU team. Outcomes were (1) improvement in patients' clinical condition after early goal-directed therapies (frequent monitoring, shifting to ICU), (2) discharged alive from the hospital, and (3) patient death.

**Results:** In our study, all the patients with MEWS from 1 to 7 were discharged alive and all the patients with a score above ≥8 were succumbed to death suggesting MEWS score of ≥8 implicates the strict need for SICU admission and an increased mortality of the patient in the post-operative period. MEWS improved communication between nursing staff, junior doctors with surgical team to "flag-up" and prioritize patients.

**Conclusion:** The MEWS is an important risk management tool that is simple to implement and effective in identifying the early deterioration of the patients, which can be used as a routine protocol in post-operative period and assessing the need of ICU for further interventions.

**Keywords:** Modified early warning score, Emergency major surgical procedures, Mortality and morbidity, Predictor efficacy of modified early warning score.

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## INTRODUCTION

The post-operative mortality and morbidity of the patient's undergoing major invasive surgical procedures can be dramatically decreased only by a team-guided approach [1]. The multimodality approach including doctors of various specialties including the operating general surgeon, anesthetist, intensivist and specialist physician, and finally nursing care can be involved [2]. In a post-operative patient, the physiological parameters can be monitored by invasive methods such as central venous pressure monitoring and intra-arterial blood pressure monitoring. However, all these invasive monitoring techniques are difficult to perform in operating setups which lack highly sophisticated monitoring systems [3].

Fortunately, there are many scoring systems in evaluating the post-operative mortality and morbidity in patients undergoing major invasive surgical procedures [4]. These non-invasive scoring systems based on various physiological parameters. Moreover, these scoring systems will provide the pathological changes occurring in the patient's physiological system [5]. They usually do not require a highly sophisticated setup and can be undertaken using simple and regular clinical examinations. The various clinical examinations which can be used for the bedside monitoring of the post-operative patient are pulse rate, blood pressure, respiratory rate, temperature, level of consciousness, and urine output [7].

In 1997 Morgan, Williams and Wright in the UK were the first to develop and publish the early warning score (EWS) of five physiological parameters (heart rate, SBP, respiratory rate, temperature, and consciousness level). Each parameter had a range of cut points with corresponding color banded trigger points, not to predict outcome but to serve as a track-and-trigger system to identify early signs of deterioration [7]. In 1999, Stenhouse *et al*. proposed modification of EWS to modified EWS (MEWS) which includes original five parameters from EWS and oxygen saturation, and urine output are added [8].

The present study conducted to predict role of MEWS in evaluating mortality in post-operative period.

## METHODS

This is a prospective and cohort study conducted over a period of 1.5 years conducted on patients who undergo elective and emergency surgeries in all the units of the Department of Surgery, Navodaya Medical College Hospital, Raichur, Karnataka. Study sample size is 150 patients who undergo elective and emergency surgeries in all the units of the department of surgery. Age below 18 years, polytrauma, pregnant patients, and patients not willing to give informed consent were excluded from the study. Informed consent was taken from the patients who are willing to be a part of the study.

Information was collected through a prepared pro forma which contains patient's details and MEWS chart. MEWS was calculated immediately after admission to post-operative ward and repeated according to patients' condition and MEWS guidelines. The graded response strategy for patients identified as being at risk of clinical deterioration should be triggered by either physiological track and the score or clinical concern. The trigger threshold for implementing the graded response strategy is set locally and is clearly stated on the observation chart. The threshold should be reviewed regularly to optimize sensitivity and specificity.

**Table 1: MEWS chart [9,10]**

| MEWS score | 3 | 2 | 1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| Temperature (°c) | | ≤35 | 35.1–36 | 36.1–38 | 38.1–38.5 | ≥38.6 | |
| Systolic BP | ≤70 | 71–80 | 81–100 | 101–199 | | ≥200 | |
| Heart rate | | ≤40 | 41–50 | 51–100 | 101–110 | 111–129 | ≥130 |
| Respiration rate | | ≤8 | | 9–14 | 15–20 | 21–29 | ≥30 |
| Oxygen saturation | <85 | 85–89 | 90–93 | ≥94 | | | |
| Urine output (mL/hr) | <80 | | 80–120 | >120 | | | |
| Level of consciousness | | | | Alert | Response to voice | Response to pain | Unresponsive |

MEWS: Modified early warning score

A graded response strategy depends on scores. It consisted of three levels – low (0–3), medium (4–5), and high scores (≥6).

## RESULTS

A total of 150 patients who major surgeries were analyzed in the study. Table 4 shows the gender distribution of the study.

From the above tabular column, the p value of sex distribution of admissions into the surgical intensive care unit (SICU) ward and post-operative ward was found to <0.518 which was found to be insignificant value. The patients who underwent major surgical procedures under general anesthesia (GA) were 51, out of which 21 (95.45%) patients were admitted in SICU and 30 (23.44%) patients were admitted in post-operative ward using the MEWS scoring system.

Patients who underwent major surgical procedures under regional anesthesia (RA) were 99, out of which one (4.55%) is admitted into the SICU, and 98 (76.56%) patients were admitted in post-operative ward using MEWS scoring system. After applying Chi-square test, the p value was found to be < 0.00 for the admissions into the SICU ward following major surgical procedures under general/RA which is found to be significant (Fig. 1).

Table 5 shows the various parameters assessed in the patients. These parameters are used for calculation of MEW scoring.

From the above tabular column, the Chi-square was found to be 143.15 and the p value was found to be 0.00 and was found to be significant.

Table 6 shows the number of days patients (both SICU and ward) stayed in the hospital.

Moreover, Table 7 shows the MEWS scoring in patients admitted in SICU and ward.

Table 8 shows the incidence of mortality (death rate) in SICU and post-operative wards.

## DISCUSSION

For a surgeon, post-operative care and monitoring are as important as a surgical procedure in preventing mortality. Successful and skillful surgery with inadequate post-operative monitoring, leading to the death of a patient is certainly unacceptable [13]. Inappropriate action in response to observed abnormal physiological and biochemical variables might lead to avoidable death. Suboptimal care prior admission to a critical care unit can lead to increased mortality [14].

Khan *et al.*, conducted a study on the role of MEWS in the prognosis of acute pancreatitis and they found that with 90.8% of specificity and 83.3% of positive predictive value, the highest MEWS value >2 on day one is most accurate in predicting severe acute pancreatitis. Moreover, mean MEWS of >1.2 on day two was the most accurate in predicting severe acute pancreatitis, with a 6.6%, of specificity, 81.2% of sensitivity, 85.9% of negative predictive value, and positive predictive values of 69.8% [15].

**Table 2: Grading of MEWS [11]**

| Risk stratification | MEWS score |
|---|---|
| Low risk | 0–3 |
| Medium risk | 4–5 |
| High risk | ≥6 |

MEWS: Modified early warning score

**Table 3: Treatment strategy based on modified early warning score [9,10,12]**

| MEWS | Treatment strategy |
|---|---|
| MEWS score of 1–3 | Escalation of monitoring done |
| MEWS score of 4–5 | Escalation of monitoring, urgent assessment by the surgical team with physician/anesthetists opinion. Shift of patient to ICU if required |
| MEWS score of≥6 | Shift of patient to ICU with emergency assessment by the surgical/medical/ICU team |

MEWS: Modified early warning score, ICU: Intensive care unit

**Table 4: Gender distribution**

| Sex | SICU, n (%) | Ward, n (%) | Total, n (%) | $\chi^2$ | p |
|---|---|---|---|---|---|
| Male | 15 (68.18) | 78 (60.94) | 93 (62) | 0.418 | 0.518 |
| Female | 7 (31.82) | 50 (39.06) | 57 (38) | | |
| Total | 22 (100) | 128 (100) | 150 (100) | | |

SICU: Surgical intensive care unit

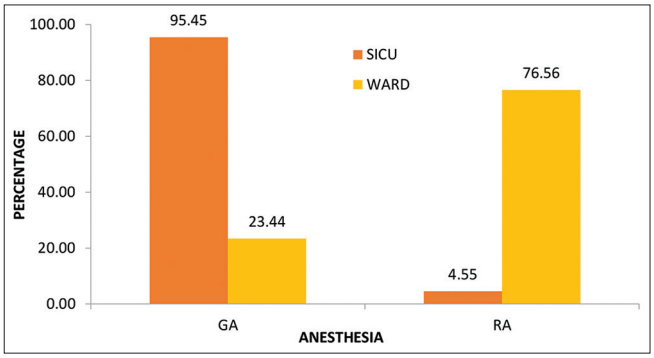


**Fig. 1: Types of anesthesia used in the study population**

In a study conducted by Kumar *et al.*, among 263 consecutive patients, 29.3% of mortality was seen following unplanned escalation of care, ranging from 22% to 57%, with all positive MEWS values. There was no significant association between MEWS with future mortality (p=0.0107) [16].

Yu *et al.*, concluded from their study that both MEWS and revised trauma score (RTS) were independent predictors of the prognosis in patients with emergency trauma, and better predictive efficacy was observed with MEWS [17].

**Table 5: Various parameters in surgical intensive care unit and ward patients**

| Parameter | SICU | Ward | Total | $\chi^2$ | p |
|---|---|---|---|---|---|
| Duration of surgery (h) | | | | | |
| One | 2 (9.09) | 99 (77.34) | 101 (67.33) | 51.611 | 0.000 |
| Two | 7 (31.82) | 19 (14.84) | 26 (17.33) | | |
| Three | 11 (50) | 10 (7.81) | 21 (14) | | |
| Four | 2 (9.09) | 0 | 2 (1.33) | | |
| Comorbidity | | | | | |
| Yes | 13 (59.09) | 29 (22.66) | 42 (28) | 12.362 | 0.000 |
| No | 9 (40.91) | 99 (77.34) | 108 (72) | | |
| Pulse rate | | | | | |
| 111–129 | 12 (54.55) | 0 | 12 (8) | 80.897 | 0.000 |
| 101–110 | 10 (45.45) | 64 (50.00) | 74 (49.33) | | |
| 51–100 | 0 | 64 (50.00) | 64 (42.67) | | |
| Blood pressure | | | | | |
| ≤70 | 2 (9.09) | 0 | 2 (1.33) | 76.146 | 0.000 |
| 71–80 | 2 (9.09) | 0 | 2 (1.33) | | |
| 81–100 | 18 (81.82) | 19 (14.84) | 37 (24.67) | | |
| 101–199 | 0 | 109 (85.16) | 109 (72.67) | | |
| Respiratory rate | | | | | |
| 9–14 | 1 (4.55) | 109 (85.16) | 110 (73.33) | 66.177 | 0.000 |
| 15–20 | 19 (86.36) | 19 (14.84) | 38 (25.33) | | |
| 21–29 | 2 (9.09) | 0 | 2 (1.33) | | |
| Temperature | | | | | |
| ≤35 or≥38.6 | 7 (31.82) | 0 | 7 (4.67) | 53.804 | 0.000 |
| 35.1–36 or 38.1–38.5 | 15 (68.18) | 61 (47.66) | 76 (50.67) | | |
| 36.1–38 | 0 | 67 (52.34) | 67 (44.67) | | |
| Urine output (mL) | | | | | |
| 80–120 | 15 (68.18) | 7 (5.47) | 22 (14.67) | 66.190 | 0.000 |
| >120 | 6 (27.27) | 121 (94.53) | 127 (84.67) | | |
| <80 | 1 (4.55) | 0 | 1 (0.67) | | |
| Oxygen saturation | | | | | |
| 85–89 | 1 (4.55) | 0 | 1 (0.67) | 75.889 | 0.000 |
| 90–93 | 11 (50.00) | 0 | 11 (7.33) | | |
| ≥94 | 10 (45.45) | 128 (100) | 138 (92.00) | | |
| Level of consciousness | | | | | |
| Alert | 11 (50.00) | 128 (100.00) | 139 (92.67) | 69.095 | 0.000 |
| Response to voice | 11 (50.00) | 0 | 11 (7.33) | | |

SICU: Surgical intensive care unit

**Table 6: Days of hospital stay**

| | SICU/ward | n | Mean | SD | t | p |
|---|---|---|---|---|---|---|
| Hospital stay | SICU | 22 | 13.18 | 5.315 | 8.250 | 0.000 |
| | Ward | 128 | 7.48 | 2.401 | | |

SICU: Surgical intensive care unit, SD: Standard deviation

**Table 7: MEWS scoring**

| MEWS | SICU, n (%) | Ward, n (%) | Total, n (%) |
|---|---|---|---|
| 0 | 0 | 29 (22.66) | 29 (19.33) |
| 1 | 0 | 51 (39.84) | 51 (34.00) |
| 2 | 0 | 32 (25.00) | 32 (21.33) |
| 3 | 0 | 10 (7.81) | 10 (6.67) |
| 4 | 1 (4.55) | 6 (4.69) | 7 (4.67) |
| 5 | 4 (18.18) | 0 | 4 (2.67) |
| 6 | 5 (22.73) | 0 | 5 (3.33) |
| 7 | 4 (18.18) | 0 | 4 (2.67) |
| 8 | 3 (13.64) | 0 | 3 (2.00) |
| 9 | 2 (9.09) | 0 | 2 (1.33) |
| 10 | 2 (9.09) | 0 | 2 (1.33) |
| 11 | 1 (4.55) | 0 | 1 (0.67) |
| Total | 22 (100.00) | 128 (100.00) | 150 (100.00) |

SICU: Surgical intensive care unit, MEWS: Modified early warning score

According to a study done by Hester *et al*., in neurocritical ill patients, MEWS – sepsis recognition score and MEWS are associated with higher in hospital mortality and are preferentially triggered in setting of neurologic worsening. They are less reliable in identifying new infection or sepsis in this patient population [18].

**Table 8: Deaths in surgical intensive care unit and ward**

| Mortality | SICU/Ward | | Total, n (%) | $\chi^2$ | p |
|---|---|---|---|---|---|
| | SICU, n (%) | Ward, n (%) | | | |
| Death | 8 (36.36) | 0 | 8 (5.33) | 49.168 | 0.000 |
| Alive | 14 (63.64) | 12 8 (100.00) | 142 (94.67) | | |
| Total | 22 (100) | 128 (100) | 150 (100) | | |

SICU: Surgical intensive care unit

## CONCLUSION

The MEWS is an important risk management tool that is simple to implement and effective in identifying the early deterioration of patients, which can be used as routine protocol in post-operative period and assessing the need of intensive care unit for further interventions. MEWS improved communication between nursing staff, junior doctors with surgical teams to "flag-up" and prioritize patients. MEWS scoring can be effectively used in patients undergoing both elective and emergency surgical procedures and has been proven to be a valuable tool in analyzing and assessing the prognosis of the patient in the post-operative period.

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## AUTHORS' CONTRIBUTION

Dr. Nivedita and Dr. Mohammed Faizul Viqhas K designed and conceptualized the study. Data collection was done by all three authors.

Dr. Nivedita, Dr. Mohammed Faizul Viqhas K and Dr. Mohammad Noor Alam analyzed and interpreted the data. All the authors are involved in drafting of the manuscript and critical revision of the article. All authors reviewed the results and approved the final version of the manuscript.

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**CONFLICTS OF INTEREST**

All authors declare that they have no conflicts of interest.

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