JGPEMN
ISSN 2091-279X
eISSN 2362-1168

ORIGINAL ARTICLE

Comparison of the rapid emergency medicine score and rapid acute physiology score in non-surgical emergency department patients

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Date of submission: 15 May 2024

Date of acceptance: 26 Jun 2024

Date of Publication: 7 Jul 2024

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How to cite:
Yadav JK, Mansuri MI, Yadav AK, Thakur N. Comparison of the rapid emergency medicine score and rapid acute physiology score in non-surgical emergency department patients. J Gen Pract Emerg Med Nepal. 2024 Jun;11(17):21-27.

Online information
DOI:
https://doi.org/10.59284/jgpeman264

Abstract

Introduction: Emergency medical admissions pose a significant burden, necessitating effective risk stratification tools for mortality estimation. The current study aims to compare the prognostic accuracy of existing severity scoring systems, Rapid Acute Physiology Score (RAPS) and Rapid Emergency Medicine Score (REMS) in estimating mortality risk among non-surgical patients

Method: This cross-sectional study, conducted at a teaching Hospital in Nepal for three months. Data collection involved clinical assessments and estimating RAPS and REMS scores. Chi-square test and correlation analysis were employed to assess the significance of severity scores and their association with clinical parameters. The predictive accuracy of RAPS and REMS for in-hospital mortality was determined.

Result: The study encompassed 154 patients admitted to the emergency department and moved to Medicine, ICU, Emergency Room, and ENT departments. Both scores had similar overall performance, but REMS showed slightly higher sensitivity (95.93%) compared to RAPS (85.37%). Positive correlations were observed between REMS and age ($p<0.001$, $r=0.755$), Mean Arterial Pressure ($p=0.005$, $r=0.226$), and Pulse Rate ($p=0.009$, $r=0.210$), while negative correlations were noted with Oxygen saturation (SpO2) ($p<0.001$, $r=-0.430$) and Glasgow Coma Scale ($p<0.001$, $r=-0.386$). RAPS showed positive correlations with age ($p<0.05$, $r=0.15$), Pulse Rate ($p<0.001$, $r=0.176$), and negative correlations with SpO2 ($p<0.001$, $r=-0.347$) and Glasgow Coma Scale ($p<0.001$, $r=-0.405$). Both RAPS and REMS demonstrated significant associations with Chronic obstructive pulmonary disease, hypertension, and diabetes mellitus. Majority of non-survivors had intermediate-risk (6-13) REMS score (70.58%), but low (<6) RAPS score (76.47%).

Conclusion: The study compared RAPS and REMS in predicting mortality among non-surgical emergency patients, finding comparable effectiveness. While both had similar overall performance, REMS showed slightly higher sensitivity (95.93%) compared to RAPS (85.37%).

Keywords: Mortality, Non-surgical emergency admissions, Prognostic accuracy, Rapid Emergency Medicine Score (REMS), and Rapid Acute Physiology Score (RAPS).

INTRODUCTION

Emergency medical admissions represent a substantial portion of the Emergency Department's (ED) workload, placing a significant demand on healthcare resources.[1-2] To efficiently manage this patient influx, scoring systems for risk stratification serve as invaluable tools, providing essential insights into disease severity, aiding in patient prioritization, predicting prognosis, assessing care quality, and optimizing resource allocation.[3,4] Clinicians require accurate and reliable models with minimal prediction error for effective patient prioritization.[3]

Overcrowding in the ED further emphasizes the need for swift decision-making, prompting the adoption of scoring systems such as the Rapid Emergency Medicine Score (REMS) and the Rapid Acute Physiology Score (RAPS).[5-6] These models, incorporating vital parameters like heart rate, blood pressure, respiratory rate, and Glasgow Coma Scale, offer a quantitative measure of a patient's condition, facilitating rapid and informed decision-making.[5] Notably, the implementation of scoring systems, exemplified by RAPS and REMS, has demonstrated a significant impact on reducing morbidity and mortality in diverse clinical scenarios.[6-8]

Specifically, REMS has exhibited superior sensitivity (95.93%) in identifying trauma patients at risk for mortality, while RAPS demonstrated higher specificity (83.51%) in predicting mortality among trauma patients in emergency settings.[5] Despite REMS showing acceptable prognostic value for clinical use, ongoing efforts are directed toward enhancing its accuracy.[3]

In this context, our study aims to compare the prognostic accuracy of the Rapid Emergency Medicine Score (REMS) and Rapid Acute Physiology Score (RAPS) systems in estimating mortality risk among medical patients in the Emergency Department. The primary objective is to evaluate and discern the effectiveness of REMS and RAPS in predicting the risk of in-hospital mortality within our patient population.[3] Additionally, the study aims to compare the sensitivity of REMS and RAPS in assessing mortality risk, alongside an evaluation of the predictive accuracy of both scoring systems for the length of stay in the hospital.

METHOD

Study Type and Research Method:

This study is a hospital-based cross-sectional investigation conducted using quantitative research methods at a tertiary hospital in Nepal.

Sampling Method and Sample Size:

The study employed a non-probability convenience

Variable	REMS	RAPS
Age	0 – <45 +2 – 45-54 +3 – 55-64 +5 – 65-74 +6 – >74	
PR (/min)	0 – 70-109 +2 – 55-69/110-139 +3 – 40-54/140-179 +4 – ≤39/≥180	0 – 70-109 +2 – 55-69/110-139 +3 – 40-54/140-179 +4 – ≤39/≥180
RR (/min)	0 – 12-24 +1 – 10-11/25-34 +2 – 6-9 +3 – 35-49 +4 – ≤5/≥49	0 – 12-24 +1 – 10-11/25-34 +2 – 6-9 +3 – 35-49 +4 – ≤5/≥49
MAP (mmHg)	0 – 70-109 +2 – 50-69/ 110-129 +3 – 130-159 +4 – ≤49/>159	0 – 70-109 +2 – 50-69/ 110-129 +3 – 130-159 +4 – ≤49/>159
SpO_2 (%)	0 – >89 +1 – 86-89 +3 – 75-85 +5 – <75	
GCS	0 – 14 or 15 +1 – 11-13 +2 – 8-10 +3 – 5-7 +4 – 3 or 4	0 – ≥14 +1 – 11-13 +2 – 8-10 +3 – 5-7 +4 – ≤4

sampling method. The justification for this sample size was based on an assumed mortality rate of 11.3%.[3] The formula $n = \frac{z^2 p(100-p)}{d^2}$ was utilized, with z representing 1.96 at a 5% level of significance, resulting in a calculated sample size of 154.

Duration of Study and Selection Criteria:

The study spanned three months from April – June 2021 at NMC and Teaching Hospital, Birganj, Parsa, Nepal. Inclusion criteria encompassed adult patients over 18 years presenting at the emergency department, while exclusion criteria involved individuals with trauma (e.g., RTA, falls, assaults, burns), mental illness, those with surgical treatment, those deceased at the ER scene or upon arrival at the hospital, those with hospital stay < 24 hours, pregnant patients, and women in labor.

Study Variables and Data Collection

The RAPS and REMS scoring systems were adapted from Goodacre, et al., 2003,[9] which included variables such as age, respiratory rate, pulse rate, mean arterial pressure, pulse oxygen saturation, and Glasgow Coma Scale (Table 1). A RAPS score of <6, 6-10 and >10 was considered low, intermediate, and high-risk scores respectively. A REMS score of <6, 6-13 and >13 was considered low, intermediate, and high-risk scores respectively.[15] Upon conducting the RAPS and REMS scoring tests, data collection involved a comprehensive process, starting with obtaining written informed consent, followed by a quick history from patients or their representatives. Clinical examinations were conducted, and vital parameters were recorded manually or using specific instruments. Disease severity assessment was performed based on emergency protocols, and patients were admitted to the ward or ICU or discharged accordingly.

Outcome Measures and Data Analysis

Outcome measures included ICU or ward admission, hospital mortality, and duration of hospital stay. Data were entered into Microsoft Excel and analyzed using SPSS version 24.

Statistical tests such as the chi-square test and correlation analysis were applied. The sensitivity and specificity of the scores were calculated. Results were presented through tables and graphs.

Ethical Consideration:

The study adhered to ethical standards outlined in the Helsinki Declaration of 1964, as revised in 2000. Approval was obtained from the institutional review board of the NMC and Teaching Hospital, Birganj, Parsa, Nepal. Informed consent was secured from all study participants and/or their caregivers, ensuring the protection of confidentiality and the ethical treatment of participants.

RESULT

The hospital-based cross-sectional study conducted at a NMC and Teaching Hospital, Birganj, Parsa, Nepal, included 154 patients with a mean age of 48.43 (SD±18.6) years. Among the participants, 80 (52%) were males, and 74 (48%) were females, resulting in an M:F ratio of 1.08:1. The study revealed a mortality rate of 11.03%, with a mean hospital stay of 5.03 days. Detailed demographic and clinical parameters are summarized in Table 1.

Severity Scores and Patient Distribution

The severity assessment using RAPS and REMS scores revealed interesting findings. RAPS scores showed a mean of 1.733 (SD±1.906) and a median of 2. REMS scores exhibited a mean score of 4.11 (SD±3.4) and a median of 3 (Figure 1).

Admission Distribution and Severity Scores in Different Wards

Post admission to the emergency department, those moved to the Medicine ward were observed to have the highest mean RAPS (1.72) and REMS (4.11) scores. The highest emergency admissions were moved to the Medicine ward (N = 89, 57.7%), followed by ICU (N = 53, 34.4%). In Table 2, the mean RAPS and REMS scores among patients moved to different hospital wards post emergency ward admission are detailed.

The duration of stay varied across severity scores, reflecting the impact of health status on hospitalization duration. The mean RAPS and REMS scores for the entire cohort were 1.733 (±1.906) and 4.11 (±3.4), respectively. Figure 1 provide a comprehensive overview of the relationship between severity scores and the duration of hospital stay. The mean duration of stay was 5.03 (±4.8) days, with mortality rates highest in ICU (5.84%) and the Emergency department (5.1%). Notably, mean RAPS scores for non-survivors were 4.35 (SD ± 1) and mean REMS scores were 9.23 (SD ± 6).

Association of Severity Scores with Clinical Parameters and Co-morbidities

Positive correlations were observed between REMS score and age ($p < 0.001 r = 0.755$,), mean arterial pressure (MAP) ($p = 0.005$, $r = 0.226$,), and pulse rate (PR) ($p = 0.009$, $r = 0.210$). Negative correlations were noted with peripheral oxygen saturation (SpO_2) ($p < 0.001$, $r = -0.430$) and Glasgow Coma Scale (GCS) ($p < 0.001$, $r = -0.386$). These associations were found to be statistically significant. Similarly, RAPS score exhibited positive correlations with age ($p < 0.05$, $r = 0.15$), MAP ($p = 0.097$, $r = 0.97$), and PR ($p < 0.001$, $r = 0.176$), along with negative correlations with SpO_2 ($p < 0.001$, $r = -0.347$) and GCS ($p < 0.001$, $r = -0.405$). However, the association with MAP was not statistically significant. Additionally, the study explored the relationship between severity scores and co-morbidities. COPD demonstrated a

significant association with both RAPS and REMS scores ($p < 0.02$ and $p < 0.001$, respectively). REMS score also showed significant associations with hypertension (HTN) ($p = 0.003$, $r = 0.955$) and diabetes mellitus (DM) ($p < 0.02$, $r = 0.118$). The association of severity score are given in table 3.
The sensitivity, specificity, positive predictive and negative predictive value of RAPS (cut-off ≥ 6) and REMS score (cut-off ≥ 6) for predicting in-hospital mortality was 76.5%, 80.1%, 32.5%, 96.5% and 23.5%, 100%, 100%, 91.3% respectively.

In our study, a distinct association was found between elevated severity scores and heightened mortality risk. Among the deceased, 70.58% of non-survivors fell into intermediate-risk category with REMS scoring. However, RAPS scoring observed 76.47% in the low-risk category. In contrast, survivors predominantly had low-risk scores (<6) in both scoring systems. Table 5 illustrates the distribution of severity scores in discharged and deceased patients.

DISCUSSION

Our hospital-based cross-sectional study provides comprehensive insights into the demographic, clinical, and outcome characteristics of 154 patients admitted to a teaching hospital in Nepal. The study, including a diverse patient population with a mean age of 48.43 years, revealed a mortality rate of 11.03%, aligning with comparable hospital-based research on general medical admission.[5] The gender distribution (M:F ratio of 1.08:1) and prevalence of comorbidities (COPD 24%,[11] Type 2 DM 12.9%, HTN 5.8%,[12] mirror patterns observed in general medical contexts.[5]

Severity assessment using RAPS and REMS scores provided valuable insights into the perceived acuity of the patients. RAPS scores, with a mean of 1.733 was consistent with observations in general medical admissions.[12] The mean REMS score of 4.11, especially in emergency medicine contexts aligns with the expected distribution patterns, where a majority of admitted patients fell into the intermediate severity ranges.[13]

Ward-wise analysis revealed varying severity scores, with the Medicine ward accommodating the majority of patients (57.7%). The highest mean RAPS (1.72) and REMS (4.11) scores were observed in patients transferred to the Medicine ward, emphasizing its central role in general medical ER admissions. These findings are in line with expectations, as higher acuity cases are often managed in specialized units such as the ICU and Emergency Room.[5]

Table 1. Demographics, baseline characteristics, clinical presentation, and clinical parameters

Characteristics	Values	SD Value	Characteristics	Values	SD Value
Total Participants (n)	154		**Clinical Presentation (%)**		
Mean Age (years)	48.43	±18.6	Dyspnea	23.3%	
Age Range (years)	19 - 97		Fever	22%	
Mean Duration of Stay (days)	5.03	±4.8	Chest Pain	10.3%	
Maximum Duration of Stay (days)	30		Abdominal Pain	8.4%	
Improved Participants	137 (88.9%)		Swelling of Body	7.1%	
Expired Participants	17 (11.03%)		Diarrhea	6.4%	
Gender distribution Male Participants	80 (52%)		Weakness (One Side)	6.4%	
Female Participants	74 (48%)		Palpitation	2.5%	
M:F Ratio	1.08:1		Others	12.9%	
Smoking	8 (5.1%)		**Clinical Parameters**		
Alcohol Consumption	4 (2.5%)		Mean Pulse Rate (units)	91.6	±19
History of co-morbidities			Mean Respiratory Rate	21.94	±5.5
COPD	37 (24.0%)		Mean SpO_2	91.6	±9.25
DM Type 2	20 (12.9%)		Mean MAP	89.7	±2.06
HTN	9 (5.8%)		Mean GCS	14.4	±3.6
Past Tuberculosis	4 (2.5%)				

Legend: The data is represented as n (%) or mean ± SD. Abbreviations: COPD - Chronic Obstructive Pulmonary Disease, DM - Diabetes Mellitus, GCS - Glasgow Coma Scale, HTN - Hypertension, MAP - Mean Arterial Pressure, SD - Standard Deviation, SpO_2 - Peripheral Oxygen Saturation

Table 2. Mean RAPS and REMS Scores in Different Hospital Wards

Attending Ward	RAPS Score (n=154)	Mean RAPS Score (±SD)	REMS Score (n=154)	Mean REMS Score (±SD)
Medicine	89	1.72 (±1.314)	89	4.11 (±2.506)
ICU	53	1.24 (±2.309)	53	2.94 (±3.31)
ER	10	2.30 (±2.49)	10	5.42 (±5.42)
ENT	2	3.3 (±0.00)	2	8.4 (±0.00)

Legend: The data is represented as mean ± SD. Abbreviations: RAPS- Rapid Acute Physiology Score; REMS- Rapid Emergency Medicine Score; SD- Standard Deviation; ICU- Intensive Care Unit; ER- Emergency Room; ENT- Ear, Nose, and Throat

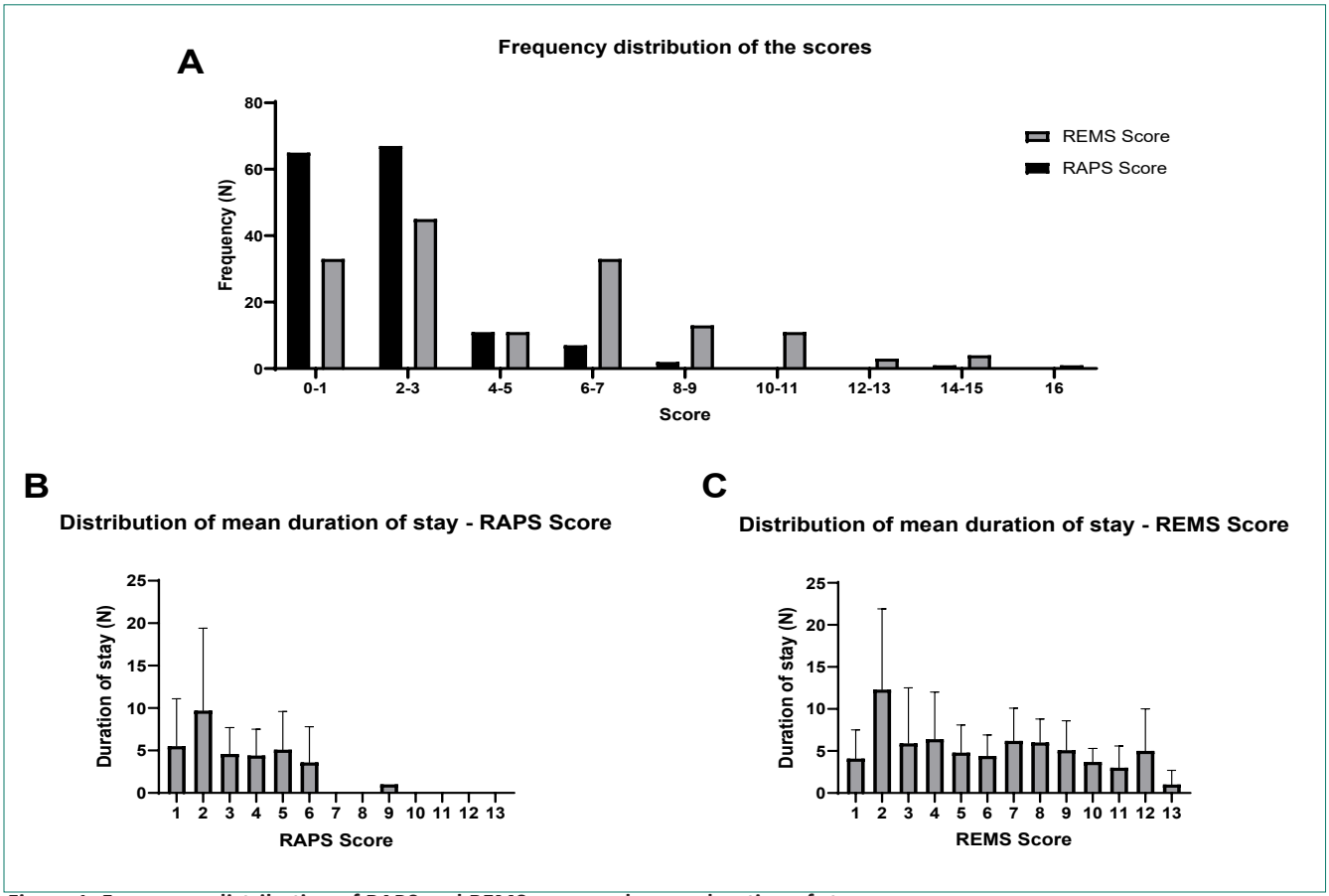

Figure 1. Frequency distribution of RAPS and REMS score and mean duration of stay
Legend: **A)** Frequency distribution of RAPS and REMS scores, **B)** Mean duration of stay with RAPS score, and **C)** Mean duration of stay with REMS score

Our study echoes trends seen in a Thai study, where critically ill patients admitted to ICUs had a higher 28-day mortality rate. Factors such as alteration of consciousness and vasopressor use were associated with increased mortality, while sicker patients with higher BMI were more likely to be accepted for ICU admission.[5]

Our study demonstrated a positive correlation between severity scores and the duration of hospital stay, reflecting the impact of health status on hospitalization duration. Patients with higher severity scores tended to have longer durations of stay, supporting the notion that more severe cases require prolonged medical attention. This aligns with the literature indicating a positive correlation between severity scores and hospital stay.[10]

Our study's mortality rate of 11.04% falls within the expected range for diverse medical admissions. Higher mortality rates in the ICU and Emergency department reflect the acuity of patients in these units. The reported incidence of early death in the ED context aligns with previous studies, ranging from approximately 0.005% to 0.03% of visits.[14]

Correlation analysis revealed significant associations between severity scores and various clinical parameters. Positive correlations with age, MAP, and PR, alongside negative correlations with SpO2 and GCS, are consistent with physiological patterns observed in various medical conditions.[5,14] These findings reaffirm the intricate relationship between patient characteristics and illness severity.

The study also explored the relationship between severity scores and co-morbidities, revealing significant associations of COPD with both RAPS and REMS scores. REMS scores also showed significant associations with hypertension (HTN) and diabetes mellitus (DM). These associations align with previous studies focusing on specific diseases.[1] The literature emphasizes the role of co-morbidities in influencing severity scores, and our findings contribute to this growing body of knowledge.[1]

The Receiver Operating Characteristic (ROC) curves demonstrated that REMS had a higher area under the curve (AUC) of 0.879±0.046 compared to RAPS with an AUC of 0.82±0.067 for predicting in-hospital mortality (Data not shown). While the difference was not statistically significant ($p > 0.05$), the higher AUC for REMS emphasizes its superior prognostic performance in this cohort. This finding aligns with previous research indicating REMS as a powerful predictor of in-hospital mortality in emergency and critical care contexts.[14]

Table 3. Correlation of clinical parameters with severity scores and association with co-morbidities

Parameters	REMS		RAPS	
	p-value	r-value	p-value	r-value
Age	<0.001	0.755	<0.05	0.15
MAP	0.005	0.226	0.097	0.97
SpO_2	<0.001	-0.430	<0.001	-0.347
PR	0.009	0.210	<0.001	0.176
GCS	<0.001	-0.386	<0.001	-0.405
Severity Score	**Co-morbidities**		**RAPS p Value**	**REMS p Value**
RAPS	HTN		0.955	0.003
	DM		0.118	<0.02
	COPD		<0.02	<0.001
	Alcohol		<0.492	0.748
	Smoking		0.176	0.764
	Past TB		0.189	<0.20
REMS	HTN		0.955	0.003
	DM		0.118	<0.02
	COPD		<0.02	<0.001
	Alcohol		<0.492	0.748
	Smoking		0.176	0.764
	Past TB		0.189	<0.20

Legend: The strength and direction of the correlation is indicated by the p-value and r-value respectively. Abbreviations: HTN - Hypertension, DM - Diabetes Mellitus, COPD - Chronic Obstructive Pulmonary Disease, SpO2 - Peripheral Oxygen Saturation, PR - Pulse Rate, GCS - Glasgow Coma Scale

Table 4. Comparison of patient characteristics between survival vs death

Patient characteristics	Discharge (n= 137)		Death (n=17)	
REMS score	**Number**	**Proportion**	**Number**	**Proportion**
High risk >13	0	0	1	5.88
Intermediate risk - 6-13	27	19.7%	12	70.58
Low risk <6	110	80.3%	4	23.52
RAPS score				
High risk >10	0	0	1	5.88
Intermediate risk - 6-10	0	0	3	17.64
Low risk <6	137	100	13	76.47

Legend: The data is represented as n (%). **Abbreviations:** RAPS- Rapid Acute Physiology Score; REMS- Rapid Emergency Medicine Score

In our study, the comparison of severity scores between survivors and non-survivors revealed significant differences in both REMS and RAPS scores. Specifically, the median (interquartile range) REMS scores of the non-survivors were substantially higher than those of the survivors [9.23 (6) vs. 6 (3), $p < 0.001$]. Similarly, the RAPS scores of the non-survivors were also significantly elevated compared to survivors [4.35 (1) vs. 1 (2), $p < 0.001$]. Several studies have reported a positive correlation between higher severity scores and increased mortality rates among critically ill patients. For instance, in a study conducted by Dundar, et al.,[15] they observed a similar trend where non-survivors had a higher proportion of intermediate-risk REMS and RAPS scores [10 (6) vs. 6 (3), 5 (6) vs. 1 (2), respectively; $p < 0.001$ for both] compared to survivors. This consistency across studies reinforces the robustness of severity scores as prognostic indicators in emergency and critical care settings.[5] The predominance of low-risk scores (<6) among survivors further corroborates findings from previous research, highlighting the utility of severity assessment tools in identifying patients with a lower risk of mortality.[16]

The results of this study suggest that both scoring systems, REMS, and RAPS, are effective in predicting the mortality of non-surgical patients presenting to the ED. The study revealed no statistically significant difference between the two scores, with an AUC of 0.879 for REMS and 0.825 for RAPS (Data not shown). This finding underscores the comparable predictive abilities of REMS and RAPS in assessing mortality risk among non-surgical patients in the emergency department.[16]

Limitations of this study include its cross-sectional design, potential lack of generalizability due to a single hospital setting and focus on non-surgical patients. The cross-sectional study design does not allow to control for confounding variables. Due to limitations in categorizing RAPS score and a small sample size, cut-off from a similar scoring system (REMS) was used for bivariate analysis. The sensitivity and specificity calculations maybe

limited by the sample size as the sample size estimation did not account for these calculations. REMS and RAPS score were calculated only during presentation and serial measurements were not considered. Following recovery and discharge, no follow-up was conducted.

CONCLUSION

In conclusion, this study found that both RAPS and REMS demonstrated comparable effectiveness in predicting mortality among non-surgical patients in the emergency department. While there was no statistically significant difference between the two scores, both exhibited an increasing trend in ICU admission and mortality with higher scores. Clinically, REMS appeared to have an edge in predicting mortality, considering co-morbidities and sensitivity.

DECLARATIONS

Acknowledgement

None

Conflict of Interest

None

Funding

None

Ethical Clearance

The clearance was obtained from institutional review board of National Medical College and Teaching Hospital, Tribhuvan University, Kathmandu, Nepal

Consent of Study

Oral consent was obtained

Author Contribution

Conception or design of the work: JKY, Literature search: IM, AKY; Manuscript draft development: JKY, IM; Critical review and editing of the manuscript: JKY, IM, AKY, NT; Final article approval: All authors, JKY, IM, AKY, NT. The final article was approved by all the authors.

Consent for Publication from Authors

Yes

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