Original Article

Quality of Medical Care Provided in ICUs

Effectiveness of Medical Care Provided in ICUs According to Acute Physiology and Chronic Health Evaluation II (APACHE Ⅱ) Score Requirements

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ABSTRACT

Objective: The present study was conducted to assess the quality of medical care delivered in ICUs of IMAM Hussein Medical City, Karbala, Iraq, using the APACHE II scoring system.

Study Design: Cross-sectional study

Place and Duration of Study: This study was conducted at the Imam Al-Hussein Medical City in Karbala, Iraq from October–December 2023.

Methods: This study of 131 ICU patients (≥18 years) conducted at Imam Al-Hussein Medical City in Karbala, Iraq across emergency, medical, and surgical units. Demographic, clinical, and cardiovascular data were used to compute APACHE II scores and accurately predict mortality.

Results: Majority of the patients were males, 62.6%, and above 60 years of age, 38.2%. Pathological admission caused 61.8% into the ICU. The general mortality rate was 52.7% whereas 73.3% of patients were on mechanical ventilation. The statistical analysis done revealed that the APACHE II scores had a significant relation to the patient outcome mainly in the surgical and medical ICUs. Higher APACHE II scores were associated with an increased mortality and mainly so in the emergency ICU since the patients were admitted with more acute illnesses, with their mean APACHE II score standing at 21.77. The surgical ICU remarkably recorded an actual outcome significantly different from the APACHE II predicted mortality with a p-value less than 0.001.

Conclusion: APACHE II predicts ICU mortality, notably in surgical units (scores ≥30–34: 100% fatality; $p<0.001$). Age, comorbidities (DM/HTN), and pathological admissions elevate scores (medical: $r=0.553$; surgical: $r=0.384$; $p\leq0.002$). Males exhibit lower scores ($p\leq0.05$). Emergency ICUs show highest mortality (69.2%) despite comparable scores. Mechanical ventilation correlates with medical ICU scores ($p=0.009$). APACHE II's clinical/metabolic focus (no MAP/HR link) supports risk stratification. Future research needs biomarkers and gender-specific protocols.

Key Words: APACHE II, ICU's criteria, mortality, medical care &ICU.

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INTRODUCTION

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The intensive care unit plays an essential role in managing critically ill patients, providing specialized medical care to those who have life-threatening conditions. Evaluating the effectiveness of care in these units is crucial for improving patient outcomes and ensuring consistent, high-quality treatment. One prominent tool for assessing the severity of illness and predicting patient outcomes in ICUs is the Acute Physiology and Chronic Health Evaluation II (APACHE II) scoring system.[1]

APACHE II has been widely validated across various populations and medical conditions making it a reliable benchmark for monitoring ICU performance.[2] The score incorporates multiple physiological measurements and clinical data to estimate the risk of mortality. By comparing predicted outcomes with actual patient outcomes, medical practitioners can evaluate the performance of their ICUs and identify areas needing improvement.[3]

This study investigates the effectiveness of medical care provided in the ICUs of IMAM Hussein Medical City in Karbala, Iraq, by utilizing the APACHE II scoring system. Previous research has highlighted the importance of APACHE II in different settings, including surgical and medical ICUs, and has shown a strong correlation between high scores and increased mortality rates.[4] Furthermore, demographic factors such as age, gender, and cause of admission have also been shown to influence ICU outcomes.[5,6]

METHODS

This cross-sectional study evaluated the effectiveness of ICU care using APACHE II scores to predict mortality at Imam Al-Hussein Medical City in Karbala, Iraq -a tertiary referral center managing ~70% of the region's 641 annual ICU admissions (2021 data). The study enrolled 131 patients, ensuring generalizability to Karbala's urban population (1,066,900 residents; median age 36; 25% elderly). Participants included adults (≥20 years) admitted ≥24 hours to medical, surgical, or emergency ICUs between October–November 2023. Exclusion criteria comprised age <20, non-study ICU admissions, or incomplete records. Variables encompassed demographics (age, sex), clinical characteristics (admission cause, ICU type), physiological parameters (MAP, HR, mechanical ventilation), and outcomes (survival/death). APACHE II scores were calculated via MDApp, a validated mobile tool, using data from routine ICU monitoring (vital signs, arterial blood gas analyzers, and ventilators).

A simple random sampling method was applied to hospital records. Cases with incomplete data were excluded and replaced via identical randomization to maintain sample integrity. Non-pharmacological interventions (e.g. blood sampling) and pharmacological interventions (e.g. vasopressors: atropine, dopamine, adrenaline/noradrenaline) were documented. Ethical approval was obtained from the Karbala Health Directorate, adhering to WHO guidelines. Data were analyzed in SPSS-27. Normality was assessed via Kolmogorov-Smirnov tests; parametric (t-tests, ANOVA, Pearson correlation) or non-parametric (Mann-Whitney, Kruskal-Wallis, Spearman correlation) tests were applied as appropriate. Regression analyses identified predictors of mortality linked to APACHE II scores.

RESULTS

The study analyzed 131 ICU patients (62.6% male, mean age 50.2±22.8 years) across surgical (47.3%), emergency (42.7%), and medical (9.9%) units. Mortality was 52.7%, with higher rates in emergency ICU (69.2% vs. 50–51.8% elsewhere). APACHE II scores differed significantly by ICU type ($p<0.001$), highest in emergency (35.7±19.3 vs. 30.5±20.3 surgical, 32.4±19.5 medical). Mortality escalated with APACHE II thresholds: scores ≥30–34 predicted 100% mortality in all ICUs. Mechanical ventilation use (73.3% overall) correlated with higher APACHE II scores in medical ICU ($p=0.009$). Age strongly predicted APACHE II scores in medical ($r=0.553$, $p<0.001$) and surgical ($r=0.384$, $p=0.002$) units. APACHE II scores significantly associated with mortality in surgical ICU ($t=4.362$, $p<0.001$) but not medical/emergency units. Age and comorbidities (DM/HTN) influenced scores ($p<0.05$). Cardiovascular parameters (MAP, HR) showed weak/no correlation with APACHE II. Mortality rates aligned with APACHE-predicted risk strata ($p<0.001$): 34–66% risk groups had 24–25% mortality, rising to 100% in ≥67% strata. Gender impacted scores in surgical ($p=0.05$) and medical ($p=0.027$) ICUs, with males scoring lower. Trauma admissions had lower scores vs. pathological causes ($p\leq0.003$) [Tables 1-6).

Table No.1: Distribution of the patient's socio demographic data and clinical data characteristics (n=131)

Characteristics	No.	%
ICU wards		
Medical	13	9.9
Surgical	62	47.4
Emergency	56	42.7
Age (years)		
< 20	13	9.9
20 – 39	35	26.7
40 -59	33	25.2
> 60	50	38.2
Gender		
Male	82	62.6
Female	49	37.4
Cause of admission		
Traumatically	50	38.2
Pathological	81	61.8
Outcome		
Dead	69	52.7
Pass	62	47.3
Mechanical ventilation		
Yes	96	73.3
No	35	267
APACHE M. Rate		
0% - 33%	77	58.7
34% - 66%	42	32.1
67% - 100%	12	9.2

Table No.2: Distribution of the patients socio demographic data and clinical data characteristics according to ICU ward

Characteristics	Emergency (N=13)		Surgical (n=62)		Medical (n=56)	
	No.	%	No.	%	No.	%
Age (years)						
<20	-	-	6	9.7	7	12.5
20 – 39	1	7.7	23	37.1	11	19.6
40 – 59	1	7.7	15	24.2	17	30.4
> 60	11	84.6	18	29.0	21	37.5
Gender						
Male	8	61.5	40	64.5	34	60.7
Female	5	38.5	22	35.5	22	39.3
Cause of admission						
Traumatically	-	-	31	50.0	19	33.9
Pathological	13	100.0	31	50.0	37	36.1
Outcome						
Dead	9	69.2	31	50.0	29	51.8
Pass	4	30.8	31	50.0	27	48.2
Mechanical ventilation						
Yes	8	61.5	44	71.0	44	78.6
No	5	38.5	18	29.0	12	21.4
APACHE M. Rate						
0% - 33%	7	53.8	38	61.3	32	57.2
34% - 66%	5	38.5	18	29.0	19	33.9
67% - 100%	1	7.7	6	9.7	5	8.9

Table No.3: Comparing the APACHE II scores with the actual outcome for patients at surgical ICU, medical ICU and emergency ICU

APACHE II	Emergency ICU			Surgical ICU			Medical ICU		
	No.	Dead	%	No.	Dead	%	No.	Dead	%
0 – 4	-	-	-	2	2	-	-	-	-
5 – 9	1	-	-	7	3	42.0	4	2	50.0
10 – 14	-	-	-	8	5	62.5	13	8	61.1
15 – 19	5	3	60.0	16	10	62.5	14	12	85.7
20 – 24	3	2	66.6	15	13	86.6	11	10	90.9
25 - 29	3	2	66.6	7	4	57.1	10	8	80.0
30 - 34	1	1	100.0	5	5	100.0	4	4	100.0
≥ 35	-	-	-	2	2	100.0	-	-	-
Total	13	8	61.5	62	44	70.9	56	44	78.5

Table No.4: Comparing the APACHE II scores for the three groups with their socio demographic data and clinical data

Characteristics	Emergency				Surgical				Medical			
	Mean	SD	Analysis	Sig.	Mean	SD	Analysis	Sig.	Mean	SD	Analysis	Sig.
Age (years)												
<20			F=.418	.669	14.50	6.656	F=1.900	.140	12.57	3.645	F=11.23	.000
20 – 39	24.00	.			16.91	8.312			16.55	6.138		
40 – 59	16.00	.			20.67	5.653			16.53	6.135		
> 60	22.09	6.862			21.56	9.954			24.10	4.969		
Gender												
Male	24.00	6.024	t=1.673	.122	17.40	8.098	t=2.000	.050	17.26	6.694	t=2.280	.027
Female	18.20	6.181			21.73	8.253			21.36	6.374		
Cause of admission												
Traumatically	.	.	.	.	15.84	6.827	t=3.122	.003	15.21	5.360	t=3.100	.003

Patholo-gical	21.77	6.521			22.03	8.681			20.76	6.776		
Outcome												
Dead	23.67	5.500	t=.691	.119	23.00	8.386	t=4.362	.000	20.03	7.124	t=.684	.190
Pass	17.50	7.371			14.87	6.109			17.63	6.368		
Mechanical ventilation												
Yes	23.88	5.540	t=1.558	.148	20.07	8.793	t=1.695	.095	20.09	6.386	t=2.698	.009
No	18.40	7.127			16.17	6.573			14.42	6.735		
APACHE M. Rate												
0% - 33%	17.14	4.413	F=14.67	.001	14.58	5.889	F=45.72	.000	13.97	3.889	F=86.08	.000
34% - 66%	25.80	1.789			22.67	4.537			24.11	2.664		
67% - 100%	34.00	.			35.33	2.658			30.40	1.140		

M = Mean of APACHE score, S.D = Standard Deviation, P=probability value, NS: Non-Significant at P > 0.05, S: Significant at P < 0.05, HS: Highly Significant at P < 0.001

Table No.5: correlation of APACHE II scores for the three groups with their age, MAP, and HR

APACHE II	Emergency		Surgical		Medical	
	Cc.	Sig.	Cc.	Sig.	Cc.	Sig.
Age	-.021-	.944	.384	.002	.553	.000
MAP	-.307-	.308	-.018-	.887	.092	.498
H.R	.234	.424	.057	.660	-.007-	.958

Table No.6: Comparing between the actual outcome with APACHE mortality rate for patients at surgical ICU, medical ICU and emergency ICU

Ward	Dead		Pass		Statistical analysis		
	Mean	SD	Mean	SD	t	df	P value
Medical	39.22	19.136	27.75	19.670	.990	11	.343
Surgical	41.16	20.892	19.87	12.793	4.839	60	.000
Emergency	35.38	22.116	29.26	15.956	1.180	54	.243

DISCUSSION

A central observation is that APACHE II scores strongly correlate with patient outcomes, particularly within the surgical ICU. Notably, patients in the moderate-to-high APACHE II score categories (15–19, 20–24, and 25–29) experienced significantly higher mortality rates, with 96 deaths out of 131 cases - most of which occurred in the surgical ICU setting. These results contrast with other studies; for instance, Naved et al[7] reported that patients in the lowest APACHE II score category (3-10) had a 90% discharge rate, while those in higher score categories (31-40) faced substantially increased mortality rates. Similar evidence from (Lee et al[8] and Escarce et al[9] further validates that a higher APACHE II score reliably forecasts an increased risk of mortality, suggesting that the scoring system's calibration in our study is consistent with international benchmarks.[10]

The study found a predominance of male patients (62.6%), a trend supported by Garland et al[5], who postulated that men might present with more severe underlying conditions or be more inclined to accept aggressive ICU care compared to women. Furthermore, a significant proportion of patients (38.2%) were aged 60 years and above. These findings resonate with Boumendil et al[6], where the inclusion of older patients despite lower rates of certain co-morbid conditions was consistently linked to higher post-ICU mortality after adjusting for illness severity.

Pathological causes accounted for 61.8% of ICU admissions, a contrast to studies like Adenekan et al[11], which emphasize that ICU admissions resulting from internal medical conditions differ fundamentally from trauma cases. The high mortality rate (52.7%) observed in this study, particularly among patients requiring mechanical ventilation (73.3%), might be influenced by extrinsic factors such as frequent power outages, deficiencies in nursing training, medication shortages, inadequate nutrition, and complications associated with MV. In contrast, studies like those by Abate et al[12] noted that such factors contribute significantly to unstable vital signs - hypotension, sepsis, coma, and hypoxemia - all of which were prevalent and closely tied to 30-day ICU mortality in their cohort.

Age distribution analysis across ICU types revealed that the emergency and medical ICUs predominantly admitted older patients (60 years and above), whereas the surgical ICU had a greater proportion of younger patients (aged 20–39). This trend is supported by Chittawatanarat et al[13], suggesting that underlying disease profiles may differ markedly between elective surgical admissions and emergency cases. Despite reporting similar gender distributions across units,

outcomes varied significantly. The surgical ICU demonstrated relatively balanced outcomes (a 50-50 survival-to-mortality ratio) compared to the heightened mortality rates noted in both the emergency and medical ICUs.

Statistical analyses further underscored the efficacy of APACHE II scores in predicting outcomes. Table 6 demonstrated that the APACHE II score's predicted mortality closely aligned with observed mortality, particularly in the surgical ICU. This observation is in line with Asadzandi et al[14], where significant differences in APACHE II scores were noted between survivors and non-survivors, reinforcing the need for precise risk stratification in ICU settings. Moreover, the higher mean APACHE II score observed in the emergency ICU (Table 3) substantiates findings by Sungono et al[15] that non-operative and emergency surgical admissions are often burdened with prior organ insufficiencies, which intensify their overall risk profile.

Additional analysis (Table 5) indicated a strong positive correlation between APACHE II scores and patient age in the medical and surgical ICUs, although this relationship did not reach statistical significance in the emergency ICU. This pattern, consistent with Xu et al[16], signals that advancing age contributes to increased mortality risk as reflected in rising APACHE II scores. Furthermore, Table 4 revealed that the outcomes in the surgical ICU notably diverged based on the cause of admission, while in the medical ICU, factors such as gender, cause of admission, and mechanical ventilation usage influenced APACHE II scores and outcomes. These findings may be attributed to the differences in therapeutic aggressiveness and patient management strategies between ICU types. Surgical ICUs, for example, may benefit from more immediate and robust resuscitative measures compared to the more conservative approaches often adopted in medical ICUs.

CONCLUSION

The APACHE II-guided risk stratification in resource-limited ICUs to prioritize high-risk patients (e.g., elderly, comorbid) for targeted interventions. Emergency ICUs, despite comparable APACHE scores, exhibited the highest mortality (69.2%), suggesting unmeasured acuity factors. Future research should integrate dynamic biomarkers to refine prognostication, while clinical protocols must address gender and admission-specific vulnerabilities to optimize outcomes.

Author's Contribution:

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