

**Original article****Pattern of admission and outcome of patients admitted to dedicated trauma intensive care unit (ticu), emergency department, teaching hospital, north-eastern malaysia**

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**Abstract**

**Background:** The role of dedicated Trauma ICU (TICU) in Emergency Department is vital in the chain of trauma care to ensure rehabilitation and sustainable critical care for a better survival outcome. This study is conducted to find out demographic patterns and predictors that can affect the outcomes of trauma patients. **Methods:** A retrospective review of all patients admitted to TICU, Hospital Universiti Sains Malaysia (HUSM) was carried out from January 1<sup>st</sup>, 2016 till December 31<sup>st</sup>, 2018. Data were collected from TICU admission and discharge registers and were analysed using SPSS version 23.0. **Results:** A total of 108 trauma patients were included in this study. All cases were exclusively blunt trauma (99.1%) and mainly attributed by road traffic injuries (92.6%). In terms of trauma clinical scoring, 25% (p= 0.001) presented with GCS score < 4, 46.9% (p=0.001) with RTS score <5.5 and 15.6% (p=0.012) with APACHE II score > 28 had demonstrated prolonged ICU stay (> 7 days). Meanwhile 62.5% (p= 0.000) with GCS < 4, 75% (p= 0.000) with RTS < 5.5 and 75% (p= 0.000) with APACHE II > 28 were died in TICU. Besides that, those who had prolonged ICU stay (> 7 days) were 8.5 times higher odds to get sepsis (adj OR= 8.532; 95% CI: 2.710, 26.863; p= 0.000) and 7 times higher odds to get acute kidney injury (AKI) (adj OR= 7.131; 95% CI: 1.464, 34.733; p= 0.015). Meanwhile, patient who received blood transfusion led to 5 folds higher odds of association with rhabdomyolysis (adj OR= 4.968; 95% CI: 1.821, 13.549; p= 0.002). **Conclusion:** In the midst of pandemic COVID-19 it is important for ED physician to early identify and prioritise high risk trauma patient based on predictors and allows for targeted monitoring and intervention that may improve their outcome and also optimise resources accordingly.

**Keywords:** trauma intensive care unit; emergency department; pattern admission; predictors; outcome

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## Introduction

Trauma is a major health problem and a leading cause of mortality and morbidity among adults in the world<sup>1,2</sup>. In Malaysia, the number of road traffic accidents (RTA) was 521, 466 in 2016, a steady increase from 489, 606 in 2015<sup>3</sup>. This rising trend becomes a huge burden to our healthcare system especially Emergency Medical Service across the country. Hence the establishment of dedicated TICU plays a pivotal role to improve the quality of care and outcome in trauma management.

Trauma management in ED required high level of care especially for the multi-system injuries patient. The successful of trauma management is depend on interdisciplinary involvement, adequate structure and staffing level<sup>4</sup>. However with the 'busy' ED its very difficult to perform at your best. According to the Malaysian National Audit Department 2018, ED in Malaysia were understaffed, overcrowded, underfunded and do not have enough equipment to provide proper levels of care<sup>5</sup>. In addition, the report also stated the patient have to stay longer in ED because of the 'access block' including critical ill patient. Moreover, many studies have shown that increasing boarding time is associated with worst outcomes for patient requiring ICU-level of care<sup>6,7</sup>.

In 2015, the Hospital USM Management created dedicated TICU, an ICU under ED flagship and co-managed with Anaesthesiology and Intensive Care Department. The aim is to improve critical care delivery in ED and fasten the admission to ICU care. To our knowledge, this is the first model in Malaysia. Thus, the objective of this study is to explore the demographic patterns, severity of injury and clinical assesment trauma patients admitted to TICU and secondly to explore the association between outcome variables.

## Materials and methods

This retrospective observational study was conducted between Jun 2016 till May 2018 in Trauma Intensive Care Unit (ICU), Emergency Department, Hospital Universiti Sains Malaysia (HUSM). All trauma patients admitted to TICU through Emergency Department, Hospital USM as inclusion criteria. The new TICU was established in 2015 with 5 bedded capacity. It was managed by highly qualified and experienced physicians (senior consultants and specialists) both from Anesthesiology & ICU and Emergency Department along with well-trained critical care nurses and allied health professionals.

## Data Collection

Data was collected from the patient's folders who were admitted to Trauma ICU from June 2016 till May 2018 using the data collection form. The proforma was aimed at:

- i. Patient particulars: gender, age, race
- ii. Injury: mechanism of injury, causes
- iii. Clinical details: pulse rate, respiratory rate, blood pressure, GCS score, RTS score, APACHE score
- iv. Hospital outcome: blood transfusion, length of ICU stay, intubation, mechanical ventilation, mortality, trauma related complications

## Statistical Analysis

Statistical analysis was performed using IBM SPSS for Windows, version 23.0 (SPSS Inc. Chicago, IL, USA). Demographic data was reported as the mean and standard deviation (SD) as appropriate. A p value of  $< 0.05$  was considered statistically significant. The predictors or demographic factors that affect the outcome of the patient were expressed in simple and multiple logistic regression. Adjusted odds ratio (adj OR) and 95% confidence intervals (CI) were reported, and  $p < 0.05$  was considered statistically significant.

## Ethical Consideration

This study received ethical board approval from the Human Research Ethics Committee of Universiti Sains Malaysia (USM/JEPeM/17120722). The study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a prior approval by the human research committees. No written consent is needed in this study.

## Results

### Demographic Patterns

A total of 108 patients were recruited in this study, with a mean age of 29.49 (SD= 17.71) years old. The mechanism of injury was mainly attributed to blunt trauma (99.1%) and majority due to road traffic accident (RTA) (92.6%), with the motorcyclist occupied two thirds (62%) of the cases. Glasgow Coma Scale (GCS) of  $< 8$  occupied more than half of the patients (57.8%), moderate GCS of 9-12 was 24.1%, and mild GCS of 13-14 was 23.1%. The Revised Trauma Score (RTS) of  $> 5.0$  occupied 88.9% of patients and score 2.5-4.9 occupied 11.1%. The Acute Physiology and Chronic Health Evaluation (APACHE) II score of  $< 25$  occupied 92.6% of the patients and score 26-50 occupied 7.4%. (Table 1)

**Table 1:** Baseline variables/ demographic patterns of patients admitted to TICU (n = 108)

Variable	n (%)
<b>Sociodemography</b>	
Age (years) (mean +/- SD)	29.49 (17.71)
<b>Gender</b>	
Male	93 (86.1)
Female	15 (13.9)
<b>Mechanism of injury</b>	
Mechanism of injury	107 (99.1)
Blunt trauma	1 (0.9)
Others	
<b>Cause of injury</b>	
Cause of injury	100 (92.6)
Road traffic accident	4 (3.7)
Fall > 2 metre	4 (3.7)
Others	
<b>Type of RTA</b>	
Type of RTA	67 (62)
Motorcycle rider	7 (6.5)
Motorcycle pillion	9 (8.3)
Driver	3 (2.8)
Front seat passenger	2 (1.9)
Back seat passenger	8 (7.4)
Bicyclist	
Pedestrian	
<b>Clinical trauma scoring</b>	
<b>Glasgow Coma Scale (GCS)</b>	
Glasgow Coma Scale (GCS)	25 (23.1)
Mild (13-14)	26 (24.1)
Moderate (9-12)	57 (57.8)
Severe (< 8)	
<b>Revised Trauma Score RTS</b>	
Revised Trauma Score RTS	12 (11.1)
2.5-4.9	96 (88.9)
> 5.0	
<b>APACHE II Score</b>	
APACHE II Score	100 (92.6)
< 25	8 (7.4)
26-50	
<b>Complications</b>	
Complications	83 (76.9)
Intubated	
Mortality	8 (7.4)
Rhabdomyolysis	
Acute kidney injury (AKI)	66 (61.1)
Fat embolism	18 (16.7)
Sepsis	0 (0)
<b>Blood transfusion</b>	
Blood transfusion	29 (26.9)
Packed RBC	55 (50.9)
Fresh frozen plasma	26 (24.1)
Platelet	22 (20.4)
Whole blood	1 (0.9)
Cryoprecipitate	21 (19.4)
<b>ICU admissions</b>	
ICU admissions	76 (70.4)
< 7 days	32 (29.6)
> 7 days	

**Outcome/ Complications**

Seventy-six percent of patients were intubated and 7.4% of them died during TICU stay as shown in Table 1. More than two thirds (70.4%) of patients were admitted to TICU for < 7 days. Mean hospital stay (ICU and ward) was 17.43 (SD= 15.37) days. Most of them received packed cell transfusion (50.9%), followed by fresh frozen plasma (24.1%) and platelet transfusion (20.4%). About two thirds of them developed rhabdomyolysis (61.1%), one third developed sepsis (26.9%) and one fifth developed acute kidney injury (AKI) (16.7%)

**Predictors of Outcome/ Complications**

Table 2 showed GCS score < 4, RTS score < 5.5 and APACHE II score > 28 were associated with prolonged ICU stay (> 7 days) and increased mortality.

**Table 2:** Association between trauma scoring systems with length of ICU stay and mortality

Variable	Number of patients, N	Percentage (%)	Chi-squared test	P value
<b>Length of ICU Stay &gt; 7 days</b>				
GCS < 4	8	25.0	10.91	<b>0.001</b>
RTS < 5.5	15	46.9	17.75	<b>0.000</b>
APACHE II > 28	5	15.6	6.272	<b>0.012</b>
<b>Mortality</b>				
GCS < 4	5	62.5	25.85	<b>0.000</b>
RTS < 5.5	6	75.0	14.87	<b>0.000</b>
APACHE II > 28	6	75.0	66.92	<b>0.000</b>

**Table 3:** Predictors of intubation and mechanical ventilation in patients admitted to TICU according to univariate and multivariate regression

Variable	Univariate		Multivariate	
	B	P value	Adj B	P value
Gender				
Male	-2.783	<b>0.302</b>	-0.869	0.675
Female	1		1	
RTA	0.678	<b>0.202</b>	0.405	0.663
RTS	-1.869	<b>0.021</b>	0.405	0.663
Blood transfusion	3.616	<b>0.048</b>	-1.280	0.383
APACHE II	0.453	<b>0.002</b>	0.000	0.998
Length of ICU stay				
< 7 days	1		1	
> 7 days	10.409	<b>&lt;0.001</b>	4.012	<b>0.021</b>

Variable	Univariate		Multivariate	
	B	P value	Adj B	P value
Mortality				
Yes	-4.773	<b>0.122</b>	-5.935	0.064
No	1		1	
Sepsis				
Yes	-8.665	<b>&lt; 0.001</b>	-1.735	0.312
No	1		1	
Trauma related complications				
Yes	5.488	<b>0.012</b>	-0.357	0.843
No	1		1	

Table 3 showed only length of ICU stay > 7 days (p= 0.021) was significant in predicting intubation and mechanical ventilation in multivariate analysis. In addition, predictors for trauma-related complications showed that prolonged ICU stay (> 7 days) resulted 8.5 times higher odds to get sepsis (p= 0.000) and 7 times higher odds to get AKI (p= 0.015) in trauma patients. Trauma patients who received blood transfusion had association with rhabdomyolysis almost 5 times higher compared to those who didn't receive blood (p= 0.002). (Table 4)

**Discussion**

Since pandemic COVID-19, daily healthcare system activity had been affected<sup>8</sup>. Emergency Department had severely overcrowded with COVID-19 patient. However at the same time trauma patient need to be manage accordingly. Thus, by knowing the clinical characteristics & predictors of patient outcome

will guide physician to prioritise the trauma patient management<sup>12</sup>.

Since hospital USM was the only neurosurgical referral center in North-Eastern Malaysia, more than 50% of road traffic injuries were motorcyclist and most of them suffered head injury. In our study those trauma patient with low RTS (<5.5), low GCS (<4) and high APACHE II (>28) score were able to predict mortality and length of ICU stay. Overall mortality rate in our study was 7.4% which is lower than study by Chalya et al<sup>1</sup> (32.7%) and Gunning et al<sup>9</sup> (10%). Varies of mortality rate could be due to severity of injuries and transportation time to tertiary centre<sup>3</sup>.

In addition, patients who stayed more than 7 days in TICU were 4 times more likely of getting intubated and ventilated, 8.5 times to get sepsis and 7 times to get acute kidney injury (AKI) in TICU. This finding was similar with Goins et al<sup>10</sup> study whereby mechanical ventilation was required in 78.5% of the time spent in ICU, and the mean time for those patients in ICU was 60 days. Krasnalhia et al<sup>15</sup> also conclude that almost half of trauma patients had AKI and more than half of them were due to sepsis when stay longer in ICU. In our study, most of our patients received packed cell transfusion (50.9%), followed by 24% given FFP and 20.9% given platelets. As evidenced in multivariate analysis, we found that trauma patients who received blood transfusion were 5 times more likely associated with rhabdomyolysis. However further study need to confirm this finding because of knowledge gap in this issue.

**Table 4:** Predictors of trauma-related complications in patients admitted to TICU according to multivariate analysis

Variable	Sepsis			Rhabdomyolysis			AKI		
	Adj B	Adj OR (95% CI)	P value	Adj B	Adj OR (95% CI)	P value	Adj B	Adj OR (95% CI)	P value
GCS	0.292	1.338 (0.207, 8.653)	0.760	0.724	2.062 (0.375, 11.333)	0.405	-0.667	0.513 (0.083, 3.193)	0.475
RTS	0.521	1.684 (0.578, 4.904)	0.339	0.466	1.593 (0.561, 4.526)	1.593	0.628	1.873 (1.227, 2.860)	0.797
APACHE II	-0.075	0.928 (0.760, 1.133)	0.461	0.077	1.080 (0.911, 1.281)	0.373	0.017	1.017 (0.853, 1.212)	0.852
ICU stay									
<7 days	1			1			1		
>7 days	2.144	8.532 (2.710, 26.863)	<b>0.000</b>	-0.467	0.627 (0.181, 2.166)	0.460	1.964	7.131 (1.464, 34.733)	<b>0.015</b>
Blood transfusion	0.424	1.528 (0.425, 5.488)	0.516	1.603	4.968 (1.821, 13.549)	<b>0.002</b>	0.790	2.202 (0.392, 12.376)	0.370

### **Limitations**

The presents study has several limitations due to small sample size and couldn't be generalize to other trauma centre. Furthermore we only used physiological trauma scoring system in our study rather than anatomical scoring in view of difficulty to get complete data as we were using manual entry patient record. Despite limitations we believed this study provide important finding in managing trauma patient and hope in future we are able to explore the impact of TICU towards patient outcome in Emergency department.

### **Conclusion**

In the midst of pandemic COVID-19 it is important for ED physician to early identify and prioritise high risk trauma patient based on predictors and allows for targeted monitoring and intervention that may improve their outcome. This will lead to optimise resources and lessen healthcare burden in managing trauma patient in ED.

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### **Declaration of conflicting interests**

We declare that there were no conflict of interests to the study, authorship and/ or publication of this article.

### **Author contribution**

Study idea and design: (WCK,MHF,KM,AY,TH),

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Writing and submitting manuscript:  
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Editing and approval final draft:  
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