COMPARISON OF TRIAGE REVISED TRAUMA SCORE AND CRAMS SCALE AS PREDICTORS OF OUTCOME FOR ADULT TRAUMA PATIENT IN EMERGENCY DEPARTMENT, HOSPITAL UNIVERSITI SAINS MALAYSIA

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Dissertation Submitted In Partial Fulfillment Of The Requirements For The Degree Of Master Of Medicine

(EMERGENCY MEDICINE)

UNIVERSITI SAINS MALAYSIA

2017

ACKNOWLEDGEMENT

First of all, I am grateful to Allah the Almighty for establishing me to complete this dissertation.

I wish to express my sincere thanks to my supervisor, Dr Tuan Hairulnizam Tuan Kamauzaman, Lecturer and Emergency physician HUSM for all the knowledge, valuable guidance, constant encouragement and necessary facilities throughout the process of producing this study. All the deeds only Allah SWT can be repay.

I also thanks to Dr Najib Wajdi, lecturer of Biostatistic Department, School of Medical Sciences, USM and Mr Aiman, Statistician, Clinical Research Center, Hospital Sultanah Bahiyah. I am grateful for their expert and guidance in the process of this study.

I would like to take this opportunity to record my sincere thankful to all the lecturers of Emergency Department, School of Medical Sciences, Universiti Sains Malaysia for all the knowledge that I obtained through out this master programme. I also thanks to my colleagues, and all the staff of Emergency department for all the joy and difficulties that we had been through together.

I also like to expressed my gratitude to anybody that involved in my study; direct or indirectly and gave help in this study.

And last but not least to my family, especially Mak and Ayah for unceasing encouragement, love, support and tolerance throughout my life.

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ABSTRAK (BAHASA MELAYU)

PENGENALAN: Trauma merupakan masalah kesihatan yang penting dan penyebab kematian utama dikalangan remaja dan belia. Mengenalpasti tahap kecederaan pesakit terutamanya yang mengalami kecederaan parah di peringkat awal membantu dalam perawatan pesakit. Sistem pemarkahan 'triage' yang baik dapat meramal tahap kecederaan pesakit dan dapat membantu pesakit untuk medapat rawatan segera di pusat rawatan trauma.

OBJEKTIF: Membandingkan keberkesanan penggunaan 'Triage Revised Trauma Score (T-RTS)' dan 'CRAMS Scale' dalam meramal keadaan pesakit trauma di Jabatan Kecemasan, Hospital Universiti Sains Malaysia (HUSM)

METODOLOGI: Satu kajian 'prospective cohort' yang telah dijalankan selama tiga bulan bermula dari Disember 2015 sehingga Februari 2016. Penilaian pesakit trauma dewasa telah dinilai di 'triage' dan juga ketika pesakit dipindahkan dari Jabatan Kecemasan, HUSM.

KEPUTUSAN: Seramai 91 pesakit terlibat dalam kajian ini. Keputusan penggunaan T-RTS menunjukkan seramai 12 orang pesakit (13.2%) telah dikategorikan sebagai major dan 79 orang pesakit (86.8%) telah dikategorikan sebagai minor (median=12, IQR=0). Keputusan penggunaan 'CRAMS scale' pula menunjukkan, seramai 10 orang (11.0%) telah dikategorikan sebagai major, dan 91 orang pesakit (89.0%) telah dikategorikan sebagai minor (median-=10, IQR=1). Sensitiviti T-RTS ialah 71.4% manakala sensitiviti 'CRAMS scale' ialah 72.4 %. Spesifisiti CRAMS Scale lebih tinggi iaitu 94.0% jika dibandingkan spesifisiti

T-RTS iaitu 91.7%. kedua-dua sistem pemarkahan mempunyai ‘negative predictive value’ yang tinggi iaitu, 97.5% . CRAMS Scale mempunyai nilai ‘positive predictor value’ lebih tinggi berbanding T-RTS (50.0% dan 41.7%)

KESIMPULAN: Kajian ini menunjukkan bahawa pengunaan CRAMS Scale dapat meramal keadaan pesakit ketika dipindahkan daripada jabatan kecemasan dengan lebih tepat berbanding T-RTS. Kajian lanjutan dengan jumlah subjek yang lebih besar dan julat masa yang lebih lama perlu untuk memastikan kajian seperti ini boleh diaplikasikan penggunaannya.

ABSTRACT

INTRODUCTION: Trauma is an important health problem and a leading cause of death among young adults. Early recognition of injury severity could aid in managing trauma patient. Triage scores that capable to predict outcome would give better assessment of patient urgency to get proper treatment at trauma center.

OBJECTIVE: To compare the utility of Triage Revised Trauma Score (T-RTS) with CRAMS Scale in determining outcome of adult trauma patient in Emergency Department (ED), Hospital Universiti Sains Malaysia (HUSM).

METHODS: A Prospective cohort study that was conducted within three months study period from December 2015 until February 2016 by assessing adult trauma patients at triage and their disposition from ED.

RESULT: 91 patients were recruited. For T-RTS, 12 patients (13.2%) were score as major, and 79 patients (86.8%) were scored as minor (median=12, IQR=0). For CRAMS, 10 patients (11.0%) were scored as major, and 81 patients (89.0%) were scored as minor (median-=10, IQR=1). T-RTS sensitivity is 71.4% while CRAMS Scale sensitivity is 72.4 %. CRAMS score have higher specificity 94.0% compare to T-RTS specificity 91.7%. Both scoring system have high negative predictive value, 97.5%. CRAMS Scale had higher positive predictive value compared to T-RTS (50.0% and 41.7% respectively).

CONCLUSION: Our study showed CRAMS Scale was better than T-RTS in predicting patient outcome from ED. Further study needed to be done with larger sample size and longer duration in order to improve the reliability of the study.

1.1 Introduction

Trauma remains the leading cause of morbidity and mortality in adolescent and young adults in Malaysia. Malaysia Ministry of Health 2013 report showed that trauma is the third principal causes of hospital admission and the fifth leading cause of death.[1] It is neglected cause of morbidity and mortality despite many campaigns regarding injury and road traffic accident prevention had been addressed to public. Most of trauma patients were within their productive age and disability as result from trauma will reduce patient's productivity.[2] Differences of trauma patients' mortality and morbidity rates in between countries reflected the countries health care quality and standard.[2]

Triage systems are method of systematically prioritizing patient base on patients' condition and severity. Its goal is to identify the right patient, bring them to the right place and to get treatment at the right time.[3] Trauma patients will be effectively distributed and will be managed accordingly at the designated trauma centre.[4] A good scoring system with high accuracy, reliability and specificity enable to predict patients' outcome.[4] It is also will be a useful tool for prehospital and emergency care triage personnel in managing trauma. Certain prehospital triage scores able to predict severity of injury, prolonged Intensive Care Unit stay and massive haemorrhage.[5]

There are multiple types of trauma triage scoring systems that assessed either patients' physiological, anatomical or combination of both. Triage score that assessed physiological component can be done at prehospital or emergency department triage as it used simple measurement tool such as standard vital sign monitoring devices and also rapid bedside clinical assessment. Physiological assessment reflects patient's acute dynamic change post

trauma.[6] Triage score that used anatomical assessment need more complicated diagnostic tool especially radiological investigation and only reflects patient injury at one point of time; thus it is not suitable to be done at prehospital or emergency triage level. Triage Revised Trauma Score (T-RTS) and CRAMS Scale are the example of trauma scores used physiological indices, Abbreviated Injury Scale (AIS), Injury Severity Score (ISS) and Anatomic Profile (AP) are the example of trauma scores that used anatomical indices and Trauma Score- Injury Severity Score (TRISS) is the example of trauma score that used both anatomical and physiological indices.[7]

T-RTS and CRAMS scale were chosen as both scoring system used physiology severity assessment. Both of this scoring systems could be done at prehospital level and also primary triage at any hospital. Both scoring systems can be used by inexperienced triage personnel in identifying severely injured. [7,8] However, comparison of both scoring systems in Malaysia was not known as no comparison study has been conducted before.

Revision of Trauma Score (TS) consists of Triage Revised Trauma Score (T-RTS) and Revised Trauma Score (RTS).[7,9] Certain parameters of TS are found difficult to be assessed at field especially capillary refilling time and respiratory expansion. The usage of TS as a triage tool is replaced by T-RTS; while RTS is used for quality assurance and outcome prediction.[10] The RTS is measured in coded form which GCS is weighted heavily in RTS as RTS emphasizes the significant impact of traumatic brain injury outcome.[9,11]

T-RTS is a physiologic injury severity score that numerically summarize assessment of circulation, respiration and central nervous system function.[11] The component of T-RTS consisted of respiratory rate that were calculated as breath per minute, systolic blood pressure in mmHg, and Glasgow Coma Scale (GCS). Each component had maximum score of 4

(normal value of component being assessed) and minimum score of 0(abnormal value of component being assessed). Total maximum score is 12 and total minimum score is 0. Score equal or less than 11 consider major trauma[9] with sensitivity of 59% and specificity 82%.[11]

CRAMS scale is a 10 points scoring system that develop for the purposed of determining which patient should be sent in trauma centre.[12] It consists of 5 component; circulation, respiration, abdomen/thorax, motor and speech. For each component of CRAMS scale, normal value is scored as 2, mildly abnormal value is scored as 1 and severely abnormal is scored as 0. CRAMS scale provides effective in identifying major trauma while ensuring that minor trauma was not necessarily sent to trauma centre. CRAMS Scale defined major trauma if score equal of less than 8 and minor trauma with score of 9 and above.[12] Patients' CRAMS scale score were compared with the final disposition from emergency department.[11] The outcome of CRAMS Scale is considered major if patient died in emergency department, or went to operating theatre or intensive care unit while outcome is considered minor if patient was allowed discharge from emergency department.[6] CRAMS Scale have high sensitivity, 92 percent, high specificity 98 percent[12] and can discriminate well between minor and major trauma.[6,12]

The purpose of this study is to compare the utility of T-RTS with CRAMS scale in determining outcome of adult trauma patient in Hospital Universiti Sains Malaysia (HUSM).

2.1 General Objective

To compare the utility of Triage Revised Trauma Score with CRAMS Scale in determining outcome of adult trauma patient in emergency department HUSM.

2.2 Specific Objectives

1. To determine mean score of Triage Revised Trauma Score and CRAMS Scale of adult trauma patient who visit emergency department HUSM.
2. To determine the association between patient outcome (major injury/minor injury) with Triage Revised Trauma Score and CRAMS Scale.
3. To compare sensitivity and specificity of Triage Revised Trauma Score and CRAMS Scale in determining outcome of adult trauma patient in emergency department HUSM.

3.1 Title Page

Comparison of Triage Revised Trauma Score (T-RTS) and CRAMS Scale as Predictors of Outcome for Adult Trauma Patient in Emergency Department, Hospital Universiti Sains Malaysia.

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3.2 Abstract

INTRODUCTION: Trauma is an important health problem and a leading cause of death among young adults. Early recognition of injury severity could aid in managing trauma patient. Triage scores that capable to predict outcome would give better assessment of patient urgency to get proper treatment at trauma center.

OBJECTIVE: To compare the utility of Triage Revised Trauma Score (T-RTS) with CRAMS Scale in determining outcome of adult trauma patient in Emergency Department, Hospital Universiti Sains Malaysia.

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RESULT: 91 patients were recruited. For T-RTS, 12 patients (13.2%) were score as major, and 79 patients (86.8%) were scored as minor (median=12, IQR=0). For CRAMS, 10 patients (11.0%) were scored as major, and 81 patients (89.0%) were scored as minor (median-=10, IQR=1). T-RTS sensitivity is 71.4% while CRAMS Scale sensitivity is 72.4 %. CRAMS score have higher specificity 94.0% compare to T-RTS specificity 91.7%. Both scoring

system have high negative predictive value, 97.5%. CRAMS Scale had higher positive predictive value compared to T-RTS (50.0% and 41.7% respectively).

CONCLUSION: Our study showed CRAMS Scale was better than T-RTS in predicting patient outcome from ED. Further study needed to be done with larger sample and longer duration in order to improve the reliability of the study.

Keywords: trauma, injury, triage, Triage Revised Trauma Score, CRAMS Scale

3.3 Introduction

Trauma remains the leading cause of morbidity and mortality in adolescent and young adults in Malaysia. Malaysia Ministry of Health 2013 report showed that trauma is the third principal causes of hospital admission and the fifth leading cause of death.[1] It is neglected cause of morbidity and mortality despite many campaigns regarding injury and road traffic accident prevention had been addressed to public. Most of trauma patients were within their productive age and disability as result from trauma will reduce patient's productivity.[2] Differences of trauma patients' mortality and morbidity rates in between countries reflected the countries health care quality and standard.[2]

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clinical assessment. Physiological assessment reflects patient's acute dynamic change post trauma.[6] Triage score that used anatomical assessment need more complicated diagnostic tool especially radiological investigation and only reflects patient injury at one point of time; thus it is not suitable to be done at prehospital or emergency triage level. Triage Revised Trauma Score (T-RTS) and CRAMS Scale are the example of trauma scores used physiological indices, Abbreviated Injury Scale (AIS), Injury Severity Score (ISS) and Anatomic Profile (AP) are the example of trauma scores that used anatomical indices and Trauma Score- Injury Severity Score (TRISS) is the example of trauma score that used both anatomical and physiological indices.[7]

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Revision of Trauma Score (TS) consists of Triage Revised Trauma Score (T-RTS) and coded Revised Trauma Score (RTSc).[7,9] Certain parameters of TS are found difficult to be assessed at field especially capillary refilling time and respiratory expansion. The usage of TS as a triage tool is replaced by T-RTS; while RTSc is used for quality assurance and outcome prediction.[10] The RTSc is measured in coded form which GCS is weighted heavily in RTSc as RTSc emphasizes the significant impact of traumatic brain injury outcome.[9,11]

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The purpose of this study is to compare the utility of T-RTS with CRAMS scale in determining outcome of adult trauma patient in Hospital Universiti Sains Malaysia (HUSM).

3.4 Methodology

This was a prospective cohort study conducted in Emergency Department(ED), HUSM, Kubang Kerian, Kelantan from December 2015 until February 2016. All trauma patients age 18 years old and above chosen via convenience sampling were included in this study. Referred trauma patients from other hospital were excluded.

Adult trauma patients were identify and selected at triage upon visited to ED. Patient demographic data such as age, gender, race and type of trauma were recorded. Vital signs such as blood pressure, respiratory rate, Glasgow coma Scale (GCS) and examination findings of the thorax and abdomen were obtained to calculate score for T-RTS and CRAMS scale. For T-RTS, parameters needed were respiratory rate per minute, systolic blood pressure in mmHg and GCS. Each parameter had been divided into range of value and the highest score of each parameters was 4 and the lowest was 0. The summation of each parameter score were calculated and noted in assessment form (total score maximum was 12, minimum total score was 0). Score of 12 was categorized as minor injury while score 11 and below were categorized as major injury.[12]

Parameter that needed for CRAMS Scale were circulation, respiration, abdomen and thorax, motor and speech. Each parameter highest score was 2 and lowest score was 0. For circulation, patients were evaluated based on capillary refilling time or systolic blood pressure and for respiration was based on breathing pattern. Abdomen and thorax were evaluated based on present of tender part or patient having rigid abdomen or flail chest. Motor functions assessment was evaluated based on respond or posture while speech was evaluated based on vocalization respond. Score from each parameter were sum up (maximum total

score was 10, minimum total score was 0). Score of 9 and above were categorized as minor injury while score 8 and below were categorized as major injury.[13]

Endpoint of this study was patients' outcome from emergency department. Patients' disposition from ED were followed up. The parameter for outcome was either patient was discharged, admitted to general ward, admitted to intensive care unit or directly to operation theatre or death in emergency department. Patients' outcome were categorized into two categories; major injury or minor injury. They were considered have major injury outcome if patient died in the emergency department or admission to intensive care unit or directly to operation theatre.[13] Patients who were discharged or admitted to general ward were considered to have minor injury outcome.[11,12]

Data management and statistical analysis were done using software IBM SPSS version 22.0. Descriptive statistic were used for demographic data. The continuous variable was described in mean and standard deviation while categorical variables such were described in frequency and percentage. Both scoring systems, T-RTS and CRAMS were divided into major (T-RTS score <12, CRAMS score < 9) and minor (RTS score 12, CRAMS score >8) injury describe in frequency, percentage and interquartile range.

Independent T -test was used for association of patients' age and outcome while Fisher Exact test was used to analyse association of both scoring systems and categorical variables with patient's outcome. Sensitivity and specificity of T-RTS and CRAMS scale were evaluated using crosstabs. Negative Predictive Value (NPV) and Positive Predictive Value (PPV) were estimated for both T-RTS and CRAMS Scale. Kappa statistic test were used to obtained accuracy and agreement for both scoring.

This study had obtained ethical approval from Human research Ethics Committee, Universiti Sains Malaysia (USM/JEPeM/15030102).

3.5 Results

A total number of 91 adult trauma patients who visited ED between December 2015 and February 2016 were included in this study. The mean age of all adult trauma patient was 38.5±19.29 years old. The majority of the respondents were male (n=68, 74.7%). Most of patients were Malay (n=86, 94.5%), followed by Chinese (n=3, 3.3%), Indian (n=1, 1.1%) and others (n=1, 1.1%). Majority of patients involved in road traffic accident (n=54, 59.3%).

All patients were scored on both T-RTS and CRAMS Scale. The median score for T-RTS was 12 (IQR=0). Twelve patients (13.2%) were classified as major injury, while the rest (n=79, 86.8%) were classified as minor injury. By CRAMS Scale, the median score was 10 (IQR=1). Ten patients (11.0%) were classified as major injury, while the rest (n=81, 89.0%) were classified as minor injury. All patients were followed up for their outcome. Our study showed that 84 patients (92.3%) had minor injury outcome which was either discharged home after emergency visit or been admitted to general ward. Seven patients (7.7%) had major injury outcome which was either admitted to ICU, sent directly to operation theatre or died in ED (Table 1).

The mean age for major injury outcome was 27±7.42 years old while the mean age for minor injury outcome was 39±19.68 years old. There was a significant association of patient age with patients' outcome (p=0.003). Among trauma patients who had involved in road traffic

accident, 42 patients (87.0%) had minor injury outcome while another 7 patients (13.0%) had major injury outcome. All patients who had not involved in road traffic accident had minor injury outcome (n=37, 100%). Type of trauma had a significant association with patients' outcome (p=0.039).

For male patients, 61 patients (89.7%) outcome were minor injury while another 7 patients (10.3%) outcome were major injury. All female patients had minor injury outcome. However, there was no significant association of patients' gender with their outcome (p=0.185). Our results also showed that there was no significant association of patients' race with their outcome post trauma (p=1.000). Among the Malays, outcome of 79 patients (89.7%) were minor injury and outcome for another 7 patients (8.1%) were major injury.

Among the twelve patients who were classified by T-RTS as major injury, 7 patients (58.3%) had major outcome and 5 patients (41.7%) had minor outcome. Among the 79 minor injury patients as classified by T-RTS, 77 patients (97.5%) had minor outcome while other 2 patients (2.5%) had major outcome. Ten patients had been classified by CRAMS Scale as major injury of which five patients (50%) had major outcome while another five patients (50%) had minor outcome. For 81 patients with CRAMS Scale classified as minor injury, 79 patients (97.5%) had minor outcome while another 2 patients (2.5%) had major outcome. There was a significant association for both patients' T-RTS and CRAMS Scale scores with patients' outcome ($p<0.001$). (Table 2)

With crosstabs analysis, T-RTS had a sensitivity of 71.4% while CRAMS Scale had sensitivity of 72.4% of predicting patient outcome in ED. CRAMS Scale had higher specificity (94.0% as compared to T-RTS (91.7%). T-RTS and CRAMS Scale have high NPV (97.5%) with high accuracy (90.1% and 92.3% respectively). Both scoring systems

however had low PPV (T-RTS 41.7% and CRAMS 50.0%). Comparison of both scoring systems using Kappa test analysis showed moderate agreement with Kappa=0.54 ($p<0.001$). (Table 3)

3.6 Discussion

Trauma among adults were more common in younger age group especially between 21 to 40 years old.[14-15] Majority of trauma patients were Malay. There was different findings with other center in Malaysia in view of high Malay population in study area, Kelantan (92.3%) in 2015 compared to Malaysia population (50.78%).[16] Road traffic accident was major type of trauma encountered by patients. However the percentage was lower in these study population compared with other centers.[14-15] The differences were due to only adult trauma patients who visited to emergency department in HUSM were chosen to be involved in this study and referral cases were excluded.

Most of trauma patients were categorized as minor for both T-RTS and CRAMS Scale. The figure showed similar result with other study.[17] The percentage of trauma patients scored major were very minimal due to multiple factor. Few factors were identified such as investigator had difficulty in getting consent as the surrogate relatives were not available and referral case from other hospitals were excluded. Actual comparison with other study was not feasible with limited references in view of most study involving T-RTS and CRAMS were done retrospectively rather than prospectively. The outcome of trauma patients that had been followed up also showed major injury comprised only small number of patient

compared to minor injury. The percentage of major injury also differed from other study due to similar factor stated before prior to data collection.[12]

Age factor did correlates with severity of injury. Majority of patients who had major injury were within young age group and the figure similar to Malaysia's figure with 54.3% of major injury occur in patients within 15 to 34 years old.[14] This situation was not bizarre in view of urbanization and economic status with vehicle ownership at younger age and involvement in high risk behavior such as disobedience to the road traffic laws, non-adherences to the personal protective equipment such as helmets and safety belt and also illegal racing.[18]

Types of trauma did correlate with severity of injury. Among major injury victims, majority were due to road traffic accident and it was similar to Malaysia's figure.[14] Majority of road traffic accidents involved high impact mechanism especially the vehicular speed prior to incidents and these caused severe injuries especially to the head, neck, limb and abdomen.

T-RTS and CRAMS Scale had low sensitivity (71.4% for T-RTS and 72.4% for CRAMS). Sensitivity from this study was low compared to similar study that had been done in United Kingdom (UK).[17] However this study and study that had been done in UK showed the sensitivity of CRAMS Scale were low compared to actual CRAMS Scale study (92.0%) and also it validation study (100%).[5,12-13] For T-RTS, it showed different result. In this study sensitivity was 71.4% compared to study had been done in UK (61.0%).[18] Actual T-RTS study showed lower sensitivity (59%). Despite of lower T-RTS sensitivity compared to CRAMS Scale, it is widely used and being studied in multiple trauma center in the world due to feasibility of assessment that involved only three physiological parameter.

Our study shows that T-RTS and CRAMS Scale had high specificity (T-RTS for 91.7% and 94.0% for CRAMS Scale). The findings varies if compared to actual study. For T-RTS, actual T-RTS study showed lower specificity (82%). However, result showed higher specificity (90%) in a study done in UK.[11,18] CRAMS Scale had high specificity (94%). However, actual CRAMS Scale showed higher specificity (98%). A study done in UK showed different result as CRAMS Scale specificity was only 75%. Our study and a study done in UK showed similar findings; both studies had high negative predictive values with low positive predictive values.

Presence of results variability and also limited number of comparison studies that had been conducted using these two scoring system made it difficult to determine which scoring systems could be used for adult trauma patient in prehospital or triage in ED.

Limited number of study used CRAMS Scale as prehospital triage tool even though it has higher sensitivity and specificity if compare to T-RTS. Few studies had been conducted against the usage of T-RTS in view of poor prognostic value. Study done Switzerland showed that high incidence of major injuries to chest, abdomen and extremities among patients with T-RTS maximum score 12.[19] The T-RTS also was noted inaccurately triage patients with major injuries. Some patients were scored as minor injury using T-RTS however were noted to have major injuries during treatment.[20]

3.7 Conclusion

Our study showed CRAMS Scale was better than T-RTS in predicting patients' outcome from ED. Further study needed to be done with larger sample size and longer duration in order to improve the reliability of the study.

Acknowledgement

Special thanks to Dr Tuan Hairulnizam Tuan Kamauzaman, Supervisor and Senior Lecturer, Emergency Department, School of Medical Sciences, Universiti Sains Malaysia (USM), Dr Najib Wajdi, Statistician, Biostatic Unit, School of Medical Sciences, USM and En. Aiman, Statistician, Clinical Research Center, Hospital Sultanah Bahiyah, Alor Setar for their expert advice and guidance along the process for completion of this study.

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3.9 Tables

Table 1. Sociodemographic Characteristics and Clinical Variables of the Samples

Variables		n (%)	Mean (SD)	Median (IQR)
Age			38.5(19.29)	
Gender				
	Male	68(74.7)		
	Female	23(25.3)		
Race				
	Malay	86(94.5)		
	Chinese	3(3.3)		
	Indian	1(1.1)		
	Others	1(1.1)		
Type of Trauma				
	RTA	54(59.3)		
	non RTA	37(40.7)		
T-RTS				12(0)
	Major	12(13.2)		
	Minor	79(86.8)		
CRAMS				10(1)
	Major	10(11.0)		
	Minor	81(89.0)		
Outcome				

Discharge	49(53.8)
Admit	35(38.5)
ICU/Operation Theatre	4(4.4)
Death	3(3.3)

notes: SD = Standard Deviation, IQR= Interquartile Range

Table 2. Association of Sociodemographic, T-RTS and CRAMS Scale with Outcomes

		Major injury		Minor injury		
Variable		Mean (SD)	n (%)	Mean (SD)	n (%)	p-value
Age		27.0(7.42)		27.0(7.42)		0.003†
Sex						0.185‡
	Male		7(10.3)		61(89.7)	
	Female		0(0.0)		23(100.0)	
Race						1.000‡
	Malay		7(8.1)		79(91.9)	
	non-Malay		0(0.0)		5(100.0)	
Trauma						0.039‡
	RTA		7(13.0)		42(87.0)	
	non- RTA		0(0.0)		37(100.0)	
T-RTS						<0.001‡
	Major		5(41.7)		7(58.3)	
	Minor		2(2.5)		77(97.5)	
CRAMS						<0.001‡
	Major		5(50.0)		5(50.5)	
	Minor		2(2.5)		79(97.5)	

Note: †Independent t-test, ‡Fischer's Exact test

Table 3. . Sensitivity and Specificity between T-RTS, CRAMS and Outcome

Variables	Sensitivity	Specificity	PPV	NPV	Accuracy	p-value[§]
T-RTS	71.4	91.7	41.7	97.5	90.1	<0.001
CRAMS	72.4	94.0	50.0	97.5	92.3	<0.001

Note: [§]Kappa test