RESEARCH ARTICLE

Trauma and Injury Severity Score in Predicting Mortality of Polytrauma Patients

Bambang Gunawan, Risa Dumastoro, Achmad Fauzi Kamal*

Department of Orthopaedic and Traumatology
FM Universitas Indonesia-Dr. Cipto Mangunkusumo Hospital

*Corresponding author: fauzikamal@yahoo.com
Received 15 August 2017; Accepted 26 October 2017
DOI: 10.23886/ejki.5.8148.

Abstract

TRISS (Trauma and Injury Severity Score) is one of the most commonly used trauma score. Currently, there is no data about using TRISS in the care of polytrauma patients at emergency department of dr. Cipto Mangunkusumo Hospital (CMH). This research was intended to evaluate whether TRISS can predict the mortality of polytrauma patients at CMH. This was an analytic descriptive study with retrospective cohort design. Data was collected from medical records of polytrauma patients who were admitted to emergency department of CMH from 2011-201 4 then we analyzed the relationship between TRISS and patient's prognosis. Furthermore, we conducted bivariate and multivariate analysis by SPSS 20 software. Seventy medical records were included in this study. The majority of patients were male (65%) in young age. There were 69 patients who experienced blunt trauma, with the majority (94.3%) were caused by motor vehicle accident. After receiving trauma care, there were 26 deaths, while other 44 patients survived. From bivariate and multivariate analysis, we found a significant difference between TRISS and patient's prognosis. TRISS strongly predicts polytrauma patient's mortality (AUC 0,899; IK95% 0,824-0,975). TRISS has 84,6% sensitivity and 81.8% specificity with optimal intersection point ≤ 90,5. TRISS is able to predict the mortality of polytrauma patients at CMH.
Key words: *polytrauma;TRISS; prognosis.*

TRISS untuk Memprediksi Mortalitas Pasien Politrauma

Abstrak

TRISS merupakan salah satu penilaian trauma yang paling sering digunakan. Namun, saat ini belum ada data penggunaan TRISS dalam penanganan pasien politrauma di Instalasi Gawat Darurat (IGD) Rumah Sakit Umum Pusat Nasional dr. Cipto Mangunkusumo (RSUPNCM). Penelitian ini bertujuan untuk mengetahui kemampuan TRISS dalam memprediksi mortalitas pasien politrauma di IGD RSUPNCM. Penelitian ini adalah studi analitik deskriptif dengan menggunakan desain kohort retrospektif. Data diambil dari rekam medis pasien politrauma yang datangke IGD RSUPNCM tahun 2011-2014. Selanjutnya, kami lakukan analisis bivariat dan multivariate terkait hubungan antara TRISS dengan prognosis pasien politrauma menggunakan program SPSS 20. Tujuh puluh rekam medister masuk dalam criteria inklusi pada studi ini. Mayoritas pasien adalah pria (65%) dan berusia muda. Terdapat 69 pasien yang mengalami trauma tumpul dengan kecelakaan lalu lintas menjadi penyebab terbanyak (94.3%). Setelah pasien menjalani perawatan, didapatkan 26 pasien meninggal dunia sedangkan 44 lainnya selamat. Dari analisis bivariat dan multivariate ditemukan bahwa terdapat perbedaan bermakna antara TRISS dengan prognosis pasien. TRISS mampu memprediksi kuat mortalitas pasien politrauma (AUC 0,899; IK95% 0,824-0,975). TRISS memiliki sensitivitas sebesar 84.6% dan spesifisitas sebesar 81.8% dengan titik potong optimal ≤ 90,5. TRISS dapat memprediksi mortalitas pasien politrauma di RSUPNCM.
Kata kunci: *politrauma; TRISS; prognosis.*

Introduction

Trauma is the leading cause of death and disability throughout developed and developing countries.[1] Approximately 16,000 people die every day as a result of trauma (5.8 million deaths per year), and it is estimated that the number will increase to 8.4 million deaths per year in 2020. Traumatic incidents may increase, especially in developing countries with industrialization, where motor vehicles are increasingly being used.[2] Although the incidence is low, trauma remains the most common cause of death and disability in children and young adults in developed countries.[3] Polytrauma patient mortality ranged between 18-23% worldwide in 2000-2005, while there were 4 deaths from 17 polytrauma patients in dr. Cipto Mangunkusumo Hospital (CMH) from January 2011 to December 2014. One way to objectively measurehospital trauma care is by using trauma score. Of the many trauma scores, trauma and injury severity score (TRISS) is the most commonly used tool to evaluate trauma patient care.[5] Quality of hospital care may be evaluated by comparing predictions of the patient's prognosis with the outcome.[6] In addition, TRISS permits comparison between the qualities of one hospital care to the other hospitals.[6] This study was aimed to evaluate the relationship between TRISS and the prognosis of polytrauma patients in the emergency room (ER) of CMH.

Methods

This was an analytic descriptive study with retrospective cohort design in the ER of CMH from January 2011 to December 2014. Patients with incomplete or missing records as well as intubated or death on arrival were excluded from the study.

We collected data which comprised of patient characteristics, Glasgow Coma Scale (GCS), type of trauma, TRISS, referral status, response time, and outcome (death or survive). From the data, we set gender, referral status, response time, and TRISS as independent variables. The dependent variable of the study was patient's prognosis. Bivariate analyses were carried out by chi square test, Fisher's exact test, and Mann-Whitney test between prognostic variables. Variables with correlation according to bivariate analyses ($p < 0.25$) were compiled by multivariate analysis with logistic regression.

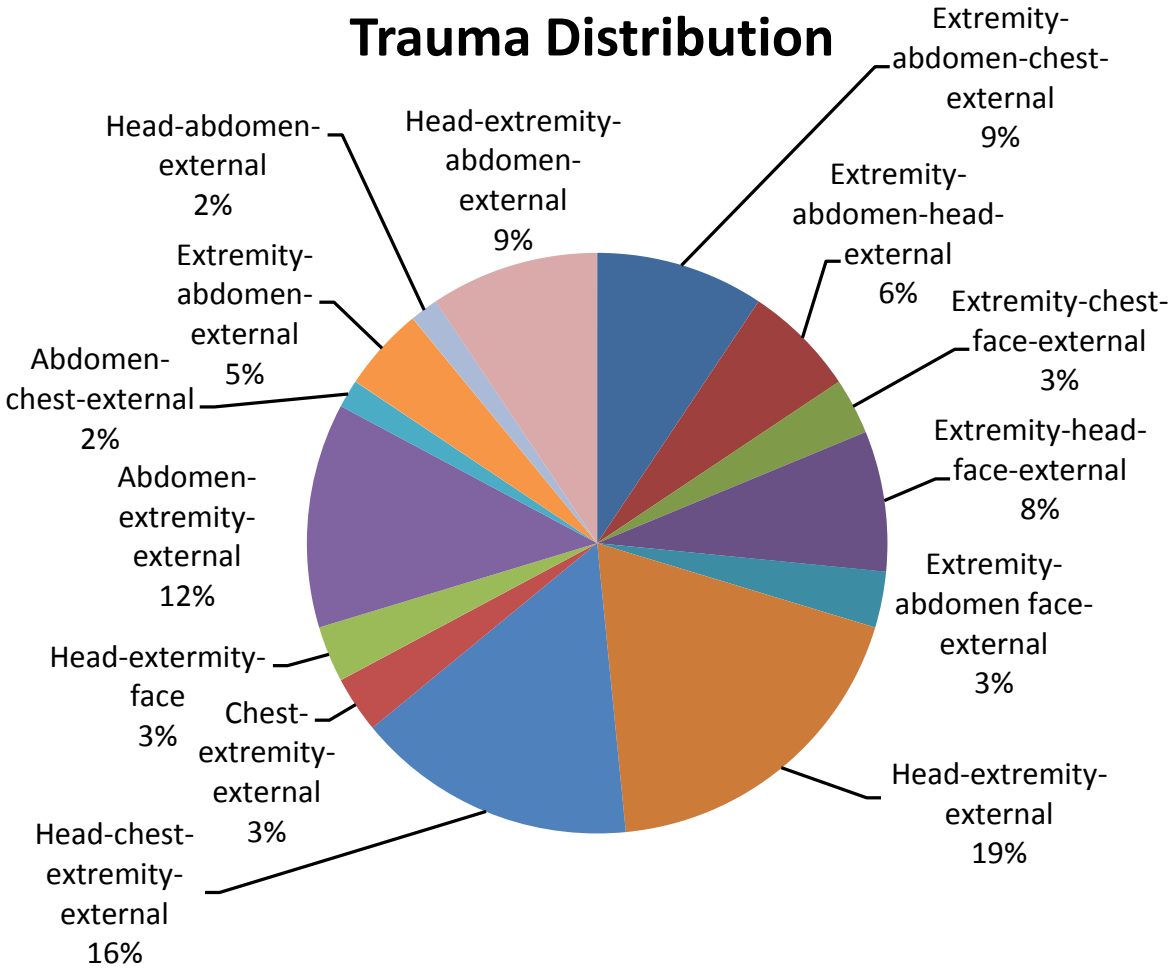
Results

From January 2011 to December 2014 there were 158 polytrauma patients who were admitted to ER of CMH, but only 70 patients who met the inclusion and exclusion criteria of the study. There were 19 polytrauma patients in 2011, 24 in 2012, 14 in 2013, and 13 in 2014. Subject characteristics were shown in Table 1.

Table 1. Characteristics of Study Subjects

Variable	Description
Year of admission	
2011	19 (27.1%)
2012	24 (34.3%)
2013	14 (20.0%)
2014	13 (18.6%)
Age	29.00 (13.00-67.00)
Gender	
Male	60 (85.7%)
Female	10 (14.3%)
Payment method	
Out-of-pocket	40 (57.2%)
Local or national insurance	21 (30.0%)
Homeless person	5 (7.1%)
Others	4 (5.7%)
Occupation	
Employee	16 (22.9%)
Labour	2 (2.8%)
Unemployed	32 (45,7%)
Entrepreneur	10 (14.3%)
Student	10 (14.3%)
Type of admission	
Referred	31 (44.3%)
Not referred	39 (55.7%)
Transportation	
Ambulance	32 (45.7%)
Public transportation	38 (54.3%)
Reason to refer	
Full ICU	12 (38.7%)
No facilities and full ICU	12 (38.7%)
No experts, facilities and full ICU	7 (22,6%)
Cause of trauma	
Traffic accident	66 (94.3%)
Occupational accident	3 (4.3%)
Fight	1 (1.4%)
Type of trauma	
Blount trauma	69 (98.5%)
Penetrating trauma	1 (1.5%)
Region of trauma	
Extremity	68 (97.1%)
Head	42 (60%)
Abdomen	34 (48.5%)
Chest	23 (32.8%)
Face	8 (11.4%)
External	70 (100%)
Observation room	
ICU+ward	45 (64.3%)
HCU+ward	9 (12.9%)
Resuscitation room	8 (11.4%)
Ward	8 (11.4%)
Response time	4.00 (0.16-168.00)
< 1 hours	9 (12.9%)
1-6 hours	37 (52.9%)
7-24 hours	19 (27.1%)
>24 hours	5 (7.1%)
GCS score	14.00 (3.00-15.00)
< 9	16 (22.9%)
9-13	17 (24.3%)
14-15	37 (52.8%)
TRISS Outcome	92.20 (12.40-98.70)
Survive	44 (62.9%)
Death	26 (37.1%)
Time of death	
<24 hours	11(42.3%)
24-48 hours	5 (19.2%)
>48 hours	10 (38.5%)

Twelve patients had a polytrauma in head-extremity-external region which made it the most common trauma distribution in this study. The second most common trauma distribution was head-chest-extremity region in 10 patients. Those two locations were followed by abdomen-extremity-external region (8 patients), head-extremity-abdomen and extremity-abdomen-chest region (6 patients), extremity-head-face region (5 patients), extremity-abdomen-head-external region (4 patients), and extremity-abdomen-external region (3 patients). We also recorded subjects who suffered polytrauma in extremity-chest-face-external, extremity-abdomen-face, chest-extremity-external, and head-extremity-face, each with 2 patients. The least frequent regions we recorded were abdomen-chest-external region and head-abdomen-external region, each with 1 patient. Complete distribution



data of trauma location in our subjects was shown in Figure 1.

Figure 1. Trauma Distribution of Study Subjects

Table 2. Bivariate Analysis Between independent Variables and Prognosis

	Death (n=26)	Survive (n=44)	p-value
Gender			
Male	21 (35%)	39 (65%)	0.483 [a]
Female	5 (50%)	5 (50%)	
Referral status			
Referred	11 (35.5%)	20 (64.5%)	0.798 [c]
Not referred	15 (38.5%)	24 (61.5%)	
TRISS	78.60 (12.40-97.60)	97.00 (55.10-98.70)	<0.001 [b]
Response time (hours)	1.50 (0.25-48.00)	5.00 (0.16-168.00)	0.093 [b]
Response time classification			
<1 hours	4 (44.4)	5 (55.6)	0.496 [b]
1-6 hours	14 (37.8)	23 (62.2)	
7-24 hours	7 (36.8)	12 (63.2)	
>24 hours	1 (20.0)	4 (80.0)	

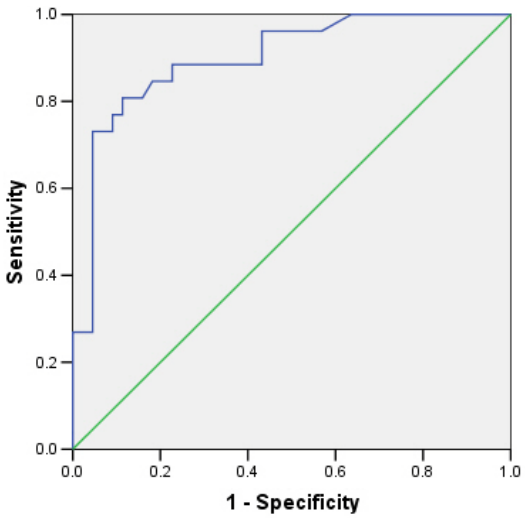
Numerical variables were abnormally distributed, presented as median (minimum-maximum).

Categorical variables were presented as n (percentage).
[a] Fisher's exact test; [b] Mann-Whitney test; [c] Chi-square test

Multivariate analysis was carried out by incorporating variables that had a bivariate analysis with p<0.25 (response time and TRISS) into logistic regression. From the logistic regression, we found that TRISS had a correlation with patient's prognosis with p value < 0.001 as shown in Table 3.

Table 3. Multivariate Analysis between Independent Variables and Prognosis

		B	S.E.	Wald	df	p-value	OR	95% CI	
Step 1	TRISS	-0.118	0.033	12.840	1	<0.001	0.89	0.83	0.95
	Response time	-0.007	0.016	0.227	1	0.634	0.99	0.96	1.02
	Constanta	9.731	2.921	11.097	1	0.001	16837.47		
Step 2	TRISS	-0.121	0.033	13.401	1	<0.001	0.89	0.83	0.95
	Constanta	9.862	2.928	11.346	1	0.001	19188.74		



The third model: AUC = 0.899 (95% CI 0.824-0.975); p<0.001; Hosmer and Lemeshow, p=0.177;
Regression equation y=9.862 – 0.121 TRISS; probability of death p=1/(1+exp(-y))

Figure 2. TRISS Discrimination to Patient's Prognosis.
AUC = 0.899 (95% CI 0.824-0.975); p<0.001

By using receiver operating characteristic (ROC) model, AUC was found to be 89.9% as shown in Figure 2, meaning that TRISS was a strong factor to predict patient's prognosis with polytrauma. TRISS also had a good calibration to predict patient's survival which was calculated and proved using Hosmer and Lemeshow test (p value = 0.177).

Mortality Prediction Using TRISS Score

Mortality prediction for polytrauma patients from our study could be estimated by regression equation shown in Table 3. For clinical practice, we simplifed our data and equation in a form of probability curve shown in Figure 3. the higher the TRISS was, the higher probability to survive.

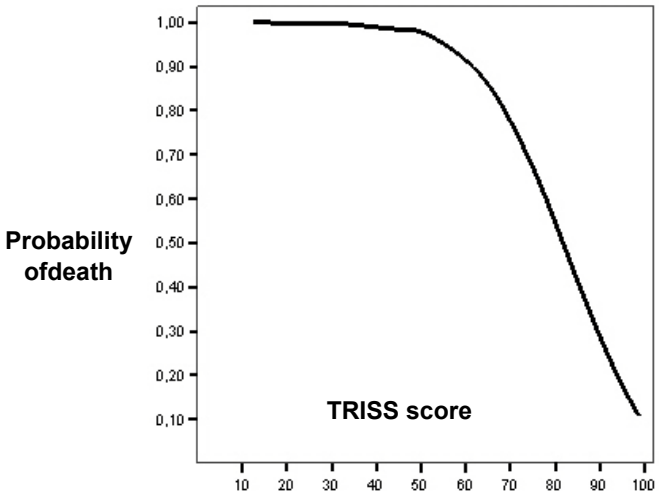


Figure 3. Mortality Prediction Using TRISS

Intersection Point of TRISS for Mortality Prediction

We drew sensitivity and specificity lines of TRISS to predict the mortality of polytrauma patients in our study. The optimal point was an intersection of two afore mentioned lines observed when TRISS ≤90.5 with 84.6% sensitivity and 81.8% specificity value.

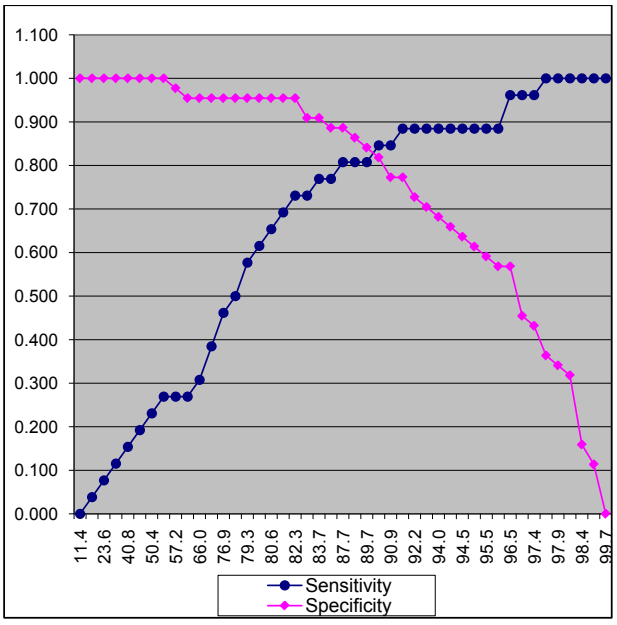


Figure 4. Intersection Point of TRISS for Mortality Prediction

Discussion

The number of male patients in this study was six times more than the number of female counterparts. It was probably because the male population worked more actively, travelled more frequently, and drive motor vehicle more commonly than female population.[20] The proportion was similar with Pakistan population according to a study by Chaudri et al.[5] In Singapore, male to female polytrauma patient ratio was smaller, which is 2.8:1.[22]

Nearly 70% of polytrauma patients in our study were aged between 20-55 years old which was classified as the productive age. Some studies reported that trauma was more frequently occurred in young age. This fact is quite worrying since prolonged hospitalization and disability may impair patient's productivity.[6,22,23]

Majority of patients in our study was admitted to hospital without using any insurance. Polytrauma care costs are quite substantial, and patients should be encouraged to take an effective payment method, especially insurance, to reduce the hospitalization cost. On a larger scale, the burden of public financing for trauma care are astronomical, and in developing countries is estimated to be hundreds of millionsdollars per day.[24]

More than half of the patients were brought to hospital using public transportation. This phenomenon was similar with Iran,[5] therefore public education about the use of transportation for patients becomes an urgent matter.[25] In polytrauma patients, blunt trauma was more commonly found than penetrating trauma. This finding was similar with other studies.[2,24,26] In this study, commonly involved body regions were extremity (97.1%), head (60%), abdomen (48.6%), chest (32.9%), and face (11.4%). Chaudry et al[5] reported that the body regions involved in polytrauma patients were abdomen (71%), chest (68%), face (14%), head (6.8%), and extremity (6.8%).[5] Moreover, Chen et al[27] reported that the body regions involved in their patients were extremity (63%), head (26%), chest (15%), abdomen (12%), and face (12%).

There were 11 patients died within 24 hours, 5 patients within 24-48 hours, and 10 patients after 48 hours of admission. Mortality in the first 24 hours was largely associated with head injury and abdominal bleeding. Some studies suggested that majority of trauma patients who died within the first 48 hours were related to head injury and bleeding.[30,31] After 48 hours, mortality was due to sepsis and multi organ failure.[30]

Loss of consciousness was largely related to head injury. Low level of consciousness was associated to the increase of mortality, while high level of consciousness was associated with survival.[28] Severe head injury was the leading cause of death and disability. More than half of the death was associated with head injury.[20]

Majority of polytrauma patients in this study (94.3%) was related to motor vehicle accidents. In accordance to Krug et al,[2] traffic accidents are the leading cause of deaths in productive age. Therefore, some preventive actions need to be taken seriously. Counselling and training toward the road users, especially for young people who drove motor vehicles as well as elderly and young adult pedestrians who are prone to traffic accidents and injuries, should be conducted widely.[29]

Majority of subjects in this study were referred patient due to ICU unavailablity of the referring hospital. Polytrauma patients were hemodynamically unstable and therefore demanded intensive observation in intensive care unit.[20] The availability of bed and facilities of ICU in many hospitals ares limited compared to the need of patients, not only trauma patients but also patients suffered from various systemic diseases.

In contrary with a study by Horst et al[32] we found that response time did not affect patient's prognosis. It was probably because most of our patients were admitted in a bad condition, therefore had poor prognosis regardless of their response time. Pre-hospital care in the present study did not affect patient's mortality. It was presumably due to missed diagnoses and delayed diagnoses, which were common in the management of polytrauma patients. Byun et al[33] reported that missed diagnosis occurred in 1.3 to 39% of the polytrauma patients. Missed diagnosis and delayed diagnosis might contribute to patient's mortality, morbidity, and length of hospital stay. Both missed diagnoses and delayed diagnoses might be minimized by improvingmedical personnel ability and facility, which were frequently lacking in developing countries.[33] Therefore, integrated trauma system including pre-hospital care and patient transportation needed to be improved, and trauma centres had to be developed.[34]

By using ROC we found AUC 0.899 (95% CI 0.824 – 0.975), which concluded that TRISS had a strong predictive value. The higher the TRISS was, the higher probability to survive. In this study, TRISS score had good sensitivity and specificity, which were 84.6% and 81.8% respectively with optimal intersection point at TRISS score ≤90.5. Other

study reported higher sensitivity and specificity for TRISS, 90.9% and 97.2% respectively.[19]

TRISS was frequently used to predict the prognosis of polytrauma patients.[19] The score can also be utilized to evaluate hospital trauma care, to compare trauma care in a hospital with other hospitals, as well as to organize and improve trauma care system in a larger scale.[18] Good trauma care was associated with better prognosis and less mortality.[30]

TRISS had several noticeable weaknesses. First, the score was not able to calculate multiple injuries in the same body region.[16] Second, the score did not include systemic comorbidities, which also contributed to patient's prognosis. Third, the score was not able to evaluate intubated patients, because the score was dependent to patient's respiratory rate.[18]

Other specific conditions such as trauma epidemiology, emergency care, referral system, and medical care cannot be overlooked. In the end, the outcome of polytrauma patientsdepends on those factors, including trauma severity, comorbidity, emergency personnel, and trauma management system.[18,35]

Conclusion

From this study we conclude that TRISS may predict the mortality of polytrauma patients with strong factor to predict prognosis, analyzed using ROC model (AUC = 0.899; IK95% 0.824-0.975). TRISS also has high sensitivity and specificity value, hence it can be used to evaluate quality of service and treatment on patients with polytrauma.

References

1. Murlidhar V, Roy N. Measuring trauma outcomes in India: an analysis based on TRISS methodology in a Mumbai university hospital. Injury 2004;35:386–90.
2. Krug EG, Sharma GK, Lozano R. The global burden of injuries. Am J Public Health. 2000;90:523–6.
3. Murray CL, Lopez AD. Alternative projections of mortality and disability by cause 1990–2020. Lancet. 1997; 349:1498–504.
4. Pfeifer R, Tarkin IS, Rocos B, Pape HS. Patterns of mortality and causes of death in polytrauma patients—Has anything changed? Injury. Int J Care Injured. 2009;907–11.
5. Chaudhry N, Naqi SA, Qureshi AU. Effectiveness of TRISS to evaluate trauma care in a developing country. Emergency Med. 2012;2:124.
6. Norouzi V, Feizi I,Vatankhah S, Pourshaikhian M. Calculation of the probability of survival for trauma patients based on trauma score and the injury severity score model in Fatemi Hospital in Ardabil. Arch Trauma Res. 2013;2(1):30–4.
7. Butcher NE, Enninghorst N, Sisak K,Balogh ZJ. The definition of polytrauma: variable interrater versus intrarater agreement a prospective international study among trauma surgeons. J Trauma Acute Care Surg. 2012;884–9.
8. Colton CL, Holz FD, Kellam JF, Ochsner PE. AO trauma-principle management of fracture. Switzerland: AO Publising;2000.
9. Tien H, Chu P, Brenneman F. Causes of death following multiple trauma. Current Orthopaedics. 2004;304–10.
10. Gebhard F, Lang MH. Polytrauma: pathophysiology and management principles. Langenbecks Arch Surg. 2008; 825–31.
11. Brochner AC, Toft P. Pathophysiology of the systemic inflammatory response after major accidental trauma. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine. 2009;17:43
12. Aldrian S, Koenig F, Weninger P, Ve´csei V, Nau T. Characteristics of polytrauma patients between 1992 and 2002: What is changing? Injury. Int J Care Injured. 2007;1059–64.
13. Dhar SA et al. 'Damage control orthopaedics' in patients with delayed referral to a tertiary care center: experience from a place where composite trauma center do not exist. Journal of Trauma Management & Outcomes. 2008;2:2.
14. Giannoudis PV. Surgical priorities in damage control in polytrauma. J Bone Joint Surg Br. 2003;478–83.
15. Nicola R. Early total care versus damage control: current concepts in the orthopedic care of polytrauma patients. ISRN Orthopedics. 2013;2013:1–9.
16. Champion HR, Sacco WJ, Carnazzo AJ, Copes W, Fouty WJ. Trauma score. Crit Care Med. 1981;672–6.
17. Lefering R. Trauma score systems for quality assessment. Eur J Trauma. 2002;52–63.
18. Dillon B, Wang W, Bouamra O. A comparison study of the injury score models. Eur J Trauma. 2006;538–47.
19. Siritongtaworn P, Opasanon S. The use of trauma score-injury severity score (TRISS) at Siriraj hospital: how accurate is it? J Med Assoc Thai. 2009;92(8):1016–21.
20. Orhom R et al. Comparison of trauma scores for predicting mortality and morbidity on trauma patients. Ulus Travma Acil Cerrarhi Derg. 2014;20:258–64.
21. Kalkulator Skor Triss. Diunduh dari http://www.trauma.org/archive/scores/triss.html.
22. Leong MKF, Mujumdar S, Lim YH, Chao TC, Anantharaman V. Injury related death in Singapore. Hongkong J Emerge Med. 2003;10:88–96.
23. Payal P, Sonu G, Anil G, Prachi V. Management of polytrauma patients in emergency department: an experience of tertiary care health institution of northern India. World J Emerg Med. 2013;4(1):15–9.
24. Qureshi MA. Polytrauma: epidemiology & prognosis versus trauma score. Professional Med J. 2006;57–62.
25. Settervall CHC, Sousa RMC, Silva SCF. In-hospital mortality and the Glasgow coma scale in first 72

hours after traumatic brain injury. Rev Latin-Am Enfermagem. 2011;19(6):1337–43.
26. Sauaia A, Moore FA, Moore EE, Moser KS, Brennan R, Read RA, et al. Epidemiology of trauma deaths: a reassessment. J Trauma. 1995;38(2):185–93.
27. Chen SC, Lin FY. Chang KJ. Body region prevalence of injury in alcohol- and non-alcohol-related traffic injuries. J Trauma. 1999 Nov;47(5):881–4.
28. Wolfe RFS, Galvagno SM, Grissom TE. Critical Care Consideration in the management of the trauma patient following initial resuscitation. Scandinavian Journal Trauma, resuscitation. 2012; 20: 68
29. Byun CS, Park H,Oh JH, Bae KS, Lee KH, Lee E. Epidemiology of trauma patients and analysis of 268 mortality cases: trens of a single centre in Korea. Yonse Med J. 2015;56:220-26.
30. Sobrino J, Shafi MD. Timing and causes of death after injuries. Proc Byl Univ Med Cent. 2013;26:120-23.
31. Trajano AD, Pereira BM, Fraga GP. Epidemiology of in hospital trauma deaths in a Brazilian university hospital. BMC Emergency Medicine. 2014;14:22.
32. Murad MK, Larsen S, Husum H. Prehospital trauma care reduces mortality. Ten years result from a time cohort and trauma audit study in Iraq. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine. 2012;20:13
33. Horst K, Dienstknecht, Pleifer R, Pishnamaz, Hildebrand F, Pape HC. Risk Stratification by injury distribution in polytruama patients-does the clavicular fracture play a role? Patient Safety in Surgery. 2013;7:23.
34. Vikram U, Deshmukh, Mrunal N, Ketkar, Erach K, Bharucha. Analysis of trauma outcome using the TRISS method at tertiary care centre in Pune. Indian J Surg. 2012;74:440-44.
35. Byun CS, Park H,Oh JH, Bae KS, Lee KH, Lee E. Epidemiology of trauma patients and analysis of 268 mortality cases: trends of a single centre in Korea. Yonse Med J. 2015;56:220-26. Norris R et al. TRISS unexpected survivors: an outdated standard? J Trauma. 2002;52:229-34.