

Implementation of Trauma Score Using Kampala Trauma Score (KTS) in the Emergency Room (ER)

Akhmad Fauzi^{1*}, Suryanto²

^{1,2}Master of Nursing, Brawijaya University, Malang, Indonesia

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ABSTRACT: Trauma is physical damage that occurs to the body due to external forces that can cause morbidity and mortality in the emergency room. Trauma patients are assessed for severity, one of the scores used is the Kampala Trauma Score (KTS) with an accuracy value of 80% -92.3%. The advantages of KTS are simple and easy to help determine medical interventions to increase the chances of survival of trauma patients. The purpose of this study was to explore the satisfaction, barriers and expectations of nurses in implementing the Kampala Trauma Score in the ER. This study used a qualitative method, starting with identifying problems, determining evidence-based interventions, conducting socialization of the use of KTS, implementing KTS in the ER, conducting in-depth interviews, analyzing data. This study had 5 participants with accidental sampling techniques. The results of this study are that the KTS form makes it easier for nurses to assess and make critical decisions quickly, but there are several obstacles in its application such as still being unfamiliar with the new form, time constraints and lack of socialization and ongoing training, impacting the delay in filling out the KTS form, especially in crowded situations in the ER with emergency conditions. Nurses' expectations that the KTS form is sustainable in the ER by integrating KTS into the Hospital Management Information System (SIMRS) and the formation of a trauma team in the hospital. Innovation reflects the need for modernization in trauma management so that in the future it is expected to increase efficiency and minimize the risk of errors and improve the quality of service in the ER.

I. INTRODUCTION

Trauma is physical damage or injury that occurs to the body due to external forces, such as impact, accidents, falls, physical violence, or exposure to chemicals and heat(Herman, 2019; Hall and Hall, 2020; Vassiliu et al., 2022). Trauma is an emergency condition that requires immediate treatment because it can cause serious damage and

is one of the main causes of morbidity and mortality in emergency room care(Shanthakumar et al., 2021; Bagaria et al., 2024).

The prevalence of trauma incidents in the world is around 5 million each year, with 85-90% resulting from traffic accidents(Bari et al., 2021; Godthelp et al., 2024). In Indonesia, the prevalence of trauma cases is 31.1% with sharp trauma of 59.2%(Kalampung, Lampus and Wagiu, 2024), Trauma due to traffic accidents, amounting to 65.3%-86% (Zai, Wagiu and Rawung, 2018; Mulyono, 2021). In East Java, trauma cases in the ER are between 143-171 patients per month(Abdullah, Al-Rasyid and Rusli, 2022). In Jember, trauma patient visits in 2023 amounted to 668 patients, with 52.8% due to traffic accidents(Arti Tyagita, 2024).

Trauma patients are assessed as triage to assess the severity of trauma and prognosis. In Indonesia there is still no standard for assessing trauma patients, but several articles discuss the use of the Revised Trauma Score (RTS) in the initial assessment of trauma in the Emergency Room(Ristanto et al., 2016; Banin, Yueniwati and Utami, 2020; Fatimah, Astilia and Saputra, 2022). Other scoring systems that can be used are TRISS, MGAP, GAP, Kampala Trauma Score (KTS) to predict severity(Lindfors et al., 2019; Abeytunge et al., 2021; Javeed et al., 2022). The use of trauma measuring tools can be the basis for providing therapy to increase the patient's chances of survival(Hume, Wright and Kinsella, 2022), Emergency Room (ED) nurses play a role in the use of trauma scores to enable nurses to immediately identify the need for critical interventions and determine treatment priorities that can significantly improve patient survival.(Mohammed et al., 2022; Picetti et al., 2023). Emergency room nurses undergo ongoing training in the use of trauma scoring assessments to ensure accuracy and efficiency in emergency situations to reduce assessment errors that can be fatal to patients(Bahlibi et al., 2022; Zagalioti et al., 2023).

The use of the Kampala Trauma Score (KTS) has an accuracy of 80-92.3%(Weeks et al., 2016; Basak et al., 2023; Hakimzadeh et al., 2024), with the advantages of being very simple and easy to quickly help determine medical interventions to increase the patient's chances of survival, help with risk stratification and clinical management of patients, but cannot be used to assess the severity of injury(Clarkson et al., 2012; Hakimzadeh et al., 2024).

The application of trauma scores aims to explore the experiences of nurses in applying the Kampala trauma score (KTS) to assess the severity of trauma patients in the ER.

II. METHODS

This study used a qualitative design, with 5 participants as ER nurses who had completed the Kampala Trauma score. The study began by identifying problems with direct observation and interviews with nurses and ER room heads, determining the selection of evidence-based trauma scores by conducting literature studies in the PubMed, Proquest and Science Direct databases

related to research results on trauma scores. Conducting socialization of filling out the Kampala Trauma Score (KTS) form to ER nurses, implementing the Kampala Trauma Score (KTS) form by ER nurses for 3 weeks, conducting an evaluation with in-depth interviews related to nurses' experiences in implementing the KTS for 15-25 minutes according to the theme of satisfaction, obstacles and expectations of nurses, data analysis using the Colaizzi analysis method, namely Familiarization, identification of meaningful statements, formulating meaning, grouping themes, developing complete descriptions, producing fundamental structures and verifying fundamental structures.

III. RESULT

The description of the characteristics of the demographic data of the ER nurses who carried out the trauma score assessment amounted to 5 people. There were 3 male nurses and 2 female nurses, 3 Diploma nurses and 2 Bachelor Profession nurses with the longest work period of more than 6 years, as explained in Table 1

Table 1 Data on participant characteristics

Participant characteristics		F	%
Sex	Male	3	60%
	Female	2	40%
Education	Diploma	3	60%
	Bachelor Ners	2	40%
Years of service	1-3 Year	1	20%
	3-6 Year	3	60%
	>6 Year	1	20%

1. Theme 1: Convenience and Detail

The majority of nurses consider that the KTS form is easy to apply and simple, detailed and facilitates assessment, although further socialization is needed.

“ simple in my opinion, so it is easy to fill it in ” (R.1)

“ the items are easy and detailed, to fill it in we just have to checklist ” (R.2)

“ yes the items are detailed and detailed for trauma cases ” (R.4)

“ this form is more detailed and detailed, this form is easy and simple, the items are not many but detailed and cover everything ” (R.3 and R.5).

Some nurses feel that there is ease in the process of assessing trauma patients, the KTS form is

considered to make it easier to diagnose severe trauma or mild trauma.

“ also diagnosing this patient with severe trauma or mild trauma is easier ” (R.1)

“ it is very easy to distinguish between severe trauma and mild trauma patients ” (R.4)

2. Theme 2. Time Constraints and Familiarity

The majority of nurses reported time constraints in filling out the KTS form, especially in emergency situations with many patients and also because they are not familiar with it.

“If you fill it out, you have to read it one by one again, it takes a long time there, like there is a time delay” (R.1)

"When there are trauma patients who are really critical and there are many, sir, there is a bit of a delay there because I feel like I don't really know the location of the items" (R.3)

"It is filled in but only after triage can I fill it in, the delay is there, especially if there are a lot of patients and some are critical" (R.4)

"Especially if the patients are crowded, we can't immediately fill out the form, so later after triage or handling new patients, we fill out the form, so it's a bit slow" (R.5)

Another constraint conveyed by nurses was the need for further socialization so that the KTS form is adopted more quickly by nurses who still need to adapt to the new form

"In my opinion, this is a new form, so we have to, uh, if we fill it out, we have to read it one by one again" (R.1)

"Yes because this is a new form that has been introduced to us, so we have to remember the location of the points, and for socialization too, it needs more socialization, sir" (R.2)

"I feel like I'm not too familiar with the location of the items, we're using a new form so it's still a bit awkward to fill it in quickly because we haven't memorized all the locations of the items, it needs more adaptation, further introduction like more socialization" (R.3, R.5)

3. Theme 3. Development expectations

Several nurses conveyed their desire for further development by wanting integration in the digital system, namely being able to be integrated into SIMRS.

"I hope that this KTS form will continue, of course in the ER" (R.1)

"Yes, I also hope that this can be continued in its implementation, hopefully it can be included in our SIMRS later so that the hospital can develop" (R.3)

"So I hope this KTS form can be continued and included in SIMRS to make it easier for us in the assessment process" (R.5)

Other developments were also identified as hopes for innovation conveyed by nurses, nurses hope that with this KTS form a trauma team can be formed in the hospital, similar to the code blue team that previously existed.

"Later, we can also form a trauma team like the code blue team that previously existed in our hospital" (R.3)

"We can form a trauma team, like my friend said earlier, the code blue team already exists in the hospital" (R.4)

"Hopefully your report regarding the KTS form can be adopted by the hospital management and immediately implemented in the ER and can also form a trauma team in the hospital" (R.5)

IV. DISCUSSION

1. Nurse Satisfaction in the Implementation of Kampala Trauma Score (KTS) in the Emergency Department

The implementation of the KTS form in in-depth interviews related to satisfaction with using the form has a significant impact on improving interventions for trauma patients. In the analysis process, the researcher identified that the majority of nurses evaluated stated that the KTS form was easy to use and had detailed items to assess the condition of trauma patients, several respondents also stated that they felt this form was easy to fill out and helped in the trauma diagnosis process. The simplicity of the KTS form makes it easy for nurses to make rapid assessments of patients with severe or mild trauma. This simplicity is an important factor, especially in emergency situations. The speed of initial assessment of trauma patients is crucial, because delays in evaluation can have a direct impact on the patient's prognosis. The respondents' statements indicate that the KTS is effective in providing a structured and simple framework, so that nurses are able to make decisions more quickly and accurately in emergency conditions.

The KTS form has simple yet detailed assessment components that allow nurses to perform rapid triage and determine the necessary actions. Previous research by Weeks et al. (2016) stated that the use of KTS can reduce the time required to perform triage and increase the overall efficiency of the trauma patient management process. Similar results were found in the study of Rosenkrantz et al. (2022) which stated that KTS is a very efficient assessment tool for countries with limited resources. This proves the effectiveness of KTS in accelerating decision-making in the emergency setting and also makes KTS an ideal choice for use in health facilities with limited resources (Weeks et al, 2016; Rosenkrantz et al, 2022)

2. Barriers to Nurses in Implementing Kampala Trauma Score (KTS) in the Emergency Room

Nurses in the ED also reported several barriers to its use. Barriers that emerged in the analysis process were related to lack of familiarity with the new form, time constraints, and the busy emergency situation. The use of the KTS form

requires significant adaptation from nurses, they feel they have to adjust to a format and assessment items that are different from the form they used before, so this often causes a slowdown in the triage process, especially in emergency situations that require speed and accuracy in decision making. According to Shanthakumar et al. (2021), adaptation to a new scoring system requires structured and ongoing training, as well as support from hospital management (Shanthakumar et al, 2021). This is in line with reports from nurses in the ER who stated that they needed more time to understand and remember the items in the KTS form, especially in emergency situations where the number of patients increased.

Lack of training and socialization regarding the use of the KTS form is also another identified obstacle. Therefore, in the process of adapting to the new scoring system, nurses need repeated training to become familiar with the assessment items and the order in which the form is filled out. Ongoing training is important to ensure that all ED staff have the same understanding regarding the application of the KTS form in various trauma scenarios. Without socialization or structured training, there is a risk that the KTS form may be filled out inconsistently, which will result in an inaccurate assessment result that can slow down the assessment and reduce service efficiency.

Several studies support the importance of ongoing training in the implementation of trauma scoring systems, Mohammed et al. (2022) in their study highlighted that regular training can help improve the speed and accuracy of trauma scoring assessments by medical personnel. With adequate training, nurses will master the new system more quickly and be more comfortable using it in emergency situations. In addition, training can also help reduce anxiety and stress felt by medical personnel when dealing with new forms that are not yet familiar (Mohammed et al, 2022)

3. Nurses' Expectations in Implementing the Kampala Trauma Score (KTS) in the Emergency Room

The hope for nurses to improve the quality of service, especially for trauma patients. From the analysis process, the author identified the integration of the KTS form into the Hospital Management Information System (SIMRS) as one of the hopes expressed by nurses. SIMRS is a computer system used in all health service operations to record and manage data efficiently. This technology is important because it helps hospitals operate more effectively (Nur et al, 2024).

The nursing care process and all health services have been integrated with SIMRS including in the ER. This is the basis for nurses wanting innovation by integrating the KTS form into SIMRS. This statement indicates that the integration of the KTS form into SIM-RS will speed up the documentation process and reduce errors in filling out manual forms, nurses will be able to access data more easily and quickly for further analysis. Thus, this integration is expected to improve the quality of services in the ER.

Another development that the author identified is the nurse's hope for the formation of a focused trauma team, such as a code blue team. The formation of a special trauma team in the hospital can improve patient response and treatment, this is very beneficial in handling severe trauma cases and for plans to establish a special trauma hospital. The existence of a trauma team will support the use of KTS according to Standard Operating Procedures (SOP) and ensure that it is carried out strictly, thus maintaining the quality of services provided to patients. The formation of a trauma team in the hospital allows for better treatment protocols in trauma situations to reduce patient mortality and morbidity.

Several studies have shown that the formation of a trauma team in the hospital can increase the survival rate of trauma patients, especially in trauma centers. Research conducted by Clarkson et al. (2012) stated that hospitals that have trauma teams show a significant reduction in mortality rates for trauma patients compared to hospitals that do not have similar teams (Clarkson et al, 2022). This indicates that the hope for the formation of a trauma team in the hospital will increase a more structured and organized response in dealing with emergency situations which will have an impact on more effective trauma handling, reducing resuscitation time, and increasing the accuracy of the medical actions provided.

V. CONCLUSIONS

The implementation of the Kampala Trauma Score (KTS) form provides significant benefits in assessing the severity of patient trauma quickly and efficiently. The KTS form makes it easier for nurses to quickly assess and make critical decisions, this is because the KTS form is simple and detailed. However, there are several obstacles in its application reported by nurses such as still being unfamiliar with the new form, time constraints and lack of socialization and ongoing training. These obstacles will have an impact on the delay in filling

out the KTS form, especially in crowded situations in the ER with emergency conditions.

The hope for the continued implementation of the KTS form in the ER was expressed by nurses by integrating the KTS into the Hospital Management Information System (SIMRS) and the formation of a trauma team in the hospital. Innovation reflects the need for modernization in trauma management so that in the future it is expected to increase efficiency and minimize the risk of errors and improve the quality of services in the ER.

REFERENCE

- [1]. Abdullah, T., Al-Rasyid, H. and Rusli, K.N.D.M.A. (2022) 'Perbandingan Triage Early Warning Score, National Early Warning Score, Rapid Emergency Medicine Score, Dan Modified Early Warning Score Dalam Memprediksi Tingkat Kematian Pasien Trauma Di Igd Rsud Dr. Saiful Anwar Malang', *Majalah Kesehatan*, 9(2), pp. 78–85. Available at: <https://doi.org/10.21776/majalahkesehatan.2022.009.02.3>.
- [2]. Abeytunge, K. et al. (2021) 'Development of a Mortality Prediction Tool in Pediatric Severe Traumatic Brain Injury', *Neurotrauma Reports*, 2(1), pp. 115–122. Available at: <https://doi.org/10.1089/neur.2020.0039>.
- [3]. Al-Fadhl, M.D. et al. (2024) 'Traumatic Brain Injury as an Independent Predictor of Futility in the Early Resuscitation of Patients in Hemorrhagic Shock', *Journal of Clinical Medicine*, 13(13). Available at: <https://doi.org/10.3390/jcm13133915>.
- [4]. Amare, A.T. et al. (2021) 'Survival status and predictors of mortality among traumatic brain injury patients in an Ethiopian hospital: A retrospective cohort study', *African Journal of Emergency Medicine*, 11(4), pp. 396–403. Available at: <https://doi.org/10.1016/j.afjem.2021.06.003>.
- [5]. Amila, Sembiring, E. and Hutajulu, D.E. (2019) The Factor Associated with Mortality in Severe Traumatic Brain Injury Patients, *International Conference on Science, Technology, and Environment*.
- [6]. Ariaka, H. et al. (2020) 'A Comparison of the Predictive Value of the Glasgow Coma Scale and the Kampala Trauma Score for Mortality and Length of Hospital Stay in Head Injury Patients at a Tertiary Hospital in Uganda: A Diagnostic Prospective Study', *Surgery Research and Practice*, 2(1), pp. 1–9. Available at: <https://doi.org/10.1155/2020/1362741>.
- [7]. Arti Tyagita (2024) Laporan Tahunan. Jember.
- [8]. Bagaria, D. et al. (2024) 'Trauma systems in Asian countries: challenges and recommendations', *Critical Care*, 28(47), pp. 2–7. Available at: <https://doi.org/10.1186/s13054-024-04838-x>.
- [9]. Bahlili, T.T. et al. (2022) 'Effect of triage training on the knowledge application and practice improvement among the practicing nurses of the emergency departments of the National Referral Hospitals, 2018; a pre-post study in Asmara, Eritrea', *BMC Emergency Medicine*, 22(1), pp. 1–8. Available at: <https://doi.org/10.1186/s12873-022-00755-w>.
- [10]. Banin, S.R., Yueniwati, Y. and Utami, Y.W. (2020) 'Comparison of Trauma Scoring Ability to Predict Survival Rate in Countries with Low to Middle-Income', *International Journal of Science and Society*, 2(4), pp. 194–206. Available at: <https://doi.org/10.54783/ijssoc.v2i4.204>.
- [11]. Bari, I. et al. (2021) '0073 Global road safety: analysis of global status reports on road safety', *Injury Prevention*, 27(3), p. A20.1-A20. Available at: <https://doi.org/10.1136/injuryprev-2021-savir.50>.
- [12]. Basak, D. et al. (2023) 'Glasgow coma scale compared to other trauma scores in discriminating in-hospital mortality of traumatic brain injury patients admitted to urban Indian hospitals: A multicentre prospective cohort study', *Injury*, 54(1), pp. 93–99. Available at: <https://doi.org/10.1016/j.injury.2022.09.035>.
- [13]. Bedada, A.G., Tarpley, M.J. and Tarpley, J.L. (2021) 'The characteristics and outcomes of trauma admissions to an adult general surgery ward in a tertiary teaching hospital', *African Journal of Emergency Medicine*, 11(2), pp. 303–308. Available at: <https://doi.org/10.1016/j.afjem.2021.04.002>.
- [14]. Bertotti, M.M. et al. (2023) 'Glasgow coma

- scale pupil score (GCS-P) and the hospital mortality in severe traumatic brain injury: analysis of 1,066 Brazilian patients', *Arquivos de Neuro-Psiquiatria*, 81(5), pp. 452–459. Available at: <https://doi.org/10.1055/s-0043-1768671>.
- [15]. Biuki, N.M. et al. (2023) 'Comparison of the predictive value of the Helsinki, Rotterdam, and Stockholm CT scores in predicting 6-month outcomes in patients with blunt traumatic brain injuries', *Chinese Journal of Traumatology - English Edition*, 26(6), pp. 357–362. Available at: <https://doi.org/10.1016/j.cjtee.2023.04.002>.
- [16]. Chae, H.R. et al. (2022) 'Predictive value of modified early warning score for massive transfusion in patients with traumatic brain injury', *Ulusal Travma ve Acil Cerrahi Dergisi*, 28(8), pp. 1082–1087. Available at: <https://doi.org/10.14744/tjtes.2021.13611>.
- [17]. Clarkson, C.A. et al. (2012) 'A Comparison of the Kampala Trauma Score with the Revised Trauma Score in a Cohort of Colombian Trauma Patients', *Panamerican Journal of Trauma, Critical Care & Emergency Surgery*, 1(3), pp. 146–149. Available at: <https://doi.org/10.5005/jp-journals-10030-1032>.
- [18]. Erickson, S. et al. (2020) 'Mean Arterial Pressure and Discharge Outcomes in Severe Pediatric Traumatic Brain Injury', *Neurocritical Care*, 34(1), pp. 1–9. Available at: <https://doi.org/10.1007/s12028-020-01121-z>.
- [19]. Farzan, N., Foroghi Ghomi, S.Y. and Mohammadi, A.R. (2022) 'A retrospective study on evaluating GAP, MGAP, RTS and ISS trauma scoring system for the prediction of mortality among multiple trauma patients', *Annals of Medicine and Surgery*, 76(March), p. 103536. Available at: <https://doi.org/10.1016/j.amsu.2022.103536>.
- [20]. Fatimah, F., Astilia, A. and Saputra, N. (2022) 'Penggunaan Skoring Trauma Gap Score dan Revised Trauma Score (RTS) Sebagai Prediktor Mortalitas Pasien Cedera Kepala', *Health and Medical Journal*, 4(2), pp. 138–143. Available at: <https://doi.org/10.33854/heme.v4i2.950>.
- [21]. Ghimire, P. et al. (2021) 'Factors Predicting outcome of patients with polytrauma in tertiary center of western Nepal', *Journal of Brain and Spine Foundation Nepal*, 2(1), pp. 13–18. Available at: <https://doi.org/10.3126/jbsfn.v2i1.39005>.
- [22]. Godthelp, H. et al. (2024) 'Capacity building for road safety in LMICs: the need for a sustainable local knowledge and research infrastructure', *Traffic Safety Research*, 8(63), pp. 1–8. Available at: <https://doi.org/10.55329/weks9456>.
- [23]. Hakimzadeh, Z. et al. (2024) 'The predictive value of the Kampala Trauma Score (KTS) in the outcome of multi-traumatic patients compared to the estimated Injury Severity Score (eISS)', *BMC Emergency Medicine*, 24(1), pp. 1–10. Available at: <https://doi.org/10.1186/s12873-024-00989-w>.
- [24]. Hall, J.E. and Hall, M.E. (2020) *Guyton and Hall Textbook of Medical Physiology*. 14th edn. Elsevier.
- [25]. Haveman, J.W. et al. (2018) 'Results of streamlined regional ambulance transport and subsequent treatment of acute abdominal aortic aneurysms', *Emergency Medicine Journal*, 23(10). Available at: <https://doi.org/https://doi.org/10.1136/emj.2006.037879>.
- [26]. Herman, J. (2019) 'The Aftermath of Violence: Trauma and Recovery', in *Transforming Terror*, p. 157. Available at: <https://doi.org/10.1525/9780520949454-026>.
- [27]. Hosseinalizadeh, E. et al. (2023) 'Designing a Model to Predict the Mortality in Multiple Trauma Patients due to Traffic Accidents', *Iranian Red Crescent Medical Journal*, 25(10). Available at: <https://doi.org/10.32592/ircmj.2023.25.10.2299>.
- [28]. Huang, Ching Ya et al. (2024) 'The Stress Index as a Predictor of Mortality in Patients with Isolated Moderate to Severe Traumatic Brain Injury', *Diagnostics*, 14(12), pp. 1–12. Available at: <https://doi.org/10.3390/diagnostics14121244>.
- [29]. Hume, C.H., Wright, B.J. and Kinsella, G.J. (2022) 'Systematic Review and Meta-Analysis of Outcome after Mild Traumatic Brain Injury in Older People', *Journal of the International Neuropsychological*

- Society, 28(7), pp. 736–755. Available at: <https://doi.org/10.1017/S1355617721000795>.
- [30]. Javeed, F. et al. (2022) ‘The Prediction of Outcomes in Patients Admitted With Traumatic Brain Injury Using the Rotterdam Score’, *Cureus*, 0(9), pp. 25–30. Available at: <https://doi.org/10.7759/cureus.29787>.
- [31]. Jiang, D. et al. (2024) ‘Predictive value of the Trauma Rating Index in Age, Glasgow Coma Scale, Respiratory rate and Systolic blood pressure score (TRIAGES) for the short-term mortality of older patients with isolated traumatic brain injury: a retrospective cohort study’, *BMJ Open*, 14(3), pp. 1–10. Available at: <https://doi.org/10.1136/bmjopen-2023-082770>.
- [32]. Kalampung, J., Lampus, H.F. and Wagiu, A.M.J. (2024) ‘Profil Pasien Trauma di RSUP Prof Dr. R. D. Kandou Manado Periode Januari - Desember 2021’, *e-CliniC*, 12(2), pp. 238–243. Available at: <https://doi.org/10.35790/ecl.v12i2.55047>.
- [33]. Kim, D.K. et al. (2021) ‘Performance of modified early warning score (Mews) for predicting in-hospital mortality in traumatic brain injury patients’, *Journal of Clinical Medicine*, 10(9), pp. 0–9. Available at: <https://doi.org/10.3390/jcm10091915>.
- [34]. Kobata, H. (2024) ‘Therapeutic Hypothermia for Severe Traumatic Brain Injury: an Overviews of Reviews and Future Prospects Therapeutic Hypothermia for Severe Traumatic Brain Injury: An Overviews of Reviews and Future Prospects’, *preprints.org*, pp. 1–18. Available at: <https://doi.org/10.20944/preprints202404.1171.v1>.
- [35]. Koirala, P. et al. (2022) ‘Comparision between the Glasgow Coma Scale and Glasgow Coma Scale Pupil reactivity score in predicting mortality in traumatic brain injury patients’, *Nepal Journal of Neuroscience*, 19(4), pp. 22–27. Available at: <https://doi.org/10.3126/njn.v19i4.44561>.
- [36]. Komboz, F. et al. (2024) ‘Assessing outcomes in traumatic brain injury: Helsinki score versus Glasgow coma scale’, *European Journal of Trauma and Emergency Surgery [Preprint]*. Available at: <https://doi.org/10.1007/s00068-024-02604-w>.
- [37]. Komisarow, J.M. et al. (2021) ‘Utilization of Brain Tissue Oxygenation Monitoring and Association with Mortality Following Severe Traumatic Brain Injury’, *Neurocritical Care*, 36(2). Available at: <https://doi.org/10.1007/s12028-021-01394-y>.
- [38]. Lindfors, M. et al. (2019) ‘Prognostic performance of computerized tomography scoring systems in civilian penetrating traumatic brain injury: an observational study’, *Acta Neurochirurgica*, 161(12), pp. 2467–2478. Available at: <https://doi.org/10.1007/s00701-019-04074-1>.
- [39]. Liu, C. et al. (2021) ‘Clinical predictors of prognosis in patients with traumatic brain injury combined with extracranial trauma’, *International Journal of Medical Sciences*, 18(7), pp. 1639–1647. Available at: <https://doi.org/10.7150/ijms.54913>.
- [40]. Maas, A.I.R. et al. (2017) ‘Traumatic brain injury: Integrated approaches to improve prevention, clinical care, and research’, *The Lancet Neurology*, 16(12), pp. 987–1048. Available at: [https://doi.org/10.1016/S1473-4422\(17\)30371-X](https://doi.org/10.1016/S1473-4422(17)30371-X).
- [41]. Maraka, H. et al. (2024) ‘Traumatic Brain Injury In Children: A Comprehensive Study Of Epidemiology, Treatment, And Outcomes In Guntur, Andhra Pradesh’, *Journal of Innovations in Applied Pharmaceutical Science [JIAPS]*, 9(2), pp. 7–12. Available at: <https://doi.org/https://doi.org/10.37022/jiaps.v9i2.591>.
- [42]. Merchant, A.A.H. et al. (2023) ‘Which curve is better? A comparative analysis of trauma scoring systems in a South Asian country’, *Trauma Surgery and Acute Care Open*, 8(1), pp. 1–7. Available at: <https://doi.org/10.1136/tsaco-2023-001171>.
- [43]. Mohammed, Z. et al. (2022) ‘Evaluation of the Revised Trauma Score, MGAP, and GAP scoring systems in predicting mortality of adult trauma patients in a low-resource setting’, *BMC Emergency Medicine*, 22(1), pp. 1–10. Available at: <https://doi.org/10.1186/s12873-022-00653-1>.
- [44]. Mulyono, D. (2021) ‘Perbedaan nationale early warning score dan glasgow coma scale dalam memprediksi outcome pasien

- trauma kepala di instalasi gawat darurat', Jakhkj, 7(1), pp. 15–23.
- [45]. Naghavi, M. et al. (2024) 'Global burden of 288 causes of death and life expectancy decomposition in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021', The Lancet, 403(10440), pp. 2100–2132. Available at: [https://doi.org/10.1016/S0140-6736\(24\)00367-2](https://doi.org/10.1016/S0140-6736(24)00367-2).
- [46]. Phunghassaporn, N. et al. (2022) 'Accuracy and external validation of the modified rapid emergency medicine score in road traffic injuries in a Bangkok level I trauma center', Heliyon, 8(12), p. e12225. Available at: <https://doi.org/10.1016/j.heliyon.2022.e12225>.
- [47]. Picetti, E. et al. (2023) 'Early management of isolated severe traumatic brain injury patients in a hospital without neurosurgical capabilities: a consensus and clinical recommendations of the World Society of Emergency Surgery (WSES)', World Journal of Emergency Surgery, 18(1), pp. 1–12. Available at: <https://doi.org/10.1186/s13017-022-00468-2>.
- [48]. Rice, A.D. et al. (2022) 'Correlation between prehospital and in-hospital hypotension and outcomes after traumatic brain injury', The American Journal of Emergency Medicine, 65(2). Available at: <https://doi.org/10.1016/j.ajem.2022.12.015>.
- [49]. Ristanto, R. et al. (2016) 'Akurasi revised trauma score sebagai prediktor mortality pasien cedera kepala', Jurnal Kesehatan Hesti Wira Sakti, 4(2), pp. 76–90. Available at: <https://jurnal.poltekkes-soepraoen.ac.id/index.php/HWS/article/download/144/65>.
- [50]. Sah, N.P. and Khan, A.R. (2024) 'Outcome Predictors of Glasgow Coma Scale Score in Patients with Severe Traumatic Brain Injury', International Journal for Research in Applied Science and Engineering Technology, 12(1), pp. 1183–1187. Available at: <https://doi.org/10.22214/ijraset.2024.58086>.
- [51]. Shanthakumar, D. et al. (2021) 'Trauma Care in Low- and Middle-Income Countries', The Surgery Journal, 7(4), pp. 281–285. Available at: <https://doi.org/10.1055/s-0041-1732351>.
- [52]. Shiraishi, A. et al. (2019) 'Derivation and validation of an easy-to-compute trauma score that improves prognostication of mortality or the Trauma Rating Index in Age, Glasgow Coma Scale, Respiratory rate and Systolic blood pressure (TRIAGES) score', Critical Care, 23(1), pp. 1–5. Available at: <https://doi.org/10.1186/s13054-019-2636-x>.
- [53]. Shoji Yokobori et al. (2004) 'Comparisons of Hemodynamic and Respiratory Parameters, and Outcomes between High and Low Cerebral Perfusion Pressure Groups in a Severe Head Injury', Nihon Kyukyu Igakukai Zasshi, 15(12), pp. 627–635. Available at: <https://doi.org/10.3893/jjaam.15.627>.
- [54]. Skaansar, O. et al. (2020) 'Traumatic brain injury—the effects of patient age on treatment intensity and mortality', BMC Neurology, 20(1), pp. 1–11. Available at: <https://doi.org/10.1186/s12883-020-01943-6>.
- [55]. Tegegne, N.G. et al. (2023) 'Incidence and Predictors of Mortality Among Patients with Traumatic Brain Injury at University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia: A Retrospective Follow-Up Study', Patient Related Outcome Measures, Volume 14(March), pp. 73–85. Available at: <https://doi.org/10.2147/prom.s399603>.
- [56]. Trivedi, D.J. et al. (2022) 'The significance of direct transportation to a trauma center on survival for severe traumatic brain injury', European Journal of Trauma and Emergency Surgery, 48(4), pp. 2803–2811. Available at: <https://doi.org/10.1007/s00068-022-01885-3>.
- [57]. Vassiliu, P. et al. (2022) 'Advanced trauma life support course for medical students. A new era?', Frontiers in Surgery, 9(December), pp. 1–6. Available at: <https://doi.org/10.3389/fsurg.2022.1025920>.
- [58]. Wati, D.K. (2016) 'Traumatic Brain Injury in Children', in Intech, p. 13. Available at: <https://doi.org/http://dx.doi.org/10.5772/intechopen.96010>.
- [59]. Weeks, S.R. et al. (2016) 'A modified Kampala trauma score (KTS) effectively

- predicts mortality in trauma patients', *Injury*, 47(1), pp. 125–129. Available at: <https://doi.org/10.1016/j.injury.2015.07.004>.
- [60]. Yumoto, T. et al. (2016) 'Impact of Cushing's sign in the prehospital setting on predicting the need for immediate neurosurgical intervention in trauma patients: A nationwide retrospective observational study', *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, 24(1), pp. 2–5. Available at: <https://doi.org/10.1186/s13049-016-0341-1>.
- [61]. Yumoto, T. et al. (2018) 'Cushing's sign and severe traumatic brain injury in children after blunt trauma: A nationwide retrospective cohort study in Japan', *BMJ Open*, 8(3), pp. 1–8. Available at: <https://doi.org/10.1136/bmjopen-2017-020781>.
- [62]. Zagalioti, S.C. et al. (2023) 'The first positive evidence that training improves triage decisions in Greece: evidence from emergency nurses at an Academic Tertiary Care Emergency Department', *BMC Emergency Medicine*, 23(1), pp. 1–8. Available at: <https://doi.org/10.1186/s12873-023-00827-5>.
- [63]. Zai, P.C., Wagiu, A. and Rawung, R. (2018) 'Profil Pasien Trauma akibat Kecelakaan Lalu Lintas yang Dirawat di Instalasi Rawat Darurat Bedah RSUP Prof. Dr. R. D. Kandou Manado Periode 1 Januari – 31 Desember 2017', *e-Clinic*, 6(2). Available at: <https://doi.org/10.35790/ec1.6.2.2018.22125>.
- [64]. Zhu, M. et al. (2022) 'Heart Rate Variability Can Detect Blunt Traumatic Brain Injury Within the First Hour', *Cureus*, 14(7), pp. 1–12. Available at: <https://doi.org/10.7759/cureus.26783>.
- [65]. Zuniga, R.D. dos R. et al. (2024) 'Long-term outcome of traumatic brain injury patients with initial GCS of 3–5', *World Neurosurgery*: X, 23. Available at: <https://doi.org/https://doi.org/10.1016/j.wnsx.2024.100361>.