Correlation between APACHE II Score on Mortality Severe Head Injury Patients in the Educational Room of Dr. Mohammad Hoesin General Hospital Palembang in 2019-2020

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A B S T R A C T

Head injury is a condition of injury to the head that can cause damage to brain tissue due to trauma. Severe head injuries account for about 10% of the total head injuries. In addition to death caused by severe head injury itself, head injury patients are susceptible to complications that can occur while the patient is hospitalized. The purpose of this study was to determine the correlation between the APACHE II Score on the mortality of severe head injury patients who were treated in the GICU room, Dr. Mohammad Hoesin Palembang. This type of research is a quantitative research using a retrospective analytical study survey design. Between group variables are unpaired because no matching is done. The research sample is 30 respondents. Results of analysis in this study, after statistical testing using the Chi Square test, p value < 0. 002 was obtained which clarified that there was a relationship between APACHE II Score and mortality in respondents with severe head injuries who were treated in the GICU, Dr. Mohammad Hoesin Palembang. Severe head injury in the GICU room, Dr. Mohammad Hoesin Palembang (p=0.002). The higher the patient's APACHE II score, the more likely the patient to leave the GICU dead. From a total of 30 respondents who were treated in the GICU room, the highest APACHE II score was 28 and the lowest was 3 the more likely the patient to leave the GICU dead. From a total of 30 respondents who were treated in the GICU room, the highest APACHE II score was 28 and the lowest was 3 the more likely the patient to leave the GICU dead. From a total of 30 respondents who were treated in the GICU room, the highest APACHE II score was 28 and the lowest was 3.

1. Introduction

Head injury is a condition of injury to the head that can cause damage to brain tissue due to trauma. Head injury is the most common neurological disease among other neurological diseases that are usually caused by accidents. Head injury is an injury that includes trauma to the scalp, skull and brain.[18,23,22,6]

Injuries due to trauma or impact are the leading cause of death under 44 years of age in the United States. The World Health Organization (WHO) explains that every year around the world around 1.2 million people die from traffic accidents and another 50 million are injured. The Indonesian Central Statistics Agency explained that the number of accidents in Indonesia in 2013 was more than 100,000, around 26,000 people died due to traffic accidents. In addition to the fatalities, more than 139,000 residents were injured in traffic accidents throughout 2013.[2]

Injuries caused by collisions are generally caused by traffic accidents, followed by falls, burns, and by

intent (attempted murder or other violence, and suicide). Trauma is the leading cause of death for patients under 45 years of age, and nearly 50% of all head injuries. According to research conducted by the National Trauma Project in the Islamic Republic of Iran that among the highest types of injuries reported was head injury (78.7%) and most deaths were also caused by head injuries.[12,13]

According to RISKESDAS 2018, the prevalence of head injury in Indonesia is 11.9%. Injuries to the head occupy the third position after injuries to the lower limbs and upper limbs with a prevalence of 67.9% and 32.7%, respectively. The incidence of head injuries that occurred in the province of South Sumatra had a prevalence of 13.9%, with the incidence of head injuries in the city of Palembang itself having a prevalence of 16.15%.

Head injuries are divided into 3, namely mild head injury, moderate head injury, and severe head injury. Minor head injuries account for about 80–90% of all head injuries and have a mortality rate of about 0.1% that occurs due to missed intracerebral hemorrhage. Moderate head injuries have an incidence rate of about 10%. On average, moderate head injury patients were treated in the General Intensive Care Unit (GICU) on the first day of hospital admission.[4,11,19,17]

Severe head injuries account for about 10% of the total head injuries. In addition to death caused by severe head injury itself, head injury patients are susceptible to complications that can occur while the patient is hospitalized. Complications that can occur include infection, pneumonia, sepsis and multi-organ failure. The incidence of head injuries that occurred in South Sumatra mostly occurred at the age of 1-4 years (28.71%), age 15-34 years (28.69%) and age >65 years (32.73%). Based on gender, cases of head injury were more common in males (14.86%) than females (12.50%).[20,9,7,8,14]

Based on the data obtained at Dr. Mohammad Hoesin General Hospital Palembang with head injuries in the GICU room in 2017 was 21 patients,

decreased in 2018 was 18 patients, decreased again in 2019 was 14 patients, and lastly in 2020 the cases recorded in the records section of Dr. Mohammad Hoesin General Hospital Palembang who was treated in the GICU room was again doubled to 39 people.

Advances in the diagnosis, treatment and treatment of serious illnesses or critical conditions increase the need for intensive care. In developed countries from 1970 to early 1980 the rate of increase in the need for intensive care per year was very high (United States reached 8% per year and Canada 4.8% per year).

According to the guidelines for providing General Intensive Care Unit (GICU) services in hospitals issued by the Ministry of Health of the Republic of Indonesia Number 1778/MENKES/SK/XII/2010, the GICU is a part of a hospital equipped with special staff and special equipment intended for observation. Patient care and therapy ± patients suffering from disease, injury or complications ± life-threatening or potentially life-threatening complications with the prognosis of Dubia.[10]

Around 1980 several experts in the field of Intensive Care decided to score the severity of disease in patients admitted to the GICU with the aim of comparing populations and evaluating patient outcomes. The critical illness scoring system can also predict in-hospital mortality. This scoring system has evolved in the last thirty years at GICU.

In 1985 Knaus et al. introduced APACHE II Score; "Acute Physiology And Chronic Health Evaluation II", based on the results of research conducted by Knaus et al. of 5815 patients admitted to the GICU. This system is one of the most widely used scoring systems in the GICU based on the physiological objective values of the variables measured during treatment. This score is a good model in determining the prediction of in-hospital mortality.[21,7,20]

There is no standard calculation used in the GICU room at Dr. Mohammad Hoesin General Hospital Palembang in predicting the mortality of severe head injury patients and an increase in patients with

severe head injuries compared to the previous year, deeply the correlation between the APACHE II Score on the mortality of severe head injury patients treated in the GICU room at Dr. Mohammad Hoesin General Hospital Palembang in 2019-2020.

2. Methods

This research was conducted in the GICU room, Dr. Mohammad Hoesin Palembang in 2019-2020 in February 2021 - December 2021. The research design used was a research design in the form of a retrospective analytical study survey on adult respondents with severe head injuries who were treated in the GICU Room, Dr. Mohammad Hoesin General Hospital Palembang in 2019-2020. The sampling technique in this study is total sampling where the number of samples is the same as the population.

so in this study the researchers will evaluate more

The instruments in this study are as follows; Respondent data review sheet and APACHE II Score respondent mortality measurement tool (used within 24 hours after starting hospitalization in the GICU. The number of assessments ranges from 0 to 71 based on several parameters, where the higher the value, the higher the mortality).

Before testing the hypothesis, the data will be coded into two categories. The hypothesis test used to measure the effect of the APACHE II Score is the Chi Square Test.

3. Results

The frequency distribution of respondents was reviewed based on age, gender, status, occupation, outcome (after intensive care), APACHE II Score.

a. Characteristics of research respondents

Gender		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Woman	9	30.0	30.0	30.0
	Man	21	70.0	70.0	100.0
	As much	30	100.0	100.0	

Based on the table above, respondents in this study experienced more severe head injuries in men than women.

Age		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Risk	18	60.0	60.0	60.0
	No risk	12	40.0	40.0	100.0
	As much	30	100.0	100.0	

Based on the table above, the respondents in this study amounted to 30 people with 18 respondents being at risk of being at risk and 12 people not being at risk for mortality.

Profession		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Housewives	6	20.0	20.0	20.0
	Private	17	56.7	56.7	76.7
	Farmer/labor	5	16.7	16.7	93.3
	Student	1	3.3	3.3	96.7
	Civil servant	1	3.3	3.3	100.0
	As much	30	100.0	100.0	

Based on the table above, the respondents in this study, the occupations that experienced the most severe head injuries were private sector with as many as 17 people and the lowest in the student profession and only 1 civil servant.

		Max	Min	Average	Frequency	Percent	Valid Percent	Cumulative Percent
Outcome								
Valid	Die	28	9	16.5	10	33.3	33.3	33.3
	Life	15	3	9.2	20	66.7	66.7	66.7
	Total				30	100.0	100.0	

Based on the table above, the respondents in this study after receiving intensive care in the GICU with the outcome alive as many as 20 people with the highest APACHE II score of 28, the lowest 9 and an average value of 16.5 while there were 10 patients who died with the highest APACHE II score. 15, the lowest is 3 and the average value is 9.2.

		Max	Min	Average	Frequency	Percent	Valid Percent	Cumulative Percent
APACHE Value								
Valid	Heavy	28	12	18.3	9	30.0	30.0	30.0
	Light	11	3	8.8	21	70.0	70.0	70.0
	Total				30	100.0	100.0	

Based on the table above, the respondents in this study after calculating using the APACHE II Score assessment, patients were treated in the GICU in the mild category with as many as 21 patients with the highest APACHE II score of 11 and the lowest 3 with an average value of 8.8 while for the severe category as many as 9 patients with the highest APACHE II score of 28 and the lowest 12 with a mean score of 18.3.

Bivariate analysis in this study was used to determine the relationship between the APACHE II Score and mortality in patients with severe head injury who were treated in the GICU room, Dr. Mohammad Hoesin General Hospital Palembang

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	11,429a	1	.001		
Continuity Correction	8,750	1	.003		
Likelihood Ratio	11,431	1	.001		
Fisher's Exact Test				.002	.002
Linear-by-Linear Association	11,048	1	.001		
N of Valid Cases	30				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.00.
b. Computed only for a 2x2 table

Test results analysis used to measure the effect of the APACHE II Score is the Chi Square test where the table above shows a correlation between the APACHE II Score assessment to predict mortality in severe head injury patients treated in the GICU room, Dr. Mohammad Hoesin Palembang with a p-value <0.05, which is 0.002.

4. Discussion

Characteristics of respondents in this study were reviewed based on age, gender, status, occupation, outcome (after intensive care), APACHE II Score). The age of the respondents in this study was > 18 years where there were 18 respondents who had an increased risk of mortality (>45 years) and 12 respondents who were not at risk (<45 years). %). This is in line with the results of research conducted by Afni (2016) in his research also found that the risk of CKB occurs at an older age (51.3 years). These results illustrate that the elderly age group is at risk for CKB due to lack of physiological reserves (especially when falling in a state of shock) and comorbidities.

However, this is not in line with the results of research from Afni (2016) research shows that most respondents are aged between 15-45 years with a percentage of 84.6% and ages above >45 years with a percentage of 15.4%. Age is a strong factor in influencing the prognosis of a disease. It is also supported by research conducted by Wijanarka et al (2005) which shows that the average age of head injury sufferers is 29.6 years and most of them occur due to traffic accidents.

It is generally agreed that children fared better than elderly patients. The significant effect of age is not only due to the presence of systemic complications or intracerebral hematoma according to age. However, due to a decrease in organ function to improve drawat in the GICU room, Dr. Mohammad Hoesin Palembang. Increasing age is an independent factor in prognosis, there is a significant increase in poor outcomes at age > 60 years (Sastrodiningrat,

2006). The results of the study are also in line with research conducted by Saini (2012) regarding the outcome of patients with severe head injuries dividing the age of the respondents into three groups, namely < 20 years, 20-40 years and > 40 years.

Based on the results of the research conducted by the above studies and a review of previous facts, it can be concluded that age is one of the predisposing factors that determine the outcome of patients with head injuries. This result can also occur based on the data obtained in none of the respondents <18 years. And also researchers only classify age based on age < 45 years and > 45 years.

The characteristics of the respondents were also seen from the gender of the respondents in this study, the incidence of severe head injuries was more experienced by men (21 respondents) than women (9 respondents). This is in line with research from Brahmi, Soesilowati, and Pujo (2016), Characteristics of patients in the study showed that severe head injuries occurred in men (79 people) and women (56 people). There was a significant difference between the sexes of male and female p = 0.011 (p <0.05), where gender influenced the occurrence of mortality in non-surgical patients treated in the GICU Dr Kariadi Hospital.

However, the results of this study are different from the research conducted by Hanafie & Wijaya (2017), where 33 male subjects (46%) and female subjects 38 people (54%) with an average age of average 48.10 years.

Research by Ratan, Pandey, Kulsrestha, and Ratan (2002) explains that gender is not associated with mortality in patients with head injuries. Another study conducted by Tude Melo, et al (2010), regarding the mortality of patients with severe head injuries in France argued that patients with severe head injuries mostly occur in men because men have activities that pose a risk of trauma, but gender is not related. with mortality in this group of patients.

Another factor that can affect the occurrence of mortality in CKB patients is the employment status

of the respondents in this study, the occupations that have the most severe head injuries are private sector with as many as 17 people and the lowest in the student profession and only 1 civil servant. This is in contrast to research conducted by Hanafie & Wijaya (2017), most of the subjects (41%) work as housewives and the most common types of cases found are surgical cases 49 people (69%).

Another factor that can affect the occurrence of mortality in CKB patients is the outcome (after intensive care) of respondents in this study after receiving intensive care in the GICU, most of the patients went home alive and alive with 20 people with the highest APACHE II score of 28, the lowest of 9 and the lowest score of 9 the average was 16.5 while there were 10 people died with the highest APACHE II score of 15, the lowest 3 and the average value of 9.2.

This is in line with research conducted by Afni (2016), where the results of his research show that from 65 respondents, data on respondents who died during 12 hours of initial treatment were 21 respondents (32.2%). While the respondents who spent 12 hours of life care were 44 respondents (67.7%).

Another factor that can affect the occurrence of mortality in CKB patients is the APACHE II Score of respondents in this study after calculations using the APACHE II Score assessment, most patients enter the GICU in the mild category with as many as most patients enter the GICU in the mild category with as many as 21 people. with the highest APACHE II score of 11, the lowest of 3 and an average value of 8.8 while for the heavy category there were 9 people with the highest APACHE II score of 28, the lowest 12 and an average value of 18.3.

This is in line with the research conducted by Handayani (2014), Based on the outcome or the final results of patients leaving the hospital, 64 (27.2%) patients died and 171 (72.8%). The distribution of outcomes differed significantly between case groups and between data groups. The mean APACHE II score was also significantly different between dead and living patients.

Existing data show that patients who enter the GICU > 24 hours, both patients who are discharged dead or patients who are discharged alive are the most patients with postoperative indications followed by heart disease, impaired consciousness, respiratory disorders and kidney disease. This is the same as the study conducted by Knaus et al, which found that the most indications of patients entering the GICU were postoperatively. However, this is different from the results of research conducted by Chiavone PA, et al. They found that patients who entered the GICU more than 24 hours were patients with disease ± disease who did not undergo surgery, but the results were only slightly different from postoperative patients.

Research conducted by Armiati (2014), the results of the independent t-test difference between the APACHE II score of patients who were discharged from the GICU in a dead condition (30.11 ± 5.086) and the APACHE II score of patients who were discharged alive (16.49 ± 5,424) had p value < 0.001. The interpretation is that there is a significant difference between the APACHE II scores in patients who were discharged from the GICU and died compared to patients who were discharged from the GICU alive. Where the mean APACHE II score of patients who left the GICU in a dead condition was higher than the average APACHE II score of patients who left the GICU alive. From the results of the correlation test using the Somers'd correlation test between APACHE II Score and death status, the correlation strength was r=0.705, with p=0.001 and the direction of the correlation was positive (+). The interpretation is that there is a significant correlation between the APACHE II score and mortality status, with a strong correlation strength (0.600-0.799) and in the same direction. It can be said that the higher the patient's APACHE II score, the more likely the patient is to leave the GICU in a dead condition.

According to Markam, Atmadja, and Budijanto

(2005), that other factors that also need to be taken into account as a factor that worsens the prognosis of patients with severe head injuries are the impact of trauma such as injuries to other body parts or the presence of intracranial hematomas. Luerssen, Klauber and Marshal (1988), argue that the presence of injury associated with severe head injury is closely related to posttraumatic mortality. Head injuries are sometimes accompanied by injuries to other parts that can result in secondary damage and infection with systemic effects on other body organs. If this condition is not handled properly, it can worsen the condition of patients with head injuries which can lead to death (Fauzi, 2002). Tude Melo, et al.

Effect of APACHE II score on mortality rate

The APACHE II score was first developed by Knaus et al. in 1985 using three assessment components; acute physiological score (APS), the largest component derived from 12 clinical measurements obtained within 24 hours of treatment in the GICU.15

Critically ill patients experience perfusion failure and failure of different organ functions. This causes different degrees of disease severity. One of the ways to measure the severity of the disease is the APACHE II score. Determining the level of mortality is an important thing in a series of follow-up plans for inpatient care in the GICU room, Dr. Mohammad Hoesin Palembang. Many studies have been carried out to find good predictors of mortality for patients who are treated in the GICU room, Dr. Mohammad Hoesin General Hospital Palembang. The APACHE II scoring system is a scoring system that has been recognized for its validity in predicting patient mortality.

Respondents in this study amounted to 30 people, with the outcome after undergoing treatment in the GICU room, Dr. Mohammad Hoesin Palembang there were 20 respondents who lived and moved to the usual care room and there were 10 respondents who died while undergoing treatment in the GICU room, Dr. Mohammad Hoesin General Hospital Palembang.

From a total of 30 respondents, 30 patients were treated in the GICU room, the APACHE II score with the highest score of 28 and the lowest APACHE II score in this study 3. There were 10 patients in a dead condition with the highest APACHE II score of 28 and the lowest 9 with an APACHE average. II score is 16.5. There were 20 patients alive with the highest APACHE II score of 15 and the lowest 3 with the mean APACHE II score of 9.2.

In the previous study of Naved, S., Siddiqui, S., Khan, F. in Pakistan in 2011 regarding the APACHE II score of patients in the GICU, the average APACHE II score was 20.84.21 The Lee CK, Rainer TH study in Hong Kong got the average APACHE II score of GICU patients was 20.00. In contrast to the research conducted by Knaus WA, Draper EA, Wagner DP, Zimmerman JE. in America, the patient's average APACHE II score was 10,7.16. The Chiavone PA study, Sens YA in France received an average APACHE II score of 16.1.24. The Marik PE study, Varon J. in New Zealand 14.2 and the Gupta R, Arora VK study. in India get a mean score of 12.87. Meanwhile, in a study conducted by Armiati (2014) it was found that data for patients who were discharged from the GICU in living conditions had an average ± APACHE II score of 16.49±5 patients, 42 and for patients who were discharged from the GICU in a dead condition, the patient's average ± APACHE II score was 30.11 ± 5.08. The previous data ± data were equivalent to the APACHE II total score of 20.24 ± 8,097.25 The existence of some differences in the mean APACHE II score obtained could be due to differences in GICU settings, types of patient management in the GICU and operational standards of patient care in the GICU between Indonesia, Pakistan, America, France, New Zealand and India. The average APACHE II score in Indonesia is almost the same as the results in other Asian countries, namely Pakistan and Hong Kong. Lower mean scores are found in advanced medical sciences such as the US, France, and India. 24±8,097.25 There are several differences in the mean APACHE II score obtained

due to differences in GICU settings, types of patient management in the GICU and operational standards of patient care in the GICU between Indonesia, Pakistan, America, France, New Zealand and India. The average APACHE II score in Indonesia is almost the same as the results in other Asian countries, namely Pakistan and Hong Kong. Lower mean scores are found in advanced medical sciences such as the US, France, and India. 24±8,097.25 There are several differences in the mean APACHE II score obtained due to differences in GICU settings, types of patient management in the GICU and operational standards of patient care in the GICU between Indonesia, Pakistan, America, France, New Zealand and India. The average APACHE II score in Indonesia is almost the same as the results in other Asian countries, namely Pakistan and Hong Kong. Lower mean scores are found in advanced medical sciences such as the US, France, and India. The average APACHE II score in Indonesia is almost the same as the results in other Asian countries, namely Pakistan and Hong Kong. Lower mean scores are found in advanced medical sciences such as the US, France, and India. The average APACHE II score in Indonesia is almost the same as the results in other Asian countries, namely Pakistan and Hong Kong. Lower mean scores are found in advanced medical sciences such as the US, France, and India.

The average APACHE II score in this study showed that the mean APACHE II score for patients who were discharged from the GICU in a dead condition was quite low because there were very contradictory values between the highest and lowest scores in the outcome of patients dying. There was a result that the mean APACHE II score of patients who left the GICU in a dead condition was higher ($p<0.001$) compared to the mean APACHE II score of patients who left the GICU alive.

In this study, after statistical testing using the Chi Square test, the p value < 0.002 was obtained which made it clear if there was a relationship between the APACHE II Score and mortality in respondents with severe head injuries who were treated in the GICU, Dr. Mohammad Hoesin Palembang because the p value < 0.05.

These results support previous research which states that the APACHE II score can predict patient outcomes in the GICU, including predicting patient mortality. The results of this study are in line with research conducted by Andrias, Hanafie, and Wijaya (2017), with 71 research subjects stating that the APACHE II scoring system has a good ability to predict mortality. Based on the ROC, the area of AuROC was 84.7%. The sensitivity of the APACHE II scoring system in predicting mortality was 81% with a specificity of 87%.26 This result is similar to the study conducted by Sunaryo et al. that the area of AuROC for the APACHE II grading system is 91.2%.

The results of the independent t-test difference between the APACHE II score of patients who were discharged from the GICU conducted by Armiati (2014), in a dead condition (30.11 ± 5.086) and the APACHE II score of patients who were discharged alive ($16.49 \pm 5,424$) had a value $p < 0.001$.25 The interpretation was that there was a significant difference between the APACHE II scores in patients who were discharged from the GICU and who died compared to patients who were discharged from the GICU alive. Where the mean APACHE II score of patients who left the GICU in a dead condition was higher than the average APACHE II score of patients who left the GICU alive. APACHE II score with mortality status obtained correlation strength of $r = 0.705$, with p value $= 0.001$ and the direction of the correlation is positive (+). The interpretation is that there is a significant correlation between the APACHE II score and mortality status, with a strong correlation strength (0.600-0.799) and in the same direction. It can be said that the higher the patient's APACHE II score, the more likely the patient is to leave the GICU in a dead condition.

Treatment in the GICU room plays an important role in determining the patient's recovery. Predicting patient outcomes in the GICU room is one part that

must be considered in the GICU, one of which is a scoring system, so that the APACHE II score can be used to predict patients leaving the GICU in a state of recovery or death.

Prediction scores for mortality are urgently needed in order to maximize the efficiency of the GICU so as to increase the effectiveness of the budget issued by the hospital for the GICU related to medical decision making by doctors. A good predictor score will be able to give an idea of the severity of the patient's illness and ultimately predict the patient will be discharged from the GICU in recovery or in a dead condition and further decide whether to keep the patient in the GICU or not. As previously explained, patient mortality is one indicator to determine the level of utilization, quality, and efficiency of hospital services.

In the end, this research can provide an overview to hospitals, especially Dr. Mohammad Hoesin Palembang that the APACHE II score is very useful in predicting the mortality of severe head injury patients admitted to the GICU.

5. Conclusion

There is a significant relationship between the APACHE II score on the mortality of severe head injury patients in the GICU room, Dr. Mohammad Hoesin Palembang (p=0.002). The higher the patient's APACHE II score, the more likely the patient to leave the GICU dead. Of the total respondents, 30 patients who were treated in the GICU room had the highest APACHE II score of 28 and the lowest 3. There were 10 patients in a dead condition with the highest APACHE II score of 28 and the lowest 9 with an average APACHE II score of 16.5. There were 20 patients alive with the highest APACHE II score of 15 and the lowest 3 with the mean APACHE II score of 9.2. The mortality rate of patients in the GICU room, Dr. Mohammad Hoesin Palembang in the 2019-2010 period was 33.3%.

6. References

1. Almashrafi A, Elmontsri M, Aylin P. Systematic review of factors influencing length of stay in ICU after adult cardiac surgery. BMC Health Serv Res. 2016.

2. Health Research and Development Agency, Ministry of Health, Republic of Indonesia. Basic Health Research 2013. Jakarta: Health Research and Development Agency, Ministry of Health RI. 2014.

3. Central Bureau of Statistics. Transportation Statistics 2013. Jakarta: Statistics Indonesia. 2014.

4. Baroto, TB Effect of Coagulopathy on Glasgow Outcome Scale in Patients with Severe Head Injury with CT Scan Diffuse Injury. In the Diponegoro University Thesis Journal. 2007.

5. Bouch C, Thompson J. Severity scoring systems in the critically ill. Cont Edu Anaest Crit Care Pain. 2008.

6. Bruns, J., & Hauser, WA The Epidemiology of traumatic brain injury. A Review. Epilepsia, 44 New York: Blackwell Publishing, Inc. 2003.

7. Cardozo, LCM, Silva, RRD. Sepsis in intensive care unit patients with traumatic brain injury: factors associated with higher mortality. 2014. Accessed on 20 May 2021 inhttp://doi.org/10.5935/0103-507X.20140022

8. Christian MD, Hawryluck L, Wax RS, Cook T, Lazar NM, et al. Development of triage protocol for critical care during an influenza pandemic. CMAJ. 2006.

9. Djaja, S., Widyastuti, R., Tobing, K., Lasut, D., & Irianto, J. Overview of Traffic Accidents in Indonesia, 2010-2014 Description of Traffic Accident in Indonesia, Year 2010-2014. 2016.

10. Director General of Health Efforts number: HK 02.04/1/1966/11. Technical instructions for the implementation of Intensive Care Unit services in hospitals. 2011 Retrieved 18 February 2021 inhttp://www.perdici.org/

11. Fithrah, BA, Oetoro, BJ, Umar, N., & Saleh, SC Recurrent Postcraniotomy Bleeding in Minor Head Injury Patients Recurrent Post Craniotomy Hemorrhage in Patient with Mild Head Injury. 2016.

12. Japardi, Iskandar. Head Injury Understanding Important Aspects in Managing Head Injury Patients. Medan: PT Bhuana Popular Science Gramedia Group. 2004.

13. Karbakhsh, Zandi, Rouzrokh, Zarei. Injury Epidiomology in Kermanshah: The National Trauma Project in the Islamic Republic of Iran. Retrieved 01 June 2021 in the Eastern Mediterranean Health Journal. 2009.

14. Ministry of Health of the Republic of Indonesia. Data and Information Center of the Ministry of Health of the Republic of Indonesia. 2016. Retrieved June 01, 2021 in http://kemenkes.go.id/

15. Knaus WA, Wagner DP, Draper EA, Zimmerman JE, Bergner M, et al. 1985. The APACHE III prognostic system. Chests.

16. Knaus WA, Wagner DP, Draper EA, Zimmerman JE, Bergner M, et al. The APACHE-III prognostic system. Risk prediction of hospital mortality for critically ill hospitalized adults. 1992.

17. Lund, SB, Gjeilo, KH, Moen, KG, Schirmer-mikalsen, K., Skandsen, T, et al. Moderate traumatic brain injury, acute phase course and deviations in physiological variables: an observational study. Scandinavian Journal of Trauma, Resuscitation and Mergery Medicine. Accessed on September 10, 2021 at http://doi.org/10.1186/s13049-016-0269-5

18. Morton, et al. Critical nursing approach to holistic care. Jakarta: EGC medicine. 2012; 1.

19. Nasution, SH. Mild Head Injury. Medula. Lampung: Faculty of Medicine, University of Lampung. 2014; 2(4)

20. National Institute of Neurological disorders and Stroke (NINDS), NI. Brain Basics Understanding Sleep. 2013. Retrieved September 10, 2021 in http://www.ninds.nih.gov/disorders/brain_basics/understanding_sleep.html

21. Naved, S., Siddiqui, S., Khan, F. APACHE-II Score correlation with mortality and length of stay in an intensive care unit. Journal of the College of Physicians and Surgeons Pakistan. 2011. Retrieved June 01, 2021 in http://ecommons.aku.edu/pakistan_fhs_mc_anaesth/1

22. Price, SA, Wilson, LM. Pathophysiology of clinical concepts of disease processes 6th Edition Jakarta: EGC Medical Book Publisher. 2006; 2

23. Smeltzer, SC & Brenda GB. Textbook of Medical Surgical Nursing: Brunner Suddarth, Jakarta: EGC. 2002; 1.