Volume 5, No. 5 May, 2024
p ISSN 2723-6927-e ISSN 2723-4339

Comparison of Sensitivity, Specificity, and Accuracy of ISS, RTS, and TRISS Instruments in Predicting Mortality of Trauma Patients

Fenny Tianda[1], Kumboyono Kumboyono[2], Suryanto Suryanto[3]
[1,2,3]Brawijaya University, Malang, East Java, Indonesia
Email: arteri19@gmail.com[1], abu_hilmi.fk@ub.ac.id[2], suryanto.s@ub.ac.id[3]

ABSTRACT

This study aims to compare the effectiveness of three trauma scoring systems—Injury Severity Score (ISS), Revised Trauma Score (RTS), and Trauma and Injury Severity Score (TRISS)—in predicting mortality among trauma patients at Inche Abdoel Moeis Regional General Hospital Samarinda's emergency room. Trauma assessment tools are crucial for reducing mortality rates and enhancing patient outcomes. While ISS focuses on anatomical factors, RTS integrates physiological parameters, and TRISS combines both for a comprehensive evaluation. Previous research suggests their effectiveness in mortality prediction, albeit with variations in performance. The absence of a dedicated trauma assessment system at the hospital underscores the urgency of this research. By evaluating the performance of ISS, RTS, and TRISS, this study aims to inform clinical practice and enhance trauma patient management, ultimately reducing mortality rates and improving outcomes in the emergency room setting. The study's methodology involves retrospective analysis of trauma patient data, including demographics, injury characteristics, and outcomes. Statistical analysis will compare the performance of the three scoring systems in predicting mortality with implications for trauma care protocols and resource allocation. Results will contribute to evidence-based decision-making in emergency room settings, facilitating more accurate triage and treatment strategies for trauma patients.

Keywords: ISS, RTS, TRISS, Trauma

INTRODUCTION

Every year, thousands of people lose their lives due to trauma, such as traffic accidents and serious injuries. The impact is not only limited to mortality rates but also causes long-term disability and significant financial burdens (Organization, 2020). The high mortality and morbidity rates in trauma patients are due to certain factors that contribute to an increased risk of complications and poor prognosis.

To reduce the morbidity and mortality of trauma patients, it is essential to carry out an efficient and thorough trauma assessment. One tool used in this assessment is the trauma scoring system, designed to predict mortality rates and assist in patient management decision-making (Kostiuk & Burns, 2023). Some studies have also shown that trauma scoring systems can make it easier for clinicians to evaluate the severity of a patient's trauma and help in choosing appropriate management (Andara, Kadar, & Albar, 2022).

Research conducted by (Khan, Hussain, &; Mehmood, 2016) Indicates the existence of nearly 60 severity measures or scoring systems developed for injury and trauma research. This indicates the complexity of measuring the severity of injuries and the need for an accurate assessment. Complexity in the assessment of injury severity and trauma necessitates the development of various scoring systems or scores that are based on anatomical injury patterns, physiological data, or a combination of both ((Magee et al., 2021); (Khan et al., 2016); (Yilmaz et al., &; Tataroglu, 2021)). An anatomical injury pattern-based scoring system evaluates the type, location, and severity of injuries that occur to specific body parts. Examples of anatomy-based assessments include AIS (Abbreviated Injury Scale), ISS (Injury et al.), Modified ISS, Anatomic Profile, and ICISS (International Classification of Diseases-based Injury Severity Score).

Meanwhile, a physiological data-driven scoring system involves measuring and assessing physiological parameters such as blood pressure, pulse rate, and level of consciousness. The assessment system that combines these two aspects seeks to integrate anatomical and physiological information to provide a more comprehensive assessment of the severity of the trauma. Examples that combine anatomical and physiological aspects are TRISS (*Trauma and Injury Severity Score*), Polytrauma-Schussel, *Trauma Index*, and ASCOT (*A Severity Characterization of Trauma*).

In addition to other explanations, (Magee et al., 2021) Highlights the various trauma scoring systems used to evaluate and identify high-risk trauma patients. This system uses anatomical, physiological, or a combination of both properties in evaluating the severity of trauma. This suggests variations in approaches to trauma severity assessment, and selecting an appropriate assessment system depends on research objectives or specific clinical needs.

The application of valid and accurate trauma scores is expected to reduce mortality and morbidity rates in trauma patients. Trauma scores assist healthcare professionals in quickly and accurately evaluating the severity of injuries, enabling informed treatment decisions. With a growing understanding of the factors that influence trauma prognosis, trauma scores can be an effective tool for improving the life safety of trauma patients and reducing complications that can lead to death ((Andara et al., 2022); (Farzan et al., &; Mohammadi, 2022); (Khan et al., 2016)).

In research conducted by (Farzan et al., 2022), it was found that about 25-50% of trauma deaths are preventable. In this context, the mortality rate is the most accurate parameter in measuring trauma prognosis. Efficient assessment using trauma scores helps healthcare professionals to quickly and accurately assess the severity of injuries and manage patients appropriately. Studies conducted by (Khan et al., 2016) revealed that several pragmatic and practical trauma/injury assessment systems have been used in Indonesia, which has limited health resources. Reported rating systems include ISS, RTS, and TRISS. These scoring systems are used to measure the severity of injuries and provide guidance in managing trauma patients. The use of this assessment system helps in the setting of limited resources and helps improve the quality of trauma care in Indonesia.

The ISS is used to calculate and categorize the severity of injuries in trauma patients, as well as to predict morbidity, mortality, and other trauma outcomes (Ahmad

et al., 2022). The ISS relies exclusively on anatomical factors of injury, where a score is assigned to each body part affected by the injury. This assessment helps determine the appropriate medical measures based on the specific type of injury to the patient. Although the ISS is effective in providing information on the severity of injuries, there are obstacles in applying it to patients during primary surveys in the emergency department. The process of calculating ISS scores takes time and details that may not be available or practical for most patients with severe trauma. Therefore, it is recommended to calculate the ISS score within 24 hours after the patient enters the trauma unit to limit their potential for triage utility (Farzan et al., 2022).

RTS consists of *the Glasgow Coma Score* (GCS), systolic blood pressure, and respiratory rate and has been shown to perform well in predicting trauma patient outcomes. Studies show that RTS has a high sensitivity (100%) in predicting one-month mortality and the highest specificity (97.22%) in predicting death from trauma. RTS is a critical tool in the medical world to predict the survival of injured patients.

Further research by (Farzan et al., 2022) affirmed that RTS, along with other scoring systems, has helped clinicians identify patients who need priority treatment and prompt care. In addition, research by (ALVAREZ et al., 2016) shows that RTS is effective in predicting death, especially when the patient has an RTS score above seven, indicating a high survival probability. This reinforces the optimistic view of RTS as a reliable tool for making medical decisions in trauma situations.

Unlike the ISS, TRISS synthesizes injury mechanisms and physiological and anatomical factors to assess injury severity (Ahmad et al., 2022). TRISS involves factors such as patient age, physiological response, and ISS scores in generating more holistic predictions of prognosis. Although TRISS provides more comprehensive information, as does the ISS, calculating TRISS scores requires limited time and detail during a primary survey in the emergency department. Therefore, it is recommended to calculate the TRISS score within 24 hours after the patient arrives at the trauma unit to maximize the benefits of triage (Mohammed et al., 2022).

In a series of studies on evaluating injury severity assessment systems in trauma patients, TRISS, ISS, and RTS are scores that are given special attention in predicting mortality. The results showed that TRISS is often the top choice with a very high predictive value, such as an AUC (Area Under the Curve) of about 0.923 to predict mortality and an AUC of around 0.789 to predict the need for postoperative mechanical ventilators (Yasa et al., 2023). Other studies confirmed the role of TRISS as a highly effective predictor in predicting mortality, with an AUC of 0.972, making it one of the most accurate scores in assessing mortality risk in trauma patients (Patil et al., 2019). However, results from several studies show variation in predictions between TRISS, ISS, and RTS, highlighting the importance of considering patient context and specific population characteristics (Milton et al., 2021). The results also emphasize that TRISS continues to be a valuable tool in the care of trauma patients. However, more research is needed to confirm these findings and understand their variability (Andara et al., 2022).

Some views differ in research, such as those conducted by (Mohammed et al., 2022) and (Vorbeck et al.,2023), stating that the three trauma scores had no significant difference in predicting the death of trauma patients. This view suggests that, in their view, the selection of trauma scores becomes more flexible because all three can be

used with similar results.

However, there are also different views, as stated by (Indurkar et al., 2023), which consider that although TRISS and RTS support each other in predicting death, the ISS is less supportive. It emphasizes that the role of the ISS is more limited in modeling the prognosis of trauma patients compared to the other two scores. This view highlights the advantages of TRISS in integrating aspects of anatomical injury and physiological responses in the assessment of trauma patient prognosis. Different again, according to (ALVAREZ et al., 2016), in their research, emphasize the effectiveness of RTS in predicting mortality, suggesting that each trauma score has its role and ability in modeling a patient's risk of death.

Overall, TRISS, ISS, and RTS are reliable scores in predicting mortality in trauma patients. Although TRISS often excels in prediction accuracy, ISS and RTS remain relevant in clinical practice and can provide important information in managing trauma patient care. The selection of the most appropriate score should be carefully considered based on patient characteristics and specific clinical context (Vorbeck et al., 2023). In the context of application in the emergency room, these scores can be crucial in evaluating and managing trauma patients to improve treatment outcomes and reduce mortality rates.

More than 70% of trauma-related deaths in developing countries occur in the pre-hospital stage, and the higher mortality rate in this study may be because the study considered prehospital deaths (Yadollahi, 2019). The severity of injury or illness also affects the mortality rate. Scores such as RTS, ISS, and TRISS assess severity and predict mortality (Patil et al., 2019). The results of these systems help determine the appropriate type of treatment for patients, including whether they require mechanical ventilators or other medical measures. Early evaluation and prompt action in the emergency room are essential. However, patient death can occur both quickly after the injury and after some time, depending on various factors such as the severity of the injury and the care provided. Although various trauma scoring systems are used to predict mortality, more research is needed to understand better the factors that influence trauma patient mortality in the ER.

In two separate studies conducted (Yadollahi, 2019) and (Chiang et al., 2021), it was revealed that a number of factors had a significant influence on the mortality rate of trauma patients admitted to the ER. The high mortality rate in emergency rooms has a significant impact on the health system. This creates a heavy burden on human resources and medical facilities, increases stress on medical personnel who have to deal with critical situations, and negatively impacts patient and family satisfaction levels.

The impact of Traffic and Road Transport (LLAJ) accident deaths is also significant, including health care costs, lost work productivity, and rehabilitation costs (Irman, 2018). The use of trauma scores that can predict the death of trauma patients in the emergency room plays a vital role in patient management and health outcomes. This relationship reflects the importance of quick and efficient treatment of trauma patients, aiming to reduce mortality and improve the efficiency of care.

The high mortality rate in the emergency department also puts a burden on the health system as well as a negative impact on patient satisfaction, family, and significant economic aspects. Therefore, a deeper understanding of this relationship and the

implementation of an effective trauma scoring system can potentially reduce mortality and negative impacts on various aspects associated with trauma patients in the ER. Studies have shown that there is a significant relationship between trauma scores, such as ISS, RTS, and TRISS, with predictions of trauma patient mortality in the Emergency Department (Javali et al., 2019). Higher trauma scores, such as an increased ISS, are usually associated with an increased risk of patient death.

The use of this trauma score provides excellent benefits for medical teams in evaluating the severity of injuries, forecasting prognosis, and making appropriate management decisions for trauma patients in the ER. In critical medical situations, RTS remains a relevant and valuable tool in the effort to save patients' lives ((ALVAREZ et al., 2016); (Yuniar et al., 2021)). Using this information, medical teams can provide better care and better suit patients' needs, hoping to reduce traumatic injury-related mortality and morbidity. Therefore, the use of trauma scores has become an effective tool in an effort to improve outcomes for trauma patients in the ER.

This research was conducted at Inche Abdoel Moeis Regional General Hospital (RSUD IA Moeis), which is a Samarinda City government hospital with a type c level. The hospital is adjacent to intercity access and is connected by toll roads. From the results of preliminary studies, it was found that the number of patients admitted in 2022 was 33,574 patients, with 906 trauma cases consisting of 49% open wound cases, 11% allergic jury, 5% fracture, 9% corpus alenium, 5% superficial wounds, 7% contusions, 2% burns and the remaining 13% with multiple cases. At the same time, the average number of deaths is 5-6 patients/month.

The mortality rate standard that has been set at the IA Moeis Hospital emergency room based on the Minimum Service Standard (SPM) is less than 2/1000 in 1 year, while based on the data obtained by the emergency room, it gets a mortality rate of 2.3/1000 patients which means it exceeds SPM. To assess the quality of emergency room and hospital services, it is essential to pay attention to the time standards that have been set. The standard patient stay in the ER is 6 hours, with care responsibilities continuing for the next 24 hours in preparation for the patient's hospitalization. In addition, the hospital's NDR (*Net Death Rate*) mortality rate is also evaluated within 48 hours after the patient receives services at the hospital.

Currently, IA Moeis Hospital does not use a particular trauma assessment system, such as GCS, which is one of the trauma score assessments but is only used for awareness assessment. This points to the need for a more comprehensive trauma assessment system to assist medical personnel in determining effective and efficient death predictions. This phenomenon also aligns with the behavior pattern of people seeking help at IA Moeis Hospital because of its strategic location in the Samarinda Seberang area. Therefore, implementing an appropriate trauma assessment system can provide significant benefits in optimizing patient mortality prediction and improving overall health services at the emergency room of IA Moeis Hospital.

From the description above, according to researchers, there is a need for corrective steps that must be taken by IA Moeis Hospital, one of which is to determine the use of severity assessment instruments on trauma that can be used to predict the death of patients in the emergency room. This severity assessment system can then be used as a fixed basis to improve the efficiency of time spent treating patients served in

the emergency room. Based on the description and existing phenomena, researchers see an urgency in applying a trauma assessment system. Therefore, the author conducted a study comparing the sensitivity, specificity, and accuracy of ISS, RTS, and TRISS instruments in predicting the mortality rate of trauma patients in the emergency room of RSUD IA Moeis Samarinda at 6, 24, and 48 hours.

RESEARCH METHODOLOGY

This study used a cross-sectional study approach with a diagnostic test research design to compare the sensitivity, specificity, and accuracy of three trauma assessment instruments: Injury Severity Score (ISS), Revised Trauma Score (RTS), and Trauma and Injury Severity Score (TRISS) in predicting the mortality rate of trauma patients in the emergency room of IA Moeis Hospital Samarinda. Primary data was obtained from trauma patients who came to the emergency room of IA Moeis Hospital between January and March 2024. The study population consisted of all primary data of trauma patients, but after the screening process, 166 patients met the inclusion criteria. The study sample was selected using non-probability sampling techniques, specifically convenience/incidental sampling, where all trauma patients who met the research criteria became part of the sample. Data was collected through observation sheets filled out by researchers and enumerators, using online calculators to calculate trauma scores (ISS, RTS, and TRISS). The data collection process is carried out by ensuring the completeness and suitability of the data, and the results are entered into an observation table in the Excel program for further analysis.

Data processing begins with the pre-analysis stage, which involves checking, identifying, tabulating, and cleansing the data. The data were then analyzed univariately to obtain a distribution of respondents' characteristics and bivariately to examine the relationships between certain variables. Analysis of diagnostic test data was performed using the Reciever Operating Characteristics (ROC) statistical tool to measure the sensitivity, specificity, and accuracy of each trauma assessment instrument. Research ethics are maintained by obtaining ethical permission from Universitas Brawijaya and following the principles of research ethics, such as respecting respondents' privacy and freedom, prioritising the good of respondents, maintaining justice, and maintaining data confidentiality. Thus, the study not only contributes to the understanding of the trauma assessment system but also maintains the integrity and security of data as well as the well-being of respondents.

RESULTS AND DISCUSSION

Univariate Analysis

Frequency distribution of sample characteristics by age

Table 1. Distribution of sample frequency by age

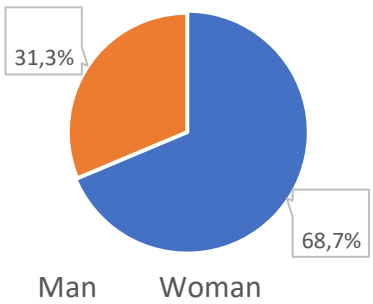
Data	Nilai

Mean	40,12
Median	38,5
Mode	17
Std. Deviation	18,42
Minimum	16
Maximum	89

Source: Primary Data (2024)

Based on the table above, a descriptive statistical picture of the age of respondents is obtained. The average age recorded was 40.12 years, with a median value of 38.5 years, and the highest mode was located at 17 years of age. A significant standard deviation of 18.42 years indicates considerable variation in age data. The age range, which ranged from 16 to 89 years, showed striking diversity in the sample.

Frequency distribution of sample characteristics by sex



Source: Primary Data (2024)

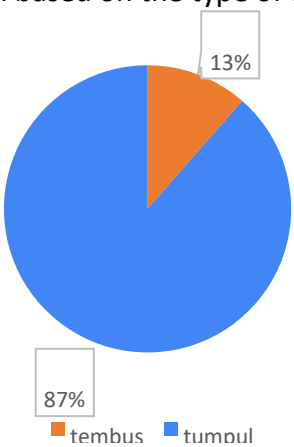
Figure 1.

Characteristics of respondents by gender

In the results of this study, there were 114 male sex groups (68.7%) and 52 female patients (31.3%).

Frequency distribution of sample characteristics by type of trauma

Data on sample dissemination based on the type of trauma are as follows;



Source: Primary Data (2024)

Figure 2.

Characteristics of respondents by type of trauma

The highest distribution according to the type of trauma included in this study was

blunt trauma at 145 cases (87%) and penetrating trauma at 21 cases (13%).

Frequency distribution of sample characteristics based on patient condition

Data on sample distribution based on the patient's condition are as follows;

Table 2. Characteristics of respondents based on the patient's condition

Condition	6 hours	24 hours	48 hours
Alive	117	115	107
Die	49	51	59
Total patients	166	166	166

Source: Primary Data (2024)

The distribution according to the condition of patients included in this study was patients died, namely at 6 hours by 49 patients (29.5%) and lived 117 patients (70.5%), at 24 hours by 51 patients (30.7%) and lived 115 patients (69.3%), and at 48 hours by 59 patients (35.5%) and lived 107 patients (64.5%).

Frequency Distribution of Trauma Scores

The average and median values in the study are ISS, RTS, and TRISS, as shown in the table.

Table 3. Trauma score frequency scores

	ISS Value	RTS Value	TRISS Value
Mean	22,23	6,57	0,80
Median	10	7,84	0,989
Mode	4	7,84	0,996
Std. Deviation	23,43	1,85	0,274
Skewness	1,204	-1,295	-1,197
Kurtosis	0,313	0,555	0,145
Minimum	1	1,31	0,106
Maximum	75	7,84	0,998

Source: Primary Data (2024)

The table above shows the distribution of trauma score values based on the Severity Injury Score (ISS), Revised Trauma Score (RTS), and Trauma and Injury Severity Score (TRISS) indices. The ISS average was recorded at 22.23 with a median of 10 and mode 4, indicating significant variation in injury severity, supported by positive skewness values (1.204) and slightly tapered kurtosis (0.313). RTS has an average of 6.57 with a median of 7.84 and a mode of 7.84, indicating the concentration of data on a particular RTS value, with negative skewness (-1.295), indicating a longer distribution tail on the left side and kurtosis (0.555) indicating a lower and wider distribution peak. TRISS showed an average of 0.80 with a median of 0.989 and a mode of 0.996, indicating variation in injury severity, with skewness (-1.197) indicating a longer distribution tail on the left side and kurtosis values not available.

Bivariate Analysis

Test Normality data Trauma score

Table 4. Trauma Score Data Normality Test

Trauma Score	df	Sig.

ISS	166	<0,001
RTS	166	<0,001
TRISS	166	<0,001

Source: Primary Data (2024)

The results of the normality test of trauma score data, measured through the Severity Injury Score (ISS), Revised Trauma Score (RTS), and Trauma and Injury Severity Score (TRISS) indices, show that the distribution of values for all variables does not follow the normal distribution ($p < 0.001$ for all variables), as indicated by the results of the Kolmogorov-Smirnov test. Therefore, Spearman's rho non-parametric test was used to analyze the relationship between these variables.

Non Parametric Test

Table 5. Results of Spearman's rho

Trauma Score	Value	6	24	48
ISS	Cooefisien Colleration Sig. (2-tailed)	0,729 <0,001	0,748 <0,001	0,803 <0,001
RTS	Cooefisien Colleration Sig. (2-tailed)	-0,799 <0,001	-0,811 <0,001	-0,908 <0,001
TRISS	Cooefisien Colleration Sig. (2-tailed)	-0,734 <0,001	-0,737 <0,001	-0,808 <0,001

Source: Primary Data (2024)

The results of the Spearman's rho correlation test showed that there was a positively strong relationship between the ISS trauma score value and the patient's condition (6 hours, 24 hours, and 48 hours after the trauma event), with the correlation coefficient ranging from 0.729 to 0.803. On the other hand, RTS and TRISS showed a robust and negatively significant association with the patient's condition, with the correlation coefficient ranging from -0.799 to -0.908.

Analysis Diagnostic tests

Cut-off Point, ROC, AUC ISS, RTS, and TRISS

Table 6. Cut-off points Instrument

Cut off points	6	24	48
TRIISS	34,5	30,5	22,5
ISS	40,5	40,5	40,5
RTS	7	7	7

Source: Primary Data (2024)

The table above presents *cut-off points* for three instruments, namely TRIISS, ISS, and RTS, at three different time intervals, namely the 6th, 24th, and 48th hours after the trauma event. The TRIISS instrument has *cut-off points* on each timeframe, with values of 34.5, 30.5, and 22.5, respectively. Meanwhile, the ISS has a fixed *cut-off point* on each period, which is 40.5. RTS also has constant cut-off points on all timeframes, which is 7.

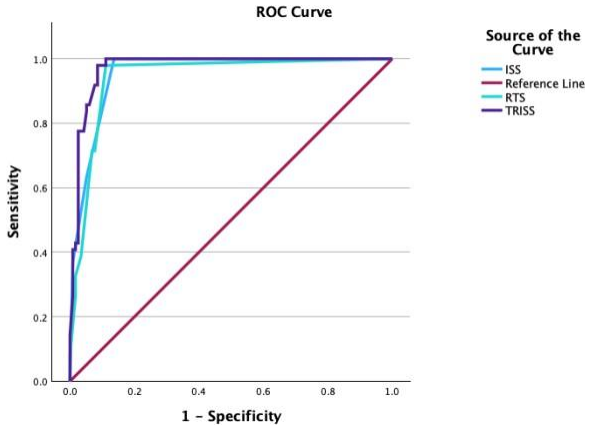
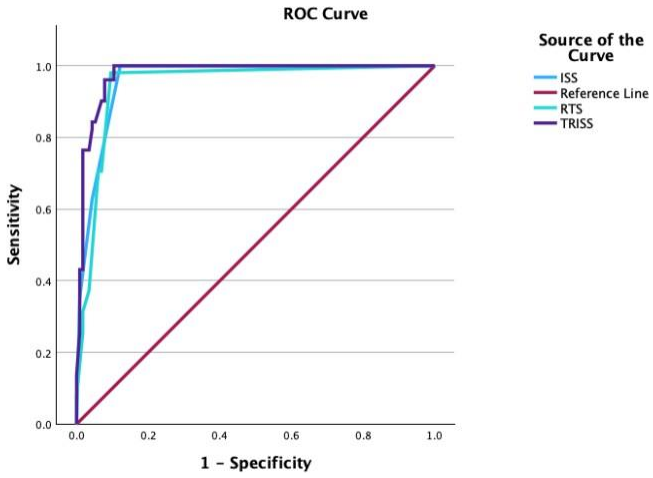


Figure 3.
ROC hour to 6

From the 6th hour ROC, ISS, RTS, and TRISS graphs above, it can be seen that it has a model with high sensitivity and specificity in the upper left corner of the plot. This shows that the model can predict the mortality rate in trauma patients well.



Source: Primary Data (2024)

Figure 4.
ROC hour to 24

From the 24-hour ROC, ISS, RTS, and TRISS graphs above, it can be seen that it has a model with high sensitivity and specificity in the upper left corner of the plot. This shows that the model can predict the mortality rate in trauma patients well.

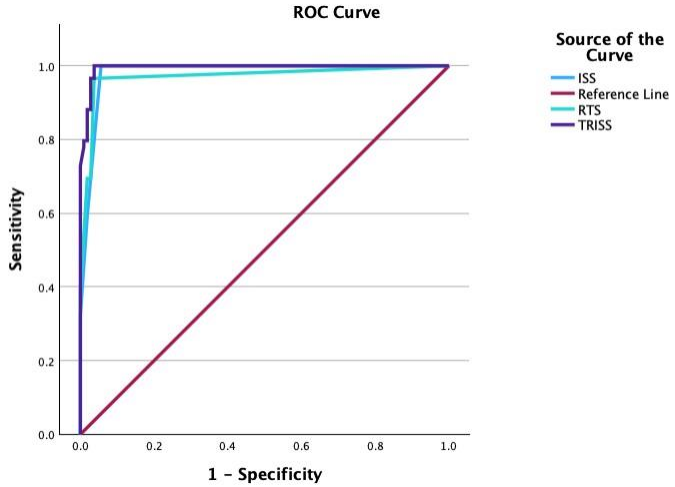


Figure 5.
ROC hour to 48

From the 48-hour ROC ISS, RTS, and TRISS graphs above, it can be seen that it has a model with high sensitivity and specificity in the upper left corner of the plot. This shows that the model can predict the mortality rate in trauma patients well.

Table 7. AUC ISS, RTS, TRISS

	AUC (Hours to)		
	6	**24**	**48**
ISS	0,956	0,964	0,982
RTS	0,943	0,946	0,971
TRISS	0,973	0,977	0,994

The table above displays *Area Under the Curve* (AUC) values for ISS, RTS, and TRISS instruments at three different time intervals, namely 6 hours, 24 hours, and 48 hours after the trauma event. The TRISS instrument recorded the highest AUC on all timeframes, with values of 0.973, 0.977, and 0.994, respectively. Meanwhile, the ISS instrument has the second highest AUC value as the standard standard, followed by the RTS instrument, with values of 0.956, 0.961, and 0.982 for the ISS, respectively, and 0.943, 0.946, and 0.971 for the RTS. This table provides information on the ability of these instruments to predict the patient's condition at various time stages after the trauma event, with TRISS performing best compared to the ISS and RTS.

Table 8. SPSS calculation results

Time	Cut off points	Sensitivity	Specificity	PPV	NPV	Accurate	AUC
6 Hours							
TRIISS	34,5	0,918	0,915	94,90%	83,70%	91,60%	0,973
ISS	40,5	1	0,863	86,30%	100%	90,40%	0,956
RTS	7	0,98	0,889	96,60%	38,80%	79,50%	0,943
24 jam							
TRIISS	30,5	0,922	0,922	95,70%	84,30%	92,20%	0,977
ISS	40,5	1	0,878	87,80%	100,00%	91,60%	0,961
RTS	7	0,98	0,904	93,90%	70,60%	86,70%	0,946
48 hours							

TRIISS	22,5	0,966	0,963	97,20%	96,60%	97%	0,994
ISS	40,5	1	0,944	94,40%	100,00%	96,40%	0,982
RTS	7	0,966	0,963	96,30%	96,60%	96,40%	0,971

Source: Primary Data (2024)

The table above presents the calculation results from SPSS statistical software for three instruments, TRIISS, ISS, and RTS, at three different periods, namely 6 hours, 24 hours, and 48 hours after the trauma event. Sensitivity, specificity, predictive positive value (PPV), predictive negative value (NPV), accuracy, and Area Under the Curve (AUC) are evaluated for each instrument on each timeframe. Results show that the TRISS instrument has excellent performance, with high sensitivity, specificity, PPV, NPV, accuracy, and AUC on all timeframes, followed by ISS and RTS ISS, RTS, and TRISS Sensitivity Levels.

Table 9 . Sensitivity Values

		6	24	48
TRIISS	Cut off points	34,5	30,5	22,5
	Sensitifity	0,918	0,922	0,966
ISS	Cut off points	40,5	40,5	40,5
	Sensitifity	1	1	1
RTS	Cut off points	7	7	7
	Sensitifity	0,98	0,98	0,966

Source: Primary Data (2024)

The table above presents sensitivity values for three instruments, TRIISS, ISS, and RTS, at three different periods, namely 6 hours, 24 hours, and 48 hours after the trauma event. Sensitivity is the ability of an instrument to identify patients who are positive for a particular condition accurately. In this table, the sensitivity of the TRISS instrument ranges from 0.918 to 0.966, while the ISS, as the standard, indicates perfect sensitivity (1) at all time ranges. RTS sensitivity is also high, with values of 0.98 on 6-hour and 24-hour timeframes and 0.966 on 48-hour. These results show that all three instruments have high sensitivity in identifying the patient's condition at different time frames, with the ISS achieving perfect sensitivity at all times. In contrast, TRISS and RTS show excellent sensitivity.

ISS, RTS, and TRISS Specificity Levels

Table 10. Specificity Value

		6	24	48
TRIISS	Cut off points	34,5	30,5	22,5
	Spesifity	0,915	0,922	0,963
ISS	Cut off points	40,5	40,5	40,5
	Spesifity	0,863	0,878	0,944
RTS	Cut off points	7	7	7
	Spesifity	0,889	0,904	0,963

Source: Primary Data (2024)

The table above shows the difference in specificity values between the TRIISS, ISS, and RTS instruments at three different time spans after the trauma event. In the 6 hours,

the highest specificity was found in the TRISS instrument with a value of 0.915, followed by RTS with a value of 0.889, and ISS had the lowest specificity with a value of 0.863. In the 24 hours, the highest specificity was also found in the TRISS instrument (0.922), followed by RTS (0.904) and ISS (0.878). While on 48 hours, TRISS again had the highest specificity (0.963), followed by RTS (0.963), and ISS had the lowest specificity (0.944). Therefore, the TRISS instrument consistently showed higher specificity than the ISS and RTS on all timescales following the trauma event.

Positive Presumptive Value (PPV), Negative Presumptive Value (NPV), and Accuracy

The presumptive value obtained in logistic regression analysis is as follows.

Table 11. PPV, NPV, and Accuracy values in 6 hours

Score	PPV	NPV	Accuracy
ISS	86,3%	100%	90,4%
RTS	96,6%	38,8%	79,5%
TRISS	94,9%	83,7%	91,6%

Source: Primary Data (2024)

From the table above, the highest value for *Positive Predictive Value* (PPV) is obtained from the RTS instrument at 6 hours at 96.6%, while the lowest value for PPV is on the TRISS instrument at 86.3%. For *Negative Predictive Value* (NPV), the highest value is 100% of the ISS instrument at the 6th hour, while the lowest value is 38.8% of the RTS instrument. As for Accuracy, the highest value is 91.6% for the TRISS instrument, and the lowest value is 79.5% for the RTS instrument.

Table 12. PPV, NPV, and Accuracy values in 24 hours

Score	PPV	NPV	Accuracy
ISS	87,8%	100%	91,6%
RTS	93,9%	70,6%	86,7%
TRISS	95,7%	84,3%	92,2%

Source: Primary Data (2024)

From the table above, the highest value for *Positive Predictive Value* (PPV) is obtained from the TRISS instrument at the 24-hour hour of 95.7%, while the lowest value for PPV is on the ISS instrument at 87.8%. For Negative Predictive Value (NPV), the highest value is 100% of the ISS instrument at the 24th hour, while the lowest value is 70.6% of the RTS instrument. As for Accuracy, the highest value is 92.2% for the TRISS instrument, and the lowest value is 86.7% for the RTS instrument.

Table 13. Nilai PPV,NPV, dan akurasi dalam 48 jam

Score	PPV	NPV	Accuracy
ISS	94,4%	100%	96,4%
RTS	96,3%	96,6%	96,4%
TRISS	97,2%	96,6%	97,0%

Source: Primary Data (2024)

From the table above, the highest value for *Positive Predictive Value* (PPV) was obtained from the TRISS instrument at 48 hours at 97.2%, while the lowest value for PPV was on the ISS instrument at 94.4%. For Negative Predictive Value (NPV), the highest value was 100% of the ISS instrument at 48 hours, while the lowest value was 96.6% of the RTS instrument. As for Accuracy, the highest value is 97.0% for the TRISS instrument,

and the lowest value is 96.4% for the ISS and RTS instruments.

DISCUSSION

The results of this study revealed that the majority of patients who experienced trauma were men with an average score of 40 years. Previous research by Rohilla et al. (2019) and Helen et al. (2022) also supports these findings, which suggest that trauma is more common in men of productive age. This phenomenon attracts attention because trauma is a significant cause of preventable mortality and morbidity, especially among people in the productive age group. The impact is significant, not only for the affected individuals but also for society as a whole and the health system. Many of them are permanently disabled, causing significant emotional, physical, and financial burdens for families and communities.

In this study, traffic accidents were recorded as the leading cause of blunt trauma at 147 (88.6%) in most samples. This finding is in line with statistical data from the Indonesian National Police Traffic Corps (Korlantas POLRI), which shows that the number of traffic accidents in Indonesia continues to increase every year. The report for the period 2014-2018 shows an average increase of 3.3% per year. This condition reflects serious challenges in injury prevention efforts and the need for more effective preventive measures. With increasing mobility and urbanization, the risk of traffic accidents is increasing, indicating the need for more serious attention in developing transportation safety policies and public education on traffic safety (Hulwah et al., 2021).

The sensitivity of ISS, RTS, and TRISS in predicting mortality of trauma patients

In this study, the sensitivity of trauma severity evaluation instruments, such as ISS, RTS, and TRISS, showed significant variation at various observation times. At the 6th hour, the ISS showed the highest sensitivity, reaching 100%, followed by RTS with 98% and TRISS with 91.8%. At the 24th hour, the sensitivity of the ISS and RTS remained high (100% and 98%, respectively), while the TRISS increased to 92.2%. However, at the 48th hour, the sensitivity of the ISS decreased to 83.1%, while the RTS reached the highest sensitivity of 97.2%, followed by the TRISS with 96.3%. Although the ISS showed decreased sensitivity, RTS and TRISS remained relatively stable, with RTS showing the best performance at that stage. According to Andara et al. (2022), the ISS has a sensitivity of 83.1%, which makes it a reliable predictor in assessing mortality in polytrauma patients. However, the study highlights that RTS and TRISS cannot effectively be predictors of mortality, as both have low sensitivity and specificity. This is due to the dependence of such scores on physiological factors and their inability to consider systemic comorbidities.

According to findings from Javali et al. (2019), the overall sensitivity of RTS and TRISS is equivalent, reaching 97.06% each, which indicates the ability of both to detect trauma patients at high risk of death. Furthermore, these findings highlight that the sensitivity of the RTS is much higher than that of the ISS, which only reaches 91.18%. This shows that in the context of trauma patient mortality prediction, RTS and TRISS have an advantage in detecting cases that are prone to death.

From a sensitivity perspective, these findings highlight the importance of considering the reliability and fit of trauma severity indices in the context of trauma

patient mortality prediction. Although the ISS has a reasonably high sensitivity, RTS and TRISS show more significant potential in detecting trauma patients who are at high risk of death. Therefore, selecting the most appropriate and reliable index should be carefully considered in clinical practice to improve trauma patients' overall management and outcomes.

The level of specificity of ISS, RTS, and TRISS in predicting mortality rates of trauma patients

In this study, within 6 hours, the highest specificity was found in TRISS, with a value of 91.5%, followed by RTS, 88.9%, and ISS, 86.3%. At 24 hours, the highest specificity remained on TRISS with 92.2%, followed by RTS with 90.4%, and ISS with 87.8%. At 48 hours, the highest specificity was shared by ISS and RTS, with a value of 96.3%, followed by TRISS, with 96.3%. This suggests that the specificity of the ISS and RTS instruments is likely to increase over time while the TRISS remains stable at a high level. However, previous research, as reported by Javali et al. (2019), found that ISS has a higher level of specificity at 89.8%, while RTS and TRISS have lower levels of specificity at 80.1% and 88%, respectively. These results highlight differences in specificity assessments between this study and previous studies, possibly due to differences in sample characteristics, methodology, or other factors affecting the study results.

In addition, research conducted by Farzan et al. (2022) also provides different perspectives regarding the specificity of the trauma index. In his study, ISS had a specificity rate of 84.26%, while RTS had a slightly lower specificity rate of 83.33%. This suggests that despite the difference in results, the two indices still show a high degree of specificity in predicting mortality in trauma patients.

In addition, research conducted by (Aspelund et al., 2019) also contributes to understanding the specificity of the trauma index. Its findings show that RTS has a higher level of specificity than the ISS and TRISS, at 91% and 69%, respectively. This emphasizes that RTS may be superior in determining specificity, which can be essential in selecting the most appropriate index in clinical practice to ensure optimal management of trauma patients.

Positive presumptive values of ISS, RTS, and TRISS in predicting mortality rates of trauma patients

From the data presented in this study, it can be seen that the highest value for *Positive Predictive Value* (PPV) varies depending on the instrument and measurement time. At the 6th hour, the RTS instrument had the highest PPV at 96.6%, while the TRISS instrument had the lowest PPV with a value of 94.9%. However, at 24 and 48 hours, the TRISS instrument recorded the highest PPV of 95.7% and 97.2%, respectively, while the ISS instrument had the lowest PPV in both periods. This suggests that TRISS instruments tend to provide optimistic predictions more accurately identifying trauma severity than ISS and RTS instruments. It should be noted that the PPV value reflects the proportion of patients who suffer from a positive condition out of the total patients who tested positive by tests or evaluation instruments.

Therefore, increasing PPV values on the TRISS instrument at 24 and 48 hours may indicate that the instrument is better at identifying positive cases and providing more helpful information in trauma care. However, previous research by Jojczuk et al. (2022) showed that ISS had a higher positive presumptive value of 100%, while RTS and TRISS

had slightly lower values of 96.8% and 97.1%, respectively. These differences may be due to sample characteristics, different methods, or variations within the population studied.

On the other hand, research conducted by Milton et al. (2021) revealed different results related to positive presumptive values. In his study, ISS, RTS, and TRISS had lower positive presumptive values of 45.44%, 44.64%, and 51.89%, respectively. This shows significant variation in research results related to positive presumptive values between this study and previous studies. These findings underscore the importance of considering diverse research outcomes in evaluating the performance of trauma indices in predicting outcomes in trauma patients.

Negative presumptive values of ISS, RTS, and TRISS in predicting mortality of trauma patients

In this study, at the 6th hour, the ISS, as the gold standard, had the highest NPV of 100%, demonstrating its excellent ability to exclude negative cases. Meanwhile, TRISS also recorded a good NPV of 83.7%, slightly higher than RTS, which is only 38.8%. This suggests that TRISS is more effective than RTS in excluding negative cases at 6 hours. Furthermore, at 24 and 48 hours, the ISS maintained the highest NPV at 100%, while TRISS and RTS recorded equally good NPVs at 24 hours (84.3% and 70.6%, respectively) and 48 hours (96.6%). This suggests that both TRISS and RTS showed an increased ability to exclude negative cases over time, with TRISS showing comparable or even better performance than RTS. In this analysis, we can see that TRISS performed better than RTS in terms of NPV at 6 hours, while at 24 and 48 hours, both had equally good performance with ISS as the gold standard. However, previous research conducted by Jojczuk et al. (2022) showed that ISS had a negative presumptive value of 95.7%, while RTS and TRISS had lower values of 77.8% and 88.9%, respectively.

Research conducted by (Milton et al., 2021) produced somewhat different findings regarding negative presumptive values. In his research, ISS, RTS, and TRISS tended to have equivalent negative presumptive values, namely 88.70%, 88.49%, and 92.85%, respectively. This difference shows variations in research results related to the performance of trauma indices in identifying patients who do not experience the predicted condition. Thus, it is crucial to consider findings from various studies before making solid conclusions about the performance of trauma indices in clinical practice.

The accuracy of the ISS, RTS, and TRISS in predicting the mortality rate of trauma patients

In evaluating accuracy performance, it is crucial to compare RTS and TRISS instruments with the gold standard, the ISS, in assessing trauma severity. At the 6th hour, the ISS recorded an accuracy rate of 90.4%, while RTS and TRISS had accuracy rates of 79.5% and 91.6%, respectively. This shows that TRISS has a degree of accuracy closer to the ISS than RTS at 6 hours. TRISS also shows higher accuracy than RTS, corresponding to better NPV values. However, it should be noted that both still have a lower accuracy rate than the ISS. At 24 hours, the ISS recorded an accuracy rate of 91.6%, while RTS and TRISS had accuracy rates of 86.7% and 92.2%, respectively. Once again, TRISS showed accuracy closer to the ISS than RTS at 24 hours. TRISS also remained consistent with an increased accuracy rate from 6 hours, demonstrating its stable ability to assess trauma severity. At 48 hours, the ISS recorded an accuracy rate of 96.4%, while RTS and TRISS

had accuracy rates of 96.4% and 97.0%, respectively. Both instruments, RTS and TRISS, demonstrated an accuracy level almost equivalent to the ISS at 48 hours, with TRISS demonstrating high-performance consistency throughout the observed period.

Thus, TRISS showed better or at least comparable performance to RTS in accuracy, especially at 6 and 24 hours, and showed a stable and consistent ability in assessing trauma severity. The results showed that ISS had an accuracy rate of 96.4%, followed by RTS with an accuracy rate of 97.6%, and TRISS with an accuracy rate of 97.0%. However, previous research by Jojczuk et al. (2022) showed slightly different results. In his research, ISS had an accuracy rate of 95.7%, while RTS and TRISS had a higher accuracy rate, respectively, at 96.5% and 96.9%. This difference shows variations in research results related to the performance of trauma indices in accurately classifying patients.

CONCLUSION

Based on the results of research and discussion, it can be concluded that in predicting the mortality rate of trauma patients in the emergency room of RSUD IA Moeis Samarinda, the RTS instrument showed the highest level of sensitivity, followed by ISS as the gold standard, and TRISS. The best specificity is observed in TRISS, while ISS shows a lower specificity level than RTS and TRISS. TRISS also stands out in predicting positive outcomes, followed by ISS and RTS, while in negative presumptive values, TRISS has a high rate, followed by ISS, and RTS shows variation. TRISS has the highest accuracy rate, followed by ISS and RTS. Advice can be given to the IA Moeis Samarinda Hospital and health workers, especially nurses, to apply the TRISS assessment system as a tool and information for predicting patient conditions. This is expected to improve response time and clinical approaches to obtain more comprehensive and optimal treatment, as well as become the basis for the prevention of disability and even death in trauma cases. For future studies, it is recommended that researchers consider conducting studies focusing on specific areas of the body, such as the head, chest, or abdomen, to obtain more specific results. In addition, further attention to the timing of the study and other factors that can affect mortality in trauma cases also needs to be considered to obtain more representative samples and more accurate results.

BIBLIOGRAPHY

Ahmad, Muayyad, Qurneh, Ali, Saleh, Mohammad, Aladaileh, Mohammad, & Alhamad, Ruba. (2022). The effect of implementing adult trauma clinical practice guidelines on outcomes of trauma patients and healthcare providers. *International Emergency Nursing*, *61*, 101143. https://doi.org/10.1016/j.ienj.2021.101143

ALVAREZ, BRUNO DURANTE, RAZENTE, DANILO MARDEGAM, LACERDA, DANIEL AUGUSTO MAUAD, LOTHER, NICOLE SILVEIRA, VON-BAHTEN, LUIZ CARLOS, & STAHLSCHMIDT, CARLA MARTINEZ MENINI. (2016). Analysis of the Revised Trauma Score (RTS) in 200 victims of different trauma mechanisms. *Revista Do Colégio Brasileiro de Cirurgiões*, *43*(5), 334–340. https://doi.org/10.1590/0100-69912016005010

Andara, Rinadi, Kadar, Pranajaya Dharma, & Albar, Husnul Fuad. (2022). Comparison of Injury Severity Score (ISS), New Injury Severity Score (NISS), Revised Trauma Score (RTS), and Trauma and Injury Severity Score (TRISS) In Predicting Mortality In

Polytrauma Patients At Haji Adam Malik General Hospital. *International Journal of Scientific and Research Publications (IJSRP)*, *12*(5), 400. https://doi.org/10.29322/IJSRP.12.05.2022.p12551

Chiang, Yueh Tzu, Lin, Tzu Hsin, Hu, Rey Heng, Lee, Po Chu, & Shih, Hsin Chin. (2021). Predicting factors for major trauma patient mortality analyzed from trauma registry system. *Asian Journal of Surgery*, *44*(1), 262–268. https://doi.org/10.1016/j.asjsur.2020.06.014

Farzan, Nina, Foroghi Ghomi, Seyed Yaser, & Mohammadi, Atefeh Raeisi. (2022). A retrospective study on evaluating GAP, MGAP, RTS and ISS trauma scoring system for predicting mortality among multiple trauma patients. *Annals of Medicine & Surgery*, *76*. https://doi.org/10.1016/j.amsu.2022.103536

Indurkar, Shubham K., Ghormade, Pankaj S., Akhade, Swapnil, & Sarma, Bedanta. (2023). Use of the Trauma and Injury Severity Score (TRISS) as a Predictor of Patient Outcome in Cases of Trauma Presenting in the Trauma and Emergency Department of a Tertiary Care Institute. *Cureus*. https://doi.org/10.7759/cureus.40410

Irman, Ode. (2018). Hubungan Length Of Stay Dengan Kepuasan Keluarga Pasien Prioritas Satu Di Igd Rsud Dr. Hendrikus Fernandez Larantuka. *Journal of Nursing Care and Biomoleculer*, *3*(2), 135–144.

Khan, Majid Jamal, Hussain, Dildar, & Mehmood, Waqar. (2016). Why do firms adopt enterprise risk management (ERM)? Empirical evidence from France. *Management Decision*, *54*(8), 1886–1907.

Kostiuk, Michael, & Burns, Bracken. (2023). Trauma assessment. In *StatPearls [Internet]*. StatPearls Publishing.

Magee, F., Wilson, A., Bailey, M., Pilcher, D., Gabbe, B., & Bellomo, R. (2021). Comparison of Intensive Care and Trauma-specific Scoring Systems in Critically Ill Patients. *Injury*, *52*(9), 2543–2550. https://doi.org/10.1016/j.injury.2021.03.049

Milton, Maxine, Engelbrecht, Andreas, & Geyser, Mimi. (2021). Predicting mortality in trauma patients-A retrospective comparison of the performance of six scoring systems applied to polytrauma patients from the emergency centre of a South African central hospital. *African Journal of Emergency Medicine*, *11*(4), 453–458.

Mohammed, Zeinab, Saleh, Yaseen, AbdelSalam, Eman Mohammed, Mohammed, Norhan B. B., El-Bana, Emad, & Hirshon, Jon Mark. (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), 90. https://doi.org/10.1186/s12873-022-00653-1

Organization, World Health. (2020). *WHO consolidated guidelines on tuberculosis: tuberculosis preventive treatment*. World Health Organization.

Patil, Akkamahadevi, Srinivasarangan, Madhu, Javali, Rameshbabu Homanna, LNU, Krishnamoorthy, LNU, Suraj, & LNU, Sriharsha. (2019). Comparison of Injury Severity Score, New Injury Severity Score, Revised Trauma Score and Trauma and Injury Severity Score for Mortality Prediction in Elderly Trauma Patients. *Indian Journal of Critical Care Medicine*, *23*(2), 73–77. https://doi.org/10.5005/jp-journals-10071-23120

Vorbeck, Jana, Bachmann, Manuel, Düsing, Helena, & Hartensuer, René. (2023). Mortality Risk Factors of Severely Injured Polytrauma Patients (Prehospital

Mortality Prediction Score). *Journal of Clinical Medicine*, *12*(14), 4724. https://doi.org/10.3390/jcm12144724

Yadollahi, Mahnaz. (2019). A study of mortality risk factors among trauma referrals to trauma center, Shiraz, Iran, 2017. *Chinese Journal of Traumatology*, *22*(4), 212–218. https://doi.org/10.1016/j.cjtee.2019.01.012

Yilmaz, Sarper, Ak, Rohat, Hokenek, Nihat Mujdat, Yilmaz, Erdal, & Tataroglu, Ozlem. (2021). Comparison of trauma scores and total prehospital time in the prediction of clinical course in a plane crash: Does timing matter? *The American Journal of Emergency Medicine*, *50*, 301–308. https://doi.org/10.1016/j.ajem.2021.08.029

Yuniar, Isma, Suwarsih, Evi, & Setianingsih, Endah. (2021). Revised Trauma Score (RTS) as a Mortality Predictor for Heavy Head Injury Patients (in IGD) PKU Muhammadiyah Gombong Hospital. *Proceedings of the 2nd Borobudur International Symposium on Humanities and Social Sciences, BIS-HSS 2020, 18 November 2020, Magelang, Central Java, Indonesia*. https://doi.org/10.4108/eai.18-11-2020.2311691

Copyright Holder:
Fenny Tianda[1], Kumboyono Kumboyono Penulis[2], Suryanto Suryanto[3] (2024)

First Publication Right:
Jurnal Health Sains

This article is licensed under: