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Research Article

Pediatric Logistic Organ Dysfunction-2, Pediatric Risk Of Mortality-IV And Pediatric Index Of Mortality-3 For Predicting Mortality In Pediatric Surgery Patients With Sepsis

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ABSTRACT

Background: Sepsis and shock septic still is one of the causes of morbidity and mortality that many in pediatric patients. The study is intended to determine the effectiveness of the systems Pediatric Risk of Mortality-IV(PRISM-IV), Pediatric Logistic Organ Dysfunction-2 (PELOD-2) and Pediatric Index of Mortality-3 (PIM-3) in predicting the outcome of patients.

Methods: Data were taken from the medical record of patients. Medical records are then evaluated using the inclusion criteria and the criteria for exclusion. Data is processed statistically.

Result: The number of survived subjects was 38 patients and the number of deaths was 26 patients. The regression test showed that to a relationship that significant between the value of scoring PRISM-IV against mortality with p 0.001 (p <0.05 CI 95%). The PIM-3 score was analyzed. The regression test showed that there is no significant relationship between the score PIM-3 against mortality with p 0.371 (p <0.05 CI 95%). Test relationship score PELOD-2 against mortality showed that patients who survived had a value score of PELOD 0, whereas the patients who died had a mean score of 3.6 (SD ± 4.5). The results of the test regression showed a significant relationship with p 0.018 ((p <0.05 CI 95%) with the strength of the relationship R = 0.595.

Conclusion: The PELOD-2 and PRISM-IV grading systems are equally good at predicting the outcome of pediatric surgical patients with sepsis. The PELOD-2 system has advantages in specificity and accuracy, while the PRISM-IV system has an advantage in sensitivity.

Keywords: PELOD, PRISM, PIM, sepsis, mortality, pediatrics

INTRODUCTION

Sepsis is an infection-induced syndrome, mostly caused by bacteria, of organ dysfunctions that are caused by host response dysregulations [1]. Sepsis and shock septic still in one of the causes of morbidity and mortality that many in the pediatric patient. The mortality rate is higher in immunodeficient children [2]. The mortality rate is higher in immunodeficient children [2]. Sepsis and shock septic are two clinical conditions of infectious disease that require action immediately [3]. Data epidemiology of various studies vary widely associated with age, population and criteria for diagnostic are different. The incidence of sepsis and septic shock were increasing in the last 30 to 40 years [4]. However, the prevalence of which is obtained is still great. Study Global Sepsis Prevalence, Outcome and Therapy (SPROUT) in 2013 of 128 hospitals in 26 countries, both countries developed as well as developing countries, reported the prevalence of sepsis reached 8.2% in patients in the ICU with mortality reached 25%.

Data in Indonesia, especially in Rumah Sakit Cipto Mangunkusumo (RSCM) in the year 2015 mentioned 19.3% of 502 patients of children who admitted to experiencing sepsis with numbers mortality reached 54%. The problem does not only arise from the terms of morbidity and mortality, but also the aspect of treatment. The original infection that causes sepsis also varies, making treatment difficult. Patients children with sepsis or shock sepsis require modalities of treatment are many and strategies of care that are optimal to get the outcome that much better [5]. Neonatal sepsis one of infectious diseases in newborns is a major problem that cannot be solved until today [6]. Various internal and

external factors also determine the occurrence of sepsis [7].

Knowledge of patients who are at risk of high has meaning important in the management of sepsis in children. In sepsis case, micronutrients also determine the success of treatment due to redistribution of vitamin and trace element from circulation to the tissue which involved in the proteins formation and immune system [8]. Evaluation of the factor's prognosis should be done since the beginning so that therapies are aggressive can be immediately applied. Because of it, an objective scoring system is necessary to determine the quality of service, improving the outcome of patients and predict morbidity and mortality [9]. Some scoring systems can be used to assess mortality in the Pediatric Intensive Care Unit (PICU) such as the Pediatric Risk of Mortality (PRISM) scoring system and the Pediatric Index of Mortality (PIM). The PRISM score is a variable quantification of physiological status and is used to control disease severity and service quality through a standard mortality ratio. This score was improved in 2015 to PRISM-IV with consideration of measurement timings and admissions to reduce treatment bias. PIM score is an assessment of mortality with variables of risk factors, diagnosis and physiological status of patients. Score PIM calibrated into the year 2013 to predict is an accurate outcome of patients with the data scale international of PICU state of the commonwealth. PIM-3 systems have the good effectiveness, but the two systems are not reserved in patients with sepsis [10].

By because it is, necessary system of assessment else can be a factor predictor of patients with characteristics of sepsis. In the year 1999, the system ratings Pediatric Logistic Organ Dysfunction Score (PELOD) was developed to assess the severity of the dysfunction of multiple organs. The system is then undergoing the process of development and validation anniversary in the year 2013 into a system of rating PELOD-2. System assessment is comprised of ten indicators of the objective which is summarized in the five vital organs, namely: Glasgow coma scale (GCS) and the reaction of the pupil (neurological); lactate levels and mean arterial pressure (cardiovascular); serum creatinine (kidney); PaO2, PaCO2 and the ventilation invasive (breathing); and the number of leukocytes and platelets (hematology). Previous Research shows this system is more efficient than the old PELOD system. It is due to the variables that are used in the system PELOD-2 is a bit without sacrificing the figure of sensitivity and specificity [9, 11].

Other scoring systems that can be considered to predict bag mortality are Pediatric Sequential Organ Failure Assessment (pSOFA) and Pediatric Multiple Organ Dysfunction Score (P-MODS). The pSOFA system is an adaptation of the Sequential Organ Failure Assessment (SOFA) system for adults by changing objective indicator variables from kidney and cardiovascular organs to age-related. The system is rated similar to the score PELOD-2 in determining the risk of mortality of patients with children with sepsis [12]. The difference fundamental in both systems is the variable levels of bilirubin as an evaluation of the function of the liver. This parameter also exists in the old PELOD grading system. Bilirubin levels as a parameter of hepatic function were also examined in the P-MODS assessment system [13]. However, in the Emergency Unit of dr. Soetomo General Hospital, levels of bilirubin are not routinely evaluated when the patient does not have symptoms of jaundice so that the measurement system is difficult to do. By because it is, the system PELOD-2 is considered more convenient to use, because the variables are calculated over a little to the effectiveness of which is still significant.

Pediatric Surgery Department of dr. Soetomo General Hospital has not yet implemented the system assessment to predict mortality in patients with surgical children with sepsis. Based on the thought that we research to measure and compare the system ratings PELOD-2, and the system of assessment else has not been tested specifically for patients of children with sepsis that PRISM and PIM. The study is intended to determine the effectiveness of the systems PRISM-IV, PELOD-2 and PIM-3 in predicting the outcome of patients.

METHOD

Research conducted on pediatric surgery patients with characteristics of sepsis is undergoing treatment in hospitals IRD dr. Soetomo Surabaya throughout January 2015 until April 2019. Data were taken from the records of medical patients. Total found 205 records medical with the subjects of patients who experienced sepsis. Record medical are then evaluated to determine whether the variables are studied full or not. The number of records medical that is complete is 108. Record medical are then evaluated using the criteria of inclusion and obtained 64 records medical that meet the criteria for inclusion and the remaining amount of 44 records medical entrance criteria for exclusion. The data obtained are grouped based on demographic data and clinical data. Variables that there is then incorporated into the formula to calculate the system rating PELOD-2, PRISM-IV, and PIM-3.

Data management is done using the SPSS 17.0 program. Data is presented in the form of

frequency distribution tables and cross-tabulations. Data from independent and dependent variables will be tested using diagnostic tests of sensitivity, specificity, positive predictive value, negative predictive value, accuracy test, likelihood ratio, and discrimination calibration.

RESULTS

Subjects are homogeneous data of children with definitions of age between 3 months and 18 years (100%) with sepsis characteristics (100%). Table 1 present the diagnosis of sepsis is evaluated through clinical and laboratory parameters that lead to bacterial infections and are established through a blood culture and organ dysfunction parameters. Male patients were 35 patients, female patients were 29 patients. The youngest age is 3 months and the oldest is 204 months. The mean age of the subjects was 40.19 months.

Table 1: Frequency of demographic characteristics of research subjects

Category	Description	Frequencies
Gender	Male Female	35 (54.69 %) 29 (45.31 %)
Age (months)	3- 12 months > 1-4 years > 4- 8 years > 8-12 years > 12-18 years old	27 (42.19 %) 17 (26.56 %) 9 (14.06 %) 6 (9.38 %) 5 (7.81%)

Examination vital signs are recorded to obtain a variable clinical before calculating value scores PELOD-2, PRISM-IV, and PIM-3. The data in the form of a GCS, pressure blood systolic, MAP and temperature recorded in Table 2 characteristic clinical others still need to be evaluated based on the range of age of the subject.

Table 2: Characteristics of clinical data of study subjects

Description	Range	Mean	Standard Deviation (SD)
GCS	3-15	11.1	4.78
Systolic BP (mmHg)	63-110	78.78	12.76
MAP (mmHg)	54-71	66.41	3.58
Pulse (times/minutes)	90-161	128.66	15.45
Temperature (^{0}C)	35.8-40.6	38.25	1.08

Laboratory examination is also recorded to obtain the variable parameters of impaired organ function before calculating the PELOD-2 score, PRISM-IV and PIM-3. Characteristics of laboratory tests in the form of impaired renal function, hematology, respiration, glucose levels, and serum potassium are noted in table 3 levels of lactic only be examined in 16 subjects with a range of 0.3 to 2.7 mg/dL and a mean of 1.86 mg/dL (SD ± 0.68mg/dL).

Table 3: Characteristics of laboratory data of research subjects

Description	Range	Mean	Standard Deviation (SD)
Urea (mg/dL)	10-35	19.56	7.82
Creatinine (mg/dL)	0.01-1.7	0.5	0.32
WBC (x103/μL)	0.56-184	18.33	22.63
Platelets (x103/μL)	3-753	31.67	22.19
PT (seconds)	9-13	10.54	1.18
pH	6.81-7.56	7.31	0.17
PaO2	18-408.9	114.73	74.77
PaCO2	20-105	36.38	15.61
Blood Glucose (mg/dL)	14-246	106.67	42.63
Potassium (mmol/L)	2-6.2	3.59	0.86
Lactate (mg/dL)	0.3-2.7	1.86	0.68

Table 4 contains the number and percentage of assessment results of the three scorings of patient outcomes of all study subjects. System rating PELOD-2 only contains 16 subjects because the

number of patients who were examined for lactate was only 16, while the system that requires variable lactatemia to measure score. Scores were much higher indicates one subject only to the outcome died (score 6-12). Data end of the subjects was measured score PIM3 showed that 34 (53.1%) patients with a score of PIM -6 -17 life and 28 (43.8%) patients died. The remaining 2 (3.1%) subjects with high PIM-3 scores (42-63) had live outcomes.

Table 4: Frequency characteristic score PELOD-2, PRISM-IV, and PIM3

Rating System			Total
	Survived (%)	Mortality (%)	n (%)
PELOD-2			16 (100%)
0-6	11 (68.75%)	4 (25%)	
7-12	0	1 (6.25%)	
13-17	0	0	
PRISM- IV			64 (100%)
0-24	0	0	
25-49	35 (54.75%)	25 (39%)	
50-74	0	4 (6.25%)	
PIM-3			64 (100%)
-6-17	34 (53.1%)	28 (43.8%)	
18 - 41	0	0	
42 - 63	2 (3.1%)	0	

Analysis of the ROC test was only carried out on the PELOD-2 and PRISM-IV grading systems. It is caused due to the results of testing the relationship in table 5 show that not there is a relationship that is significant (p 0.371) with the strength of the relationship that is low (R = 0.113) between the system of assessment PIM-3 and mortality of patients with sepsis.

Table 5:Test the relationship between the PELOD-2, PRISM-IV and PIM-3 grading systems on mortality

Score	Mortality	N	Mean ± SD	Median	P (95% CI)	R
PRISM-IV	Survived	38	18.34 ± 14.47	14	0.001 (0.004-0.013)	0.463
	Dead	26	43.38 ± 33.31	31		
PIM-3	Survived	38	3.95 ± 10.03	1.79	0.371 (-0.03-0.009)	0.113
	Dead	26	2.17 ± 0.94	2.03		
PELOD-2	Survived	11	0	0		
	Dead	5	3.6 ± 4.5	3	0.018 (0.043-0.55)	0.595

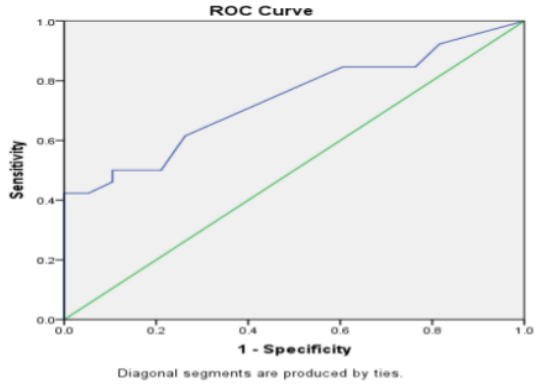

Fig.1: Prediction values of the PRISM-IV scoring system for mortality based on the AUC-ROC curve

Figure 1 provides information that scores PRISM-IV has a value predicted mortality of patients surgical children with sepsis amounted to 73.5% (CI 60.3% - 86.7%).

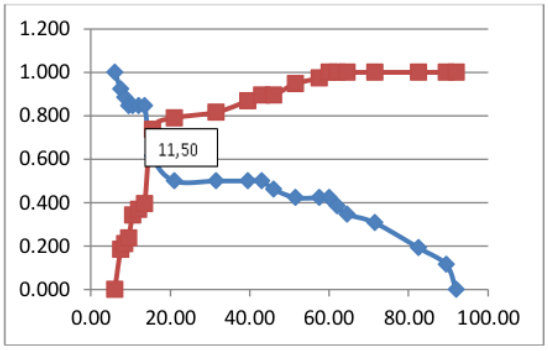

Fig.2: PRISM-IV grading system cutoff value for mortality

Figure 2 shows that a score of 11.5 gives the greatest sensitivity value of 84.6%. Before the revision, PRISM-III was considered quite good in predicting mortality in pediatric patients with sepsis.

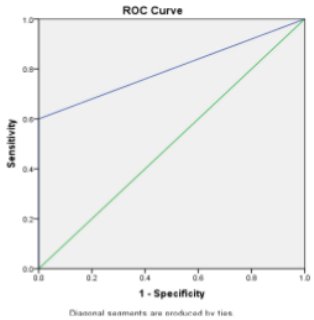

Fig.3: Value prediction system ratings PELOD-2 against mortality by curve AUC-ROC

Figure 3 shows the results cutoff that score PELOD- 2 amounting to 1.5 has the value of the sensitivity reached 60%.

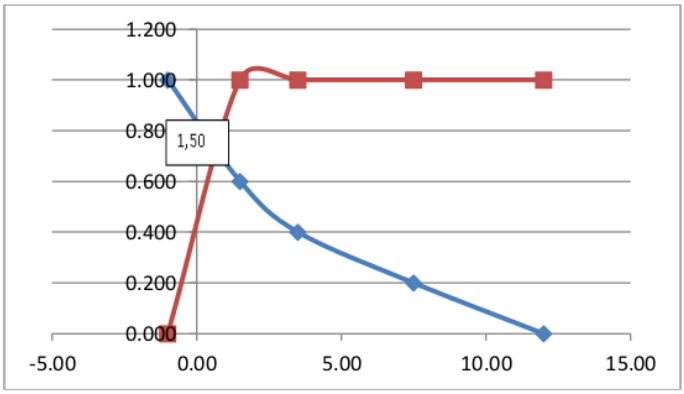

Fig.4: The cutoff value of the PELOD-2 grading system for mortality

Figure 4 shows the results of the low are at odds with the basic theory and some research the other.

Table 6: Analysis of Diagnostic Tests in the PELOD-2 and PRISM-IV Assessment Systems

Rating System	PELOD-2	PRISM-IV
Sensitivity	60%	61.54%
Specificity	100%	73.68%
Positive Prediction Value	100%	61.54%
Negative Prediction Value	84.62%	73.68%
Accuracy	81.25%	68.75%
Likelihood Ratio	8.71	8.01
Value of p	0.018	0.011
OR (95% CI)	0.154 0.043-0.55	4.48 1.54-13.07

The conclusion that can be drawn from Table 6 is that there is no superior system in terms of the PRISM-IV and PELOD-2 systems which have their privileges in predicting patient outcomes. PRISM-IV has a value of sensitivity which is good, but PELOD-2 has a value of specificity and accuracy that is better. These results vary when compared to several other studies. However, until when these authors have not found the study which compares the third system of ratings that.

DISCUSSION

The number of survived subjects was 38 patients and the number of death was 26 patients. Subjects who survived had a mean value of the PRISM-IV 18, 34 (SD ± 14.47) with the value of the median 14. The subjects who died had a mean value of the PRISM-IV 43.38 (SD ± 33.31) with the value of the median 31. The regression test showed that to a relationship that significant between the value of scoring PRISM-IV against mortality with p 0.001 (p <0.05 CI 95%). The PIM-3 score was analyzed. Subjects who survived have an average score of 3.95 (SD ± 10.03) with the value of the median of 1.79. The subjects who died had a mean value of 2.17 (SD ± 0.94) with a median value of 2.03. The regression test showed that there is no significant relationship between the score PIM3 against mortality with p 0.371 (p <0.05 CI 95%). Test relationship score PELOD-2 against mortality showed that patients who survived had a value score of PELOD 0, whereas the patients who died had a mean score of 3.6 (SD ± 4.5). The results of the test regression showed a significant relationship with p 0.018 (p <0.05 CI 95%) with the strength of the relationship R = 0.595.

Characteristic clinical others still need to be evaluated based on the range of age of the subject. In total there were 11 (68.75%) patients were alive with a score late PELOD-2 in the range of 0-6 and 4 (25%) of patients who died with a score the same. Scores were much higher indicates one subject only to the outcome died (score 6-12). It is contrary to previous the study in which the score PELOD is highly correlated to the mortality of patients. It is probably caused by the least number of subjects were examined levels of lactate so that subjects who died were not able to be evaluated [14]. Several 35 (54.75%) patients with a range of scores PRISM-IV 25-49 have a superficial life and 25 (39%) patients with a range of scores that same die. Four (6.25%) patients with a score of PRISM-IV are high (50-74) died. It is according to research other where the scores are highly correlated to the mortality of patients [15].

The score PIM3 showed that 34 (53.1%) patients with a score of PIM -6 -17 life and 28 (43.8%) patients died. It is contrary to studies in which increasingly higher score PIM3 the increasingly high rate of mortality of patients so that the system ratings that need to be tested relation to the outcome of mortality [16, 17]. The relationship between the three systems assessment at the top of the mortality needs to be tested first in advance before determining the value of the diagnostic of the three systems assessment. Subjects with an output of life as much as 38 patients and who died as many as 26 patients. Subjects that life has a mean value of the PRISM-IV 18, 34 (SD ± 14.47) with the value of the median 14. The subjects who died had a mean value of the PRISM-IV 43.38 (SD ± 33.31) with the value of the median 31. Tests regression further indicates that to a relationship that significant between the value of scoring PRISM-IV against mortality with p 0.001 (p <0.05 CI 95%). Relationships are shown strength being the value of R 0.463. The previous research shows that PRISM-IV is a good diagnostic tool for evaluating mortality from patients in the intensive care space [10].

The PIM3 score was then tested for its relationship to the mortality of 64 subjects. Subjects that life has a scoring average of 3.95 (SD ± 10.03) with the value of the median of 1.79. The subjects who died had a mean value of 2.17 (SD ± 0.94) with a median value of 2.03. It is contrary to the study of others, for example by Jung et al in which increasingly higher value PIM3 the percentage

probability of death of patients is getting higher. It is probably caused by factors confounding diagnosis varies, where a patient with a value PIM3 that a low has a diagnosis of complications is more much than patients with grades PIM3 that high living [15]. Test regression showed that not there is a relationship that significant between the score PIM3 against mortality with (p 0.371) (p <0.05 CI 95%). Studies in New Delhi showed similar results, where both systems PIM2 and PIM3 show the calibration that bad (p <0.001). The previous research showed calibration of the low is also observed in the study of other countries developing the resulting range of the area on the profile of patients, the comparison between the staff medical that slightly and the number of patients that many who contributed to the prediction of the death of the poor [18].

The previous research states that the result of bias can be caused by factors confounding as an overview of demographic and factors taking samples by nurses and counting vital signs by a physician can affect the outcome of PIM3 [19]. Factors confounding Another possible is the subject has been treated before it is sent to the central service of tertiary which causes the bias of the results of treatment. Also, bias factors in the collection of variable data can play a role in the final score. The PIM3 system uses subject variable data during the first hour of admission. In the study of this, do not be proved that the data was taken from the records of medical truly data on hours the first admission of patients, such as delays in monitoring vital signs and taking samples of blood. Test relationship score PELOD-2 against mortality showed that patients whose lives have value score PELOD 0, whereas the patients who died had a mean score of 3.6 (SD ± 4.5). The test results of regression showed that of the relationship that significant between the results of the final with mortality with (p 0.018) (p <0.05 CI 95%) with the strength of the relationship being (R = 0.595). The other study showed also that the system PELOD-2 can predict mortality in patients [9].

The previous research concludes that every rise 1 point PRISM-III patients of children who hurt critically in the PICU had OR 6.2 times fold (95% CI 3.4 to 11.3) to experience mortality [14]. The previous research against the PRISM-IV proves that a system that can predict the risk of mortality of patients (AUC 90% ± 1.8%) [10].

In the end, a score of PELOD-2 also tested the value of its predictions with the curve AUC-ROC and obtained information that the value of predictive PELOD-2 reaches 80% (CI 51.7% - 100%). Guidelines for the treatment of sepsis in Indonesia in 2015 states that to uphold sepsis required score PELOD minimum of 11 at home sick of type A or 7 at home sick of type B. The other study showed said that the sensitivity PELOD-2 reached 80.2% by value cutoff of 10.5 [20]. The previous research showed that the score PELOD-2 has a value predicted that high reaches 92%, where the value of the prediction at above 90% indicates that the system of assessment that is already good [14]. The difference is probably due to the number of samples which is little compared to research other because of the value of lactate were not checked at a most large sample of the entry criteria for inclusion. System ratings PRISM-IV and PIM3 not affected because the system ratings are not included levels of lactate as a variable so that the number of subjects approaching the number of subjects in the study to another. Generally speaking, system assessment of PELOD-2 has a value of prediction which is better than the PRISM-IV and PIM3 with AUC reached 0.8.

The previous research compared the PELOD-2, PIM3, and PRISM-III systems [20]. The results of the study that is the third system of appraisal well in distinguishing patients who survive and do not, in which the system ratings PIM3 and PELOD-2 are better than the PRISM-III (AUC PIM3 and PELOD-2 respectively 82.4% and 80,3%). Research in Hongkong compares the system ratings PIM3 and PRISM-III where the system ratings PRISM-III is more superior in predicting the number of mortality of patients [21]. Research in Mumbai year 2018 compares the system ratings PRISM-III, PIM2, and PIM3 [22].

CONCLUSION

Of the three systems, the PIM3 grading system cannot predict mortality in pediatric surgical patients with sepsis because there is no significant relationship between the system and the mortality of pediatric surgical patients with sepsis (p 0.371). The PELOD-2 and PRISM-IV assessment systems are equally good at predicting the outcome of pediatric surgical patients with sepsis. The PELOD-2 system has advantages in specificity and accuracy (100% and 81.25%, respectively), while the PRISM-IV system has an advantage in sensitivity (61.54%).

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