Paediatrica Indonesiana

p-ISSN 0030-9311; e-ISSN 2338-476X; Vol.59, No.6(2019). p. 318-24; doi: http://dx.doi.org/10.14238/pi59.6.2019.318-24

Original Article

Severe sepsis criteria, PELOD-2, and pSOFA as predictors of mortality in critically ill children with sepsis

Anindita Wulandari, Pudjiastuti, Sri Martuti

Abstract

Background Sepsis is one of the main causes of death in infants and children. Currently, it is defined as a life-threatening organ dysfunction, caused by an inflammatory response of infection. Several organ dysfunction assessment methods are available, but they are not uniformly used.

Objective To compare the accuracy of three mortality predictor tools: severe sepsis criteria, pediatric logistic organ dysfunction (PELOD)-2, and pediatric sequential organ failure assessment (pSOFA), in critically ill children with sepsis.

Methods This prospective cohort study was conducted in the pediatric intensive care unit (PICU) and pediatric high care unit (HCU) of dr. Moewardi Hospital, Surakarta, Central of Java. All patients who met the systemic inflammatory response syndrome (SIRS) criteria were included in our study. The exclusion criteria were congenital anomalies of heart or kidney, malignancy, or hematological abnormalities. The data were taken from laboratory and physical examinations by the physicians on duty. The outcome assessed was mortality.

Results Of 30 subjects, the mean age was 22.22 (SD 29.36) months; the most common infection source was the respiratory tract, followed by gastrointestinal tract and central nervous system. Most subjects were treated in the PICU and had a mean length of stay of 8.70 (SD 11.91) days. Severe sepsis and PELOD-2 were not significant predictors of death. However, pSOFA score was a statistically significant predictor of mortality, with odds ratio 10.11 (95%CI 1.054 to 97.002; P=0.039).

Conclusion Pediatric SOFA (pSOFA) is a better predictor of mortality compared to PELOD-2 and SIRS-severe sepsis. A pSOFA score ≥ 2 increases the risk of mortality by 10.11-fold. **[Paediatr Indones. 2019;59:318-24; doi: http://dx.doi.org/10.14238/pi59.6.2019.318-24]**.

Keywords: *children; mortality; sepsis; PELOD-2; SIRS; SOFA*

Sepsis is one of the leading causes of death in infants and children all over the world.[1-4] Currently, sepsis is defined as multiple organ dysfunction due to an unregulated host response to infection, which affects the course of the disease and prognosis in patients.[5,6] Several scoring systems are used to assess organ dysfunction, which in turn are used to diagnose sepsis. These assessment methods aim to consider the risk of mortality, outcome predictions, prediction of the severity of the disease, and organ failure. Such grading systems also assist clinical decision-making, research standardizing, and comparison of patient services among intensive care units.[5-9]

In 2005, the *International Pediatric Sepsis Consensus Conference* (IPSCC) introduced the SIRS criteria with several additional parameters to assess organ dysfunction in diagnosing severe sepsis,[9] considered the same as those uses to diagnose sepsis nowadays.[6]

From the Department of Child Health, Universitas Sebelas Maret Medical School/Dr. Moewardi Hospital, Surakarta, Central Java, Indonesia.

Corresponding author: Anindita Wulandari. Department of Child Health, Universitas Sebelas Maret Medical School/Dr. Moewardi Hospital. Jl. Kolonelk Soetarto No. 132 Surakarta, Central Java, Indonesia; Email: ilmiah.anin@gmail.com.

Submitted July 11, 2019. Accepted December 6, 2019.

The Indonesian Pediatric Association (IPA) currently recommends PELOD-2 to assess multiple organ dysfunction in sepsis.[8] The latest consensus regarding sepsis in adults (Sepsis-3) uses SOFA to assess organ dysfunction.[6] In pediatric population, Matics *et al.*[10] proposed the pediatric SOFA which has been adapted to age and normal pediatric physiology.

In Indonesia, few studies have compared mortality prediction accuracy in pediatric patients using the new internationally introduced pSOFA criteria. Hence, we aimed to compare several systems for evaluating organ dysfunction (severe sepsis criteria, PELOD-2, and pSOFA) and used to diagnose sepsis in children, with regards to their accuracy in predicting mortality.

Methods

This prospective cohort study was conducted to compare severe sepsis criteria, PELOD-2, and pSOFA in predicting mortality among critically ill pediatric patients with sepsis treated in the PICU and HCU in Dr. Moewardi General Hospital, Surakarta, Central of Java. The study started in September 2018, ended in March 2019, and employed a consecutive sampling method. All pediatric patients diagnosed with sepsis based on the SIRS criteria[9] and whose parents provided written informed consent were included in our study. Patients with previously known malignancy, hematological abnormalities, or congenital heart, lung, or kidney anomalies were excluded from the study. We assessed the variables of severe sepsis criteria, PELOD-2 scores, pSOFA scores, and mortality incidence.

Subjects were assessed by three methods and divided into (+) and (-) groups accordingly. Sepsis is defined as systemic inflammatory response syndrome caused by suspected or proven infection. Subject with sepsis categorized as severe sepsis (-), while subject with sepsis plus one of organ dysfunction as mentioned in **Table 1** was categorized as severe sepsis (+).[9] The PELOD-2 was assessed using two cut-off values, namely ≥ 8 and ≥ 11; PELOD-2 score ≥ 8 was rated as (+) and score < 8 as (-). Similarly, if we used the higher cut-off score, PELOD-2 score ≥ 11 was rated as (+) and score < 11 as (-). Scores for pSOFA were considered (+) for ≥ 2, and (-) for < 2. The mortality outcome assessed and subjects were divided into two groups, namely alive (survivors) and died (non-survivors). Examination and assessment of the dependent variable was performed by the physician in charge of the ICU within the first 24 hours of treatment and was followed until the patient was discharged from the ICU (survived or died).

The description of each study variable was performed for the whole sample according to the distribution of outcome categories (mortality).

Table 1. Organ dysfunction criteria[9]

Cardiovascular dysfunction Despite administration of isotonic intravenous fluid bolus ≥40 mL/kg in 1 hr • Decrease in BP (hypotension) 5th percentile for age or systolic BP <2 SD below normal for age OR • Need for vasoactive drug to maintain BP in normal range (dopamine >5 µg/kg/min or dobutamine, epinephrine, or norepinephrine at any dose) OR • Two of the following: • Unexplained metabolic acidosis: base deficit >5.0 mEq/L • Increased arterial lactate >2 times upper limit of normal • Oliguria: urine output <0.5 mL/kg/hr • Prolonged capillary refill: >5 secs • Core to peripheral temperature gap >3°C
Respiratory • PaO_2/FIO_2 <300 in absence of cyanotic heart disease or preexisting lung disease OR • $PaCO_2$ >65 torr or 20 mm Hg over baseline PaCO2 OR • Proven need or >50% FIO_2 to maintain saturation ≥92% OR • Need for nonelective invasive or noninvasive mechanical ventilation
Neurologic • Glasgow Coma Score ≤11 (57) OR • Acute change in mental status with a decrease in Glasgow Coma Score ≥3 points from abnormal baseline
Hematologic • Platelet count <80,000/mm^3 or a decline of 50% in platelet count from highest value recorded over the past 3 days (for chronic hematology/oncology patients) OR • International normalized ratio >2
Renal • Serum creatinine ≥2 times upper limit of normal for age or 2-fold increase in baseline creatinine
Hepatic • Total bilirubin ≥4 mg/dL (not applicable for newborn) OR • ALT 2 times upper limit of normal for age

BP=blood pressure; ALT=alanine transaminase.

Numerical variables are presented as frequency and percentage (n and %), while categorical variables are presented in mean and standard deviation (mean and SD). The OR value to state mortality risk was calculated and the relationship between each assessment criteria (severe sepsis criteria, PELOD-2, and pSOFA) with mortality was analyzed by Chi-square or Fisher's exact test for the unmet minimum expected value in cross-distribution. Results with P value <0.05 were considered to be statistically significant. The accuracy of predicting mortality for each tool and the comparison of the three tools were also assessed by various diagnostic parameters including sensitivity, specificity, negative predictive value (NPV), positive predictive value (PPV), positive likelihood ratio (LR +), and negative likelihood ratio (LR -). All data were analyzed with *Microsoft Excel 2007* and *SPSS version 21 for Windows* software.

This study was approved by the Health Research Ethics Committee of the Universitas Sebelas Maret Medical School/Dr. Moewardi Hospital Surakarta.

Results

Of 30 subjects, the mean age was 22.22 (SD 29.36) months. The proportion of males was twice the number of females. The most common infection was respiratory tract infection (22/30). Most subjects (25/30) were treated in the PICU and the rest were in the HCU. The mean of length of stay (LOS) was 8.70 days. The proportion of subjects who died reached 46.7%. The demographic characteristics of subjects are presented in **Table 2**.

In comparing subjects who died to subjects who survived, the group who died had younger mean age (12.61 vs. 30.62 months, respectively), lower mean body weight (6.42 vs.10.33 kg, respectively), and shorter mean length of stay (5.00 vs. 11.94 days, respectively). All subjects who died were treated in the PICU. The characteristics of subjects based on the outcome are shown in **Table 3**.

The three methods to assess organ dysfunction (severe sepsis criteria, PELOD-2, and pSOFA) were analyzed in accordance to mortality incidence (**Table 4**). The PELOD-2 cut-off scores used in this study were ≥ 8 and ≥ 11, while the pSOFA cut-off score was ≥ 2.

Table 2. Subjects' characteristics

Characteristics	N=30
Mean age (SD), months	2.22 (29.36)
Gender, n	
Male	20
Female	10
Mean weight (SD), kg	8.51 (5.62)
Infection, n	
Respiratory tract	22
GI tract	3
CNS	4
Other	1
Hospital unit, n	
PICU	25
HCU	5
Mean LOS (SD), day	8.70 (11.91)
Outcome, n	
Died	14
Survived	16

The significance of prediction accuracy of severe sepsis criteria, PELOD-2, and pSOFA on mortality was analyzed by Fisher's exact test, which revealed that severe sepsis criteria and PELOD-2 were not significant predictors for mortality (P> 0.05). However, the pSOFA was a significant predictor for mortality (P=0.039). The OR value for the pSOFA was also the highest at 10.111 (95%CI 1.054 to 97.002). These results indicate that pSOFA was the best predictor for mortality compared to severe sepsis criteria and PELOD-2 with both cut-off scores of 8 and 11 (**Table 5**).

Table 3. Subjects' characteristics based on outcome

Characteristics	Died (n=14)	Survived (n=16)
Mean age (SD), months	12.61 (16.20)	30.62 (35.74)
Gender, n		
Male	7	13
Female	7	3
Mean weight (SD), kg	6.42 (3.24)	10.33 (SD 6.65)
Infection, n		
Respiratory tract	11	11
GI tract	2	1
CNS	0	4
Others	1	0
Hospital unit, n		
PICU	14	11
HCU	0	5
Mean length of stay (SD), days	5.00 (7.64)	11.94 (14.13)

Table 4. Organ dysfunction assessment system in accordance to mortality incidence

Variables	Total (N=30)	Died (n=14)	Survived (n=16)
Severe sepsis criteria			
Positive	25	13	12
Negative	5	1	4
PELOD-2 (score ≥ 11)			
Positive	6	5	1
Negative	24	9	15
PELOD-2 (score ≥ 8)			
Positive	14	9	5
Negative	16	5	11
pSOFA (score ≥ 2)			
Positive	22	13	9
Negative	8	1	7

Table 5. Statistical analysis and OR value of the relationship between mortality and severe sepsis criteria, PELOD-2, and pSOFA scores

Organ dysfunction assessment system	OR	95%CI	P value
SIRS (severe sepsis)	4.333	0.423 to 44.428	0.336
PELOD-2 (score ≥ 11)	8.333	0.835 to 83.167	0.072
PELOD-2 (score ≥ 8)	3.960	0.865 to 18.119	0.070
pSOFA (score ≥ 2)	10.111	1.054 to 97.002	0.039

The prognostic accuracy of the three methods of assessment for sepsis can be compared with various diagnostic parameters. The highest sensitivity was found using severe sepsis criteria and pSOFA, namely 92.9% for both. The PELOD-2 score ≥ 11 had the highest specificity (93.8%). The diagnostic parameter values for each tool are shown in **Table 6**.

Table 6. The diagnostic parameters of severe sepsis criteria, PELOD-2, and pSOFA as mortality predictors.

Diagnostic parameters	SIRS (severe sepsis)	PELOD-2 (score ≥ 11)	PELOD-2 (score ≥ 8)	pSOFA (score ≥ 2)
Sensitivity	92.9%	35.7%	64.3%	92.9%
Specificity	25.0%	93.8%	68.8%	43.8%
NPV	80.0%	62.5%	68.8%	87.5%
PPV	52.0%	83.3%	64.3%	59.1%
Positive LR	1.238	5.714	2.057	1.651
Negative LR	0.286	0.686	0.519	0.163
Positive PP	52.0%	83.3%	64.3%	59.1%
Negative PP	20.0%	37.5%	31.3%	12.5%

Discussion

In our study, the mean age of subjects who met the SIRS criteria and were treated in the PICU or HCU was 22.22 months (1 year 10 months). The subjects who died had a younger mean age than the survived group (12.61 months *vs.* 30.62 months, respectively). A study in Jakarta stated the same results, which analyzed mortality in pediatric patients with sepsis and found out that the median age of subjects was 15 months (range 2-192) with the highest distribution in the 1 month - 1 year age group (62%).[11] Younger age has been associated with immune system immaturity and is usually accompanied by comorbidities, such as congenital heart disease and kidney disease, thus the incidence of infections that cause sepsis is a factor that increases the risk of mortality.[1,11–13] Also, the *Sepsis Prevalence, Outcomes, and Therapies Study* (SPROUT) conducted in 128 PICUs in 26 countries revealed that patients who met SIRS-severe sepsis criteria based on international consensus had a mean age of 3 years, and the foci of infection were the respiratory system (40%) and bacteremia (19%).[1] In our study, the most common focus of infection was the respiratory system, followed by the central nervous system (CNS) and gastrointestinal (GI) infections. Respiratory tract infection is a major cause of illness and death in infants and children. Environmental factors and highly contagious, air-borne pathogens cause airway infections.[14]

All subjects who died were treated in the PICU with mean LOS of 8.7 days, which was shorter than that of the survived group (11.94 days). This finding was likely due to the fact that PICU patients tend to have more severe clinical conditions than those treated in HCU. Furthermore, patients with severe airway infections generally require invasive breathing support, which is available only in the PICU. In a study validating the PELOD-2 method of the use of mechanical ventilation led to OR of 3.99 (95%CI 2.07 to 7.70) on mortality (P <0.0001).15 A previous study also stated that sepsis increased the risk of death by 18 times compared to non-sepsis patients with infection (OR 18; 95%CI 11 to 28). Most of them died because of sepsis or septic shock (65%), and the course of disease necessitated intensive care unit treatment.[10]

The SIRS criteria (IPSCC 2005) have been used to diagnose sepsis for a long time, but not specific. The components of these criteria were found in >90% of pediatric patients with fever in the emergency room, but in <5% of those who needed intensive care. Tachycardia and tachypnea are among the SIRS criteria often found in mild, non-lethal, viral diseases, thus, the SIRS criteria have a low specificity for identifying the risk of death.[16] In our study, we compared the criteria for severe sepsis with other organ dysfunction criteria and found that PELOD-2 and pSOFA predictive accuracy were better than severe sepsis criteria.

Agyeman *et al.*[17] explained that SIRS conditions with bacteremia increased the risk of death by 1% in the first 30 days, but such risk would increase by 17% if accompanied by organ dysfunction. Hence, the SIRS criteria has been abandoned and replaced by organ dysfunction assessment criteria to assess mortality outcomes in intensive care pediatric patients.

Previous studies have compared SIRS criteria to other sepsis criteria, because the 2005 International Consensus introduced SIRS as a tool for diagnosing sepsis.[18,19] Only a few studies comparing severe sepsis-SIRS criteria due to changes in the definition of sepsis that sepsis is considered equivalent to the diagnosis of severe sepsis according to the old consensus. This current definition was published in sepsis-3.

In our study, the criteria for severe sepsis were not statistically significant (P=0.336) in predicting mortality, although the sensitivity, specificity, NPV, and PPV were 92.9%, 25%, 80.0%, and 52%, respectively. A previous study showed that the criteria for severe sepsis had a 74.5% sensitivity, 42.7% specificity, 96.5% NPV, and 7.4% PPV for predicting mortality. They also noted that the criteria for severe sepsis was not good enough to predict mortality of critically ill children.[19]

We used PELOD-2 score of ≥ 11 based on the consensus guidelines for diagnosis and management of sepsis in children from the *Indonesian Pediatric Association*.[8] We also analyzed the PELOD-2 cut-off score of ≥ 8, since it is commonly used for a comparison in previous studies.[19] To date, there is not a uniform, internationally-recognized, cut-off value for PELOD-2 scores. The initial PELOD-2 validation study found that PELOD-2 scores were significantly higher in non-survivors compared to survivors [mean 14.9 (SD 6.1) *vs.* mean 4.2 (SD 3.2), respectively, P <0.0001].[20] The study showed failure of three organ systems and a mean PELOD-2 score of 7.5 predicted a mortality rate of 7.1%. Whereas failure of three organ

systems and mean PELOD-2 score of 11.5 predicted a mortality rate of 30.5%.[15] A previous study reported that PELOD-2 score of ≥ 8 had sensitivity of 85.0%, while PELOD-2 score of ≥ 11 had sensitivity of 92.6% in the incidence of mortality. Their median PELOD-2 score was significantly higher in the group who died than those who lived (died : survived = 13 : 3; P=0.0001).[20]

We found that PELOD-2 score ≥ 8 lower prognostic value compared to other mortality predictors. Although it was not the best predictor of mortality, PELOD-2 score ≥ 8 was better than severe sepsis criteria based on diagnostic parameters. Both PELOD-2 scores of ≥ 11 and pSOFA scores had advantages in several diagnostic parameters that we analyzed. PELOD-2 score ≥ 11 in our study had the highest specificity and PPV rates of 93.8% and 83.3%, respectively, suggesting the lowest mortality predictor error and highest accuracy of life expectancy, with OR 8.33 (95%CI 0.835 to 83.16). However, this PELOD-2 cut-off was not statistically significant (P=0.072). Schlapbach *et al.*[19] demonstrated good results using PELOD-2 score of ≥ 8 in predicting mortality, with sensitivity, specificity, NPV, and PPV of 88.1%, 55.7%, 97%, and 22.2%, respectively. In addition, study in Indonesia used a PELOD-2 cut-off value of ≥20, and found that such patients had a 7.75 times greater risk of death.[21]

The SOFA, a system for evaluating organ dysfunction, was recommended by the most recent consensus.[6,19] Pediatric SOFA is SOFA with adjustments.[10] The cut-off value in our study was ≥2 as suggested by consensus.[6] Our results showed that pSOFA had advantages in sensitivity, NPV, negative LR, and negative PP than the other tools. The pSOFA was better than other assessment methods, if the aim is to get a more accurate screening result for estimating the risk of death, as pSOFA had the highest odds ratio (OR) value 10.11 (95%CI 1.054 to 97,.002; P<0.05). In contrast, severe sepsis criteria and PELOD-2 scores had a lower risk of mortality and were not statistically significant (P=0.336 and P=0.072, respectively; P> 0.05).

Our result is parallel with that of a previous study which stated that the maximum score of pSOFA (AUC 0.94; 95% CI 0.92 to 0.95) was proportional to PELOD (AUC 0.93; 95% CI 0.91 to 0.95) and PELOD-2 (AUC 0.94; 95% CI 0.92 to 0.95), and better than PMODS (AUC 0.93; 95% CI 0.91 to 0.95) (P<0.001) as a predictor of mortality in patients with sepsis. They also reported that the relationship between pSOFA score on the first day of treatment (AUC 0.88; 95% CI 0.86 to 0.91) and patient mortality was better than the other organ dysfunction assessment systems. It was also proportional to PRISM III (AUC 0.88; 95%CI 0.86 to 0.91). In addition, pSOFA criteria ≥ 2 had an increased risk of death (OR 18; 95%CI 11 to 28), and the most optimal pSOFA cut-off score for predicting mortality was > 8.[10]

A similar study found that pSOFA [(adjusted AUROC 0.892 (range 0.791-0.868)] was statistically significant in assessing mortality outcomes in sepsis patients and even better than PELOD-2 score of ≥8 (AUROC 0.816; 0.777-0.854), qSOFA (AUROC 0.739; 0.695-0.784), and SIRS (AUROC 0.710; 0.664-0.756).[9] Our results suggest that pSOFA and PELOD-2 are better than severe sepsis criteria to predict mortality. This finding may have been related to the examination parameters in pSOFA and PELOD-2, which are better at describing organ function failure than the SIRS method.[19]

Our study had several limitations. The assessment of organ dysfunction was done only once when the patient was admitted to the PICU or HCU. If the patients experienced a worsening of symptoms during the treatment, their scores may have actually gone higher. Also, the study was conducted in two different places (PICU and pediatric HCU), hence, the severity of the disease, environmental factors, and supporting care may have been different. In conclusion, pediatric SOFA (pSOFA) is the best predictor for mortality compared to PELOD-2 and severe sepsis criteria. A positive pSOFA score (pSOFA ≥ 2) increases the risk of death by 10.11 times.

Conflict of interest

None declared.

Funding acknowledgement

The authors received no specific grants from any funding agency in the public, commercial, or not-for-profit sectors.

References

1. Weiss SL, Fitzgerald JC, Pappachan J, Wheeler D, Jaramillo-bustamante JC, Salloo A, *et al.* Global epidemiology of pediatric severe sepsis: The sepsis prevalence, outcomes, and therapies study. Am J Respir Crit Care Med 2015;191:1147-57. DOI: https://doi.org/10.1164/rccm.201412-2323OC.
2. Hartman ME, Linde-Zwirble WT, Angus DC, Watson RS. Trends in the epidemiology of pediatric severe sepsis. Pediatr Crit Care Med 2013;14:686-93. DOI: https://doi.org/10.1097/PCC.0b013e3182917fad.
3. Liu L, Oza S, Hogan D, Perin J, Rudan I, Lawn JE, *et al.* Global, regional, and national causes of child mortality in 2000-13, with projections to inform post-2015 priorities: An updated systematic analysis. Lancet 2015;385:430-40. DOI: https://doi.org/10.1016/S0140-6736(14)61698-6.
4. Schlapbach LJ, Straney L, Alexander J, MacLaren G, Festa M, Schibler A, *et al.* Mortality related to invasive infections, sepsis, and septic shock in critically ill children in Australia and New Zealand, 2002-13: A multicentre retrospective cohort study. Lancet Infect Dis 2015;15:46-54. DOI: https://doi.org/10.1016/S1473-3099(14)71003-5.
5. Kawasaki T. Update on pediatric sepsis : a review. J Intensive Care 2017;5:1-12. DOI: https://doi.org/10.1186/s40560-017-0240-1.
6. Singer M, Deutschman CS, Seymour C, Shankar-Hari M, Annane D, Bauer M, *et al.* The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA 2017;315:801-10. DOI: https://doi.org/10.1001/jama.2016.0287.
7. Plunkett A, Tong J. Sepsis in children. BMJ 2015;7350:3017. DOI: https://doi.org/10.1136/bmj.h3017.
8. Hadinegoro SRS, Chairulfatah A, Latief A, Pudjiadi AH, Karyanti M, Setiabudi D, *et al.* Diagnosis dan tata laksana sepsis pada anak. Jakarta: Badan Penerbit IDAI; 2016. p.1-9.
9. Goldstein B, Giroir B, Randolph A. International Pediatric Sepsis Consensus Conference: Definitions for sepsis and organ dysfunction in pediatrics*. Pediatr Crit Care Med 2005;6:2-8. DOI: https://doi.org/10.1097/01.PCC.0000149131.72248.E6.
10. Matics TJ, Sanchez-Pinto LN. Adaptation and validation of a pediatric sequential organ failure assessment score and evaluation of the Sepsis-3 definitions in critically ill children. JAMA Pediatr 2017;60611:1-9. DOI: https://doi.org/10.1001/jamapediatrics.2017.2352.
11. Saraswati DD, Pudjiadi AH, Djer MM, Supriyatno B, Syarif DR, Kurniati N. Faktor risiko yang berperan pada mortalitas sepsis. Sari Pediatr 2014;15:281-8.
12. Rusmawatiningtyas D, Nurnaningsih N. Mortality rates in pediatric septic shock. Paediatr Indones 2017;56:304. https://doi.org/10.14238/pi56.5.2016.304-10.
13. Mathias B, Mira JC, Larson SD. Pediatric sepsis. Wolters Kluwer Heal. 2016;28:1-8. DOI: https://doi.org/10.1097/MOP.0000000000000337.
14. Everard ML. Paediatric respiratory infections. Eur Respir Rev 2016;25:36-40. DOI: https://doi.org/10.1183/16000617.0084-2015.
15. Leteurtre S, Duhamel A, Salleron J, Grandbastien B, Lacroix J, Leclerc F. PELOD-2: An update of the pediatric logistic organ dysfunction score. Crit Care Med 2013;41:1761-73. DOI: https://doi.org/10.1097/CCM.ObOI.
16. Scott HF, Deakyne SJ, Woods JM, Bajaj L. The prevalence and diagnostic utility of systemic inflammatory response syndrome vital signs in a pediatric emergency department. Acad Emerg Med 2015;22:382-9.
17. Agyeman PKA, Schlapbach LJ, Giannoni E, Stocker M, Posfay-Barbe KM, Heininger U, *et al.* Epidemiology of blood culture-proven bacterial sepsis in children in Switzerland: a population-based cohort study. Lancet Child Adolesc Heal 2017;1:124-33. DOI: https://doi.org/10.1016/S2352-4642(17)30010-X.
18. Raith EP, Udy AA, Bailey M, McGloughlin S, MacIsaac C, Bellomo R, *et al.* Prognostic accuracy of the SOFA score, SIRS criteria, and qSOFA score for in-hospital mortality among adults with suspected infection admitted to the intensive care unit. JAMA - J Am Med Assoc 2017;317:290-300. DOI: https://doi.org/10.1001/jama.2016.20328.
19. Schlapbach LJ, Straney L, Bellomo R, Maclaren G, Pilcher D. Prognostic accuracy of age-adapted SOFA, SIRS, PELOD -2, and qSOFA for in-hospital mortality among children with suspected infection admitted to the intensive care unit. Intensive Care Med 2018;44:179-88. DOIhttps://doi.org/10.1007/s00134-017-5021-8.
20. Leteurtre S, Leclerc F, Duhamel A, Deken V, Grandbastien B, Biarent D, *et al.* Groupe Francophone de Reanimation et Urgences Pediatrques (GFRUP). Can the pediatric logistic organ dysfunction (PELOD)-2 score on day 1 be used in clinical criteria for sepsis in children? Pediatr Crit Care Med 2017;18:758-63. DOI: https://doi.org/10.1097/PCC.0000000000001182.
21. Bramantyo TB, Martuti S, Salimo H. Perbandingan prediktor mortalitas skor PRISM III dan PELOD 2 pada anak sakit kritis non bedah. Sari Pediatr 2018;19:284. DOI: https://doi.org/10.14238/sp19.5.2018.284-9.