

# Comparison of the Effectiveness of Sequential Organ Failure Assessment (SOFA) and Quick Sequential Organ Failure Assessment (qSOFA) in Predicting Mortality in Secondary Non-Traumatic Peritonitis Patients

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# Abstract

**Introduction**. Peritonitis has a high mortality rate, SOFA is a scoring system that represents 6 organ functions namely respiration, blood coagulation, liver, cardiovascular, Central Nervous System, and Kidney the higher the SOFA score the higher the possibility of mortality, qSOFA is a new scoring , practical and has a strong predictive value.

**Method.** This study was a diagnostic study in the form of a suitability test to assess the sensitivity, specificity, PPV and NPV, cut of points and the suitability of the SOFA and qSOFA scoring systems in predicting outcomes of patients with secondary peritonitis in RSMH Palembang.

**Results.** Data processing was performed on 27 study subjects during November 2017-June 2018. SOFA prognosis test results with a cut-off point >5 obtained a sensitivity of 84.2%, 100% specificity, PPV 73.68%, NPV 100%, prognosis test results qSOFA with a cut off point> 2 Obtained a sensitivity of 91.7%, specificity of 100%, PPV 91.66%, NPV 80%,

**Conclusion**. The qSOFA scoring system was more efficient than SOFA in predicting mortality **Keywords: Peritonitis, SOFA, qSOFA, cut-off point, sensitivity, specificity** 

## Introduction

Peritonitis is inflammation that occurs in the serous membrane lining the abdominal cavity and the organs contained in it.<sup>1</sup> Peritonitis is one of the serious infection problems that must be

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faced by the surgeon. Progress in establishing diagnosis, surgery, antimicrobial therapy, and intensive care must be understood by any surgeon because it is still a potentially fatal condition.<sup>2</sup>

Based on the source and occurrence of microbacterial contamination, peritonitis can be classified as primary, secondary, and tertiary. Primary peritonitis is defined as a monomicrobial infection of the peritoneal fluid without visceral perforation and often the source of infection comes from extra peritoneal. Secondary peritonitis is a peritoneal infection with sources originating from intra-abdominal and usually as a result of hollow viscera perforation, and is the most common type of peritonitis. Tertiary peritonitis arises accompanying secondary peritonitis therapy and is the result of a failure of the host's inflammatory response or a superinfection.<sup>2,3</sup>

Secondary peritonitis is due to contamination originating from a visceral in the peritoneal cavity. Most of these peritonitis results from primary lesions in the gastric, duodenal, small intestine, colon and appendix. <sup>1,2,3</sup> Because peritonitis is a broad spectrum disease, so it has a mortality of 10 - 40%. This mortality rate is related to the location of the lesion; perforation of duodenal ulcer and appendix is usually low between 0-10%, intestinal perforation and the biliary tract system by 20-40%, while due to leakage of anastomosis reaches 30%. Some conditions can significantly affect the prognosis, such as when it occurs in old age, usually accompanied by malfunctioning of the kidneys, lungs or heart, malignancy and diabetes mellitus. This situation increased the mortality rate by 3 times. 2,3. In intra-abdominal infections and severe peritonitis the mortality mortality increases to 30-50% and if it develops into sepsis, SIRS, multiple organ damage the mortality increases to 70%, in cases of secondary peritonitis more than 80% of deaths are accompanied by infection.<sup>1</sup>

Despite significant progress in establishing the diagnosis, the application of modern complex therapies (surgery, antibiotics, immunotherapy), safe anesthesia and efficient reanimation measures, secondary peritonitis is still a difficult problem in modern surgery. Secondary peritonitis can describe a form of severe intraabdominal infection and causes of systemic inflamatory response syndrome (SIRS), sepsis shock, and multi organ failure syndrome (MOF), and still has a high mortality rate and is often accompanied by severe postoperative complications.<sup>2</sup>

The risk of postoperative morbidity and mortality can be predicted using multiple scoring. This scoring system can also be used as an audit of surgical procedures and the quality of clinical examinations of surgeons, hospitals, and different countries.<sup>4</sup> An early and objective classification



of the level of secondary peritonitis can assist the surgeon in predicting secondary peritonitis mortality. It is also important to assess the effectiveness of different therapeutic regimens, determine patients who need more aggressive surgical treatment, and assist in giving informed consent to the patient's family more objectively.<sup>5</sup>

In the last 40 years, scoring systems for predicting mortality in critical patients have been made and developed. Although designs are made for general application, some of them prove to be specifically useful in patients with abdominal sepsis.<sup>6</sup> In particular, the prognosis of secondary peritonitis is difficult to evaluate because many factors influence it such as patient health, etiological variation, type of therapy, and differences in determining scoring system criteria and definitions.<sup>7</sup>

The problems of managing secondary peritonitis in Indonesia itself are still very varied, and all still depend on geographical conditions, the availability of health workforce resources, facilities and infrastructure of health service facilities, and the health financing system, including the health insurance system. In addition there are no guidelines for managing secondary intraabdominal infection patients that are enforced nationally, and there are still many differences in the management of secondary intraabdominal infection management between divisions, resulting in delays in referral, late diagnosis, inaccurate therapy, and limitations of hospital facilities that differ from each hospital level. <sup>8</sup>

Until now, there was no ideal scoring system yet to be used in patients and its implementation require very expensive costs. One of the scoring systems most widely used in various flashlights, including at Mohammad Hoesin's hospital is Sepsis-related organ failure assessment (SOFA). The scoring system was created and developed since 1978, and continues to be developed from APACHE to APHACHE IV. The APACHE II score is calculated by combining 12 acute physiological variables with age and chronic health status within the first 24 hours after ICU admission, so it is an initial stratification for risk factors and prediction of patient prognosis. The weakness of this scoring system is complicated and wasting time. Also, it may not be applicable at all levels of the hospital.<sup>9</sup>

In 1994, a scoring system emerged that could evaluate the state of the patient while in the intensive care room. This score system is called the Sepsis-related organ failure assessment (SOFA) score. This score is useful for assessing the state of a patient's organ system and can predict



whether organ system failure has occurred. This score assesses the respiratory, cardiovascular, hepatic, blood, kidney and nerve coagulation systems. This scoring can estimate the risk of morbidity and mortality due to sepsis.<sup>10</sup>

Over the years, medical staff especially surgeons have found it difficult to use SOFA scoring because the scoring system still uses laboratory support, especially to assess the hepatic and coagulation system.<sup>11</sup> In 2016, the Sepsis-3 group introduced a new system, the Quick Sequential Organ Failure Assessment (qSOFA) which only simplifies SOFA scores into 3 assessment criteria, namely blood pressure, respiratory rate, and level of consciousness using the Glasgow Coma Scale (GCS). <sup>12</sup> qSOFA has a simpler assessment than before but stated evaluation of accuracy similar to SOFA. To test the predicted value of SOFA and qSOFA especially in the Surgery department of the Mohammad Hoesin Hospital in Palembang, research was needed that compares the predicted values between the SOFA and qSOFA scoring systems in predicting the mortality rate of patients with an intraoperative diagnosis of non-traumatic secondary peritonitis.

## Methods

This study was an observational analytic study with a cross sectional approach in the form of diagnostic tests to predict SOFA and qSOFA scoring systems in non-traumatic secondary peritonitis cases. Twenty-seven research subjects were patients at the Dr Moh Hoesin Hospital General Hospital, Palembang, who met the inclusion and exclusion criteria. The inclusion criteria were patients with a diagnosis of non-traumatic secondary peritonitis who agreed to participate in the study and were older than 14 years. Exclusion criteria were complications and primary peritonitis was found in intraoperative findings. This study was approved by the ethics committee of the Faculty of Medicine, Universitas Sriwijaya (No 235 / kptfkunsri-rsmh / 2017).

To see the effectiveness of the mortality prediction score of qSOFA against SOFA mortality prediction, with the help of SPSS 24 software, 2x2 contingency matrix tables are used to obtain sensitivity-specificity numbers, positive predictive values, and negative predictive values, and these numbers will be included in the Receiver curve analysis. Operating Characteristics (ROC) where the areas under the curve (area under the curve / AUC) of the two diagnostic tests will be compared with each other.



Based on table 1, it is obtained from 27 respondents that the postoperative diagnosis can be grouped into 12 groups namely necrotic pancreas with sepsis shock 2 respondents (7.4%), necrotic jejunum with 1 respondent sepsis shock (3.7%), gastric perforation with shock sepsis 2 respondents (7.4%), adhesive with appendicitis 7 respondents (25.9%), gastric perforation 3 respondents (11.1%), duodenal perforation part 1 + post laparatomy exploration + primary suture duodenum + omental patch 1 respondent (11.1%) 3.7%), ileum perforation + pulmonary tb 1 respondent (3.7%), pre pyloric gastric perforation + sepsis shock + anemia 3 respondents (11.1%), pre pyloric gastric perforation + sepsis shock + ckd stage v on hd + ht + dm 2 respondents (11.1%), pre-pyloric gastric perforation + septic shock + aki stage iii 1 respondent (3.7%), app. perforation + anemia + hypoalbuminemia 3 respondents (11.1%) and leakage anastomosis jejunoileal 1 respondent (3.7%). from the above data it is known that the most postoperative diagnosis is adhesive with appendicitis.

Characteristics	Amount (n)	Percentage (%)
Sex		
Male	19	70,4
Female	8	29,6
Age		
18-25 years old (early adulthood)	1	3,7
25-65 years old (late adulthood)	19	70,4
>65 years old (elderly)	7	25,9
Post operation diagnosis		
Necrotic Pancreas + Septic Shock	2	7.4
Necrotic Jejunum + Septic Shock	1	3.7
Gastric perforation + Septic Shock	2	7.4
Adhesive + Appendicitis	7	25.9
Gastric perforation	3	11.1
Duodenum Perforation Part 1 + Post Laparotomy Exploration + Suture Primer Duodenum + Omental Patch	1	3.7

 Table 1. Subject Characteristics

SRIWIJAYA JOURNAL OF SURGERY STS Ileum Perforation + lung tuberculosis 3.7 1 Gastric Perforation Pre Pyloric + Septic Shock + 3 11.1 Anemia Gastric Perforation Pre Pyloric + Septic Shock + 2 7.4 CKD Stage V On HD + HT + DM

Gastric Perforation Pre Pyloric + septic shock +	1	3.7
AKI Stage III		
Perforation App. + Anemia + Hypoalbuminemia	3	11.1
Leakage Anastomosis Jejunoileal	1	3.7

Based on the ROC analysis in this study it was found that the optimal score for guessing death was in the upper left area and far from the diagonal line. From the following figure it appears that the ROC curve for Q SOFA scoring has an optimal cut of point.



Gambar 1 Kurva ROC Untuk Uji Q SOFA

	Table 2.	Under The Ci	urve Area for QSO	FA Scoring
Area	Std.	Asymptotic	Asymptotic 95% C	Confidence Interval
Агеи	Error <sup>a</sup>	Sig. <sup>b</sup>	Lower Bound	Upper Bound
.972	.033	.000	.907	1.000

# Table 3. ROC Curve Coordinate for Q SOFA Scoring

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No	Positive if Greater Than or Equal To <sup>a</sup>	1 - Specificity	Sensitivity	spesificity
1	-1.00	1.000	1.000	0.000
2	0.50	0.667	1.000	0.333333333333333333
3	1.50	0.000	0.917	1.000
4	2.50	0.000	0.167	1.000
5	4.00	0.000	0.000	1.000



Figure 2. Sensitivity and Specificity Curve For Q SOFA Test

Based on the ROC curve , the Area Under Curve (AUC) value is 0.972 with a P value of sig <0.001 and 95% Confidence Interval from 0.907 to 0.1000. In the above ROC curve the cutpoint value of Q SOFA score is obtained at 1.50 or in other words the Q SOFA score  $\geq 2$  with a sensitivity value of 91.7% and specificity of 100%.

Based on ROC analysis, it is found that the optimal score for predicting death is in the upper left area and away from the diagonal line. From the following figure it appears that the ROC curve for SOFA scoring has an optimal cut of point.



Figure 3. ROC Curve for SOFA test

Table 4.	Under The	e Curve Area for	SOFA Scoring	
	Std.	Asymptotic	Asymptotic 95% Co	onfidence Interval
Area	Error <sup>a</sup>	Sig. <sup>b</sup>	Lower Bound	Upper Bound
1.000	0.000	0.000	1.000	1.000

Table 5. ROC Curve Coordinate for SOFA Scoring

NO	Positive if Greater Than or Equal To <sup>a</sup>	1 - Specificity	Sensitivity	Specificity
1	0.00	1.000	1.000	0.000
2	1.50	0.750	1.000	0.250
3	2.50	0.125	1.000	0.875
4	3.50	0.000	1.000	1.000
5	4.50	0.000	0.842	1.000
6	5.50	0.000	0.684	1.000
7	6.50	0.000	0.579	1.000
8	7.50	0.000	0.421	1.000
9	8.50	0.000	0.263	1.000
10	9.50	0.000	0.211	1.000

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	11	11.50	0.000	0.105	1.000
	12	14.00	0.000	0.053	1.000
	13	16.00	0.000	0.000	1.000



Figure 4. Sensitivity and Specificity Curve for SOFA Test

Based on the roc curve above, the area under curve (AUC) value of 1,000 with a p value of sig <0.001 and 95% confidence interval 1,000 - 1,000. In the roc curve above the cut value of the SOFA score is obtained at 4.50 or in other words the SOFA score  $\geq$  5 with a sensitivity value of 84.2% and specificity of 100%.

From 27 respondents, it was found that QSOFA respondents were grouped into 2 criteria, those were respondents with Q SOFA score 0-1 and respondents with Q SOFA score 2-3 had 2 outcome criteria, namely life and death. Obtained validity data and predictive validity data are as follows:

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		<b>Respondent Outcome</b>		T-4-1
		Died Alive		1 otal
	2-3	11	1	12
Q SOFA Score	0-1	3	12	15
	Total	14	13	27

 Table 6. Q SOFA Measuring Instrument Validity

From 27 respondents, it was obtained SOFA respondents who are grouped into 2 criteria: respondents with SOFA scores 0 and respondents with SOFA Q scores 1-24 have 2 outcome criteria, namely life and died. validity data and predictive validity data were obtained as follows:

		Respondent Outcome		Total
		Died Alive		
	4-24	14	5	19
SOFA				
Score	1-3	0	8	8
	Total	14	13	27

 Table 7. SOFA Measuring Instrument Validity

Based on this information, it can be concluded that SOFA as a measuring tool to assess patient outcomes has a high predictive validity because it has a high positive predictive value and a negative predictive value that is close to 100% with a positive predictive value score of 73.68% and a score of negative predictive value 100%.

Because the positive predictive value and negative predictive value are influenced by the prevalence of the disease. These two values will be different if done in populations with different prevalence. Therefore, we need a diagnostic parameter that is not affected by prevalence. The parameter that is not affected by prevalence is disease is a positive likelihood ratio (RKP) and a negative likelihood ratio (RKN). In general, RKP values > 10 and RKN values below 0.1 are considered to have good diagnostic values. In this study, the obtained data show that the value of



the RKP (Positive Likelihood Ratio) scoring SOFA 0 and the value of the RKN (Negative Likelihood Ratio) 0, then it could be concluded that the SOFA scoring has a diagnostic value that is less good for the sample of research respondents.

Based on the Pearson correlation test data obtained that the value of sig = 0,000 which means there is a difference between SOFA and QSOFA in the effectiveness of predicting the mortality of patients with a diagnosis of secondary peritonitis who are treated in the Surgery Section of Muhammad Hoesin Hospital Palembang. With a correlation coefficient of -0.740, it means it has a negative correlation stroke, which means there is no correlation between Q SOFA and SOFA scoring in predicting the mortality of patients with a diagnosis of intra operatic secondary peritonitis at Muhammad Hoesin Hospital Palembang.

#### Discussions

Based on this information, it can be concluded that SOFA Q as a measure to assess patient outcomes has a high predictive validity because it has a high positive predictive value and a negative predictive value that is close to 100% with a positive predictive value (NPP) score of 91.66% and negative predictive value (NPN) score of 80%. Because the positive predictive value and negative predictive value are influenced by the prevalence of the disease. These two values will be different if done in populations with different prevalence. Therefore, we need a diagnostic parameter that is not affected by prevalence. The parameter that is not affected by prevalence is disease is a positive likelihood ratio (RKP) and a negative likelihood ratio (RKN). In general, RKP values> 10 and RKN values below 0.1 are considered to have good diagnostic values. In this study, data were obtained that the RKP value (positive possible ratio) was 10.20 and the RKN value (negative probability ratio) was 0.23, so it was concluded that the SOFA Q score had a good diagnostic value.

Based on this information, it can be concluded that SOFA as a measuring tool to assess patient outcomes has a high predictive validity because it has a high positive predictive value and a negative predictive value that is close to 100% with a positive predictive value (NPP) score of 73.68% and a score of negative predictive value (NPN) 100%. because the positive predictive value and negative predictive value are influenced by the prevalence of the disease. These two values will be different if done in populations with different prevalence. Therefore, we need a



diagnostic parameter that is not affected by prevalence. The parameter that is not affected by prevalence is disease is a positive likelihood ratio (RKP) and a negative likelihood ratio (RKN). In general, RKP values> 10 and RKN values below 0.1 are considered to have good diagnostic values. In this study the data obtained that the value of the RKP scoring SOFA 0 and the value of the RKN 0 then concluded that the SOFA scoring has a diagnostic value that is less good for the sample of research respondents.

From the research it was found that the SOFA Q score had a high predictive validity with a positive predictive value (NPP) score of 91.66% and a negative predictive value (NPN) score of 80% and a cut of point Q SOFA score obtained at a value of 1.50 or with in other words the Q SOFA score  $\geq 2$  with a sensitivity value of 91.7% and specificity of 100%. The study also found that the SOFA score had a positive predictive value (NPP) score of 73.68% and a negative predictive value (NPN) score of 100% with a cut-point score of the SOFA score at 4.50 or in other words the SOFA score  $\geq$  5 with sensitivity value 84.2% and specificity 100%. This is in accordance with a study conducted from a cohort study of 148,907 patients with suspected infections with 6,347 patients in ICU deceased with qSOFA (AUROC = 0.66: 95% CI, 0.64-0.68) and SOFA (AUROC = 0, 74; 95% CI0.73-0.76), and among 6652 suspect patients treated for 1886 patients died outside the ICU obtained qSOFA (AUROC = 0.81; 95% CI 0.80-0.82) where qSOFA had a higher predictive validity than SOFA (AUROC = 0.79.95% CI. 0.78-0.80). qSOFA with a score of  $\geq$  2 has a mortality rate of 3-14 times higher than a score of less than 2.<sup>12.17</sup> Jun Yu Wang et al in Beijing, using q-SOFA as a scoring system in assessing mortality predictions in 477 patients for 28 days clinically suspected of infection in Emergencies and compare these scores with SOFA, MEDS, and APACHE II. From this study it was found that qSOFA had similarities in predicting the mortality of patients with SOFA, (AUROC SOFA 0.682) and (AUROC qSOFA 0.636). And there is no significant difference with MEDS and APACHE II. In patients with qSOFAcut of point 2, the mortality rate of patients with a score <2 was 17.4% and the mortality for the score  $\geq$  2 was 42.9% .16.17

# Conclusions

The qSOFA scoring system is more efficient than SOFA in predicting mortality.

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