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The role of I-FABP in predicting mortality risk in patients with multiple organ dysfunction `

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Abstract

Background/Objectives. Multiple organ dysfunction syndrome (MODS) is a critical condition frequently associated with sepsis and carries high mortality. Recent studies have highlighted the role of intestinal barrier disruption as a key contributor to systemic inflammation and organ failure. Identifying reliable biomarkers for early detection of gut injury may enhance risk stratification and improve outcomes in critically ill patients. **Methods.** In this prospective study, was analyzed serum levels of intestinal fatty acid-binding protein (I-FABP), regenerating islet-derived protein 3 alpha (REG3α), soluble CD14 subtype (sCD14-ST), lipopolysaccharide-binding protein (LBP), and zonulin in 227 patients with MODS and 100 controls without MODS. Organ dysfunction severity was assessed using APACHE II and SOFA scores. Statistical analyses included ROC curve analysis, Kruskal–Wallis tests, and logistic regression modeling. **Results.** Patients with MODS had significantly higher levels of all studied biomarkers compared to controls. I-FABP lev-els positively correlated with SOFA and APACHE II scores. ROC analysis identified an I-FABP threshold of 120.7 pg/mL as optimal for mortality risk stratification (sensitivity: 54.9%, specificity: 84.9%). Logistic regression confirmed I-FABP and APACHE II as independent predictors of mortality. A predictive model incorporating both variables demonstrated an overall accuracy of 84.3%, with 71.3% accuracy for deceased patients. An online calculator (LOP-MODS) was developed to facilitate bedside application. **Conclusions.** I-FABP is a promising early biomarker for predicting outcomes in patients with MODS. Its integration with clinical scoring systems like APACHE II may enhance prognostic accuracy and guide timely interventions in critical care set-tings. Registration of the Clinical Trial. This study was registered on the ClinicalTrials.gov website. The unique research registration identification number (UIN) is NCT06221293. Link: https://ichgcp.net/clinical-trials-registry/NCT06221293

Keywords: multiple organ dysfunction syndrome (MODS); intestinal barrier; I-FABP; biomarkers; APACHE II; intestinal permeability; mortality prediction

1 Introduction

Multiple organ dysfunction syndrome (MODS) is one of the main causes of death in intensive care patients. The American College of Chest Physicians (ACCR) and the Society of Critical Care Medicine (SCCM) define multiple organ dysfunction syndrome as an acute

malfunction of several organs at once, as a result of which the body is unable to restore homeostasis without external intervention [9]. The main methods for diagnosing MODS and assessing the severity of the patient's condition are the APACHE II (Acute Physiology And Chronic Health Evaluation) and SOFA (Sequential Organ Failure Assessment) scales [27,18, 15, 13].

The mechanism of organ damage is associated with impaired tissue perfusion, resulting in ischemia, edema, increased levels of oxygen free radicals, and systemic in-flammation. Based on previous studies, one of the main causes and consequences of the development of multiple organ insufficiency is enterocyte apoptosis, resulting in a disruption of the intestinal barrier and the occurrence of bacterial translocation [5, 27, 11]. In addition to disruption of the barrier function, the intestinal microbiome itself is depleted, and the "innate" human immunity is reduced. Intraabdominal pressure also contributes to the organization of bacterial penetration into the blood, which exacerbates the situation and further disrupts the barrier function of the intestine [31]. Pathological bacteria, after having entered the bloodstream, cause a series of chain reactions, as a result of which the systemic inflammatory response is aggravated. Recently, research on diagnostic methods for determining bacterial translocation in patients with multiple organ dysfunction has become relevant for the scientific community. The original APACHE scale, created in 1985, included an assessment of the gastrointestinal tract using amylase, albumin, alkaline phosphatase, total bilirubin, and ASAT indicators in the subgroup of physiological criteria. However, as can be seen, markers indicating the presence of bacterial translocation and the state of intestinal barrier function were not included. Later, the scale was slightly simplified by eliminating the assessment of the gastrointestinal tract and adding only an assessment of an additional score for stress bleeding. The MODS and SOFA scales initially did not include an assessment of the gastrointestinal tract [23, 22]. One of the promising diagnostic methods today is to determine the level of biomarker of intestinal wall damage, I-FABP (Intestinal Fatty Acid-Binding Protein), in blood serum [20]. In some studies, the fact of an increase in the level of I-FABP in the blood serum has been proven in response to a violation of the integrity of the intestinal wall [4,18]. However, it is still debatable whether it is advisable to determine I-FABP in blood serum in order to differentiate the degree of intestinal ischemia and the specific location of ischemia [6].

The purpose of this study is to determine the degree of significance of the predictive role of the biomarker of intestinal wall permeability disruption, I-FABP, and to create a mathematical model and calculator for predicting a fatal outcome in patients with multiple organ dysfunction, where an indicator of intestinal barrier function disruptions is included.

2 Materials and Methods

This study is a prospective simple comparative clinical trial. The blood serum of patients in intensive care units was used as biological material. Sampling of the material was carried out in 4 clinics in Karaganda. The enzyme immunoassay of the material was carried out at the Scientific Research Laboratory of the Institute of Life Sciences (SRL IoLS). 327 patients were examined during the period 2023-2025 and divided into two groups, i.e. the main group of 227 people with MODS and the control group of 100 people without MODS.

In order to determine the level of the I-FABP biomarker, venous blood was taken on the day of the patient's admission to the hospital and on days 3 and 7, according to all generally accepted standards. The APACHE II and SOFA scores were calculated on the day of the patient's admission and on days 3 and 7. In patients from the control group, the determination of the level of the I-FABP biomarker in the blood serum, as well as as-sessment as per the APACHE II and SOFA scales, was carried out only on the day of admission to the hospital. The prepared blood serum was examined for the presence of the I-FABP biomarker using a

commercial human blood test kit with microplates, ELISA Kit for Fatty Acid Binding Protein 2 Intestinal (FAB2, Human).

2.1 Statistical Methods

The STATISTICA 8.0 software was used to calculate statistical data. The median (Me) and upper and lower quartiles (Q1-Q3) were calculated for each patient's I-FABP bi-omarker values. Given the abnormal distribution of quantitative data, the Mann-Whitney test was used for nonparametric data. For qualitative variables, Fisher's exact test and $\chi 2$ test were used. The ROC (receiver-operating–characteristics) analysis with AUC deter-mination (area under the curve) and Youden-Index (determination of the optimal misfire, balance between sensitivity and specificity) were used to assess the diagnostic accuracy of the I-FABP biomarker. The significance of the results was determined if $p<0.05$.

2.2 Calculation of the Risk of a Fatal Outcome

To build a mathematical model in order to predict the development of the risk of a fatal outcome, the regression analysis was used in the SPSS software; the probability of a fatal outcome was calculated using the following formula:

$$p=1/(1+e-z), \quad (1)$$

where, e is the base of natural logarithms = 2.71;

$$z = b1 \bullet X1 + b2 \bullet X2 + a, \quad (2)$$

X are the values of independent variables (in our case, APACHE II score and the I-FABP level in blood serum), b are coefficients, the calculation of which is the task of binary logistic regression, and a is a certain constant, which is also calculated during binary logistic regression. The values of coefficients b1 and b2 and constant a for calculating the probability of a fatal outcome are obtained as a result of regression analysis, therefore allowing us to obtain the equation of binary logistic regression. If the value for p is less than 0.5, then it can be assumed that the event will not occur (the patient will survive), otherwise, it is assumed that the event will occur (fatal outcome).

In order to verify the model that was most effective in terms of predicting the risk of death, validation was performed by dividing the total number of subjects into two groups: training (80%) and validation (20%) using the SPSS program. Following model validation. A decision tree analysis and heatmap visualization were performed to further explore variable interactions and identify critical thresholds associated with patients outcomes.

3 Results

In the main group, patients were diagnosed with multiple organ dysfunction using the SOFA (Sequential Organ Failure Assessment) and APACHE II (Acute Physiology and Chronic Health Evaluation II) scales. The control group had no signs of MODS, and the patients of the control group stayed in various departments, depending on the relevant pathology, based on which they had been admitted to the hospital.

The general characteristics of the patients in the main and control groups are presented in Table 1. There were no significant differences in gender, age, and concomitant pathology in the control and main groups (p=0.672, p=0.133, p=0.441).

Table 1 Characteristics of patients in the main and control groups

Indicators		Group		Total	p
		1	2		
Gender	Male	117 (51.5%)	49 (49%)	166 (50.8%)	0.672
	Female	110 (48.5%)	51 (51%)	161 (49.2%)	
Age		23-91	18-95		0.133
Surgical intervention	Yes	124 (54.6%)	53 (53)%	54.1%	0.004
	No	103 (45.4%)	47 (47%)	150 (45.9%)	
Related	No	48 (21.1%)	25 (25%)	73 (22.3%)	0.441
	Yes	179 (78.9%)	75 (75%)	254 (77,7%)	

The control and main groups included patients with both surgical and therapeutic pathologies. Therapeutic patients (n=86 in the main group, n=42 in the control group) were diagnosed with diseases of the cardiovascular system (coronary artery disease, hypertension, cardiac arrhythmias), pneumonia, acute cerebral circulatory disorders, or hepatic cirrhosis. Surgical pathologies (n=141 in the main group, n=58 in the control group), i.e. complications of peptic ulcer, severe acute or necrotizing pancreatitis, acute cholecystitis, acute appendicitis, intraabdominal infection, constricted hernia, acute intestinal obstruction (AIO), wound infection, urinary tract infection, or malignant neoplasms.

The mortality rate was 44.9% (102 people) in the main group and 0% in the control group. The number of operated patients is 124 (54.6%) in the main group and 53 (53)% in the control group, which is a statistically significant criterion and shows that both groups have almost the same number of operated patients.

Table 2 The number of patients with different pathologies in the main and control groups

Diagnosis	**Group**		**Total**
	main	**control**	
Pneumonia	21 (9.3%)	10 (10%)	31 (9.5%)
Coronary heart disease	24 (10.6%)	13 (13%)	37 (11.3%)
Gastrointestinal ulcers	20 (8.8%)	10 (10%)	30 (9.2%)
ACVA	21 (9.3%)	9 (9%)	30 (9.2%)
Pancreatitis	20 (8.8%)	2 (2%)	22 (6.7%)
Cancer	23 (10.1%)	11 (11%)	34 (10.4%)
Peritonitis/abdominal abscesses	19 (8.4%)	11 (11%)	30 (9.2%)
Soft tissue infections	20 (8.8%)	10 (10%)	30 (9.2%)
Hernias/AIO (non-neoplastic)	20 (8.8%)	4 (4%)	24 (7.3%)
Kidney diseases	19 (8.4%)	10 (10%)	29 (8.9%)
Cirrhosis/hepatitis	20 (8.8%)	10 (10%)	30 (9.2%)
Total	227 (100%)	100 (100%)	327 (100%)

3.1 Calculation of the risk of a fatal outcome in patients with MODS, taking into account the I-FABP biomarker being studied. The odds ratio.

Previously, our team published a study on the role of I-FABP, REG3a, sCD14-ST, and LBP biomarkers in patients with MODS. The level of all markers in the control group was significantly lower than in the main group ($p<0.0001$). When studying the dynamics of indicators on days 1, 3, and 7 in the main group I-FABP biomarker was significantly higher in patients with MODS ($p=0.010$) [19].

To assess the prognostic significance, the ideal threshold value of the I-FABP bi-omarker among the patients being studied was >120.7 ($p=0.003$), and the odds ratio was further calculated and amounted to 2.15 (95%CI: 1.26-3.68, $p=0.005$). This indicates a 2.15-fold increased risk of a fatal outcome in patients with MODS if the value of the I-FABP biomarker in the blood serum is above the threshold level. The ideal threshold value for the APACHE II and SOFA scales was also set and amounted to scores >15 and > 5, re-spectively ($p<0.0001$, $p<0.0001$). Based on the sensitivity of the I–FABP biomarker and the APACHE II and SOFA diagnostic in patients at high risk of mortality, models for pre-dicting a fatal outcome were created. According to Table 3, the highest chances of pre-dicting a fatal outcome were found in the model of APACHE II score >15 + SOFA score >5 + I-FABP >120.7 pg/mL (OR = 7.71, $p =0.0001$).

Table 3 Lethal outcome prediction models

Predicting models	Odds ratio	95% confidence interval	p-level
I-FABP >120.7 pg/mL	2.15	1.26-3.68	0.005
SOFA score >5 + I-FABP >120.7 pg/mL	6.27	2.92-13.46	0.0001
APACHE II score >15 + SOFA score >5 + I-FABP >120.7 pg/mL	7.71	3.23-18.39	0.0001
APACHE II score >15 + I-FABP >120.7 pg/mL	5.34	2.74-10.42	0.0001

3.2 Regression Analysis of Lethal Outcome Prediction Models in Hospitalized Patients.

Given that not all patients admitted to the hospital immediately experience multiple organ dysfunction, a general analysis of both (main and control) groups was conducted to identify the most accurate model for fatal outcome prediction. To assess the prognostic significance of the intestinal permeability marker I-FABP and the APACHE II scale as the most successful model, a logistic model was built that included 327 patients. The patients were randomly distributed into 80% to 20% samples, which, according to calculations, accounted for 261 observations in the training group and 66 in the validation sample.

For all hospitalized patients (with and without MODS):

$$z = -5{,}102 + 0.002 \bullet (\text{I-FABP blood serum level}) + 0{,}273 \bullet (\text{APACHE II score}) \quad (3)$$

If the value for p is less than 0.5, then it can be assumed that the event will not occur (the patient will survive), otherwise, it is assumed that the event will occur (fatal outcome).

The logistic regression performed on the training sample demonstrated high classification accuracy (84.3%) and acceptable explanatory ability of the model (Nagelkerke R2=0.587). The most significant predictive factor was the APACHE II variable (Exp(B)=1.314, p<0.001). The I-FABP variable was statistically significant, but weak (Exp(B)=1.002, p=0.024). The model showed a good balance between sensitivity and specificity, but the indicators worsened in the validation sample.: The sensitivity decreased to 53.3%, and the accuracy of the mortality forecast decreased to 40%. The F1 score was 0.457, and the area under the ROC curve was 0.733, which corresponds to the moderate quality of the model. Consequently, validation has shown that although the model is statistically significant and sensitivity and specificity correlate well in the training sample, its generalizing ability is limited.

In order to deepen the analysis and identify the nature of the interaction between I-FABP and APACHE II, the decision tree and heat map methods were additionally applied. It was decided to build a decision tree with a minimum node size of 20, which revealed a critically important cluster of patients with the highest risk of death: with APACHE II by more than 15 points and I-FABP > 120.7 pg/ml. With this combination, the risk of death reached 77%, which significantly increased the baseline mortality in the group with I-FABP>120.7 pg/ml. These data complement and strengthen the results of the logistic model, which, although it showed a statistically significant interaction of variables (p=0.037), but with minimal clinical effect (Exp(B)=1.000).

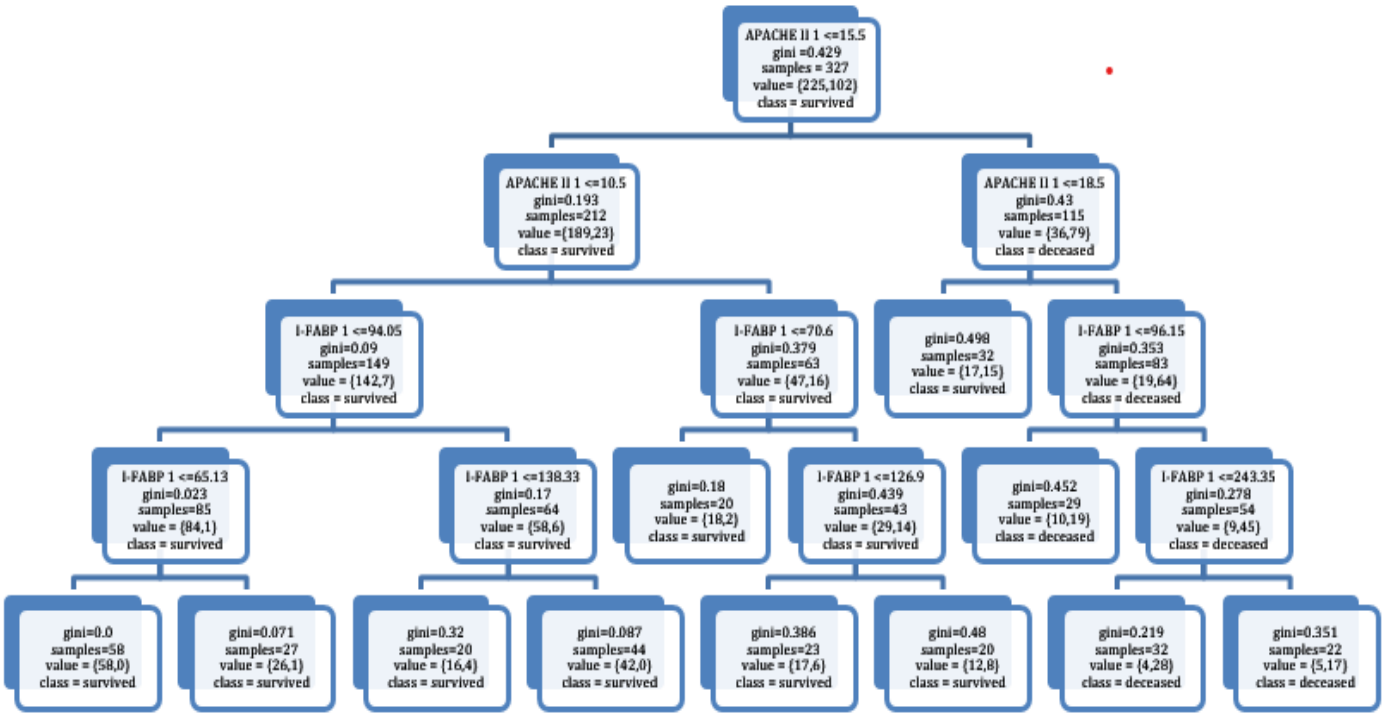


Fig 1 A decision tree with a minimum node size of 20. It was found that with APACHE II > 15 and I-FABP > 120.7, the probability of death is 77% (17 out of 22 cases)

An analysis of the heat map reflecting the dependence of mortality on levels I-FABP and APACHE II scores confirms the presence of a pronounced interaction between these two predictors. Visualization makes it clear that the highest probability of death is observed in the zone where the values of I-FABP exceed 120.7 micrograms / l, and APACHE II - 15 points. It is in this area that the map shows the most intense staining, corresponding to a mortality rate of more than 60-70%. This is completely consistent with the results obtained during the construction of the decision tree, where it was shown that the combination of APACHE II > 15 and I-FABP > 120.7 is associated with a mortality rate of 77%.

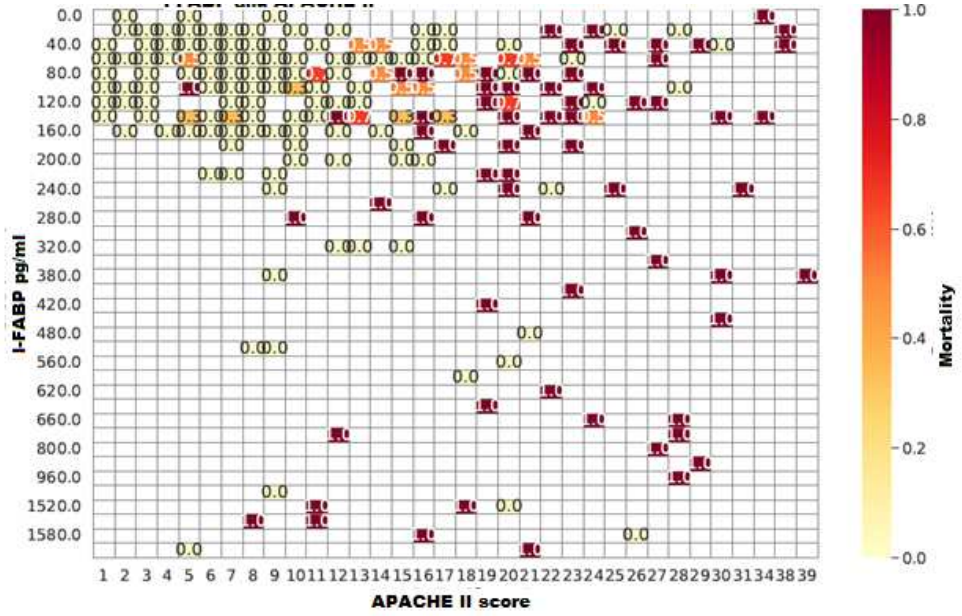
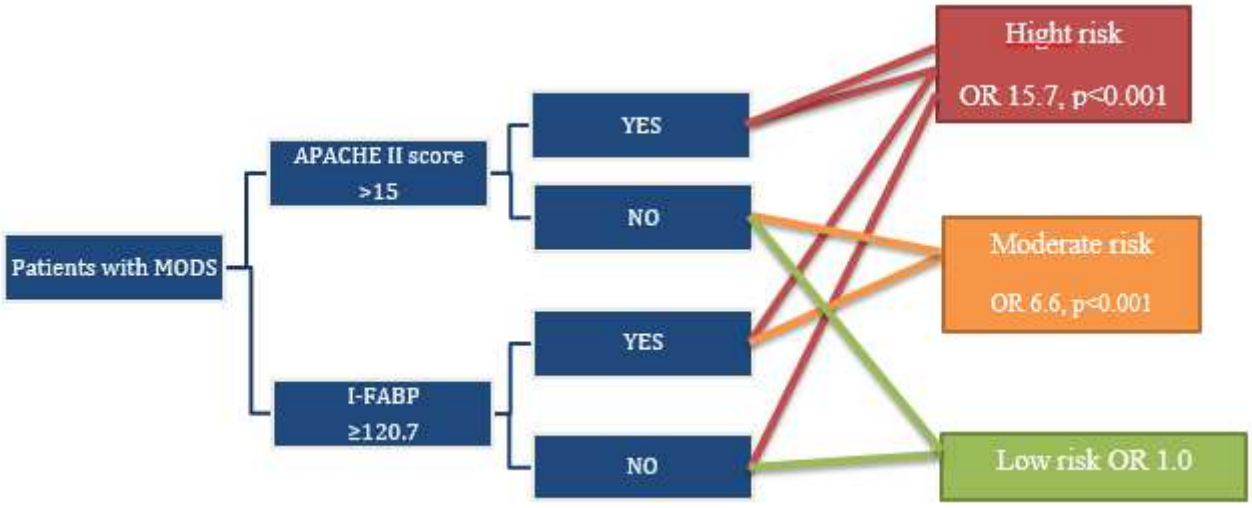


Fig 2 Heat map of the APACHE II and I-FABP relationship probability.

It is noteworthy that none of the parameters individually - neither a high level of I-FABP with a low APACHE II, nor vice versa - leads to such a high probability of an unfavorable outcome. Only their combination causes a sharp jump in risk, which indicates the nonlinear nature of the interaction and the synergetic effect. This is confirmed by the logistic model, which, although it showed the statistical significance of the interaction, did not reflect its clinical strength (Exp(B) = 1.000).

The use of a decision tree and thermal imaging made it possible to identify a clinically significant risk area that was not fully reflected by the logistic model. This highlights the need for a comprehensive approach to data analysis when building predictive models in intensive care. Based on the data obtained, an algorithm for calculating the risk of death in patients with MDS was developed. According to the results of stratification, patients with combined elevated indices (APACHE II >15 and I-FABP ≥120.7



pg/ml) had the highest probability of death — Odds Ratio = 15.7 compared with the low-risk group ($p < 0.001$). An increase in one of the markers was also associated with an increased risk: with I-FABP ≥120.7, with APACHE II ≤15 — OR = 6.6; with APACHE II >15 and I-FABP <120.7 — OR = 15.7 (Figure 1).

Fig 3 Algorithm for calculating the risk of death.

3.3 Online Calculator for Calculating a Fatal Outcome Risk in Hospitalized Patients.

Based on the created mathematical model, an online fatal outcome risk calculator, LOP MODS (Lethal Outcome Prediction in Multiple Organ Dysfunction Syndrome), was developed. The LOP MODS online calculator is based on the APACHE II scale for assessing the severity of patients in intensive care units, with the addition of a criterion for assessing the condition of the gastrointestinal tract, the protein of intestinal wall integrity violation, I-FABP. To launch the online calculator, click on the link https://speccters.github.io/calc/ or scan a QR code. There are two ways to calculate the fatal outcome risk in this calculator, i.e. with a known APACHE II score and with an unknown APACHE II score. In the case of an unknown APACHE II score, it can be calculated directly in the LOP MODS calculator. Convenient use via a link or QR code is possible from any gadget with Internet access. A simple and intuitive interface will not hinder the work of any user.

Fig 4 QR code for accessing the LOP MODS online calculator

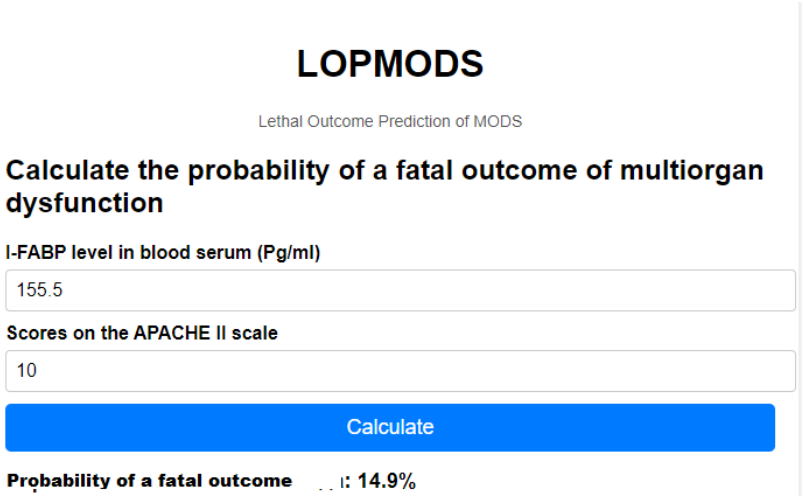


Fig 5 LOP MODS online calculator

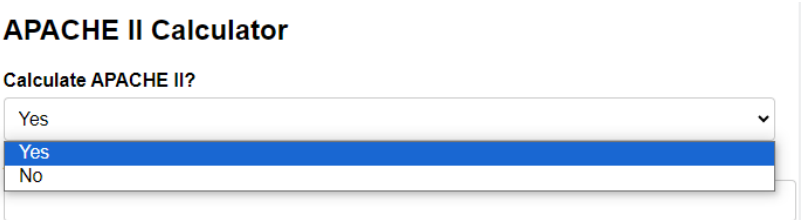


Fig 6 Optional choice of APACHE II score calculation

Figure 5 and 6 shows the interface of the LOP MODS online calculator. The percentage received in the "Probability of a fatal outcome" line is interpreted as follows: the higher the percentage, the higher the risk of a fatal outcome. Our team obtained the copyright for the developed model of the LOP MODS online calculator (certificate number: No. 56240 dated April 1, 2025).

Due to the LOP MODS online calculator, it is possible to quickly calculate the risk of death in critically ill patients with multiple organ insufficiency while minimizing subjective errors.

4 Discussion

According to the available research data 40% of adult patients admitted to the intensive care unit are diagnosed with multiple organ insufficiency syndrome. Among children, the percentage is much higher (56%), the majority of which are newborns [9; 14]. At the same time, the total mortality of patients with MODS is 51% [21]. However, according to the correlation of the percentage of mortality with the number of affected organs, if 2 to 4 organs are affected, the mortality rate will be 10 to 40%, in the case of 5 organs, the mortality rate is 50%, and in the case of 7 organs, the mortality rate will be 100% [7]. In most cases, MODS occurs due to the disruption of the activation cycle of neutrophils and macrophages, resulting in their disproportionate activation [2]. The produced cells lead to an uncontrolled cascade of reactions and cellular changes occur, which lead to impaired microcirculation and tissue ischemia [16]. One of the first organs to respond to changes in blood supply is the intestine [1,8]. When variable hypoxia occurs, the process of tissue respiration of the intestinal wall is disrupted, which leads to the active formation of aggressive forms of free radicals, resulting in the destruction of the intestinal cell wall and a disruption of the intestinal barrier function and translocation of bacteria into the bloodstream [21].

One of the most relevant diagnostic methods for multiple organ insufficiency is the APACHE II and SOFA scales. The SOFA (Sequential Organ Failure Assessment) scale is a score calculation based on an assessment of the functions of six organs, i.e. respiratory, cardiovascular, hepatic, renal, nervous systems, and hemostasis [15,13]. The APACHE II scale is designed to predict a fatal outcome and assess the severity of a patient's condition in the intensive care unit and includes 12 physiological parameters [26,17].

Unfortunately, to date, there are no modified scales for diagnosing the severity of the condition and predicting a fatal outcome, taking into account the indicator of the gastrointestinal tract. The first version of the APACHE II scale, created in 1985, included indicators of the gastrointestinal tract, i.e. amylase, albumin, alkaline phosphatase, total bilirubin, ASAT; however, a biochemical blood test is not a direct indicator of a violation of the integrity of the intestinal wall and the presence of translocation. Later, the scale was modified by completely eliminating the diagnostic criteria of the gastrointestinal tract and adding only an additional assessment in the form of a stress bleeding score. Research by M. Overhans et al. and N. T. Schwart et al. proves direct involvement of the intestine in the inflammatory process due to the fact that most cytokines involved in the formation of inflammation are produced in the intestine, as a result of which the study of the state of the intestinal wall in MODS is relevant [12].

Today, I-FABP is one of the promising markers for the diagnosis of intestinal wall integrity violations. It is a plasma membrane protein that is produced in the small intestine in the mature type of villi. The average concentration of I-FABP in the blood varies from 87 to 147 pg/mL [24]. Studies have shown that one of the first proteins released from the intestinal cell wall when its integrity is violated at the molecular level is I-FABP in dis-solved form, which makes it diagnostically significant in the first hours of the permeability disorders [3, 28, 29]. Research by Kanda T et al. in 2011 [1] revealed a high con-centration of I-FABP protein in the blood serum during surgery with a significant disruption of intestinal blood supply, and therefore, a direct correlation between intestinal wall ischemia and the level of I-FAB protein was proved. With strangulatory intestinal obstruction, a high level of I-FABP in the blood serum was also detected; its significant (10 times) increase could occur due to a disruption of the blood supply to the intestinal wall [25]. The determination of the I-FABP level in celiac disease is gradually being introduced into the routine as an indicator of enterocyte destruction and protein release into the blood; the first study on this topic was conducted in 2009 [10]. Many studies have proven the

relationship of traumatic effects on the abdominal cavity as the cause of high levels of I-FABP protein in the blood as early as 15-30 minutes after injury [32], which determines its diagnostic significance.

Based on many studies, including the papers of our team, the prognostic value of I-FABP as a biomarker that signals a violation of the integrity of the cell wall in the intestine becomes obvious [19, 20]. The combination of APACHE II and I-FABP allows you to more accurately predict deaths with MODS. Their interaction revealed a high-risk area (mortality rate up to 77%), which is confirmed by a decision tree and a heat map.

Compared to the model based only on the APACHE II scale (overall accuracy 81.6%, for survivors 90.82% and for deceased 64.4%), the logistic regression performed on the training sample with the addition of I-FABP demonstrated higher classification accuracy (overall accuracy 84.3%, for survivors 90.8% and for deceased 71.3%) and the acceptable explanatory power of the model (Nagelkerke R2=0.587).

Based on the mathematical model, the coefficients were calculated and the logistic regression equation was compiled. Validation was also performed. Decision trees and a heat map have been built. To simplify the use of the formula, the LOP MODS online calculator, which is able to quickly calculate the risk of a fatal outcome in patients while minimizing subjective errors, was developed. To use the online calculator, you need to scan a QR code or click an active link on any electronic device. Copyright certificate No.56240 dated April 1, 2025 was obtained for this development.

Authors should discuss the results and how they can be interpreted from the perspective of previous studies and of the working hypotheses. The findings and their im-plications should be discussed in the broadest context possible. Future research directions may also be highlighted.

5 Conclusions

The elevated serum level of I-FABP in patients with MODS is an indicator of a violation of the integrity of the intestinal barrier, which may worsen the course of the disease and lead to a fatal outcome. The prognostic value of the biomarker is high, and its inclusion in the diagnostic criterion along with the APACHE II scale for patients with MODS leads to more accurate results in assessing the risk of a fatal outcome. The online calculator created based on a combination of the calculation of the APACHE II score and the I-FABP biomarker calculates the risk of a fatal outcome within a short period of time, which makes it possible to quickly identify patients with a high risk of a fatal outcome and further change therapy tactics and reduce the risk of mortality.

Author Contributions: the sponsors of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Non-profit Joint-Stock Company “Karaganda Medical University”, protocol code 34-1, 18.03.2025.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patients to publish this paper.

Availability of data and materials

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

The Ethical Component of This Study

The study was conducted in accordance with the Helsinki Declaration with amendments. The study was approved the Ethics Committee of Non-profit Joint-Stock Company “Karaganda Medical University”, protocol code 34-1, 18.03.2025. The informed consent to participate was obtained from all the patients being studied.

Consent for publication

Not Applicable

Conflicts of Interest

The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

MODS	Multiple Organ Dysfunction
I-FABP	Directory of open access journals
APACHE II	Acute Physiology And Chronic Health Evaluation
SOFA	Sequential Organ Failure Assessment

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