Original Article

Comparing Sequential Organ Failure Assessment Score, Acute Physiology and Chronic Health Evaluation II, Modified Acute Physiology and Chronic Health Evaluation II, Simplified Acute Physiology Score II and Poisoning Severity Score for Outcome Prediction of Pesticide Poisoned Patients Admitted to the Intensive Care Unit

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Abstract

Objective: This study aimed to assess the severity of poisoning, various scoring systems, including Sequential Organ Failure Assessment (SOFA) score, acute physiology and chronic health evaluation II (APACHE II), Simplified Acute Physiology Score (SAPS II), Modified APACHE II, and poisoning severity score (PSS) were used. In this study, we compared the predictive value of these scoring systems on the outcome of pesticide-poisoned patients. **Methods:** This is a cross-sectional study of pesticide-poisoned patients (140 patients) who were admitted to the intensive care unit (ICU) of Khorshid Hospital, Isfahan, Iran, between January 2015 and 2019. The area under the receiver operating characteristic (AUC) curve and the predictive value of scoring systems were compared. **Findings:** Poisoning was higher in the male population (72.8%). The causes of poisoning were paraquat, (38.6%), aluminum phosphide, (32.1%), and organophosphate, (29.3%). The mean age of the patients was 33.9 years. Most patients (79.3%) attempted suicide. The mortality rate was 46.43%. The mean of "SOFA score," "APACHE II," "SAPS II," "Modified APACHE II," and "PSS" was 5.9; 15.7; 30.02; 15.8; and 1.9, respectively. There was a significant difference in the mean of all scoring systems for outcome prediction. Among all scoring systems, the SAPS II score with the cutoff point (16.5) had the best criteria for outcome prediction (AUC (0.831 ± 0.037), sensitivity (83.1%, 95% confidence interval [CI]: [71.7–91.2]), specificity (75.7%, 95% CI: [64.3–84.9]), positive predictive values (75.0%, 95% CI: [66.4–82.0]), negative predictive values (83.6%, 95% CI: [74.5–89.9]). **Conclusion:** The SAPS II scoring system may be a suitable indicator for outcome predictions in pesticide-poisoned patients in the ICU.

Keywords: *Outcome, pesticide, poisoning, severity score*

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Introduction

It has been reported that poisoning is the fifth leading cause of hospitalization and the third leading cause of death.[1] In Iran, poisoning is one of the most common causes of hospitalization (15%–20% of emergency visits) in different provinces, and the estimated mortality is 8–109 per 1000 patients.[2-4]

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In some parts of Asia, pesticide led to 60%–90% of toxicity and 15%–30% of mortality.[5,6] Studies in 108 countries, from 2010 to 2014, show that every year, approximately 168,000 (19.7%) suicidal deaths happen due to suicide with pesticide. The ratio of suicide with pesticide to the total rate of suicides varies from 0.9% in Europe to 48.3% in developing countries.[7,8] Poisoning with aluminum phosphide and zinc phosphide, which repel rice pests, is rising in Iran. The mortality rate of them is estimated at 18.6%–24%.[9]

Because many patients poisoned by pesticide need to be hospitalized and closely monitored in the intensive care unit (ICU), It is urgent to immediately decide on proper treatment intervention.[10] For the past three decades, prognostic criteria have been developed and widely applied in the ICUs.[11] Poisoning severity score (PSS) is one of these criteria for estimating poisoning severity and quality assessment, identifying real risks, and comparing data.[12] The World Health Organization recommends this measure to assess toxicity.[11-14]

Assessment of acute physiology and chronic health evaluation (APACHE II) is another criterion which is a system based on physiological disorders and has been successful in estimating the severity of the disease in critical patients.[15] The Simplified Acute Physiology Score (SAPS II) is a measure designed to assess disease severity in patients over 15 years old admitted to the ICU.[16] The most popular systems already introduced are APACHE II and SAPS II, which calculate abnormalities in physiological variables during the first 24 h of ICU admission.[16,17] The fourth criterion is the sequential assessment of organ failure (SOFA), which assesses the six major systems (nervous, respiratory, cardiovascular, hepatic, renal, and coagulation systems) during ICU admission.[18] Although in some previous studies, the performance of SOFA was lower than that of APACHE II and other death prediction criteria, these criteria are used in different groups of patients, including internal medicine and surgery.[19] The modified APACHE II has been used for patients with organophosphate (OP) poisoning with high sensitivity and specificity.[20]

Compared to other poisonings, pesticide poisoning results in more deaths. About 20% of pesticide cases need mechanical ventilation, and in ICU that nearly half of them were nonsurvived.[21,22] Several studies have been performed to compare different scoring systems in poisoned patients concerning specific poisons.[23-41] However, there was no study comparing all scoring systems in the outcome prediction of pesticide. In this study, we determined and compared the predictive powers of SOFA, APACHE II, SAPS II, Modified APACHE II, and PSS criteria, the in-hospital outcomes (complete recovery, incomplete recovery, and nonsurvived) of pesticide-poisoned patients hospitalized in the ICU of Khorshid Hospital, Isfahan, Iran, between 2015 and 2019.

Methods

This cross-sectional study was performed in 2020 in the poisoning center of Khorshid Hospital, a referral center for poisoning in Isfahan. After approving the proposal and receiving the ethics certification (IR.MUI.MED.REC.1399.303), the files related to all patients poisoned with pesticide hospitalized in the ICU of Khorshid Hospital during the years 2015–2019 were reviewed.

Inclusion criteria were patients with pesticide poisoning over 15 years of age admitted to ICU for at least 24 h and no history of cardiopulmonary resuscitation before the ICU admission. Having a past medical history of cancer, cardiovascular diseases, diabetes mellitus, severe chronic illness, and patients with unknown pesticide poisoning were considered as the exclusion criteria.

Demographic information of patients regarding the different scoring systems, including systolic and diastolic blood pressure, heart rate, respiratory rate, body temperature, electrocardiogram (ECG), Glasgow Coma Score (GCS) arterial blood gas analysis (pH, PaO2, and PaCO2), friction of oxygen, laboratory data including white blood cell count, hematocrit, platelet count, sodium, potassium, creatinine, albumin, blood sugar, bilirubin and C-reactive protein level and central nervous system symptoms, patient's complication's and outcomes, the length hospitalization, the manner of poisoning (accidentally or intentionally), poisoning agent, and the route of poisoning (oral, skin, or unknown) were obtained from the patients' records and entered into the data collecting form. SOFA, APACHE II, Modified APACHE II, SAPS II, and PSS scores were calculated using online calculators for each patient and within the first 24 h after ICU admission. The outcome of cases included complete recovery, incomplete recovery, and nonsurvivor (death or brain death).

Collected data were analyzed using SPSS-26 software (Chicago, IL, USA, SPSS Inc.). At the level of descriptive statistics, the indicators of mean, median, standard deviation, frequency, and frequency percentage were used, and at the level of inferential statistics, one-way analysis of variance and area under the curve [AUC] analysis (to identify diagnostic value and sensitivity and specificity of each criterion) were used. The area under the receiver operating characteristic (ROC) curve and the predictive value were also calculated and $P < 0.05$ were considered statistically significant differences.

Results

One hundred and forty patients ranging from 15 to 96 years of age were included in this study. The mean age of patients was 33.9 + 14.4 years (ranging between 15 and 96 years), 102 patients were male (72.8%) and 38 patients were female (27.2%). There was no relation between sex (P = 0.46), marital status (P = 0.45), occupation (P = 0.54), history of suicide (P = 0.46), and history of substance abuse (P = 0.92) with different outcomes. The poisoning agents were paraquat (54 patients, 38.6%), aluminum phosphide (45 patients, 32.1%), and OP (41 patients, 29.3%), respectively. The most common route of exposure was ingestion (136 patients, 97.1%); 79.3% (n = 111) of the poisonings occurred by suicidal attempt, ECG was normal in most patients (68.6%, 96 patients). The mortality rate was 46.43% (65 patients) [Table 1].

The outcomes of patients with different poisoning agents (P = 0.08), manner of poisoning (P = 0.22), and the route of poisoning (P = 0.09) were not statistically different. However, the frequency of normal ECG in non-survived patients was lower than in those who were completely recovered (P = 0.001). The results showed a rising order of the frequency of CNS symptoms in complete recovered cases, incomplete recovered cases, and non-survived (P = 0.001) [Table 1]. No significant difference was found between patients' vital signs and GCS and their outcomes in the Prehospital emergency or referral center and on admission (P > 0.05) [Table 2].

Table 1: Demographic characteristics and clinical findings in the three outcome groups

Variable	Complete recovery, *n* (%)	Incomplete recovery, *n* (%)	Nonsurvived, *n* (%)	Total, *n* (%)	*P*
Gender					
Male	41 (67.2)	11 (78.6)	50 (76.9)	102 (72.9)	0.41
Female	20 (32.8)	3 (21.4)	15 (23.8)	38 (27.1)	
Job					
Self-employment	31 (57.4)	8 (72.7)	40 (70.2)	79 (56.5)	0.54
Retired	1 (1.9)	0	2 (3.5)	3 (2.1)	
Housewife	15 (27.8)	2 (18.2)	11 (19.3)	28 (20)	
Employee	0	0	2 (3.5)	2 (1.4)	
Unemployed	2 (3.7)	1 (1.9)	1 (1.8)	4 (2.9)	
Worker	2 (3.7)	0	1 (1.8)	3 (2.1)	
Soldier	2 (3.7)	0	0	2 (1.4)	
Prisoner	1 (1.9)	0	0	1 (0.7)	
Unknown	-	-	-	18 (12.9)	
Marital status					
Married	45 (73.8)	8 (57.1)	42 (72.4)	95 (67.9)	0.45
Single	16 (26.2)	6 (42.9)	16 (27.6)	38 (27.1)	
Unknown	-	-	-	7 (5.0)	
Poisoning agents					
Organophosphate	20 (32.8)	8 (57.2)	13 (20)	41 (29.3)	0.08
Aluminum phosphide	20 (32.8)	3 (21.4)	22 (33.8)	45 (32.1)	
Paraquat	21 (34.4)	3 (21.4)	30 (46.2)	54 (38.6)	
Route of poisoning					
Oral	57 (95)	13 (92.9)	57 (100)	127 (90.7)	0.09
Skin	3 (5)	1 (7.1)	0	4 (2.9)	
Unknown	-	-	-	9 (6.4)	
Manner of poisoning					
Accidental	6 (9.2)	1 (7.2)	2 (3.3)	9 (6.4)	0.22
Intentionally	46 (70.8)	10 (71.4)	55 (90.2)	111 (79.3)	
Unknown	13 (20.0)	3 (21.4)	4 (6.5)	20 (14.3)	
ECG					
Abnormal	9 (14.8)	5 (35.7)	28 (44.4)	42 (30.0)	0.001
Normal	52 (85.2)	9 (64.3)	35 (55.6)	96 (68.6)	
Unknown	-	-	-	2 (1.4)	
Past history of suicide	11 (19.3)	1 (7.7)	7 (12.7)	19 (13.6)	0.46
History of substance abuse	12 (20)	3 (21.4)	10 (17.5)	25 (17.9)	0.92
CNS symptoms	20 (32.8)	7 (50)	43 (66.2)	70 (50.0)	0.001

ECG=Electrocardiogram, CNS=Central nervous system

The mean scores of all criteria, including SOFA, APACHE II, M. APACHE II, SAPS II, and PSS in non-survived patients, were significantly higher than improved patients ($P < 0.001$) [Table 3].

Based on the area below, the ROC curve and the mean of sensitivity, specificity, positive predictive value, and negative predictive value, the best predictor for patient outcome was the SAPS II score, followed by M. APACHE II, APACHE II, PSS, and SOFA scores. The results showed that the accuracy, sensitivity, and specificity of the cutoff point of 16.5 with SAPS II criteria were 79.1%, 83.1%, and 75.7%, and the positive and negative predictive values of this score were 75.0% and 83.6% [Figure 1 and Table 4].

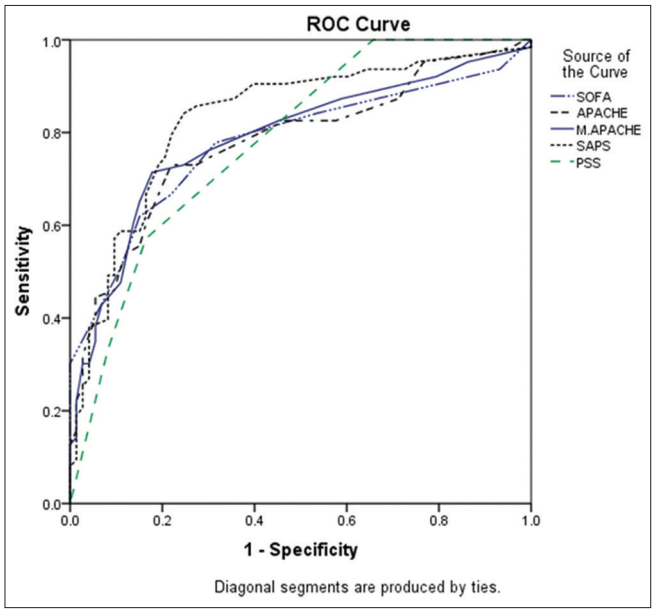

Figure 1: Receiver operating characteristic (ROC) curve to predict patient's outcome (death or recovery) based on sequential organ failure assessment, acute physiology and chronic health evaluation II, modified acute physiology and chronic health evaluation II, simplified acute physiology score II, and poisoning severity score scores

Discussion

All patients were poisoned with paraquat (38.6%), aluminum phosphide (32.1%), or OP (29.3%). These poisons are the most common and deadly pesticide hospitalized in poisoned ICUs in Iran.[2]

Although several studies have been performed to compare different scoring systems in poisoned patients, most of them have considered only one specific poisoning; this is the first study that simultaneously examines and compares five scores in pesticide poisonings. Table 5 summarizes the previous studies regarding the scoring system in patients with pesticides poisoning.

In our study, 140 patients with a mean age of 33.9 years were studied, and there was no significant difference between the mean ages of patients with different outcomes. The mean age of our patients is similar to the mean age of drug poisoning in Iran[2,9] and other studies.[20,30,32,39] The majority of our patients was male (72.8%). This is contrary to the gender distribution of poisoned patients in other studies in Iran.[2,9] In many studies, the gender distribution is similar to ours.[20,26,30,36] It has been shown that suicide in men is three times more common in women due to the choice of deadly methods. Of course, in the case of suicide, this ratio is reversed.[42]

In "Abd Elghany *et al*.'s"[31] study, there was a significant relationship between blood pressure, respiratory rate, and temperature of aluminum phosphide-poisoned patients and their outcome. The difference between these results and our study is probably due to the different pesticides agents

Table 2: Mean age, vital signs, and GCS in prehospital and on-admission stages in three study groups

Variables	Complete recovery	Incomplete recovery	Nonsurvived	*P*
Age (years)	31.4±12.3	33.6±12.8	36.5±16.2	0.14
Prehospital emergency or referral center				
GCS	14.1±2.1	13.4±2.8	13.1±3.3	0.30
SBP (mmHg)	116.1±16.1	112.2±12.02	110.7±24.4	0.43
DBP (mmHg)	74.1±11.4	71.1±7.8	71.6±16.6	0.65
Heart rate	96.1±23.3	88.2±12.7	92.8±19.3	0.53
Respiratory rate	19.9±9.6	16.4±2.3	17.2±3.8	0.19
Body temperature (°C)	36.9±0.2	36.9±0.2	36.7±0.5	0.13
On-admission				
GCS	14.4±1.9	13.2±3.4	11.9±3.9	<0.001
SBP (mmHg)	118.2±18.6	116.3±21.1	113.8±26.5	0.58
DBP (mmHg)	74.2±14.6	73.2±15.8	69.9±14.04	0.24
Heart rate	93.1±16.1	91.3±19.2	92.6±21.9	0.95
Respiratory rate	18.4±2.4	18.7±2.5	18.2±6.7	0.96
Body temperature (°C)	37±0.3	36.8±0.3	36.9±1.9	0.88

Data are presented as mean±SD. SD=Standard deviation, GCS=Glasgow coma scale, SBP=Systolic blood pressure, DBP=Diastolic blood pressure

poisoning. In our study, as in other studies, lower GCS was associated with poor prognosis of poisoned patients.[24,25,30]

In our study, the mortality rate was 46.43%. Deadly pesticide poisoning (aluminum phosphide and paraquat) may be the reason for the high mortality in our research. Among those who died, the highest mortality was due to paraquat poisoning (55.55%), aluminum phosphide (48.88%), and OPs (31.7%). These pesticides are easily available to people and farmers in Iran, which has led to a high frequency of suicide with them.[9] In other studies, the frequency of mortality was reported with paraquat (80.3%),[29] aluminum phosphide (56%),[31] and OPs (4.6%–22.1%).[20,23-28,30] The difference may be related to the amount of toxin ingested, age, the concentration of toxin, and time from admission to treatment performed. The reason for the higher frequency of deaths in OP poisoning in our study compared to others is probably that only critically ill patients are admitted to the ICU.

Our results revealed that higher AUC, cutoff point, sensitivity, accuracy, and negative predictive value were relevant to SAPS II. However, the higher Specificity value was relevant to PSS and then Modified APACHE II, and the higher Positive predictive value was relevant to Modified APACHE II as well [Table 4].

Table 3: Comparison of the on-admission mean scores of sequential organ failure assessment, acute physiology and chronic health evaluation II, modified acute physiology and chronic health evaluation II, simplified acute physiology score II, and poisoning severity score in the two groups' outcomes

Criteria	Survived	Nonsurvived	*P*
SOFA	3.3±1.8 (1–7)	5.9±2.8 (1–12)	<0.001
APACHE II	8.1±2.8 (0–26)	15.7±4.1 (2–34)	<0.001
M.APACHE II	8.4±3.5 (4–26)	15.8±5.8 (2–32)	<0.001
SAPS II	14.6±3.6 (6–51)	30.02±6.3 (0–74)	<0.001
PSS	0.9±0.4 (0–3)	1.9±0.6 (1–3)	<0.001

The survived group were completely or incompletely recovered. Data are presented as mean±SD (range). SD=Standard deviation, SOFA=Sequential organ failure assessment, APACHE=Acute physiology and chronic health evaluation, M.APACHE=Modified APACHE, SAPS=Simplified acute physiology score, PSS=Poisoning severity score

Although there has not been any research to be included all pesticides and these criteria, the previous investigations showed the different performance of the four criteria in different studies. "Sungurtekin,[23] "Ibrahim,[25] and "Peter[27] described a similar efficacy for SAPS II in predicting mortality among patients with OPs poisoning. Compared with Sungurtekin's[23] study, in our study, the mean of APACHE II and SAPS II scores were higher in patients who died. In a study by "Peter *et al*.,"[27] AUC for mortality was significantly higher for APACHE-II (0.77) and SAPS-II (0.77) than the PSS (0.67). They suggested that these criteria may be used to predict the mortality rate in OP poisoning. Compared with the present study, both studies showed relatively similar AUC for APACHE-II (0.77).

In a study by "Farzaneh *et al*.,"[35] Glasgow coma score (GCS), systolic blood pressure; urinary output, and serum HCO3 levels were the best prognostic factors for predicting mortality in ALP-poisoned patients. the APACHE II score > 8.5, SAPS II score > 24.5, and SOFA score > 7.5 were shown to predict the ALP-poisoned patient mortality rate with good specificity and sensitivity. The APACHE II score was determined to be the best discriminator between nonsurvivors and those who survive. Compared with the present study, the values of APACHE II and SAPS II are lower compared to the SOFA score.

In this study, designed for patients poisoned with pesticide admitted to the ICU, we concluded that the average scores of SOFA, APACHE II, M. APACHE II, SAPS II, and PSS criteria in nonsurvived cases were significantly higher than others. In terms of accuracy, sensitivity, specificity, positive predictive value, and negative predictive value, the best predictive score for

Table 4: Comparison of the area under the curve, cutting point, sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of sequential organ failure assessment, acute physiology and chronic health evaluation II, modified acute physiology and chronic health evaluation II, simplified acute physiology score II, and poisoning severity score scores to predict patient's outcomes

Criteria	AUC	SE	Cut-off point	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Accuracy (%)
SOFA	0.778 (0.698–0.844)	0.042	3.5	76.9% (64.8–86.5)	68.9% (57.1–79.2)	68.5% (60.2–75.8)	77.3% (68.0–84.5)	72.7
APACHE II	0.779 (0.700–0.846)	0.042	10.5	72.3% (59.8–82.7)	78.4% (67.3–87.1)	74.6% (65.0–82.3)	76.3% (68.1–82.9)	75.5
M.APACHE II	0.788 (0.709–0.853)	0.041	10.5	70.8% (58.2–81.4)	82.4% (71.8–90.3)	78.0% (67.8–85.6)	76.2% (68.4–82.6)	76.9
SAPS II	0.831 (0.757–0.889)	0.037	16.5	83.1% (71.7–91.2)	75.7% (64.3–84.9)	75.0% (66.4–82.0)	83.6% (74.5–89.9)	79.1
PSS	0.781 (0.702–0.847)	0.039	1.5	57.1% (44.0–69.5)	83.6% (73.0–91.2)	75.0% (63.2–84.0)	69.3% (62.5–75.4)	71.3

Data are presented as value (range). AUC=Area under the receiver operating characteristics (ROC) curve, SE=Standard error, SOFA=Sequential organ failure assessment, APACHE=Acute physiology and chronic health evaluation, M.APACHE=Modified APACHE, SAPS=Simplified acute physiology score, PSS=Poisoning severity score

Table 5: Characteristics of previous studies performed on the scoring systems in pesticide-poisoned patients

Reference	Clinical scoring systems	Poisoning	Ability to predict mortality	Total patients (*n*)	Gender (male), *n* (%)	Mean age (years)	Nonsurvived, *n* (%)
Present study	SOFA APACHE II SAPS II MAS PSS	Pesticide poisoning/ ICU	The SAPS II scoring system is a suitable indicator for outcome predictions and risk stratification in pesticide poisoned patients in the ICU	140	102 (72.8)	33.9±14.4	65 (46.42)
Eizadi-Mood *et al*.[20]	APACHE II MAS	OP poisoning/ ICU	Usage of MAS facilitates the prognostication of the OP poisoned patients due to its simplicity, less time-consuming and effectiveness in an emergency	131	99 (75.5)	Survived 22 (18–34), death 33.5 (21.5–50.3)	6 (4.6)
Sungurtekin *et al*.[23]	APACHE II and III SAPS II GCS	OP poisoning/ ICU	The APACHE II, III and SAPS II clinical scoring tools seem to predict the severity of OP poisoning, and may have prognostic value	48	NA	NA	NA
Davies *et al*.[24]	IPCS PSS GCS	OP poisoning/ hospital	GCS and the IPCS PSS were similarly effective at predicting the outcome	1365	NA	NA	184 (21)
Ibrahim *et al*.[25]	APACHE IV, SAPS II	OP poisoning/ ICU	Application of APACHE IV and SAPS II scores is a good predictor of high mortality in OP intoxicated patients	90	40 (44.4)	The age range of 16–55 years	12 (13.3)
Kim *et al*.[26]	SOFA APACHE II SAPS II	OP poisoning/ ICU	The SOFA score is more useful in predicting mortality, and easier and simpler than the APACHE II and SAPS II	131	82 (80.4)	61	29 (22.1)
Peter *et al*.[27]	APACHE II SAPS II PSS MPM II	OP poisoning/ Hospital	The generic scoring systems APACHE-II and SAPS-II outperform the PSS	396	NA	NA	52 (13.1)
Tang *et al*.[28]	APACHE II Blood lactate Blood cholinesterase levels Cholinesterase activity Blood pH and other factors	OP poisoning/ ICU	High 6 h postadmission blood lactate levels, low blood pH, and low postadmission 6 h lactate clearance rates were independent prognostic factors	71	44 (61.9)	Survival (50.2±19.1), death (54.7±17.6)	12 (16.9)
Lee *et al*.[29]	SOFA APACHE II SAPS II	Paraquat poisoned patients/ICU	APACHE II can be useful for outcome predictions and risk stratification in paraquat-poisoned patients in the ICU	219	138 (63)	63	176 (80.3)
Sam *et al*.[30]	GCS APACHE II PMR PSS	OP and carbamate/ hospital	This study highlights the application of clinical indices like GCS, APACHE, PMR and severity scores in predicting mortality	71	54 (76.0)	31.23±11.11	5 (7)

Contd...

Table 5: Contd...

Reference	Clinical scoring systems	Poisoning	Ability to predict mortality	Total patients (*n*)	Gender (male), *n* (%)	Mean age (years)	Nonsurvived, *n* (%)
Abd Elghany *et al*.[31]	APACHE REMS SOFA	Aluminium phosphide poisoning	The clinical scores were similar and effective tools for the determination of the severity of acute Alp poisoning. REMS score is suggested to be used in the emergencies situations to predict outcomes in Alp-poisoned patients	50	17 (34)	Age group 16–20 years (64%)	28 (56)
Wu *et al*.[32]	CRP Copeptin APACHE II	OP poisoning/ hospital	CRP, copeptin levels and APACHE II scores may be used for the determination of AOPP severity and the prediction of AOPP prognosis	100	45 (45)	39.6±8.17	Severe (*n*=14)
Yuan *et al*.[33]	APACHE II PSS SOFA Lactate	OP poisoning/ hospital	SOFA–Lactate system is significantly better at predicting mortality in AOPP patients	59	32 (54)	56.5	9 (15)
Wang *et al*.[34]	SOFA	Paraquat poisoned patients	Higher SOFA in patients with paraquat poisoning was related to severe mortality	946	NA	NA	55.20
Farzaneh *et al*.[35]	APACHE II SOFA SAPS II	Aluminium phosphide poisoning	APACHE II score can more effectively discriminate between non-survivors and survived patients	68	NA	25.0±7.3	36 (53)
Lee and Kim[36]	SOFA APACHE II SAPS II	Acute glufosinate poisoning	GCS <9, HCO_3-<16.0 mmol/L, mechanical ventilator applies, and use of vasopressors had good discriminative power for predicting mortality compared to APACHE II, SOFA, and SAPS II	253	178 (70.3)	58	34 (13.4)
Lee *et al*.[37]	Ammonia SOFA APACHE II	Acute glufosinate poisoning	Initial serum ammonia level >151 mg/dL was an independent early predictor of mortality	110	68 (61.8)	56	10 (9.1)
Sheta *et al*.[38]	SOFA	Aluminium phosphide poisoning	SOFA score was the most predictive factor of mortality detected by multivariate analysis	30	8 (28)	22.77±12.79	13 (43.3)
Eisa *et al*.[39]	POP APACHE II SOFA AChE Lactate	OP poisoning	SOFA score was more useful, easier and simpler than the APACHE II and can help emergency physician quickly detect the severity of OPIs poisoned patients. Serum lactate level was a statistically highly significant predictor of the outcome and complications	36	23 (64.9)	32.7±17.96	5 (13.9)
Acharya and Panda[40]	CCI GCS PSS	Chlorpyrifos poisoning	CCI, GCS, and PSS at the time of admission were seen as reliable predictors of outcome	40	35 (87)	44.73±10.76	10 (25)
El-Sarnagawy *et al*.[41]	MEWS APACHE II PSS	pesticide poisoning	The PSS had the best discriminatory power in predicting ICU admission and mortality, followed by APACHE II and MEWS	103	46 (44.7)	19.0 (17–30)	67 (65.0)

OP=Organophosphate, GCS=Glasgow coma scale, APACHE=Acute physiology and chronic health evaluation, PMR=Predicted mortality rate, PSS=Poisoning severity score, SOFA=Sequential organ failure assessment, SAPS=Simplified acute physiology score, MPM=Mortality prediction model, IPCS=International program on chemical safety, MAS=Modified APACHE II system, REMS=Rapid emergency medicine score, NA=Not available, CCI=Carlsons' comorbidity index, CRP=Creactive protein, AOPP=Acute organophosphorus pesticide poisoning, AChE=Acetylcholinesterase, POP=Peradeniya organophosphorus poisoning score, MEWS=Modified early warning score, ICU=Intensive care unit, OPIs=OP insecticides

outcoming of pesticide-poisoned patients was SAPS II, followed by M. APACHE II, APACHE II, PSS, and SOFA, respectively. The results of our study can help in the proper treatment and allocation of resources. It is recommended that in another study, besides these criteria, the level of cortisol and lactate and their relationship with each other and the outcome of patients be evaluated, and also, all these criteria in the first 24 h and next days of admission compared.

Authors' Contribution

G. Dorooshi and S. Samsamshariat designed the study and prepared the initial proposal. N. Eizadi-Mood critically reviewed the proposal. S. Samsamshariat gathered the data. A. Hasanzadeh analyzed the data. All authors read the manuscript and agreed to the final version of the submitted manuscript.

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Conflicts of interest

There are no conflicts of interest.

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