Original Research Article

A Proposal for a Novel Scoring System Using Vital Signs, Arterial Blood Gases and Consciousness Level as a Tool of Triage for Acutely Poisoned Patients at Tanta University Poisoning Treating Center

Abstract

Background: Poisoning is defined as exposure of an individual to a potential harmful substance either by inhalation, skin contact, ingestion, or injection.

Aim of the work: This study aimed to develop and validate a novel scoring system using vital signs, arterial blood gases (ABG) and consciousness level as a tool of triage for evaluation and outcome prediction of acutely poisoned patients.

Methods: The current prospective cohort study was conducted on patients with acute poisoning who were admitted at Tanta University Poisoning Treating Center (TUPTC) throughout a period of start of April 2020 to the end of June 2021. For each patient, age, sex, and toxicological characteristics were obtained. Clinical examination and routine laboratory investigations were also done.

Results: Significant differences were observed between survivors and non-survivors in the derivation group (444 patients) regarding systolic blood pressure, diastolic blood pressure, respiratory rate, temperature, blood pH, $PaCO_2$, serum HCO_3, and O_2 saturation. Using univariate and multivariate regression analysis SBP, serum HCO_3, and O_2 saturation were valid to construct the prediction score at cut off ≤100 mmHg, ≤16.6 mEq/L, and ≤93% respectively. Variables were given points and the score has range from 0 (the best score) to 3 (the worst score). The discrimination power in the derivation group at cut-off point >1 was excellent (AUC: 0.925) with 91.3% sensitivity and 94.9% specificity. Additionally, the discrimination power in the validation group (140 patients) at cut-off point >1 was excellent (AUC: 0.965) with 87.5% sensitivity and 93.8% specificity.

Conclusion: This proposed score could be considered a simple and excellent tool for triage to identify acutely poisoned patients who are at risk of mortality**.** In addition, it is validated and so it could be used in other population.

Key words: Poisoning, mortality, prediction, parameters, scoring system.

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Introduction

Poisoning is defined as exposure of an individual to a potential harmful substance either by inhalation, skin contact, ingestion, or injection. Adverse effects may occur in many forms and range from subtle changes to immediate death **[1].**

Triage in medicine means rating of patient's clinical urgency and severity of their medical condition and treating them according to their triage level. It is critical for proper management in acute poisoning so that, triage is a central task in emergency departments **[2].**

Various predictive models have already been developed and summarized to standardized guidelines to evaluate poisoning severity and improve patients' outcome but they have some various limitations **[3].** For example, poisoning severity score includes a large number of data points from 12 different organ systems and multiple subjective variables which decrease its inter-rater reliability **[4].**

Accordingly, there is a need to apply simple variables to assess poisoned patients and predict their outcome.

In the modern practice of medical toxicology, vital signs play an important role in diagnosis since they are the key components of toxic syndromes. However, their role in assessing severity of poisoned patients is still lacking of evidence **[5].**

ABG analysis is one of the most precise and widely available investigations in hospitals. The value of such measurements depends on proper interpretation of results **[6].** Glasgow Coma Scale (GCS) has provided a practical method for bedside assessment of consciousness level using the three components which include verbal, motor, and eye response and become an integral part of clinical practice and research worldwide **[7].**

Hence, this study aimed to develop a novel scoring system using vital signs, ABG and consciousness level as a tool of triage for evaluation and outcome prediction of acutely poisoned patients.

Patients and methods

The current prospective cohort study was conducted on patients with acute poisoning who were admitted at Tanta University Poisoning Treating Center (TUPTC) – Faculty of Medicine - Tanta University throughout the period of the start of April 2020 to the end of March 2021. These patients served as the derivation group. Then patients admitted during the following three months from the start of April 2021 to the end of June 2021 were included as the validation group. The study was carried out after the approval of the medical research ethical committee - Faculty of Medicine - Tanta University.

A written informed consent was taken from each patient or his/her legal guardians (if he/she was unfit to sign the consent) after receiving detailed information about this study. Confidentiality of patients' data were maintained by using a code for each patient.

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Inclusion criteria: Both male and female patients aged 18 years old or more with history of acute poisoning and were admitted within 24 hours of acute poisoning were included in this study. Diagnosis was based on history of exposure, availability of drug tablets or bottles brought by the patient or his relatives, characteristic clinical manifestations (symptoms and sign) and laboratory investigations if available.

Comment [SMEA4]: signs

Exclusion criteria: The current study excluded patients with history of chronic diseases such as cardiac, respiratory, hepatic, and renal. In addition, patients who received any medical intervention before admission or those with associated trauma (especially head trauma) were also excluded.

Methods: All participants were subjected to the following:

History taking: Socio-demographics (age and gender) and toxicological history (name of the drug or substance used, route of exposure, mode of poisoning and time elapsed before hospital admission) were taken.

Clinical Examination: Vital signs (pulse, blood pressure, respiratory rate and temperature) were measured and level of consciousness was assessed by GCS.

Laboratory investigations: Before giving any medication and under complete aseptic conditions, one milliliter arterial blood samples were collected from each patient in heparinized syringes to avoid coagulation of blood. These samples were used to perform ABG analysis including pH, bicarbonate level (HCO_3), partial arterial carbon dioxide pressure ($PaCO_2$), partial arterial oxygen pressure (PaO_2), and O_2 saturation. In addition, five-milliliter venous blood samples were obtained to perform routine laboratory investigations (liver enzymes, blood urea, serum creatinine, random blood glucose, serum electrolytes levels and complete blood count) for each patient to

confirm the diagnosis and to exclude patients who didn't fulfil the criteria of the study.

Treatment: All patients were treated according to protocol of treatment in TUPTC.

Assessment of Patients' Outcome: Survival or death of the patients.

Statistical analysis: Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 26. For quantitative data, the Shapiro-Wilk test for normality was performed. Normally distributed continuous numerical variables were summarized as mean ± standard deviation (SD) and the comparisons between two groups were done using the independent samples T-test. Numerical variables that did not follow the normal distribution were summarized using the median and interquartile range (IQR); Mann-Whitney test was used to compare two unpaired groups. Categorical variables were summarized as frequencies. Pearson's Chi square test for independence, Fisher's exact test or Fisher-Freeman-Halton exact test were used to examine association between two categorical variables.

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Results

A total of 584 patients met the eligibility criteria during the study period and were enrolled in the study; 444 patients belonged to the derivation group and 140 patients served as the validation group. The age of all studied patients ranged between 18 and 65 years with a mean value of 26.8 ± 9.3 years, females and males were nearly equally presented (51.5% and 48.5% respectively), and pesticides were the most common reported poison (57.2%) followed by psychotropic drugs (9.6%). Most patients were exposed to toxins by ingestion (88.2%) and alleged suicidal poisoning (91.1%). The pre-hospitalization period ranged from 3 to 24 hours with a median value of 2.5 hours. Mortality was represented in 5.8% of all patients included in the current study (**Table 1).**

Vital signs, GCS, and ABG were demonstrated in **Table (2).** For all patients, the median values of pulse, SBP, and diastolic blood pressure (DBP) were 90 beats/minute, 120 mmHg, and 80 mmHg respectively. The mean values of the respiratory rate and temperature were 21.5 ± 5.5 breaths/minute and 37.0 ± 0.3 ºC respectively. Regarding GCS, the lowest score reported in all patients was 3 and the highest score was 15 with a median value of 15**.** Statistical analysis of ABG showed that blood pH ranged from 7.05 to 7.65 with a mean value of 7.43 ± 0.08 and $PaCO_2$ ranged from 11.4 to 68.7 mmHg with a median value of 31.4 mmHg. The range of HCO_3 was from 5.8 to 46.0 with a mean value of 21.3 ± 4.9 mEq/L. Oxygen saturation ranged from 18% to 100% and the mean value was 95 ± 10.8%**.**

Statistical analysis of the current study revealed absence of significant differences between the derivation group and the validation group regarding baseline socio-demographics, toxicological data, vital signs, GCS, ABG, and outcome **(Table 1 and 2).**

Development of an outcome prediction score:

Comparison of socio-demographics and toxicological data between survivors and non-survivors in the derivation group is illustrated in **Table (3).** No significant difference was observed between survivors and non-survivors regarding age (mean value ± SD: 26.5 ± 9.2 and 28.8 ± 11.1 years respectively). It was found that 65.4% of non-survivors were females with no significant association between gender and mortality. Pesticides were responsible for 92.3% of mortality and all non-survivors alleged ingestion of the toxins and suicidal intention with no significant association between mortality and each of poison category, route of exposure, and alleged mode of poisoning. On the other hand, the median value of delay time was significantly lower in non-survivors (1.5 hours) compared to survivors (2.8 hours) **(P=0.020)**.

Table (4) compares vital signs and ABG between survivors and non-survivors. The median values of SBP and DBP of non-survived patients (70 mmHg and 40 mm/Hg respectively) were significantly lower than survivors (120 mmHg and 80 mmHg respectively) **(P<0.001).** Similarly, the mean value of temperature in non-survivors (36.8 ± 0.3 ºC) was significantly lower in comparison with survivors (37.0 ± 0.3 ºC) (**P= 0.016).** On the other hand, the mean value of respiratory rate was significantly higher in non-survivors (26.3 ± 6.4 breaths/minute) rather than the survivors (21.3 ± 5.2 breaths/minute) **(P= 0.001).** Additionally, GCS had a non-significant difference between survivors and non-survivors **(P=0.424).** For ABG, the mean values of blood pH, serum HCO_3, and O_2 saturation of non-survived patients (7.37 ± 0.12, 21.8 ± 4.3 mEq/L and 87.4 ± 8.9% respectively) were significantly lower compared to survived patients (7.43 ± 0.08, 14.2 ± 3.9 mEq/L, and 95.8 ± 9.4% respectively). Similarly, the median value of $PaCO_2$ of non-survived patients (22.5 mmHg) was significantly lower than the median value of survived patients (31.7 mmHg) **(P< 0.001).**

Statistical analysis revealed that each of SBP, DBP, respiratory rate, temperature, blood pH, $PaCO_2$, serum HCO_3, and O_2 saturation were significantly valid to predict mortality according to ROC analysis **(P< 0.05)**. On the other hand, pulse was not significantly valid for this task **(P= 0.063).** Values of AUCs, cut off, sensitivity, and specificity are demonstrated in **Table (5).**

In order to develop a mortality prediction score, backward stepwise binomial logistic regression was used to identify the most significant predictive variables. These variables were SBP, serum HCO_3 and O_2 saturation **(Table 6)**.

As demonstrated in **Table (7),** the proposed score used SBP, serum HCO_3 and O_2 saturation to predict the mortality. If SBP > 100 mmHg this means score = zero while if SBP ≤ 100 mmHg this means score = 1. If serum HCO_3 > 16.6 mEq/l this means score = zero while if serum $HCO_3 \leq 16.6$ mEq/L this means score = 1. If O_2 saturation > 93% this means score = zero while if O_2 saturation ≤ 93% this means score =1. The total score had a range from 0 (the best score) to 3 (the worst score).

The accuracy of the proposed score was assessed by ROC curve analysis. It showed excellent performance (AUC: 0.952) at cut-off more than 1 point with 91.3% sensitivity and 94.9% specificity as illustrated in **Figure (1).**

Validation of the proposed score:

The proposed score was validated on a new set of 140 patients with acute poisoning (the validation group) using ROC curve analysis. As illustrated in **Figure (2)**, AUC of the proposed score was 0.965 when cut-off value >1 point was used with 87.5% sensitivity and 93.8% specificity.

Discussion

Acute poisoning is one of the major problems facing the globe and represents a significant cause of morbidity and mortality worldwide. Applications of scoring systems as a tool of triage may help to identify high-risk acutely poisoned patients, facilitate early management decision making and decreasing unnecessary tests and expenses **[8, 9].** Different scores have been used to predict the outcome of acute poisoning including poisoning severity score and acute physiology and chronic health evaluation II score. However, large number of variables of these scores makes them difficult to be applied and consumes more time **[10, 11].** Hence, the current study was designed to develop and validate a simple score as a tool of triage to predict the outcome of acutely poisoned patients based on relatively small number of objective variables including vital signs, GCS, and ABG analysis.

Socio-demographics and toxicological data as well as results of base line clinical characteristics and laboratory investigations obtained from patients included in the present study were more or less comparable to data obtained from previous studies conducted in different toxicological centers in Egypt and worldwide **[12, 13, 14, 15, 16, 17].**

In the current study, mortality was reported in 5.8% of all patients. Previous studies showed a variation in mortality rates as an outcome of acute poisoning. **Abdelhamid [18]** and **Ali et al. [19]** reported mortality rates of 0.7% and 16.09% of their studied poisoned patients respectively. This difference could be explained by the difference in the poisoning severity, type of poison, time lag before treatment and availability of supportive and emergency care.

Comparison of socio-demographics between survivors and non-survivors in the current study revealed that the mean value of the age of non-survivors was 28.8 ± 11.1 years with no significant difference between survivors and non-survivors. Additionally, 65.4% of non-survivors were females and there was no significant association between gender and mortality**. Goga et al. [20]** reported similar findings. In contrast, **Yu et al. [5]** reported a higher mean value of the age of non-survivors (50.9 ± 17.8 years) with a significant difference between survivors and non-survivors. **Z'gambo et al. [14]** showed that 78.3% of non-survivors were males with a significant association between gender and mortality resulting from acute poisoning**.**

In the present study, pesticides were responsible for 92.3% of fatalities. Pesticides are easily available and widely used in suicidal attempts in developing countries. Moreover, Al.Ph is associated with high mortality especially with lack of a specific antidote **[21].** This finding was also attained by previous studies **[5, 21, 22].**

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It was recorded that all non-survivors alleged suicide and oral ingestion with no significant association between the route or mode of poisoning and mortality. These results are in partial agreement with **Z'gambo et al. [14]** who noted that 100% of non-survivors alleged suicidal poisoning with 73.9% of them were intoxicated by oral route but they reported a significant association between the route of exposure and mortality**.** Additionally, **Mete et al. [23]** showed that the mortality was significantly higher in patients poisoned by the parenteral route**.**

According to the current study, the median value of delay time in non-survivors (1.5 hours) was significantly lower than that of survivors (2.8 hours). In fact, poison categories associated with fatalities usually display serious and dangerous manifestations that push the patient to seek rapid medical intervention.

Vital signs play a crucial role in the field of clinical toxicology as they can be affected by poisonous agents through the sympathetic and/or parasympathetic pathways thus they are postulated to offer important physiologic cues for the severity of poisoning and outcome **[24].** In the current study, the median value of the heart rate in non-survivors was 80 beats/minute and there was no significant difference between survivors and non-survivors. **Zaghary et al. [25]** showed that the mean value of heart rate in non-survived poisoned cases was 96.0 ± 26 beats/minute and also observed absence of significant difference between survivors and non-survivors. Contrary to this, **Yu et al. [5]** and **Oreby et al. [26]** noted statistically significant differences between survivors and non-survivors regarding the heart rate.

In the present study, the median values of each of SBP and DBP in non-survived patients were significantly lower compared to survivors. This could be explained by hemodynamic instability, cardiogenic or vascular shock that may occur in most of the non-survivors. Similar findings were reported by **Zaghary et al. [25]** who noted a significant difference between survivors and non-survivors regarding SBP and DBP.

While **Yu et al. [5]** noted that DBP showed a significant difference between survivors and non-survivors while SBP didn't show any significant difference**.**

This study illustrated that the mean value of respiratory rate in non-survivors (26.3 ± 6.4 breaths/minute) was significantly higher compared to the mean value of respiratory rate in survivors (21.3 ± 5.2 breaths/minute)**.** This could be explained by respiratory distress and metabolic acidosis with compensatory tachypnea to wash CO_2 in most of the non-survivors. In the same line, **Aydin and Cetinkaya [27]** noted that the mean value of respiratory rate in non-survivors (23.8 ± 11.1 breaths/minute) was significantly higher compared to survivors (20.5±3.5 breaths/minute). In contrast, **Zaghary et al. [25]** did not observe any significant difference between survivors and non-survivors regarding respiratory rate.

As regard temperature in the current study, the mean value of temperature in non-survivors (36.8 ± 0.3 ºC) was significantly lower in comparison with survivors (37.0 ± 0.3). This could be attributed to circulatory collapse and hypotension that are mostly found in non-survivors. This coincides with **Yu et al. [5]** who showed that the mean value of the temperature in non-survivors was 36.1 ± 1.2 ºC with a significant difference between survivors and non-survivors. Additionally, **Aydin and Cetinkaya [27]** revealed that the mean value of temperature in non-survivors was 36.6 ± 0.93 ºC.

Concerning GCS, the present study revealed no significant difference between survivors and non-survivors. However, this disagrees with **Ali et al. [28]** who noted that low GCS is associated with increased mortality especially when GCS was below 8/15. Moreover, **Mete et al [24]** showed that GCS in non-survived patients was significantly lower than in survivors.

Arterial blood gases analysis is one of the most common in-hospital ordered tests and its results are likely to influence the patient's outcome and management as they reflect respiratory and metabolic events **[29].** In the current study, blood pH in non-survivors ranged between 7.12 and 7.52 with a mean value of 7.37 ± 0.12 which was significantly lower when compared to survivors (7.43 ± 0.08)**.** Moreover, it was detected that serum HCO_3 in non-survivors ranged from 6.3 to 20.8 mEq/L with mean value of 14.2 ± 3.9 mEq/L. In addition, there was a significant difference between survivors and non-survivors regarding serum HCO_3. **Aydin and Cetinkaya [27]** noted that blood pH in non-survived poisoned patients ranged from 6.7 to 7.2 with a median value of 6.91 and the serum HCO_3 ranged from 5.5 to 17.8 mEq/L with a median value of 11.7 mEq/L. In the same context, **Goga et al. [20]** showed that the median value of blood pH in non-survivors was 7.23 and the serum HCO_3 ranged from 12.5 to 23.7 mEq/L with a median value of 17 mEq/L.

$PaCO_2$ in non-survivors in the current study ranged from 14.5 to 50 mmHg with a median value of 22.5 mmHg. Moreover, there was a significant difference between survivors and non-survivors regarding $PaCO_2$. Reference-wise, **Aydin and Cetinkaya [27]** noted that the $PaCO_2$ in non-survived acute poisoned cases ranged from 24 to 78 with a median value of 53 mmHg. **Goga et al. [20]** showed that the median value of $PaCO_2$ in non-survivors was 5.2 mmHg with no significant difference between survivors and non-survivors.

In addition, the current results showed that O_2 saturation was significantly lower in non-survivors than survivors with mean values of 87.4 ± 8.9% and 95.8 ± 9.4% respectively.

In the present study, ROC curve analysis was used to predict potential factors for prediction of mortality in patients with acute poisoning. It revealed that each of SBP, DBP, respiratory rate, temperature, blood pH, $PaCO_2$, serum HCO_3 and O_2 saturation

were significantly valid to predict mortality. On the other hand, pulse was not significantly valid to predict mortality.

Various studies were conducted to predict mortality in acute poisoning. **Borron [30]** showed that high anion gap is the most significant risk factor for death, regardless of the accompanying acid-base balance status in patients with acute intoxication. Additionally, **Han et al. [31]** found in their Korean study on 42568 cases that SBP, heart rate, respiratory rate, body temperature and mental status were significant parameters in predicting mortality in acute poisoning. Moreover, **Zaghary et al. [25]** noted that SBP and DBP were the most significant factors in the prediction of mortality, while pulse, temperature and respiratory rate showed non-significant differences between survivors and non-survivors.

Backward stepwise binomial logistic regression was done and identified three independent variables that contributed significantly to the score. These variables were SBP, serum HCO_3 and O2 saturation.

The accuracy of the proposed mortality score was assessed by using ROC curve analysis and showed that its discriminatory power in the derivation group was excellent (AUC: 0.952) at a cut-off >1. Moreover, it showed 91.3% sensitivity; this means that at a cut-off more than 1, 91.3% of acutely poisoned patients who died were correctly identified. In addition, the specificity of the mortality score was 94.9% at a cut-off > 1. This means that at cut-off more than 1, 94.9% of acutely poisoned patients who survived were correctly identified.

The proposed score was validated on a new set of 140 patients with acute poisoning (the validation group) using ROC curve analysis. A cut-off value >1 point, it showed excellent performance (AUC: 0.965) with 87.5% sensitivity and 93.8% specificity.

Ebrahimi et al. [32] compared 3 scoring systems (SOFA, APACHE 4, PSS) for prediction of short-term clinical outcome and mortality in acutely poisoned patients in their study on 120 patients in Iran. They found that the AUC of these scores was 0.897, 0.808 and 0.786 at cut off points of >7.5, ≥65.5 and ≥2 respectively. The sensitivity of these scores was 70.6, 90.2 and 2% respectively and the specificity was 94.4, 44.4 and 100% respectively. Moreover, **Zaghary et al. [25]** compared the effectiveness of four different scores (PSS, Reed, modified APACHE II and GCS) in prediction of mortality in patients with acute poisoning. They showed that PSS was the best predictor (AUC of 0.92 at a cut off >2), followed by Reed scale (AUC= 0.866 at a cut off >1), then the modified APACHE II (AUC= 0.848 at a cut off >9). The worst predictor was the GCS (AUC= 0.809 at a cut off <9). The sensitivity of these scores were 100%, 88%, 64% and 64% respectively while the specificity of those scores were 73.33%, 61.3%, 85.3% and 81.3% respectively. Furthermore, **Slima, [33]** in her study used the APACHE II score for prediction of mortality. She revealed that the AUC of the APACHE II score was 0.797 at a cut-off value ≥ 12.5. She added that its sensitivity was 75.9% and its specificity was 72.4%. Although that the scores used in the mentioned studies had fair to excellent accuracy in prediction of mortality in acutely poisoned patients with more or less high sensitivities and specificities, their assessment is difficult in the emergency situations because of their large number of variables. On the other hand, the score proposed in the current study is simple and consists of parameters ready in hands that could be used rabidly without consuming a lot of time.

Conclusions

The most significant factors that could predict in-hospital mortality due to acute poisoning were O_2 saturation, SBP and serum HCO_3. The scores constructed in the

present study could be displayed as tools for triage to identify acutely poisoned patients who are at risk of mortality as they are simple, easy and can be applied rabidly with ready in hand parameters. In addition, they are validated and so they could be used in other population.

Comment [SMEA7]: rapidly

Comment [SMEA8]: populations

References:

1. Khodabandeh F, Shahin S and Matien P (2018): "Performance Assessment of the Acute Physiology and Chronic Health Evaluation IV Scoring System in Outcome of Patients fallowing Acute Poisoning". Novelty in Biomedicine J; 6(4): 174-179.
2. Askim Å, Moser F, Gustad LT, Stene H, Gundersen M, Åsvold BO and Solligård E (2017): "Poor performance of quick-SOFA (qSOFA) score in predicting severe sepsis and mortality–a prospective study of patients admitted with infection to the emergency department". Scandinavian journal of trauma, resuscitation and emergency medicine, 25(1): 1-9.
3. Brandenburg R, Brinkman S, De Keizer NF, Kesecioglu J, Meulenbelt J and de Lange DW (2017): "The need for ICU admission in intoxicated patients: a prediction model". Clinical Toxicology J., 55(1): 4-11.
4. Schwarz ES, Kopec KT, Wiegand TJ, Wax PM and Brent J (2017): "Should we be using the poisoning severity score?". Medicine Toxicology J., 13(2): 135-145.
5. Yu JH, Weng YM, Chen KF, Chen SY and Lin CC (2012): "Triage vital signs predict in-hospital mortality among emergency department patients with acute poisoning a case control study". BMC Health Services Research, 1(12): 262.
6. Kulkarni A, Saxena M, Price G, Oleary MJ, Jacques T and Myburgh JA (2005): "Analysis of blood glucose measurements using capillary and arterial blood samples in intensive care patients". Intensive care medicine J., 1(3):142-145.
7. Teasdale G, Maas A, Lecky F, Manley G, Stocchetti N and Murray G (2014): "The Glasgow Coma Scale at 40 years standing the test of time". The Lancet Neurology J., 8(13): 844-854.
8. Jayaweera D, Mitter S, Grouse A, Strachan L, Murphy M, Douglass D and Gunja N (2014): "A comparison of emergency triage scales in triaging poisoned patients". Australasian emergency nursing journal, 17(4): 184-189.
9. Alinejad S, Zamani N, Abdollahi M and Mehrpour O (2017): "A narrative review of acute adult poisoning in Iran". Iranian journal of Medical Sciences, 42(4): 327.
10. Knaus WA, Draper EA, Wagner DP and Zimmerman JE (1985): "APACHE II: a severity of disease classification system". Critical Care Medicine J., 13(10): 818-829.
11. Schwarz ES, Kopec KT, Wiegand TJ, Wax PM and Brent J (2017): Should we be using the poisoning severity score?". Medicine Toxicology J., 13(2): 135-145.
12. Acherjya GK, Ali M, Alam ABMS, Rahman MM and Mowla SGM (2020): "The Scenario of Acute Poisoning in Jashore, Bangladesh". Journal of Toxicology, 1-7.
13. Ahmadi A, Pakravan N and Ghazizadeh Z (2010): "Pattern of acute food, drug and chemical poisoning in Sari City, Northern Iran". Human & Experimental Toxicology J., 29(9): 731-738.
14. Z'gambo J, Siulapwa Y and Michelo C (2016): "Pattern of acute poisoning at two urban referral hospitals in Lusaka, Zambia". BMC Emergency Medicine J., 16(1): 1-8.
15. Wahdan AA, Heshmat MM, Maklad AI, Elsheikh RG and Elmadah EI (2012): "Study of Electrocardiographic Changes Associated with Acute Poisoning". Master Thesis, Faculty of Medicine, Tanta: Tanta University.
16. Bhandari R, Bhandari R and Gupta PP (2018): "Trend and outcome of acute poisoning case: an experience from emergency department of eastern Nepal". International Journal of Community Medicine and Public Health, 5(1): 66-71.

17. Sacak ME, Akoglu H, Onur O and Altinok AD (2021): "An analysis of 1344 consecutive acute intoxication cases admitted to an academic emergency medicine department in Turkey". Northern clinics of Istanbul, 8(4): 377-384.
18. Abdelhamid WG (2021): "Evaluation of severity of poisoning exposures among patients presented to Poison Control Center, Ain Shams University Hospitals, Egypt during 2019". Ain Shams Journal of Forensic Medicine and Clinical Toxicology, 36(1): 106-122.
19. Ali I, Sawlani KK, Himanshu D, Chaudhary SC, Usman K, Atam V and Mohd PK (2017): "Study of pattern and outcome of acute poisoning cases at tertiary care hospital in north India". Evid Based Med Healthc. J., 4(6): 2349-2570.
20. Goga R, De Vasconcellos K and Singh D (2021): "Acute poisonings presenting to King Edward VIII hospital intensive care unit in Durban, South Africa". Southern African Journal of Critical Care, 37(1): 10-15.
21. Boedeker W, Watts M, Clausing P and Marquez E (2020): "The global distribution of acute unintentional pesticide poisoning: estimations based on a systematic review". BMC Public Health J., 20(1): 1-19.
22. Ramesha KN, Rao KB and Kumar GS (2009): "Pattern and outcome of acute poisoning cases in a tertiary care hospital in Karnataka, India". Indian journal of critical care medicine: peer-reviewed, official publication of Indian Society of Critical Care Medicine, 13(3)*:* 152.
23. Mete A, Atalay H and Serin S (2019): "Evaluation of Poisoining Cases Accepted at Intensive Care Unit 5 Year Retrospective Analysis". WPRJ., 8: 106-19.
24. Hoffman RS, Howland M, Lewin NA, Nelson LS and Goldfrank LR (2015): "Initial evaluation of the patient: vital signs and toxic syndromes". In: Goldfrank's Toxicologic Emergencies. Hoffman RS, Howland M, Nelson LS, Lewin NA and Goldfrank LR (eds.) 10th ed". United States: McGraw-Hill Education. 99.
25. Zaghary MMS, Radwan RA and Elsayed RM (2021): "Validity of Vital Signs, Coma Scales and Modified APACHE Score in Prediction of Prognosis and Outcome of Acutely Poisoned Patients". The Egyptian Journal of Hospital Medicine, 85(1): 2758-2766.
26. Oreby M, Maklad A, Shihab N and Kassem H (2016): "Prediction of Outcome of Acutely Intoxicated Patients Admitted to Intensive Care Unit in Mansoura-Dakhlia Governorate-Egypt". Ain Shams Journal of Forensic Medicine and Clinical Toxicology, 26(1): 140-150
27. Aydin K and Cetinkaya A (2020): "Retrospective Review of Cases of Intoxication in Medical Intensive Care Unit. Dahili ve Cerrahi Bilimler Yoğun Bakım Dergisi". Journal of Medical and Surgical Intensive Care Medicine, 11(3): 1-7.
28. Ali Z, Rahman AMA, Muhammad R, Rahim A, Ur Rahman SK, Ullah N and Alam I (2018): "Outcome and Predictors of in-Hospital Mortality in Patients Presenting with Acute Poisoning to A Teaching Hospital". Journal of Postgraduate Medical Institute, 32:2
29. Chandran J, D'Silva C, Sriram S and Krishna B (2021): "Clinical Utility of Arterial Blood Gas Test in an Intensive Care Unit: An Observational Study". Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine, 25(2): 172.
30. Borron SW (2017): "Acid–Base Balance in the Poisoned Patient". In: Critical Care Toxicology. Borrron SW (ed.) 2nd ed. Texas; 325: 358.

31. Han KS, Kim SJ, Lee EJ, Shin JH, Lee JS and Lee SW (2020): "Prediction of Mortality in a Patient with Acute Poisoning". Crit Care J., 25: 29.
32. Ebrahimi K, Raigani AAV, Jalali R and Rezaei M (2018): "Determining and Comparing Predictive and Intensity Value of Severity Scores "Sequential Organ Failure Assessment Score" "Acute Physiology and Chronic Health Evaluation 4," and "Poisoning Severity Score"–in Short-Term Clinical Outcome of Patients with Poisoning in an ICU". Indian journal of critical care medicine: peer-reviewed, official publication of Indian Society of Critical Care Medicine, 22(6): 415.
33. Slima SR (2021): "Predictors of Mortality in Acutely Intoxicated Patients Admitted to Intensive Care Unit in Menoufia University Hospital". The Egyptian Journal of Forensic Sciences and Applied Toxicology, 21(2): 1-7

Abbreviations:
ABG**:** arterial blood gases
AUC: area under curve
CI: confidence interval
DBP**:** diastolic blood pressure
GCS: Glasgow Coma Scale
HCO_3: bicarbonate
$PaCO_2$**:** partial arterial carbon dioxide pressure
PaO_2**:** partial arterial oxygen pressure
pH: potential hydrogen
SBP**:** systolic blood pressure
TUPTC**:** Tanta University Poisoning Treating Center

Table (1): Baseline socio-demographics, toxicological data, and outcome of all studied patients (n= 584)

Variables		Cohort			Tests of significance	
		Total (n=584)	Derivation (n=444)	Validation (n=140)	Test statistic	P value
Age (years)	Mean ± SD	26.8 ± 9.3	26.6 ± 9.3	27.5 ± 9.5	0.999[a]	0.318
	Min-Max	18.0 – 65.0	18.0 - 65.0	18.0 - 63.0		
Gender	Female	301 (51.5%)	235 (52.9%)	66 (47.1%)	1.426[b]	0.232
	Male	283 (48.5%)	209 (47.1%)	74 (52.9%)		
Poison category	Pesticides	334(57.2%)	257(57.9%)	77 (55.0%)	27.274[c]	0.098
	Psychotropic drugs	56 (9.6%)	43 (9.7%)	13 (9.3%)		
	Cardio-toxic drugs	33 (5.7%)	26 (5.9%)	7 (5%)		
	Mixed drugs	31 (5.3%)	20 (4.5%)	11 (7.9%)		
	Analgesics/anti-inflammatory drugs	25 (4.3%)	15 (3.4%)	10 (7.1%)		
	Opioids	16 (2.7%)	12 (2.7%)	4 (2.9%)		
	Corrosives	14 (2.4%)	13 (2.9%)	1 (0.7%)		
	Sedative hypnotics drugs	13 (2.2%)	11 (2.5%)	2 (1.4%)		
	Carbon monoxide	11 (1.9%)	8 (1.8%)	3 (2.1%)		
	Hypoglycemic drugs	10 (1.7%)	9 (2.0%)	1 (0.7%)		
	Alcohols	9 (1.5%)	5 (1.1%)	4 (2.9%)		
	Anticonvulsants	9 (1.5%)	9 (2.0%)	0 (0.0%)		
	Muscle relaxant drugs	6 (1.0%)	5 (1.1%)	1 (0.7%)		
	Food poisoning	5 (0.9%)	3 (0.7%)	2 (1.4%)		
	Anticoagulants	3 (0.5%)	2 (0.5%)	1(0.7%)		
	CNS stimulants	3 (0.5%)	3 (0.7%)	0 (0.0%)		
	Anticholinergics	2 (0.3%)	0 (0.0%)	2 (1.4%)		
	Heavy metals (iron)	2 (0.3%)	2 (0.5%)	0 (0.0%)		
	Colchicine	1 (0.2%)	0 (0.0%)	1 (0.7%)		
	Aphrodisiacs	1 (0.2%)	1 (0.2%)	0 (0.0%)		
Route of exposure	Ingestion	515 (88.2%)	394 (88.7%)	121(86.4%)	3.580[c]	0.455
	Inhalation	46 (7.8%)	34 (7.6%)	12 (8.6%)		
	Injection	18 (3.1%)	11 (2.5%)	7 (5%)		
	Mixed ingestion and inhalation	4 (0.7%)	4 (0.9%)	0 (0%)		
	Mixed inhalation and injection	1 (0.2%)	1 (0.2%)	0 (0%)		
Alleged mode of poisoning	Alleged accidental poisoning	52 (8.9%)	37 (8.3%)	15 (10.7%)	0.744[b]	0.388
	Alleged suicidal poisoning	532 (91.1%)	407 (91.7%)	125(89.3%)		
Delay time	Median	2.5	2.5	2.0	0.779[d]	0.436

(hours)	IQR	1.0 – 5.0	1.0 - 5.0	1.0 – 4.5		
	Min-Max	0.3 – 24.0	0.3 - 24.0	0.5 – 24.0		
	Mean rank		278.9	266.5		
Mortality	No	550 (94.2%)	418 (94.1%)	132 (94.3%)	0.004[b]	0.950
	Yes	34 (5.8%)	26 (5.9%)	8 (5.7%)		

n: number; a: independent samples T-test; b: Pearson's Chi-square test for independence; c: Fisher-Freeman-Halton exact test; d: Mann-Whitney test; SD: standard deviation; IQR: interquartile range; Min: minimum; Max: maximum; * significant at p<0.05.

Table (2): Baseline vital signs, glasgow coma scale score and arterial blood gases of all studied patients obtained on admission (n= 584)

Variables		**Cohort**			**Tests of significance**	
		Total (n=584)	**Derivation (n=444)**	**Validation (n=140)**	**Test statistic**	**P value**
Pulse (Beats/minute)	Median	90.0	90.0	86.5	0.726 [a]	0.468
	IQR	75.0- 105.0	75.0 - 104.5	73.0 - 106.5		
	Min-Max	37.0- 166.0	37.0 - 166.0	40.0 - 150.0		
	Mean rank		295.3	283.5		
Systolic blood pressure (mmHg)	Median	120.0	120.0	120.0	0.190 [a]	0.849
	IQR	110.0 – 130.0	110.0 - 130.0	110.0 - 130.0		
	Min-Max	40.0 – 180.0	40.0 - 180.0	40.0 - 180.0		
	Mean rank		291.8	294.8		
Diastolic blood pressure (mmHg)	Median	80.0	80.0	80.0	0.012 [a]	0.991
	IQR	70.0 – 80.0	70.0 - 80.0	70.0 - 80.0		
	Min-Max	20.0- 110.0	20.0 - 110.0	20.0 - 100.0		
	Mean rank		292.5	292.6		
Respiratory rate (breaths/minute)	Mean ± SD	21.5 ± 5.5	21.6 ± 5.4	20.6 ± 5.6	1.821[b]	0.070
	Min-Max	4.0 – 50.0	4.0 – 50.0	5.0 – 50.0		
Temperature (ºC)	Mean ± SD	37.0 ± 0.3	37.0 ± 0.3	36.9 ± 0.3	1.557 [b]	0.120
	Min-Max	36.0- 40.0	36.0- 40.0	36.0 - 38.2		
GCS score	Median	15	15	15	1.749 [a]	0.080
	IQR	15 – 15	15 – 15	15 – 15		
	Min-Max	3 – 15	3 – 15	3 – 15		
	Mean rank		296.8	279.0		
Blood pH	Mean ± SD	7.43 ± 0.08	7.43 ± 0.08	7.43 ± 0.09	0.517 [b]	0.606
	Min-Max	7.05 – 7.65	7.05 - 7.65	7.10 - 7.62		
$PaCO_2$ (mmHg)	Median	31.4	31.4	31.3	0.481 [a]	0.630
	IQR	25.9 – 37.0	26.4 – 36.9	24.8 – 37.8		
	Min-Max	11.4 – 68.7	13.0 – 68.7	11.4 – 52.7		
	Mean rank		256.8	249.5		
Serum HCO_3 (mEq/L)	Mean ± SD	21.3 ± 4.9	21.4 ± 4.6	21.1 ± 5.5	0.514 [b]	0.607
	Min-Max	5.8 – 46.0	6.2 - 36.1	5.8 – 46.0		
O_2 Saturation (%)	Mean ± SD	95.0 ± 10.8	95.3 ± 9.6	94.0 ± 13.9	1.082 [b]	0.280
	Min-Max	18.0 – 100.0	18.0 - 100.0	20.0 - 100.0		

n: number; a: Mann-Whitney test; b: independent samples T-test; IQR: interquartile range; Min: minimum; Max: maximum; SD: standard deviation; $PaCO_2$: partial pressure of carbon dioxide;

HCO_3: bicarbonate; O_2 saturation: oxygen saturation; %: percentage; mmHg: millimeter mercury; mEq/L: milliequivilant per liter; ºC: Degree centigrade; GCS: Glasgow Coma Scale; * significant at $p<0.05$.

Table (3): Socio-demographics and toxicological data of the survivors and non-survivors in the derivation group (n=444)

Variables		Mortality		Tests of significance	
		Survivors (n=418)	Non survivors (n=26)	Test static	P value
Age (years)	Mean ± SD	26.5 ± 9.2	28.8 ± 11.1	1.253 [a]	0.211
	Min-Max	18.0 - 65.0	18.0 - 55.0		
Gender	Female	218 (52.2%)	17 (65.4%)	1.720 [a]	0.190
	Male	200 (47.8%)	9 (34.6%)		
Poison category	Alcohol	5 (1.2%)	0 (0%)	12.609[b]	0.0676
	Analgesics/anti-inflammatory	15 (3.6%)	0 (0%)		
	Anticoagulant	2 (0.5%)	0 (0%)		
	Anticonvulsants	8 (1.9%)	1 (3.8%)		
	Cardio-toxic drug	25 (6%)	1 (3.8%)		
	CNS stimulant	3 (0.7%)	0 (0%)		
	Corrosives	13 (3.1%)	0 (0%)		
	Food poisoning	3 (0.7%)	0 (0%)		
	Carbon monoxide	8 (1.9%)	0 (0%)		
	Heavy metals	2 (0.5%)	0 (0%)		
	Hypoglycemic drugs	9 (2.2%)	0 (0%)		
	Mixed drugs	20 (4.8%)	0 (0%)		
	Muscle relaxants	5 (1.2%)	0 (0%)		
	Opioids	12 (2.9%)	0 (0%)		
	Pesticides	233 (55.7%)	24 (92.3%)		
	Psychotropic drugs	43 (10.3%)	0 (0%)		
	Sedative hypnotics	11 (2.6%)	0 (0%)		
	Aphrodisiacs	1 (0.2%)	0 (0%)		
Route of exposure	Ingestion	368 (88%)	26 (100%)	3.456 [b]	0.519
	Inhalation	34 (8.1%)	0 (0%)		
	Injection	11 (2.6%)	0 (0%)		
	Mixed ingestion and inhalation	4 (1%)	0 (0%)		
	Mixed ingestion and injection	1 (0.2%)	0 (0%)		
Alleged mode of poisoning	Alleged accidental poisoning	37 (8.9%)	0 (0%)	FE	0.152
	Alleged suicidal poisoning	381 (91.1%)	26 (100.0%)		
Delay time (hours)	Median	2.8	1.5	2.320 [c]	0.020*
	IQR	1.0 – 5.0	1.0 – 3.0		
	Min-Max	0.3 – 24	1.0 – 5.0		
	Mean rank	215.4	157.4		

n: number; a: independent samples T-test; b: Fisher-Freeman-Halton exact test; FE: Fisher's exact test; c: Mann-Whitney test; IQR: interquartile range; Min: minimum; Max: maximum; SD: standard deviation; * significant at $p<0.05$.

Table (4): Comparison between the survivors and non-survivors in the derivation group as regard vital signs, glasgow coma scale and arterial blood gases (n=444)

Variables		Mortality		Tests of significance	
		Survivors (n=418)	Non-survivors (n=26)	Test statistic	P value
Pulse (beats/minute)	Median	90.0	80.0	1.937 [a]	0.053
	IQR	75.0 – 105.0	68.0 – 98.0		
	Min-Max	37.0 – 166.0	40.0 – 156.0		
	Mean rank	225.4	175.2		
Systolic blood pressure (mmHg)	Median	120.0	70.0	7.544 [a]	<0.001*
	IQR	110.0 – 130.0	40.0 – 90.0		
	Min-Max	40.0 – 180.0	40.0 – 120.0		
	Mean rank	233.8	41.0		
Diastolic blood pressure (mmHg)	Median	80.0	40.0	6.998 [a]	<0.001*
	IQR	70.0 – 80.0	20.0 – 60.0		
	Min-Max	20.0 – 110.0	20.0 – 90.0		
	Mean rank	232.8	56.5		
Respiratory rate (breaths/minute)	Mean ± SD	21.3 ± 5.2	26.3 ± 6.4	3.915 [b]	0.001*
	Min-Max	4.0 - 50.0	14.0 - 38.0		
Temperature (ºC)	Mean ± SD	37.0 ± 0.3	36.8 ± 0.3	2.425 [b]	0.016*
	Min-Max	36.0 – 40.0	36.0 - 37.3		
GCS score	Median	15	15	0.799 a	0.424
	IQR	15 – 15	15 – 15		
	Min-Max	3 – 15	3 – 15		
	Mean rank	223.2	210.9		
Blood pH	Mean ± SD	7.43 ± 0.08	7.37 ± 0.12	2.517 [b]	0.019*
	Min-Max	7.05 - 7.65	7.12 - 7.52		
$PaCO_2$ (mmHg)	Median	31.7	22.5	4.922 [a]	<0.001*
	IQR	27.0 - 37.1	19.3 - 28.8		
	Min-Max	13.0 – 68.7	14.5 – 50.0		
	Mean rank	199.2	84.3		
Serum HCO_3 (mEq/L)	Mean ± SD	21.8 ± 4.3	14.2 ± 3.9	8.285 [b]	<0.001*
	Min-Max	6.2 - 36.1	6.3 - 20.8		
O_2 saturation (%)	Mean ± SD	95.8 ± 9.4	87.4 ± 8.9	4.416 [b]	<0.001*
	Min-Max	18.0 - 100.0	67.0 - 99.0		

n: number; a: Mann-Whitney test; b: independent samples T-test; IQR: interquartile range; Min: minimum; Max: maximum; mmHg: millimeter mercury; ºC: Degree centigrade; GCS: Glasgow Coma Scale; SD: standard deviation; $PaCO_2$: partial pressure of carbon dioxide; HCO_3: bicarbonate; O_2 saturation: oxygen saturation; %: percentage; mEq/L; mmHg: millimeter mercury; milliequivilant per liter; * significant at p<0.05.

Table (5): Receiver operating characteristics curve analysis for prediction of mortality using vital signs and arterial blood gases in the derivation group (n= 444)

Variables	AUC	95% CI	p[a]	Cut-off	Sensitivity (%)	Specificity (%)
Pulse (bests/minute)	0.613	0.566 to 0.659	0.063	≤91	73.1	46.9
SBP (mmHg)	0.934	0.907 to 0.955	<0.001*	≤100	84.6	85.9
DBP (mmHg)	0.897	0.865 to 0.924	<0.001*	≤60	80.8	84.7
Respiratory rate (breaths/minute)	0.760	0.717 to 0.799	<0.001*	>20	84.6	62.2

Temperature (ºC)	0.629	0.582 to 0.674	0.022*	≤36.8	38.5	86.1
Blood pH	0.629	0.579 to 0.677	0.044*	≤7.31	34.8	94.8
$PaCO_2$ (mmHg)	0.770	0.728 to 0.808	<0.001*	≤24	61.5	89.5
Serum HCO_3 (mEq/L)	0.908	0.874 to 0.935	<0.001*	≤16.6	82.6	90.7
O_2 Saturation (%)	0.856	0.820 to 0.887	<0.001*	≤93	80.8	90.7

n: number; a: null hypothesis; SBP: systolic blood pressure; DBP: diastolic blood pressure; mmHg: millimeter mercury; ºC: Degree centigrade; O_2 saturation: oxygen saturation; %: percentage; $PaCO_2$: partial pressure of carbon dioxide; mEq/L: milliequivilant per liter; HCO_3: bicarbonate; AUC: area under curve; CI: confidence interval; *significant at p<0.05.

Table (6): Backward stepwise binomial logistic regression for assessing factors affecting the mortality in the derivation group (n=444)

Variables		**B**	**SE**	**Wald**	**P value**	**OR**	**95% CI for OR**	
							Lower	**Upper**
Final model	**SBP≤100** mmHg	2.116	0.743	8.118	0.004*	8.295	1.935	35.551
	HCO3 ≤ 16.6 mEq/L	2.537	0.680	13.939	<0.001*	12.648	3.338	47.921
	O_2 saturation ≤ 93%	2.537	0.680	13.939	<0.001*	12.648	3.338	47.921
	Constant	-5.914	0.761	60.424	<0.001*	0.003		

n: number; B: regression coefficient; SE: standard error; CI: confidence interval; OR: odds ratio; SBP: systolic blood pressure; mmHg: millimeter mercury; HCO_3: bicarbonate; mEq/l: milliequivelant per liter; O_2 saturation: oxygen saturation; %: percentage; * significant at p<0.05.

Table (7): Proposed score to predict mortality in the derivation group (n= 444)

Parameters	**Values**	**Score**
SBP (mmHg)	>100 mmHg	0
	≤ 100 mmHg	1
Serum HCO_3 (mEq/L)	> 16.6 mEq/L	0
	≤ 16.6 mEq/L	1
O_2 saturation (%)	> 93%	0
	≤ 93%	1

n: number; SBP: systolic blood pressure; mmHg: millimeter mercury; HCO_3: bicarbonate; mEq/L: milliequivelant per liter; O_2 saturation: oxygen saturation; %: percentage; * significant at p<0.05.

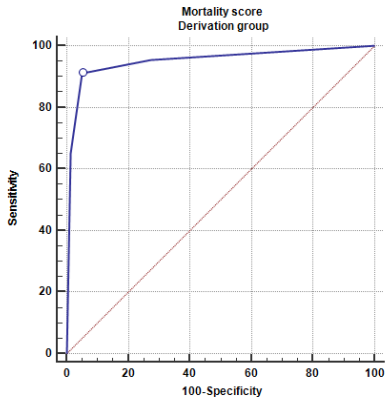

Figure (1): The ROC curve for demonstrating the discriminatory power of the mortality score in the derivation group (n= 444)

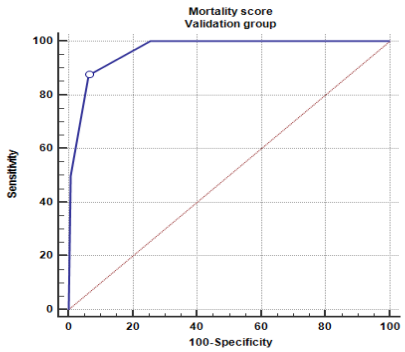

Figure (2): The ROC curve for demonstrating the discriminatory power of the mortality score in the validation group (n= 140)