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## Research Article

**Keywords:** Severity Score, Poisoning, Outcome, Complication, epidemiology, death

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**The relative risk of the Toxicological parameters based on poisoning severity and outcomes in patients with acute poisoning**

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**Abstract** 1

**Background:** Identification of complications or death risk factors in patients with acute poisoning allows better monitoring and treatment. Hence, the aim of this study was to determine the relative risk of toxico-clinical parameters based on poisoning severity and outcomes in patients with acute poisoning. 2  
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**Methods:** This cross-sectional study consisted of patients with acute poisoning admitted to the poisoning emergency room from 2018 to 2019. Patients were categorized into four groups: minor, moderate, severe, and fatal poisoning. Different toxico-clinical parameters were analyzed by multivariate logistic regression. 6  
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**Results:** The most common poisoning in the minor group was opioids, alcohols, and benzodiazepine (14.7%), in the moderate and severe groups was multidrug (23.3%) and in the fatal group pesticides poisoning (23%). Pre-hospital antidote administration (OR, 7.08; P-value, 0.006); low level of consciousness (OR, 4.38; P-value, 0.001); abnormal ECG (OR, 4.56; P-value, 0.003); and time interval of intoxication to admission in the hospital (OR, 1.15; P-value, 0.01) were the predictive factors for poisoning severity. 10  
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49.7% of patients recovered without any complications. Patients with low level of consciousness (OR, 66.06; P-value, 0.01); underlying disease (OR, 3.65; P-value, 0.03); abnormal respiration (OR, 1.14; P-value, 0.02); and longer duration of hospitalization (OR, 1.02; P-value, 0.001) had greater risk of complications/ Death. 16  
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**Conclusions:** In clinical practice, low level of consciousness, pre-hospital antidote administration, abnormal ECG, underlying disease, abnormal respiration, delay to presentation to hospital, and longer length of hospital stay can be considered important factors for determining poisoning severity and outcome. 20  
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**Key words:** Severity Score, Poisoning, Outcome, Complication, epidemiology, death 24

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## Background

Acute poisonings are one of the important medical emergencies considered as an epidemic worldwide (1). In Asian countries, more than 60% of all deaths are occurred due to intoxication(2). In developing countries, the incidence of poisoning is forecasted to be greater than in developed countries due to a lack of monitoring systems with incomplete regulations, an absence of training, insufficient availability of information systems, and large agricultural-based populations(3) .

During the past 10 years, the American Association of Poison Control Centers reported that antidepressant overdose increased most rapidly by 7.02% per year showing more serious outcomes (4). Estimations based on a systematic review showed that 385 million cases of unintentional, acute pesticide poisoning happen annually worldwide consisting of around 11,000 mortalities (5).

Clinicians with recommended criteria could predict disease outcomes, qualitative assessment of the disease, and evaluation of poisoning pattern in patients (6-8). Poisoning Severity Score (PSS) is one of the criteria reported by Persson et al. in 1998 (9). It has been presented that PSS is effective in identifying the severity of intoxication (9, 10). Some factors have been associated with the severity of poisoning including age, intentional poisoning, respiratory and circulatory failure, unresponsiveness, and seizures (11-13). In addition, electrocardiographic signs (14, 15) and biochemical markers also linked with poisoning severity (12).

Identification of complications or death risk factors in poisoning patients allows more intensive monitoring and treatment. Usually, the different scoring systems used in the emergency room selecting patients for the intensive care unit. However, some epidemiological and toxicological variables which may affect the severity and outcome of the poisoning patients, have not been included in these scoring systems. Therefore, the aim of this study was to describe the relative

risk of toxico-clinical parameters on poisoning severity and outcomes in patients with acute poisoning. 1  
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**Methods** 3

This cross-sectional study was conducted in the referral poisoning emergency center of the province. The inclusion criteria consisted of patients with acute poisoning admitted to the poisoning emergency room from 2018 to 2019. Clearance with personal consent, asymptomatic patients, and the lack of sufficient data on the medical file were exclusion criteria. The severity of poisoning was determined based on the variables in the poisoning severity score (PSS) (9). 4  
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Data were obtained from a review of the case notes of the emergency physicians. Chart abstractor (second author) trained before the study starts, using a set of "practice" medical records. Patients were categorized into four groups; minor, moderate, severe, and fatal poisoning. The sample size was determined 300 patients using the confidence interval 95%;  $Z_2=0.55$ , Test power factor 80% (75 patients in each group). The sampling method was nonprobability consecutive samplings. Demographic data ( age, gender, marital status); the history of drug abuse; previous medical or psychiatric history; type of poisoning; route of exposure; kind of substance; time to admission; clinical manifestations; electrocardiogram (ECG) changes; therapeutic modalities (pre-hospital and in-hospital gastrointestinal decontamination, administration of antidote); endotracheal intubation at the time of admission and within 24 hours of admission; length of hospital stay and outcome of the patients (recovery without complication, recovery with complications, and death were recorded in the data collection form. We ensured the uniform handling of the data collection with the consensus meetings. Also, periodic meetings with the chart abstractor (second author) and study coordinators (Corresponding author and First author) were held to resolve disputes and review coding rules. The performance of the chart abstractors was monitored by the corresponding author of the research project.

Data are presented as mean  $\pm$  standard deviation (SD) or standard error (SE), median; and frequency (percentage) as appropriate. We used chi-square/Fisher exact tests and ANOVA for analysis. Also, multivariate logistic regression analysis was employed to calculate the odds ratio (OR) as the estimate of the relative risk of the different variables for the poisoning severity and outcomes. Complications and death combined as a single ordinal variable, comprising two possible outcomes: (0) recovery without complication, (1) complication/death. The P-value less than 0.05 were considered statistically significant. All statistical analyses were conducted using SPSS software version 15 (SPSS Inc. Chicago USA).

## Results

Out of 300 patients studied, 63.7% were male, 37.0% were single, 16.6% had a previous underlying disease, and 34.7% had a history of psychiatry problems. The mean age (SD) of the patients was 34.1 $\pm$ 15.43. 33.0% of patients were addicted. Oral consumption (89.0%) was the most common route of poisoning. The most common poisoning was, opioids, alcohol, and benzodiazepine (14.7%) in the minor group, multi-drugs poisoning (23.3%) in moderate and severe poisoning, and pesticides poisoning (23%) in the fatal group. Details of toxico-clinical characteristics and treatment modalities with respect to poisoning severity are presented in Tables 1 and 2. Men had more severe and fatal poisoning compared with women. We analyzed different parameters between the genders. Intentional poisoning was more common in men (58.1%) compared to women (41.9%) (P- Value, 0.09). Such a difference with respect to the kind of substance between the two genders was detected (P- Value <.0001). Indeed, the most tendencies in males were indicated for opioids and pesticides (75%) and among women for psychotropic agents (84.6%).

The results of multivariate logistic regression to explore factors associated with the severity of poisoning have been shown in Table 3. Kind of substance, level of consciousness, ECG changes, administration of antidote in the pre-hospital setting, and time of ingestion to

admission in the hospital were identified as independent factors associated with the severity of poisoning. 149 recovered without complication (49.7%). One patient in the minor group found a complication. Twenty-three and 52 patients in moderate and severe poisoning groups respectively developed complications during hospitalization. Table 4 reveals the results of multivariate logistic regression to explore factors associated with outcome (complications/Death). Duration of hospitalization, kind of substance, the level of consciousness, respiratory rate, and underlying disease was identified as an independent factor associated with complications/death.

## **Discussion**

Our study provides information on the toxico-clinical characteristics of patients based on the severity of poisoning and its relationship with outcome. The results showed the severity of poisoning (fatal) increased with age similar to other studies (16, 17). Also, the frequency of severe poisoning was higher in men compared with women. The reason may be due to intentional and higher pesticide poisoning in men which may have high mortality. Some studies also showed a higher mortality rate in men (18, 19). In a study related to the trend of fatal poisoning from 1990 to 2015, 40,586 deaths due to poisoning were estimated and from 1998 to 2015, also the fatal cases were mostly in men (20).

In our study, similar to the other study the majority of fatal poisoning was related to suicide attempts (21). Overdoses are reasons for one-fourth of all suicide attempts (22). Psychiatric disorders are one of the more important factors that will be influenced by acute poisoning (1). A history of psychiatric disorders was recorded in 34.7% of our patients. A recent epidemiological study reported 49.8% of patients had psychiatric disorders (23). The prevalence of mental health problems, low prices, and easy access to psychological prescription drugs have made psychological drug abuse a common phenomenon in urban areas (24).

Poisoning with multidrug, pesticides, and opiates were common in severe to fatal groups. But, ethanol or drugs were the most common cause of poisoning in industrialized countries (23). A review study on acute poisoning in adults showed that drug combinations were the most common causes of acute poisoning (25). Cultural differences and access to different drugs in communities can explain this difference. In fact, drug and chemical poisoning is largely influenced by socio-economic and socio-cultural factors.

The results showed that pesticide poisoning was a predictive factor of outcomes in our population. But the large odds ratio may reduce the strength of this association in clinical practice. We did not analyze data based on the different pesticides. Aluminum phosphide, paraquat, and organophosphate poisoning are the most common pesticide intoxication in our society. Since there is no definite treatment for aluminum phosphide and paraquat poisoning, the mortality is higher in these pesticides compared to other pesticides (26). Death due to pesticide poisoning in our study was 66.7 % which is higher when compared to epidemiology reported from developing countries (21% in South-East Asia)(22). However, another study (17) presented that intoxications by opiates, cocaine, and amphetamine had the highest mortality after ICU admission (12.3%). Evaluating demographic differences in suicidal behavior is imperative for the improvement of specific service provisions in EDs (27).

Abnormal ECG predicted the severity of poisoning in our study. Akdur et al, (28) presented that no statistically significant correlation was found between the PSS and QTc intervals. However, Jang et al, (29) presented a significant rising in mortality in patients with prolonged QTc intervals. Also, prolonged QTc interval was a poor indicator for prognosis in organophosphate poisoning in another study (30). Different results were presented concerning the value of ECG including changes in rate and rhythm for assessing poisoning severity and prognosis in cases with organophosphate poisoning (31). In our study, we reported that some

abnormal ECG changes (changes in rate and rhythm) had greater odds of severity poisoning 1  
although we did not categorize them based on the type of abnormality in ECG. 2

Decreased level of consciousness state was also the important factor that predicted both 3  
severities as well as the outcome of the poisoning. Although we did not determine the level of 4  
consciousness based on the Glasgow Coma Scale (GCS), a significant correlation has been 5  
observed between the GCS and PSS scores in another study (28). PSS and GCS were effective 6  
tools for the determination of the severity of organophosphate poisoning(28). Davies et al. (32) 7  
described a similar effect for PSS and GCS in predicting mortality among patients with 8  
organophosphate poisoning. 9

The time interval from poisoning to admission in the hospital was identified as another 10  
independent factor associated with the severity of poisoning as well as the outcome. Alanazil 11  
(33) presented that among toddlers with delayed arrival times, more severe outcomes 12  
particularly in the respiratory, gastrointestinal, muscular, nervous, and kidney problems had 13  
been reported. This time is important regarding the efficiency of emergency department 14  
treatments, especially administering antidotes. Furthermore, a delayed arrival time over the 15  
three hours significantly influences the length of hospital stay (34). Delayed time is highly 16  
dependent on the issue of witnessing the occurrence of poisoning. Emergency department 17  
admission should be performed immediately when a suspected poisoning happened (35). 18

Delaying in a treatment help to elevation drug initial peak serum level, consequently, leads to 19  
irreversible tissue damage. Sam et al. (6) found a linear correlation between those two 20  
parameters as well, although they reported that clinical outcome will not influence by this 21  
duration. 22

Finally, the pre-hospital and in-hospital treatment modalities with respect to poisoning severity 23  
were statistically different. Patients with severe poisoning received antidote 7.08 times more 24

compared to others. And the only treatment statistically associated with a favorable outcome was antidote administration.

### **Conclusions**

In clinical practice, low level of consciousness, pre-hospital antidote administration, abnormal ECG, underlying disease, abnormal respiration, delay to presentation to hospital, and longer length of hospital stay can be considered important factors for determining poisoning severity and outcome. It may be suggested to include these variables in scoring systems for better outcomes evaluation. The burdens of poisonings as a public health problem need for better investigation and understanding of this topic. This study highlights the need to develop a toxico-vigilance system in our society.

### **Declarations**

**Ethics approval and consent to participate:** This research has been performed in accordance with the Declaration of Helsinki and has been approved by the ethics committee of Isfahan University of Medical Sciences (Ethical Number: IR.MUI.MED.REC.1398.210). Written informed consent was obtained from the patients (or their parent or legally authorized representative in the case of children under 16).

**Consent for publication:** Not applicable

**Availability of data and materials:** The datasets generated and/or analyzed during the current study are not publicly available due to the nature of patients who attempted suicide but are available from the corresponding author on reasonable request.

**Competing interests:** The authors declare that they have no competing interests.

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**Authors' contributions:** Nastaran Eizadi-Mood, Rokhsareh Meamar, and Rasol Heshmat 1  
contributed to the conception and design of the study. Narges Motamedi and Nastaran Eizadi- 2  
Mood interpreted the data. Nastaran Eizadi-Mood, Rokhsareh Meamar, and Rasol Heshmat 3  
have drafted the work. All authors approved the submitted version (and any substantially 4  
modified version that involves the author's contribution to the study); AND have agreed both 5  
to be personally accountable for the author's own contributions and to ensure that questions 6  
related to the accuracy or integrity of any part of the work, even ones in which the author was 7  
not personally involved, are appropriately investigated, resolved, and the resolution 8  
documented in the literature. 9

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