Archives of Academic Emergency Medicine. 2025; 13(1): e78

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ORIGINAL RESEARCH

Characteristics of 76,113 Acute Poisoning Cases Registered in Emergency Medical System of Tehran Province; A Cross-sectional Study

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Received: September 2025; Accepted: October 2025; Published online: 2 November 2025

Abstract: **Introduction:** Understanding the epidemiological patterns of poisoning cases in specific regions is essential for health authorities to implement preventive measures and strategic planning. This study aimed to describe the epidemiologic characteristics of acute poisoning cases registered in Tehran province's emergency medical services (EMS). **Methods:** This retrospective cross-sectional study was conducted on all registered acute poisoning cases from 2022 to 2024 in the Asayar database of Tehran Province's EMS. The cases were included through census sampling and descriptive analysis was used for evaluating the epidemiologic characteristics of registered cases. **Results:** 76,113 acute poisoning cases were registered by Tehran Province EMS during the study period. The mean age of cases was 34.3 ± 15.0 years (59.1% male). The most frequent method of poisoning was oral, with 71,521 (94.0%) cases, and inhalational, with 3,236 (4.2%) cases. The highest number of cases was reported in the eastern region of Tehran with 15,058 cases. Seasonal distribution of poisonings was as follows: 20,201 (26.6%) cases in summer, 21,322(28.0%) cases in winter, 21,105 (27.7%) cases in autumn, and 13,485 (17.7%) cases in spring. Most poisonings occurred in residential settings, accounting for 72,194 (94.9%) cases. The most frequent used antidote was naloxone, in 12,662 (16.6%) cases, and atropine, in 961 (1.3%) cases. **Conclusion:** Based on the findings of this study, the most vulnerable population groups to the poisoning were young individuals, males, and those with a history of psychiatric illness and substance abuse, predominantly affected by oral route. The geographical and temporal distribution of poisonings highlights the need for targeted preventive interventions, public education, and enhancement of prehospital emergency service infrastructure in high-risk areas.

Keywords: Epidemiology; Poisoning; Emergency Medical Services; Prehospital Care; Toxicology

Cite this article as: Baghernezhad AR, Khayeri F, Tavakoli ME, et al. Characteristics of 76,113 Acute Poisoning Cases Registered in Emergency Medical System of Tehran Province; A Cross-sectional Study. Arch Acad Emerg Med. 2025; 13(1): e78. https://doi.org/10.22037/aaem.v13i1.2833.

1. Introduction

Poisoning represents a significant public health concern worldwide and is one of the leading causes of emergency department visits and hospital admissions, particularly in developing countries (1, 2). Although poisoning can occur across all age groups, children, adolescents, women of reproductive age, and the elderly are especially at risk (3, 4). Every year, more than half a million people die globally from poisoning, with 33% of these fatalities occurring in developing countries, according to the World Health Organization (4). The incidence of poisoning in developing nations is 13 times higher than in industrialized countries (5), and the mortality rate from poisoning in low- and middle-income countries is four times greater than in high-income countries (6).

According to the report of the Director General of Monitoring and Supervision of Health-Related Products at the Food and Drug Organization, between 7,000 and 9,000 people in Iran die annually due to poisoning. In 2021 in Iran, drug-related poisonings accounted for 47%, chemical poisonings for 25%, poisonings due to addictive substances for 24%, envenomation by poisonous animals for 3%, food-related poisonings for 1%, mushroom poisonings for 0.2%, and plant poisonings for 0.1% of all Poisoning cases. Among poisonings related to narcotics and stimulants that led to admission in referral hospitals, the highest proportions were observed for methadone (35%) and morphine (20%) (7). In recent years, the leading cause of fatal poisoning in Iran has been related to stimulants and narcotics, accounting for approximately 60–65% of all poisoning-related deaths (8). In Tehran, intentional poisoning with psychoactive substances is more prevalent com-

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pared to other provinces (9). Over recent decades, remarkable advancements in agriculture, pharmacology, and industrial technologies have significantly altered poisoning patterns. These societal developments have increased access to medications and the growing use of household cleaners, disinfectants, and pesticides, thereby creating conditions conducive to various types of poisoning (4).

Due to the varying patterns of poisoning across different regions and the considerable financial burden this issue imposes on patients and the healthcare system, investigation of the prevalence trends and shifts in poisoning patterns within diverse communities has been emphasized as a fundamental measure by health systems to enhance management and prevention of this problem (10, 11).

Given the cultural diversity and regional contexts of the country, as well as the influence of environmental factors on poisoning and considering the widespread availability and accessibility of pharmaceuticals and toxic chemicals alongside the misuse and addiction to narcotics in various cities, which have led to a high incidence of poisoning, targeted epidemiological assessment is essential (12).

Noting that emergency medical services (EMS) constitute a critical tier of the national healthcare system by providing essential primary care and playing a key role in patient care and transportation to medical facilities, the present study aimed to describe the epidemiology of poisoning types and the characteristics of cases attended by the prehospital EMS system in Tehran province during 2022–2024.

2. Methods

2.1. Study design and setting

This retrospective cross-sectional study used data from the Incident and Emergency Management Center of Tehran Province (Emergency 115). All cases registered with a poisoning complaint between 2022 and 2024 were examined using a census sampling method. Samples were collected by reviewing mission forms for poisoned patients in the Asayar prehospital EMS system of Tehran Province and selecting records that contained complete data relevant to this investigation. The epidemiologic characteristics of registered cases with acute poisoning were reported using descriptive analysis.

This study was approved by the Ethics Committee of Iran University of Medical Sciences with the ethical approval code IR.IUMS.REC.1403.829. Since the study used de-identified secondary data from the Asayar EMS database, no direct contact with patients was made, and informed consent was not required. All patient information was anonymized before analysis, and confidentiality was strictly maintained throughout the study.

2.2. Participants

A case of "poisoning" was defined according to the initial diagnosis recorded by EMS technicians, based on clinical signs, patient history, and suspected toxic substance. Cases that were not true poisonings (including allergic reactions, bites/stings, and exposures of unknown cause) were not considered in this study and were not included in the selected database.

2.3. Data gathering

The Asayar system is available in two formats: a mobile application installed on EMS station devices and a central web-based system located at the EMS headquarters. At the end of each mission, EMS technicians complete an electronic patient care form in the Asayar application, which is simultaneously transmitted to the destination hospital and stored in the central database. No records were excluded, as all missions are mandatorily registered in the system. Each EMS mission was treated as an independent record, and it was not possible to link repeated episodes to the patient level. Furthermore, due to the design of the system, records cannot be closed unless all mandatory fields are completed, therefore, no missing data were present.

The variables analyzed comprised demographic information (age, sex, and emergency location address) and poisoning-related details (type of poisoning, time of poisoning, season of poisoning, history of previous poisoning, underlying medical conditions, level of consciousness, type of emergency site, antidote administered, therapeutic interventions performed, medical consultation provided, year of poisoning, and final mission outcome). All variables were extracted from the Asayar system and entered into a researcher-designed checklist based on the mission form of the Asayar prehospital EMS automation system.

The following variables were extracted from the Asayar EMS database and entered into the researcher-designed checklist:

• Route of poisoning: classified according to route of exposure as oral, inhalational, dermal/absorptive, or injectable.

• Time of poisoning: recorded based on the official mission start time in the system and categorized as day or night.

• Season of poisoning: derived from the mission date and coded as spring, summer, autumn, or winter.

• History of poisoning: previous poisoning episodes documented in the patient's records (yes/no).

• History of comorbidities: recorded as addiction, psychiatric disorders, other chronic diseases, or none.

• Level of consciousness: registered by EMS personnel as alert, semi-conscious, or unconscious.

• Emergency location type: coded as residential, recreational/sport, industrial, administrative, educational, or other.

• Antidote administration: documented as naloxone, atropine, dextrose, magnesium sulfate, sodium bicarbonate, or none.

• Interventions performed: included intravenous (IV) line and vital signs monitoring, cardiac monitoring, suction, intubation, cardiopulmonary resuscitation (CPR), oxygen therapy, or other measures.

• Medical consultation: whether the EMS technician contacted the supervising physician at the EMS communication center during the mission (yes/no).
• Year of poisoning: recorded as the calendar year of the mission.
• Mission outcome: classified as patient transfer to hospital, death prior to EMS arrival, initial stabilization with referral advice, or refusal of cooperation with signed documentation.
• Geographic location of emergency: categorized into nine regions of Tehran Province EMS system (North, South, East, West, Central, Northeast, Northwest, Southeast, and Southwest), as routinely recorded by EMS personnel in Asayar.

2.4. Statistical analysis

Data analysis was performed using SPSS software, version 22. Given the type and empirical distribution of the data, only descriptive statistical methods were applied, including the calculation of frequencies and percentages for qualitative variables.

3. Results

A total of 76,113 acute poisoning cases were recorded by Tehran Province EMS. The mean age of registered cases was 34.3 ± 15.0 years (59.1% male). The age distribution of cases is demonstrated in figure 1A. Table 1 shows the characteristics of studied patients.

The most frequent method of poisoning was oral with 71,521 (94.0%) cases and inhalational with 3,236 (4.2%) cases. The highest number of EMS-attended oral poisoning cases was reported in the eastern region of Tehran with 15,058 cases (figure 1B), whereas the lowest number of dermal absorption poisonings was reported in the northwest region with only 2 cases. Additionally, the highest frequency of oral poisonings was observed among males, with 42,376 (55.68%) cases.

44,871 (58.90%) cases were transferred or referred to a healthcare facility, 30,395 cases (40%) involved patient non-cooperation and informed consent was obtained from them, which included non-cooperation with the EMS team, such as the patient or their companions refusing transfer to a medical center or receiving and completing medical services provided by the technician, 761 (1%) cases received on-site initial interventions with recommendations for hospital care, and 86 (0.1%) cases resulted in death before EMS technician arrival.

Among the total 76,113 records, 17,088 cases (22.4%) had a history of substance abuse, 13,446 cases (17.7%) had a history of psychiatric illness, and 7,542 cases (9.9%) had other comorbidities. More than half of all poisonings occurred at night with 42,165 (55.4%) cases. Over the study period, 8,909 cases (11.7%) had a history of previous poisoning, whereas 67,204 cases (88.3%) had no such history. Seasonal distribution of poisonings was as follows: 20,201 (26.6%) cases in summer, 21,322(28.0%) cases in winter, 21,105 (27.7%) cases in autumn, and 13,485 (17.7%) cases in spring.

Level of consciousness upon EMS arrival indicated that 46,232 (60.7%) cases were fully conscious, 15,022 (19.7%) cases were drowsy or semi-conscious, and 14,859 (19.6%) cases were unconscious.

Most poisonings occurred in residential settings, accounting for 72,194 (94.9%) cases. 70,044 (92.0%) cases were managed without medical consultation, while 6,069 (8.0%) cases received medical consultation.

Intravenous access and vital sign control were documented in 44,123 cases, representing the most frequent procedure. Other interventions included physiological monitoring in 21,202 cases, suction in 317 cases, endotracheal intubation in 269 cases, cardiopulmonary resuscitation in 234 cases, oxygen therapy in 24,215 cases, and various other measures in 1,351 cases.

Antidote administration was recorded as follows: naloxone in 12,662 (16.6%) cases, atropine in 961 (1.3%) cases, dextrose in 229 (0.3%) cases, magnesium sulfate in 15 cases, and sodium bicarbonate in 12 cases; no antidote was administered in 62,234 cases (81.8%) (Table 1).

4. Discussion

The present study found that, between 2022 and 2024, oral poisoning accounted for approximately 94% of all cases presenting to Tehran Province prehospital EMS, a figure consistent with earlier research (4, 13, 14). The predominance of this route may be attributed to its simplicity, ease of access to pharmaceuticals (13). We suggest that the lack of need for specialized equipment and the ability to conceal ingestion until the last moment further contribute to the predominance of this route.

The results of this study indicate that the highest prevalence of poisoning was observed in the 20–40-year age group (53.3%), whereas children and the elderly accounted for a very small proportion. This finding is consistent with Nasiri et al. in Qaemshahr, in which the greatest number of poisonings occurred in the 26–35 year age group, with Mohammadi et al. in Gilan reporting the highest incidence in the 21–30 year age group, and with Jalilifard et al. in Dezful (13, 15, 16). In contrast, Jafarzadeh et al. in Fasa County found that most poisoning cases fell within the 36–59-year bracket (4). Studies indicate that young and middle-aged individuals constitute the majority of those at risk of poisoning, which may be due to high social activity, relative instability in personal life, exposure to multiple hazards, occupational contact with chemicals, a tendency toward self-medication, recreational use of alcohol and drugs, and domestic use of toxins and solvents. Although poisoning can occur at any age, its complications and outcomes are more serious and hazardous in children and in middle-aged to elderly individuals (4); therefore, special preventive measures and targeted care are required for these age groups.

Based on the results, the rate of poisoning was higher in males than in females . These findings align with Nasiri et al.'s study in Qaemshahr (13). The results of this study showed that the time of poisoning was during the day in 44.6% of

cases and at night in 55.4% of cases, which is consistent with the study by Jafarzadeh et al. in Fasa (4) and with the findings of some discordant studies (13). The number of poisonings across the seasons of the year indicates that the highest incidences occurred consecutively in winter (28%) and then autumn (27.7%), and the lowest prevalence was observed in spring (17.7%), results that do not align with other studies(13, 16). It appears that the seasonal and temporal differences in the occurrence of poisonings in different regions may stem from the climatic, economic, and cultural features of each region, the conditions of access to substances, and different lifestyles.

The place of residence for most poisoning cases was in urban areas and in the eastern region of Tehran Province (15,058 individuals), a finding confirmed by previous studies (4, 13, 16, 17). Probable reasons for the increased rate of poisoning in urban settings include easier access to toxins and medications, higher population density, problems associated with urban living (18), and the nature of recreational activities. In the present study, medical consultation by a technician was required for 8% of the patients, and a fully alert state of consciousness was recorded in 60.7% of poisoning cases. The most common therapeutic interventions performed were intravenous line placement, oxygen therapy, and monitoring. Additionally, advanced cardiopulmonary resuscitation was carried out for 234 (0.3%) of the poisoned individuals. For the treatment of poisoning, antidotes or specific naloxone therapy were used in 16.6% of cases, atropine as an antidote was used in 1.3% of cases, and 83.1% of cases did not receive any antidote. After the necessary therapeutic measures were taken, 44,871 (58.9%) of the patients were transferred to equipped medical centers, and 0.1% of the poisoned individuals died due to the severity of poisoning. These results are consistent with the study by Nasiri et al. in Qaemshahr (13).

The location of the emergency incident was predominantly in residential areas (94.9%). Moreover, 11.7% of patients had a history of prior poisoning, findings that concur with Jafarzadeh et al., who reported that over 90% of cases occurred in residential areas and 17.8% of patients had a previous poisoning history (4). These results also align with those of Razm Araei et al. (9). Regarding medical history, over the period from 2022 to 2024, out of the 76,113 recorded cases, 17,088 (22.4%) had a history of addiction and 13,446 (17.7%) had a history of psychiatric disorders, fully corresponding with several studies (4, 9, 13, 19). Given the high proportion of poisonings among individuals with addiction and psychiatric histories, it is imperative to develop and implement preventive policies targeting these two vulnerable groups.

Expanding mental health services, establishing specialized addiction treatment centers with a preventive focus, and ensuring easy, equitable access to these services are key strategies for reducing poisoning incidence in this population. Additionally, identifying predisposing factors for poisoning within these groups and enhancing mental health literacy can play an effective role in lowering incidence rates and improving overall community safety. In addition, the EMS can create direct intervention opportunities, such as providing take-home naloxone to at-risk individuals, promptly referring patients to addiction treatment or mental health services, and connecting individuals to crisis lines and emergency counseling. It should be emphasized that this was a cross-sectional study based on EMS records, and therefore, only associations can be described. Causal relationships between demographic or contextual factors and poisoning events cannot be inferred from the present findings.

Prevention of poisonings requires a multifaceted approach that includes educating parents and caregivers, enforcing stringent policies on the packaging and distribution of pharmaceuticals and chemical agents, and strengthening surveillance programs in residential and educational environments. Increasing public awareness through information campaigns and targeted training in healthcare centers and schools can significantly contribute to reducing the incidence of such events. In addition to preventive measures, enhancing the healthcare system's capacity to address poisoning cases is of particular importance. Equipping treatment facilities with appropriate diagnostic and therapeutic resources, providing continuous education for medical staff on the immediate management of poisonings, and establishing specialized poison control centers can play a key role in mitigating the consequences of these conditions. Moreover, the development and implementation of national guidelines for poisoning response and treatment, together with the creation of registries and reporting systems for poisoning incidents, can support effective health policy and preventive planning.

By accurately identifying the patterns of poisoning in relation to demographic characteristics, preventive, educational, and therapeutic interventions can be designed and implemented in a more targeted, efficient, and cost-effective manner; thereby maximizing their impact on reducing the disease burden and mortality associated with poisonings. Overall, the results of this study can serve as a foundation for designing targeted educational interventions, refining referral pathways, and optimizing the allocation of treatment resources so as to lessen the severity and consequences of poisonings and enhance the quality of prehospital services.

4.1. Recommendations for Future Research

Given that poisoning is preventable, it is recommended that future research focus on strategies for poisoning prevention. Moreover, because this study was conducted at Tehran Province Emergency Medical Services center, it is suggested that similar investigations be carried out in other prehospital EMS centers across different provinces and that their results be compared.

To monitor long-term patient outcomes and evaluate the effectiveness of therapeutic interventions, comprehensive intersectoral studies integrating prehospital EMS data, hospital records, and medicolegal mortality information should be designed and implemented. It is further recommended

that interventional studies and randomized controlled trials be conducted to assess the efficacy of preventive education programs. Such interventions might include training in the use of carbon monoxide detectors, family educational packages, and other methods to raise public awareness, in order to evaluate their impact on reducing poisoning incidence and improving timely emergency responses.

In addition, health-economics studies should be undertaken to estimate the direct and indirect costs of poisoning at both prehospital and hospital levels. The findings of these studies can substantially aid health-system decision-makers in optimal planning, effective resource allocation, and the design of cost-effective interventions for poisoning prevention and management.

Finally, future research should concentrate on evaluating the effectiveness of specialized prehospital protocols in the management of various types of poisoning. These studies could measure the impact of protocol implementation on indicators such as patient survival rates, transport times to medical facilities, and the quality of care provided, thereby clarifying their role in improving clinical outcomes. Qualitative research exploring and analyzing the experiences of poisoned patients and their families with prehospital EMS services should also be conducted; by identifying strengths and weaknesses from the perspectives of patients and their companions, such studies can provide valuable insights for enhancing service quality and increasing user satisfaction.

5. Limitations

This study has several important limitations. First, the data were extracted solely from the Asayar pre-hospital emergency medical system of Tehran Province, and therefore reflect only pre-hospital encounters of poisoned patients, not the overall incidence of poisoning in the community. Second, this database lacked detailed classification of toxic agents, making it impossible to precisely identify the substances responsible for poisoning. Third, there was no linkage between pre-hospital data and hospital outcomes, which prevented assessment of patients' subsequent clinical course, complications, or final status after admission. Finally, due to the cross-sectional nature of the study and reliance on registry data, only associations can be reported, and causal inferences cannot be drawn. Therefore, the findings of this study should be interpreted with caution and in light of these limitations.

6. Conclusions

Based on the findings of this study, the most vulnerable population groups of acute poisoning were young individuals, males, and those with a history of psychiatric illness and substance abuse, predominantly affected by oral poisoning. The geographical and temporal distribution of poisonings highlights the need for targeted preventive interventions, public education, and enhancement of prehospital emergency service infrastructure in high-risk areas.

7. Declarations

7.1. Acknowledgments

The authors wish to express their sincere gratitude to all colleagues at the Tehran Province Center for Emergency Medical Services and Incident Management for their wholehearted cooperation in collecting and compiling the necessary information.

7.2. Author contributions

All authors contributed to study design, data collection, and writing the draft of the study. All authors read and approved the final version of manuscript.

Conceptualization and study design: [AR.B]

Data collection: [S.Sh.J. and M.Gh]

Data analysis and interpretation: [F.S.]

Drafting of the manuscript: [F.Kh. and AR.B]

Critical revision and final editing: [F.Kh. and AR.B. and ME.T]

Final approval of the version to be published: All author

7.3. Ethical Considerations

This study was approved by the Ethics Committee of Iran University of Medical Sciences with the ethical approval code IR.IUMS.REC.1403.829.

7.4. Funding and Support

The authors received no specific funding for this work.

7.5. Availability of Data and Materials

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

7.6. Conflict of interest

The authors declare that they have no competing interests.

7.7. Using Artificial Intelligence Chatbots

We utilized AI-powered tools to check grammar and enhance the academic quality of the text, which was primarily written by the authors.

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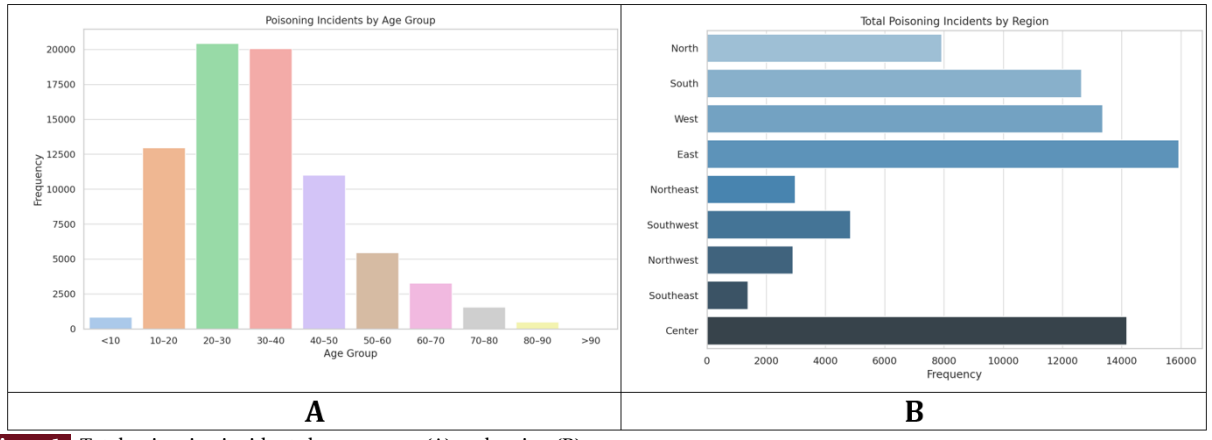

Figure 1: Total poisoning incidents by age group (A) and region (B).

Table 1: Characteristics of acute poisoning cases registered by emergency medical services of Tehran province during 2022-2024 (n = 76113)

Characteristics	Value	Characteristics	Value
Gender		**Year**	
Male	44907 (59.1)	2022	20102 (26.41)
Female	31206 (40.9)	2023	27082 (35.58)
Age (year)		2024	28929 (38.01)
<10	843	Medical history	
10 - 20	12965	Addiction	17088 (22.4)
20 - 40	40516	Mental illness	13446 (17.7)
40 - 60	16460	Other diseases	7542 (9.9)
60	5323	No underlying disease	38037 (50.0)
Route of poisoning		**History of Poisoning**	
Oral	71521 (94.0)	Yes	8909 (11.7)
Inhalation	3236 (4.2)	No	67204 (88.3)
Injection	1280 (1.7)	**Consciousness Level**	
Absorption	76 (0.1)	Alert	46232 (60.7)
Mission outcome		Drowsy/Semi-conscious	15022 (19.7)
Transferred to treatment center	44871 (58.9)	Unconscious	14859 (19.6)
Refused cooperation to transfer	30395 (40.0)	Season	
First aid only & advised to refer	761 (1.0)	Spring	13485 (17.7)
Died before technician arrival	86 (0.1)	Summer	20201 (26.6)
Treatment measure		Autumn	21105 (27.7)
IV access & monitoring	44123 (58)	Winter	21322 (28.0)
Continuous monitoring	21202 (27.9)	**Region in province**	
Suction	317 (0.4)	North	7926 (10.4)
Intubation	269 (0.4)	South	12639 (16.6)
CPR	234 (0.3)	West	13358 (17.5)
Oxygen therapy	24215 (31.8)	East	15921 (20.9)
Other procedures	1351 (1.8)	Northeast	2975 (3.9)
Medical consultation		Southwest	4845 (6.4)
Not Done	70044 (92)	Northwest	2900 (3.8)
Done	6069 (8.0)	Southeast	1384 (1.8)
Time of poisoning		Center	14166 (18.6)
Day	33948 (44.6)	Antidote	
Night	42165 (55.4)	Naloxone	12662 (16.6)
Location type		**Atropine**	961 (1.3)
Residential	72194 (94.9)	Dextrose	229 (0.3)
Sports/Recreational	529 (0.7)	Sodium bicarbonate	12
Industrial	1174 (1.5)	No antidote	62234 (81.8)
Administrative	195 (0.3)		
Educational	1960 (2.6)		
Other	61 (0.1)		

Data are presented as frequency (%). IV: intravenous; CPR: cardiopulmonary resuscitation.