

ORIGINAL ARTICLE

Toxicological emergencies in a tertiary emergency department: a retrospective single-centre study in Singapore

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Abstract

Background: Toxicological emergencies, including pharmaceutical poisonings and envenomation, remain a significant clinical and operational burden in emergency departments. This study described the presentation patterns, clinical severity, management, healthcare utilization, outcomes, and toxicology consultation patterns at a newly established tertiary hospital in Singapore.

Methods: A retrospective observational study was conducted of all toxicological cases presenting to the emergency department from 1 May 2024 to 30 April 2025. Data on demographics, exposure types, Poisoning Severity Score (PSS), interventions, and clinical outcomes were summarized descriptively. The association between PSS and hospital length of stay was explored using Spearman correlation.

Results: Among 121 presentations, 98 (81.0%) involved poisoning and 23 (19.0%) envenomation. Of the poisoning cases, 83 (84.7%) were intentional, and 89 (90.8%) had PSS 0-1. Toxicology consultation was obtained in 8 cases (6.6%). Six poisoning cases (6.1%) required intensive care, and no in-hospital mortality was recorded. An exploratory analysis among poisoning cases showed a positive correlation between PSS and hospital length of stay (Spearman $\rho = 0.527$, $p < 0.001$).

Conclusion: Most presentations were low-severity poisonings, and intentional exposure predominated. In this modest, predominantly low-severity cohort, intensive care admission and toxicology consultation were infrequent, and no in-hospital deaths were recorded. PSS showed an exploratory positive correlation with hospital length of stay; this finding is hypothesis-generating and does not validate PSS as a triage or management tool. These descriptive findings provide contemporary baseline data for toxicology service planning. Prospective multicentre comparative studies are warranted.

Keywords: Poisoning; Bites and Stings; Emergency Medicine; Referral and Consultation; Singapore

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INTRODUCTION

Toxicological emergencies encompass pharmaceutical poisonings, chemical exposures, envenomation, and illicit-substance intoxications. Emergency departments are commonly the first point of evaluation for patients with drug intoxication, and management may include supportive care, decontamination, antidote therapy, and enhanced-elimination techniques [1].

In Singapore, toxic exposures have remained a longstanding public health concern. A multicentre study conducted between 2001 and 2003 reported that toxic exposures accounted for 0.94% of total ED attendances,

with 36.1% of these patients requiring admission; among admitted patients, 4.7% required ICU care [2]. More recent institutional data reinforce these findings. For example, Changi General Hospital (CGH) established a 24/7 medical toxicology service in 2014, managing 306 referred cases in its first year—9% of which required high-dependency or intensive care [3]. Likewise, the pilot Drug and Poison Information Centre (DPIC), active from 2004 to 2006, responded to 7,926 calls, of which 831 concerned acute toxic exposures. After excluding 113 calls involving patients already admitted to wards, 532 of the remaining 718 calls (74.1%) originated from emergency departments, underscoring the continued demand for toxicology support

[4]. More recent Singapore data from a cluster-wide toxicology consultation service described 911 referrals between 2019 and 2021, most originating in the emergency department and involving intentional poisoning; however, that cohort was restricted to cases selected for specialist toxicology consultation [5]. Contemporary Asian studies have likewise demonstrated substantial variation in poisoning patterns and outcomes across institutions, reinforcing the need for local, system-specific data [6, 7].

During the study period, the ED setting included Epic-based SmartSets for common poisoning presentations, 14 standardized toxicology workflows available through the hospital intranet, and simulation-based training in toxidrome recognition and management. These resources formed part of the clinical environment during the hospital's first year. Against this background, contemporary local data were needed to characterize presentations, service use, and outcomes and to inform ongoing service development. This study therefore aimed to describe the epidemiology, clinical severity, management, healthcare utilization, and outcomes of poisoning and envenomation presentations during the hospital's first 12 months. Secondary exploratory aims were to describe the frequency of toxicology consultation and examine the relationship between Poisoning Severity Score and hospital length of stay. The study was designed to characterize clinical activity and service needs, thereby providing a baseline for future comparative evaluation of these workflows.

METHODS

Study Design and Setting

This was a retrospective, observational study conducted at Woodlands Health, a newly commissioned tertiary care hospital located in northern Singapore. The institution began operations in May 2024, and its Emergency Department (ED) provides 24-hour acute care services to a multi-ethnic urban population. All ED presentations involving toxic exposures, including both pharmaceutical poisonings and envenomation-related injuries, were reviewed over 12 months from 1 May 2024 to 30 April 2025.

Case Identification and Eligibility Criteria

Cases were identified through structured queries of the institution's electronic medical record (EMR) system. We used a comprehensive list of ICD-10 codes (T36–T65) related to poisoning, overdose, and toxic exposure. In addition, keyword searches were employed to identify presentations potentially related to bites, stings, or envenomation, which may not be consistently captured through diagnostic coding alone. All records returned by the electronic searches underwent manual review against prespecified eligibility criteria. Eligibility was determined from the complete EMR rather than diagnostic coding alone.

All patients presenting with confirmed toxicological exposures were included. This encompassed:

- Pharmaceutical overdoses (intentional or unintentional)
- Recreational or illicit drug use

- Household and industrial chemical exposures
- Natural toxin exposures, including bites and stings from insects, arachnids, reptiles, and marine animals

Exclusion criteria included:

- Presentations unrelated to toxicological diagnoses
- Adverse drug reactions without overdose
- Incomplete or miscoded entries
- Repeat visits for unrelated conditions

Each eligible record underwent manual review for eligibility, exposure classification, and data abstraction by an emergency physician trained in clinical toxicology using a standardized data abstraction form.

Data Collection and Variables

A standardized data abstraction form was used to extract relevant clinical data from the EMR. The following variables were collected:

- Demographics: age, sex, ethnicity
- Exposure characteristics: type of agent, time from exposure to ED arrival
- Clinical parameters: vital signs, electrocardiogram (ECG) performance, and Poisoning Severity Score (PSS)
- Management strategies: decontamination procedures, antidote administration, enhanced elimination methods, and toxicology consultation (defined as documented input from a trained clinical toxicologist)
- Disposition and outcomes: ED and hospital length of stay (LOS), intensive care unit (ICU) admission, 30-day readmittance, and in-hospital mortality

Exposure Classification

All exposures were categorized into two principal groups:

1. Poisoning group: including pharmaceutical overdoses, chemical exposures, and recreational substance use
2. Envenomation group: including animal or insect bites and stings, such as hornet, scorpion, centipede, and marine animal envenomation

Pharmaceutical agents were grouped by clinically relevant class. Missing information was recorded as missing and was not imputed. Following data abstraction, the dataset was reviewed for duplicate encounters, internal inconsistencies, and implausible values, with discrepancies resolved by reference to the original electronic medical record. Independent duplicate data abstraction was not performed for every record, and formal inter-rater reliability was not assessed. Protocol adherence was not defined as a prespecified study variable and was not formally assessed using a validated or independently adjudicated instrument.

Severity Assessment

The PSS was assigned retrospectively from the most severe documented exposure-related clinical features during the ED visit and subsequent admission [8]. Scores were assigned as follows:

- PSS 0: no symptoms or signs related to the exposure
- PSS 1: minor, transient, and spontaneously resolving symptoms

- PSS 2: pronounced or prolonged symptoms (moderate)
- PSS 3: severe, life-threatening symptoms

This score was applied uniformly across both poisoning and envenomation cases for consistency in severity assessment.

Statistical Analysis

All data were anonymized before analysis. Analyses were performed using IBM SPSS Statistics Version 29 and were exploratory and primarily descriptive because of the modest cohort size and limited number of outcome and consultation events. Categorical variables were summarized using counts and percentages, and consultation proportions were presented with two-sided 95% exact binomial confidence intervals. Continuous variables with skewed distributions were summarized using medians and interquartile ranges. Among poisoning cases, the association between PSS and hospital length of stay was assessed using a two-tailed Spearman correlation as a hypothesis-generating analysis, without adjustment for multiple testing. Because only eight toxicology consultation events occurred, consultation was analyzed descriptively, and multivariable modelling was not performed.

RESULTS

Study Population

The dataset comprised 121 toxicological cases presenting to the emergency department between 2024-2025, consisting of 98 poisoning cases (81.0%) and 23 envenomation cases (19.0%). Toxicology consultation occurred in 8 presentations overall (6.6%; 95% exact confidence interval, 2.9%-12.6%). Participant characteristics, severity, management, and outcomes are summarized in Table 1.

Poisoning Cases (n = 98)

The median age was 29 years (IQR 20-48), and 51 patients (52.0%) were female. Eighty-three exposures (84.7%) were intentional. Sedatives and analgesics were the most frequent agent classes. Most cases were low severity: 89 (90.8%) were graded PSS 0-1, whereas 9 (9.2%) were PSS 2-3.

Toxicology consultation was documented in 6 cases (6.1%; 95% exact confidence interval, 2.3%-12.9%), including 4 telephone and 2 in-person consultations. Antidotes were administered in 12 cases (12.2%). Median hospital length of stay was 2 days (IQR 0-3; range 0-7), 6 patients (6.1%) required intensive care, and 14 (14.3%) reattended the ED within 30 days. No in-hospital deaths were recorded.

Envenomation Cases (n = 23)

The median age was 32 years (IQR: 20.5-40.5, range: 14-65). Gender distribution was 16 males (69.6%) and 7 females (30.4%). All cases were accidental exposures.

Envenomation types included insect stings (n = 12, 52.2%), insect bites (n = 4, 17.4%), scorpion sting (n = 2,

8.7%), snake bite (n = 2, 8.7%), and single cases each of catfish sting, centipede sting, and stingray sting.

Seventeen cases (73.9%) were classified as PSS 1, and five (21.7%) were classified as PSS 2. Toxicology consultation was documented in two cases (8.7%; 95% exact confidence interval, 1.1%-28.0%). No antidotes were administered. Two patients were admitted for one day. Thirty-day emergency department reattendance occurred in one case (4.3%). No ICU admissions or in-hospital deaths were recorded.

Severity and Length of Stay

Among poisoning cases, higher PSS was associated with longer hospital length of stay (Spearman $\rho = 0.527$, $p < 0.001$); this association was exploratory.

DISCUSSION

During the first year of this tertiary ED, most toxicological presentations were poisonings and were of low clinical severity; 90.8% had PSS 0-1, with only 9.2% graded as PSS 2-3. Intentional overdoses accounted for 84.7% of poisoning presentations, making intentional exposure the predominant presentation pattern and highlighting the overlap between medical toxicology and mental-health care.

These observations indicate a predominantly mild envenomation case mix in this cohort. These patients were slightly older (median 32 years), predominantly male (69.6%), and universally conscious (GCS 15). The severity distribution was mainly mild, with 73.9% classified as PSS 1 and none requiring ICU admission. Only two patients required short inpatient observation (1 day each), and 30-day reattendance was rare (4.3%).

Overall, toxicology consultation was infrequent, occurring in 6.1% of poisoning cases and 8.7% of envenomation cases (8 consultations overall). These observations are descriptive of this cohort and should not be interpreted as evidence of the effectiveness of any particular model of toxicology service delivery.

The predominance of intentional pharmaceutical poisoning is consistent with both earlier multicentre Singapore data and the recent SingHealth cluster toxicology consultation cohort, in which intentional exposures, analgesics, and sedatives were also prominent (2,5). Direct comparison is limited because the present study included all eligible emergency department presentations, whereas the cluster cohort comprised only cases referred for specialist toxicology consultation [5]. Recent hospital-based studies from China similarly identified pharmaceutical agents as a major source of acute intoxication, although case mix and healthcare context differed substantially [6, 7]. The intensive care admission rate in the present cohort was close to that reported in earlier Singapore emergency department data and lower than the combined high-dependency and intensive care utilization reported in consultation-based Singapore cohorts [2, 3, 5]; these differences may reflect

Table 1. Characteristics, severity, management, and outcomes by exposure group

Characteristic	Poisoning (n = 98)	Envenomation (n = 23)
Age, median (IQR), years	29 (20-48)	32 (20.5-40.5)
Female sex, n (%)	51 (52.0)	7 (30.4)
Intentional exposure, n (%)	83 (84.7)	0 (0)
PSS 0, n (%)	40 (40.8)	1 (4.3)
PSS 1, n (%)	49 (50.0)	17 (73.9)
PSS 2, n (%)	7 (7.1)	5 (21.7)
PSS 3, n (%)	2 (2.0)	0 (0)
Toxicology consultation, n (%)	6 (6.1)	2 (8.7)
Antidote administered, n (%)	12 (12.2)	0 (0)
ICU admission, n (%)	6 (6.1)	0 (0)
30-day ED reattendance, n (%)	14 (14.3)	1 (4.3)
In-hospital mortality, n (%)	0 (0)	0 (0)

ED, emergency department; ICU, intensive care unit; IQR, interquartile range; PSS, Poisoning Severity Score.

referral thresholds and the preferential consultation of more severe cases.

Observational studies have associated specialist toxicology care with shorter hospital stays or distinct triage and treatment patterns [9, 10]. The present study cannot test such effects because only eight consultations occurred, consultation indications were not standardized, and more complex cases may have been preferentially referred. Consultation frequency should therefore be interpreted as a service-description measure rather than evidence of appropriate or inappropriate specialist use.

The low-severity profile observed in this cohort, with 90.8% of poisoning cases classified as PSS 0–1, was similar to the 76% reported among referrals to another Singapore hospital toxicology service [3]. Nevertheless, poisoned patients may consume substantial emergency department and inpatient resources, and observational evidence suggests that some low-severity admissions receive no specific treatment [11, 12]. However, the present study did not quantify resource use beyond length of stay and disposition. No patients required dialysis or other enhanced-elimination techniques.

The positive correlation between PSS scores and length of stay ($\rho = 0.527$, $p < 0.001$) is clinically plausible and consistent with PSS as a marker of poisoning severity [8]. However, PSS was developed primarily as a descriptive severity measure, and published reviews have identified limitations in its reliability and broad clinical application [8, 13].

In this study, this exploratory association should not be interpreted as validation of PSS as a triage or management

tool in this cohort. PSS was assigned retrospectively, and length of stay may also reflect psychiatric assessment, disposition, social circumstances, bed availability, and other unmeasured factors. The high proportion of intentional poisonings reinforces the need for coordination between emergency, psychiatric, and toxicology services; engagement with psychiatric care following hospital-treated deliberate self-harm has been associated with important long-term outcomes [14]. The present dataset did not contain sufficient detail on psychiatric assessment or disposition to evaluate specific models of integrated care.

Protocolized emergency department observation pathways have reduced medical length of stay and costs for selected acetaminophen poisonings in Singapore [15, 16]. In the present study, however, SmartSets, intranet workflows, and simulation training were contextual features rather than evaluated interventions. Their use and adherence were not measured systematically, and no association between these resources and toxicology consultation or clinical outcomes was estimated. In the absence of a comparator group, pre-implementation data, or process-fidelity assessment, the observed outcomes cannot be attributed to these tools. Future prospective evaluations should define adherence a priori, use independent or duplicate assessment, and include balancing measures such as delayed antidote administration, unplanned escalation of care, and repeat presentation.

This study has several limitations. Its retrospective, single-centre design depended on the completeness and accuracy of routinely documented clinical records, creating the possibility of selection, coding, documentation, and information bias. Case identification relied on ICD-10 codes

and keyword searches, and some eligible presentations may have been missed or misclassified. Missing information was not imputed.

Secondly, PSS was assigned retrospectively from clinical documentation and may therefore have been affected by misclassification, particularly where the clinical documentation was incomplete. An independent duplicate extraction was not performed for every record, and formal inter-rater reliability was not assessed.

Third, only eight consultation events occurred overall, including six among poisoning cases, precluding reliable multivariable modelling or strong subgroup inference. Consultation was not random and was likely influenced by clinical severity and case complexity, creating confounding by indication.

Fourth, hospital length of stay may have been influenced by illness severity, comorbidities, treatment requirements, psychiatric assessment, discharge practices, bed availability, and social factors that were not fully measured or adjusted for. Finally, this study was conducted at one institution, and the findings may not be generalizable to hospitals with different toxicology services, referral thresholds, patient populations, or clinical protocols.

CONCLUSION

This study provides contemporary baseline evidence on toxicological emergencies in a newly established tertiary emergency department in Singapore. The predominance of intentional poisoning highlights the importance of coordinated emergency, psychiatric, and toxicology care, while the observed relationship between poisoning severity and length of stay may help inform future resource planning. Prospective multicentre studies are needed to evaluate standardized consultation pathways and determine their effects on clinically important outcomes.

Declarations

The authors acknowledge the use of OpenAI Codex to improve the language, readability, structure, and document formatting during revision.

Ethical Considerations

This study was approved by the National Healthgroup Institutional Review Board and registered with the Ethics and Compliance Online System (ECOS) under reference number 2024/013. A waiver of informed consent was granted due to the retrospective study design and the use of anonymized data. All procedures were conducted in accordance with the Declaration of Helsinki and applicable institutional and national ethical guidelines.

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REFERENCES

- Gedik MS, Hakkoymaz H, Kilci Aİ, Küçük ÖF. General approach to cases of drug intoxication. *Eurasian J Crit Care*. 2023; 5:17-21.
- Ponampalam R, Tan HH, Ng KC, Lee WY, Tan SC. Demographics of toxic exposures presenting to three public hospital emergency departments in Singapore 2001-2003. *Int J Emerg Med*. 2009; 2:25-31.
- Arciaga GJ, Tan HH, Kuan KK, Mong R, Kant A. A 24/7 hospital toxicology service: experience of a new start-up. *Proc Singapore Healthc*. 2018; 27:223-8.
- Ponampalam R, Loh CS. Cost benefits of the Drug and Poison Information Centre in preventing unnecessary hospitalisation: the Singapore experience. *Hong Kong J Emerg Med*. 2010; 17:45-53.
- Kuan KK, Ponampalam R, Arciaga GJ, Kant A, Mong R, Ng M, et al. Insights into poisoning in Singapore and its impact on healthcare resource: through the lens of a cluster toxicology consultation service. *Proc Singapore Healthc*. 2026; 35:1-8.
- Wang X, Xie Y, Cai J, Zhang X, Zhou W, Zhang J, et al. Epidemiological and clinical characteristics of acute poisoning with the impact of the COVID-19 pandemic: a multicenter retrospective study in Jiangsu province, China from 2017 to 2023. *BMC Public Health*. 2025; 25:3136.
- Li C, Zhang H, Yang B. Trends in emergency department visits for acute intoxication: a 3-year retrospective study in Hangzhou, East China. *Front Public Health*. 2025; 13:1598559.
- Persson HE, Sjöberg GK, Haines JA, Pronczuk de Garbino J. Poisoning severity score: grading of acute poisoning. *J Toxicol Clin Toxicol*. 1998;36(3):205-13.
- Curry SC, Brooks DE, Skolnik AB, Gerkin RD, Glenn S. Effect of a medical toxicology admitting service on length of stay, cost, and mortality among inpatients discharged with poisoning-related diagnoses. *J Med Toxicol*. 2015; 11:65-72.
- McCabe DJ, Sun J, Vakkalanka JP, Kang T, Radke J. Association between bedside medical toxicology consultation and hospital triage and resource utilization for poisoned patients. *Am J Emerg Med*. 2026; 108:122-9.
- Traub SJ, Saghaian S, Buras MR, Temkit M. Resource utilization in emergency department patients with known or suspected poisoning. *J Med Toxicol*. 2017; 13:238-44.
- Hondebrink L, Rietjens SJ, Donker DW, Hunault CC, van den Hengel-Koot I, Verputten PM, et al. A quarter of admitted poisoned patients have a mild poisoning and require no treatment: an observational study. *Eur J Intern Med*. 2019; 66:41-7.
- Schwarz ES, Kopec KT, Wiegand TJ, Wax PM, Brent J. Should we be using the Poisoning Severity Score? *J Med Toxicol*. 2017; 13:135-45.
- Qin P, Stanley B, Melle I, Mehlum L. Association of psychiatric services referral and attendance following treatment for deliberate self-harm with prospective mortality in Norwegian patients. *JAMA Psychiatry*. 2022; 79:651-8.
- Tang D, Chan WL, Phua DH. Performance of an emergency department observation unit protocol in reducing length of

- stay for acetaminophen overdose: a retrospective study. *Int J Emerg Med.* 2018; 11:48.
16. Kuan KK, Lim HC, Goh G, Arciaga GS, Goh PL, Mong R, et al. Cost savings and efficacy in management of paracetamol poisoning in a 23-hours emergency department observation unit: a comparison to inpatient care. *Cureus.* 2019;11(12):e6294.