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CLINICAL RESEARCH



## Poisoning with malicious or criminal intent: characteristics and outcome of patients presenting for emergency care

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### ABSTRACT

**Background:** Poisoning is the leading cause of injury-related death in the USA. Poisoning with malicious or criminal intent is uncommon, and poorly characterized.

**Objectives:** To explore substances, patients' demographics, clinical presentation, management and outcome in victims of malicious poisoning in the USA.

**Methods:** Using the 47 participating sites of the Toxicology Investigators Consortium (ToxIC) Registry, a North American research consortium, we conducted an observational study of a prospectively collected cohort. We identified all patients exposed to malicious poisoning who had received medical toxicology consultation between January 2014 and June 2017. Clinical and demographic data were collected including age, sex, agents of exposure, clinical manifestations, treatment, disposition and outcome.

**Results:** We identified 60 patients who presented to the emergency department with malicious poisoning, of whom 21 (35%) were children. Among 21 children, 17 (81%) were younger than 2 years. There was no sex dominance among patients. The main substances involved in pediatric patients were sympathomimetics (35%) and opioids (19%). In adults, a more varied panel of offending substances was used, with no specific dominant toxidrome. Children received more treatment interventions compared to adults (overall treatment 81% versus 46% [ $p = 0.0132$ ]; mechanical ventilation: 29% versus 5% [ $p = 0.0176$ ], respectively). Three (5%) patients died (two children, one adult).

**Conclusions:** Poisonings with malicious intent are uncommon; they are disproportionately directed towards infants, frequently resulting in severe injury and carry relatively high mortality.

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Malicious; criminal; poisoning; intoxication; emergency medicine

## Introduction

Poisonings have evolved as a major societal challenge, and the related mortality has more than doubled in the past 15 years [1]. Poisoning with malicious or criminal intent, although occasionally reported in news headlines, is infrequently encountered in the emergency department (ED), and has not been systematically studied.

Malicious poisoning (MP) is defined by the American Association of Poison Control Centers (AAPCC) as an episode where an individual is the victim of another person's intent to harm them through poisoning [2]. In 2016, 7448 MP cases were reported to the AAPCC [2]. Notably, reviewing death certificates, children are 8–9 times more likely to die compared to adults when maliciously poisoned [3]. Further, pediatric deaths due to MP more than doubled between 2010 and 2012 [4]. MP carries both a high risk for mortality, spiking at 33% in medical child abuse cases, as well as a high risk of recidivism [5]. Importantly, it is often challenging to

identify MP victims, because the available history is typically non-reliable and deliberately deceiving, and the clinical presentations frequently tend to mimic natural illnesses. The available literature on MP is extremely sparse and comprised mainly of case reports, or relies on death certificate databases.

We sought to explore the characteristics and outcome of patients presenting for emergency care as victims of malicious or criminal poisoning in the USA by combining the formal clinical assessments by medical toxicologists with the prospective data collection within the Toxicology Investigators Consortium (ToxIC) case registry.

## Methods

In 2010, the American College of Medical Toxicology (ACMT) established a prospective, nationwide toxico-surveillance database, The ToxIC Case Registry. This registry exclusively

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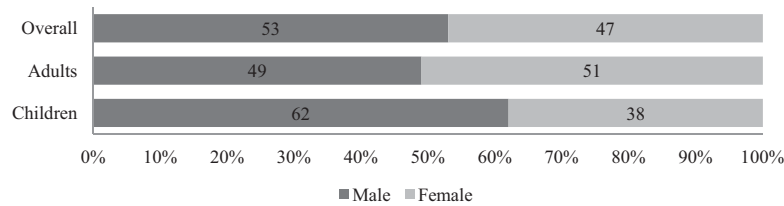


Figure 1. Patient characteristics: sex distribution.

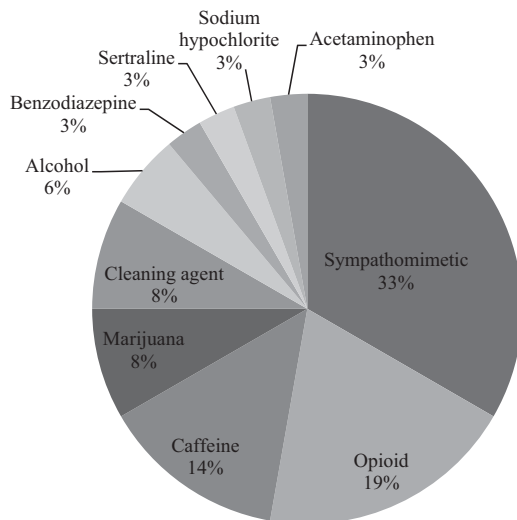


Figure 2. Toxic agents administered to children who were maliciously poisoned.

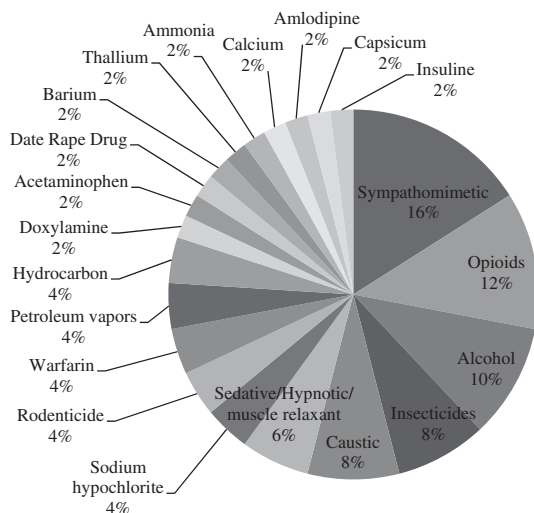


Figure 3. Toxic agents administered to adults who were maliciously poisoned.

compiles cases that have been consulted on and managed by a medical toxicology service at the bedside in its 47 participating sites. Most participating sites are hospitals within academic institutions, which collectively constitute roughly two-thirds of the medical toxicology training programs across the USA. Participating sites prospectively collect demographic, clinical and toxicological data of all patients that are cared for by the medical toxicology service at each center. The ToxIC Case Registry functions under the Western IRB approval, and each participating site has received its respective institutional ethics approval.

Cases of malicious or criminal intent are prospectively identified and coded as such in the ToxIC Registry. We identified all exposure cases which were determined in real-time to be poisoning with malicious and/or criminal intent by the respective medical toxicology service consulted. We included cases recorded in ToxIC in the 3.5-year period between 1 January 2014 and 30 June 2017.

Detailed demographic and clinical data were prospectively collected on each patient and exposures were confirmed to the extent possible by the alignment of clinical history, signs, symptoms, and confirmatory laboratory tests, when available. Collected data included, but was not restricted to, age, sex, circumstances of exposure, substances involved, clinical signs and symptoms, management and outcome. Lack of an identified substance/exposure or relevant signs/symptoms served as exclusion criteria. Descriptive and relative frequencies along with graphic methods were used to evaluate the characteristics of the study population. Fisher's Exact/non-parametric tests were used to assess differences in distribution of study variables, as appropriate. Two-tailed alpha level for statistical significance was set at  $<0.05$ .

## Results

We identified 60 confirmed cases (0.2%) of malicious poisoning out of 27,028 cases reported to ToxIC registry during the study period. The frequency of cases was consistent over the years, ranging from 16 to 19 cases/year (median =17). The victims' median age was 28 years (range: 1 month to 64 years), including 21 (35%) pediatric cases (0–18 years). Seventeen of 21 (81%) pediatric MP exposures were directed against children younger than 2 years, including nine (43% of all pediatric cases) infants younger than 12 months. The mortality rate among MP cases was 5% (3 cases out of 60), accounting for 0.83% of all ToxIC deaths (3/361) during the study period.

The sex distribution demographics are illustrated in Figure 1. The overall sex distribution among all MP cases was similar (32 males, 28 females); however, there was a trend towards male predominance in children (13 males/8 females).

The substances administered to pediatric and adult victims are shown in Figures 2 and 3, respectively. Among pediatric MP cases, a third was poisoned by sympathomimetics, a fifth by opioids, followed by a variety of medications, illicit drugs and household products (Figure 2). Sympathomimetics were mainly methamphetamines (8 cases), along with amphetamines (2) and cocaine (2). Opioids were mainly methadone (3), followed by morphine (2), oxycodone (1), and 1 was unspecified. Among adults, the same substances were leaders, but with a more diffuse distribution (Figure 3):

sympathomimetics and opioids were the main substances used for malicious exposures in adults, but only a third reported sympathomimetics, opioids and alcohol combined. Sympathomimetics were mainly cocaine (5), then methamphetamines (2) and 1 2c-series phenethylamine designer drugs. Opioids were mainly heroin (5) and 1 unspecified. In addition, various medications, illicit drugs and household products were used. No toxidromes were predominant, and the clinical manifestations varied based on the toxic substances administered. Multiple substances were administered to 14 patients (23%), 6 children and 8 adults, of which 9 were treated (6 pediatrics and 3 adults) and 4 with specific antidotes (naloxone/nalmefene, benzodiazepines, N-Acetylcysteine).

Seventeen (81%) pediatric patients received active treatment, such as antidotes, whole bowel irrigation, or intravenous fluid resuscitation. In contrast, only 18 adults (46%) received specific therapies beyond usual supportive care ( $p=0.0132$ ). Likewise, mechanical ventilation was more frequent in children (6/21; 29%) compared to adults (2/39; 5%;  $p=0.0176$ ). Three of the 60 patients (5%) died – two children – a toddler poisoned with oxycodone and a 17-year-old poisoned with cocaine – and one adult, a 46-year-old who was poisoned with amlodipine.

## Discussion

We found that poisoning with malicious intent, while uncommon, involves a wide variety of substances, and carries an exceedingly high mortality risk compared with overall overdoses. Unable to protect themselves against intended harm, infants and young children are particularly vulnerable and disproportionately subjected to malicious poisoning.

Poisonings with malicious intent are challenging to identify and complex to manage and study. From a clinical perspective, factual history is not typically disclosed, and frequently relevant information is deliberately hidden or manipulated to prevent exposure. For these reasons it is possible that we have underestimated the extent of MP cases in our cohort.

Poisonings with malicious intent are especially concerning when they involve infants and young children. Children younger than 2 years represent 81% of all children and 28% of all MP cases. That predominance is consistent with the distribution of MP cases in the US National Poison Data System [6] and death certificate databases [3], confirming infants to be at an exceedingly high risk and vulnerability. Previous research reported mortality rate of children who are victims of malicious poisoning up to 12.5% [7]. Children in our cohort also received more treatment than adults, potentially a surrogate marker of clinical status severity. Substances used to maliciously poison children were mainly sympathomimetics and opioids, the two representing more than half of substances in all pediatric MP exposures. In the adult group, a more varied list of substances was administered, with no significant dominance.

Red flags to raise concern of malicious poisoning include a history not matching the clinical picture, multiple

substances involved, recurrence [8] and additional physical signs of abuse on exam. In children, documented co-occurrence of maltreatment is found in roughly half of cases [9].

Importantly, the mortality risk for malicious poisoning in our cohort was significantly higher than that reported for malicious poisoning cases reported by the American National Poison Control Data System (NPDS) (5.0% compared to 0.07%, respectively;  $p < 0.0001$ ) [1]. This large difference likely stems from two main reasons: first, the different nature of the two registries: NPDS is representative of all phoned-in cases from a larger population base, while ToxIC registry exclusively catalogues cases in whom frontline clinicians requested medical toxicology bedside consult [10]; therefore, while complementing each other, the latter tends to include a larger proportion of more serious exposures. Second, our cohort exclusively focused on exposures with malicious intent by a third-party, while NPDS data include also minor, accidental and also suspected exposure calls from the public.

Some study limitations merit mention. As ToxIC exclusively captures cases consulted by medical toxicology services at the bedside, it tends to capture more severe cases. However, in the context of poisoning with malicious intent, it is reasonable to assume that medical toxicology services will be consulted where available if volition is exposed. Second, cases with malicious intent may go overlooked, or intent may be revealed at a later stage. Third, if patients died prior to hospital arrival, they would not be captured.

## Conclusion

In summary, malicious poisonings are uncommon, but carry high morbidity and mortality. About a third of patients were children, almost all younger than 2 years, with roughly 10% overall pediatric mortality. These facts should alert frontline providers, especially those managing young children, as infants are particularly vulnerable, cannot provide relevant verbal history nor protect themselves against malicious exposures.

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## Disclosure statement

No potential conflict of interest was reported by the authors.

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