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ORIGINAL ARTICLE

Utilization of Observation Units for the Care of Poisoned Patients: Trends from the Toxicology Investigators Consortium Case Registry

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Abstract Many poisoned patients may only require a period of observation after their exposure. There are limited data describing the use of observation units for managing poisoned adult and pediatric patients. We performed a retrospective review of all patients reported to the ToxIC Case Registry between January 1, 2012 and December 31, 2013. Eligible patients included those who received a bedside consultation by a medical toxicologist and whose care was provided in an observation unit, or those who were admitted under the care of a medical toxicologist in an observation unit. A total of 15,562 poisonings were reported to the registry during the study period, of which 340 (2.2 %) involved patients who were cared for in an observation unit. Of these patients, 22.1 % were 18 years of age or younger, and the remaining 77.9 % were greater than 18 years of age. The most common reason for exposure was the intentional ingestion of a pharmaceutical agent in both adult (30.2 %) and pediatric patients (36.0 %). Alcohols (ethanol) (24.9 %), opioids (20.0 %), and sedative-hypnotics (17.7 %) were the most common agent classes involved in adult patient exposures. The most common agent classes involved in pediatric exposures were antidepressants (12.0 %), anticonvulsants (10.7 %), and envenomations (10.7 %). In adult patients, the most common signs and symptoms involved the nervous system (52.0 %), a toxidrome (17.0 %), or a major vital sign abnormality (14.7 %). In pediatric patients, the most common signs and symptoms involved the nervous system (53.3 %), a toxidrome (21.3 %), or a major vital sign abnormality (17.3 %). The results of this study demonstrate that a wide variety of poisoned patients have been cared for in an observation unit in consultation with a board-certified medical toxicologist. Patterns for the reasons for exposure, agents responsible for the exposure, and toxicological treatments will continue to evolve. Further study is needed to identify better those poisoned patients who can be appropriately managed in an observation unit.

Keywords Medical toxicology · Observation units · Overdose · Poisonings · Registry · Toxicology

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Introduction

In 2012, approximately 27.5 % of the 613,412 human poisonings reported to poison centers and managed in healthcare facilities across the USA caused toxicity serious enough to necessitate admission to a hospital [1]. However, many poisoned patients may only require a period of observation after their exposure due to abnormal vital signs, change in mental status, need for toxicological treatment, or if there is potential for delayed toxicity. Observation units provide an alternative for clinicians in which to render care to these patients.

An observation unit has been defined as an area of the hospital, typically adjacent to or located within the emergency department, where patients can be monitored clinically and receive additional therapies and/or diagnostic tests following an emergency department evaluation [2]. Most observation units are managed by emergency department personnel [3, 4]. Usually, patients stay for less than 24 h before being discharged home or admitted for psychiatric treatment [5].

For over two decades, observation units have been used to manage patients with specific diagnoses, including poisoned patients [2, 6]. In 2007, a national survey revealed that about one third of hospitals delivered care in an observation unit [7]. Multiple studies have demonstrated that care rendered in observation units is equal or better in quality and lower in cost than inpatient care for select medical conditions [8–10].

Unfortunately, there are limited data describing the use of observation units for managing poisoned adult and pediatric patients [11–14]. Knowledge of the reasons for exposure, substances ingested, associated signs and symptoms, and toxicological treatment provided for patients cared for in an observation unit would be valuable to clinicians. Recent trends regarding the use of observation units to manage poisoned patients are also important because of the large number of toxicological patients who are treated annually in emergency departments throughout the USA and escalating healthcare costs. For this descriptive study, we sought to determine the following for poisoned patients cared for in an observation unit and whose evaluation also included consultation by a board-certified medical toxicologist: (1) reasons for exposure, (2) substances or toxins exposed to, (3) associated signs and symptoms, and (4) toxicological treatment provided.

Methods

Study Sites

The Toxicology Investigators Consortium (ToxIC) Case Registry was established in 2010 by the American College of Medical Toxicology (ACMT) to serve as a prospective toxico-surveillance system [15]. The registry prospectively gathers all cases managed at the bedside by medical toxicologists in its 41 participating sites from Australia, Canada, Israel, and 22 states across the USA. The majority of the contributing sites are university-affiliated academic institutions, including 18 of the 30 Medical Toxicology Fellowship training programs. At each participating site, case entries are performed online and stored in a password-protected database that is maintained by the ACMT.

A detailed description of the registry has been previously published [15]. Briefly, the registry database allows for identification, extraction, and pooling of information on toxicological exposures among participating sites. It also provides the most likely etiology of patients' symptoms. The registry has been approved to function without restriction by the Western Institutional Review board, as long as all patient data are de-identified and there are no patient interventions as a result of being in the registry. Sites contribute cases to the registry with the consent or waiver of their specific institutional review board. Contributors agree to enter all eligible cases that may be employed for research purposes as part of participating in the registry.

Patients

We identified all cases, entered prospectively into the registry between January 1, 2012 and December 31, 2013. Although the registry was established in 2010, it only began tracking placement of poisoned patients into observation units on January 1, 2012. Eligible patients were identified using the following search criteria: those who received a bedside consultation by a medical toxicologist and whose care was provided in an observation unit, or those who were admitted under the care of a medical toxicologist in an observation unit. For this study, an "observation unit" was defined as an area of the hospital, adjacent to or located within in the emergency department, where patients could be monitored clinically and receive additional therapies and/or diagnostic tests following an emergency department evaluation [2]. Toxicological exposures were confirmed by the performance of a detailed, bedside history, and physical examination by a board-certified medical toxicologist. Ancillary diagnostic tests (e.g., serum drug concentration, urine drug screens) were performed when necessary to aid in confirming toxicological exposures. Data output from the registry was sorted by patient age, and information entered into a database. To ensure study eligibility, each case was reviewed by the authors (BJ, MV, LO).

Data Collection

This retrospective, descriptive study analyzed all eligible cases to explore the reasons for exposure, substances ingested, associated signs and symptoms, and toxicological treatment provided. No chemicals, medications, substances, or environmental/occupational exposures were excluded. Demographic information and clinical data were tabulated for patients including (1) age group and gender; (2) circumstances and reasons for exposure; (3) all substances or toxins to which each patient was exposed, as determined by the medical toxicologist; (4) associated signs and symptoms; and (5) toxicological treatment rendered.

Results

A total of 15,562 poisonings were reported to the registry during the study period, of which 340 (2.2 %) involved patients who were cared for in an observation unit. Of these patients, 22.1 % were 18 years of age or younger, and the remaining 77.9 % were greater than 18 years of age. Of the 75 pediatric cases, 46.7 % were male, whereas 60.4 % of the 265 adult cases were male. Multiple (≥2) agent exposures were recorded in 27.5 % of adult cases and 21.3 % of pediatric cases. The median number of drugs involved in multiple exposure cases was 2 (range, 2–6) in adult patients and 2 (range, 2–4) in pediatric patients. Only three out of the 340 cases were reported by participating international sites during the study period. No deaths were reported in either cohort of patients.

Reasons for Exposure

The most common reason for exposure was the intentional ingestion of a pharmaceutical agent in both adult (30.2 %) and pediatric patients (36.0 %). A higher percentage of pediatric patients (30.7 %) was exposed unintentionally to a pharmaceutical agent compared to 9.4 % of adult patients. Withdrawal states from ethanol, opioids, and sedative-hypnotics (11.3 %); the abuse of illicit, prescription, and over-the-counter drugs (16.6 %); and ethanol abuse (16.6 %) were all common reasons for exposure in patients 18 years or older.

Adverse drug events (medication error resulting in harm) and adverse drug reactions (undesirable effect of medication used in a normal dose) accounted for 9.4 and 6.7 % of exposures in adult and pediatric patients, respectively. Envenomation by a snake, scorpion, or spider was more common in pediatric patients (10.7 %) compared with adult patients (4.2 %). The reasons for exposure for adult and pediatric patients are provided in Table 1.

Substance/Toxin Exposures

Alcohols (ethanol) (24.9 %), opioids (20.0 %), and sedative-hypnotics (17.7 %) were the most common agent classes involved in adult patient exposures. These agent classes accounted for 2.7, 2.7, and 9.3 % of pediatric exposures, respectively. The most common agent classes involved in pediatric exposures were antidepressants (12.0 %), anticonvulsants (10.7 %), and envenomations (10.7 %). For adult patients exposed to alcohol, it was the only

Table 1 Reasons for exposure

Adult patients (>18 years) (n=265)			Pediatric patients (≤18 years) (n=75)		
Reason	Number	Percent	Reason	Number	Percent
Intentional—pharmaceutical	80	30.2	Intentional—pharmaceutical	27	36.0
ETOH Abuse	44	16.6	Unintentional—pharmaceutical	23	30.7
Drug abuse—illicit	28	10.6	Snake	5	6.7
Unintentional—pharmaceutical	25	9.4	Unintentional—non-pharmaceutical	4	5.3
ADR	17	6.4	ADR	3	4.0
Withdrawal—ETOH	16	6.0	Intentional—non-pharmaceutical	2	2.7
Drug abuse—prescription	15	5.7	Drug abuse—illicit	2	2.7
Withdrawal—opioids	13	4.9	ETOH abuse	2	2.7
Intentional—non-pharmaceutical	11	4.2	ADE	2	2.7
ADE	8	3.0	Spider	2	2.7
Snake	8	3.0	Drug abuse—prescription	1	1.3
Unknown	7	2.6	Scorpion	1	1.3
Interpretation of lab data	6	2.3	Organ system dysfunction	1	1.3
Unintentional—non-pharmaceutical	3	1.1	Unknown	1	1.3
Organ system dysfunction	3	1.1			
Scorpion	2	0.8			
Drug abuse—OTC	1	0.4			
Withdrawal—sedative-hypnotic	1	0.4			
Spider	1	0.4			
Marine/fish	1	0.4			
Occupational evaluation	1	0.4			

Patients may have had more than one reason for exposure; thus, percentages do not add up to 100 %

substance which they were exposed to in 69.7 % of alcohol-related cases, including alcohol withdrawal. In 8.7 % of patients older than 18 years, it was unknown to which agent class they were exposed, compared with 13.3 % of patients ≤18 years. The agent classes involved in adult and pediatric exposures are provided in Table 2. The most common agents reported for the top three substance/toxin classes for adult and pediatric patients are listed in Table 3.

Signs and Symptoms

Adult and pediatric patients were noted to have a variety of signs and symptoms as recorded by the medical toxicologist (Table 4). In adult patients, the most common signs and symptoms involved the nervous system (52.0 %), a toxidrome (17.0 %), or a major vital sign abnormality (14.7 %). Eighty adult patients (30.2 %) were asymptomatic, whereas 27.5 % had signs or symptoms involving two or more organ systems. In pediatric patients, the most common signs and symptoms involved the nervous system (53.3 %), a toxidrome (21.3 %), or a major vital sign abnormality (17.3 %). Twenty-four (32.0 %) pediatric patients were asymptomatic, whereas 25.3 % had signs or symptoms involving two or more organ systems.

Toxicological Treatments

A large percentage of adult (44.9 %) and pediatric (53.3 %) patients received no toxicological treatment during their

Table 2 Agent classes involved in exposures

Adult patients (>18 years) (n=265)			Pediatric patients (≤18 years) (n=75)		
Substance/toxin class	Number	Percent	Substance/toxin class	Number	Percent
Alcohols (ethanol)	66	24.9	Unknown	10	13.3
Opioids	53	20.0	Antidepressants	9	12.0
Sedative-hypnotics	47	17.7	Anticonvulsants	8	10.7
Unknown	23	8.7	Envenomation	8	10.7
Analgesics	22	8.3	Analgesics	7	9.3
Anticholinergic/antihistamines	20	7.5	Sedative-hypnotics	7	9.3
Anticonvulsants	19	7.2	Anticholinergic/antihistamines	6	8.0
Antidepressants	15	5.7	Cardiovascular	6	8.0
Antipsychotics	15	5.7	Sympathomimetic	5	6.7
Cardiovascular	12	4.5	Antipsychotics	3	4.0
Envenomation	12	4.5	Hydrocarbons	3	4.0
Sympathomimetic	12	4.9	Psychoactive	3	4.0
Psychoactive	7	2.6	Alcohols (ethanol)	2	2.7
Diabetic meds	6	2.3	Opioids	2	2.7
Lithium	6	2.3	Alcohols (toxic)	1	1.3
Other—non-pharm	6	2.3	Anesthetics	1	1.3
Anticoagulant	4	1.5	Antimicrobials	1	1.3
Alcohols (toxic)	2	0.8	Cough and cold	1	1.3
Herbals	2	0.8	Diabetic meds	1	1.3
Metals/metalloids/iron	2	0.8	Herbals	1	1.3
Plants/fungi	2	0.8	Household	1	1.3
Other—pharmaceutical	2	0.8			
Anesthetics	1	0.4			
Antimicrobials	1	0.4			
Chemotherapeutic	1	0.4			
Cough and cold	1	0.4			
Endocrine/hormones/steroids	1	0.4			
Gastrointestinal	1	0.4			
Household	1	0.4			

Patients may have been exposed to two or more classes of substances or toxins; thus, the percentages do not add up to 100 %

Table 3 Most common agents reported in the top 3 substances/toxin classes for adult and pediatric patients

Adult patients (>18 years) (n=265)			Pediatric patients (≤18 years) (n=75)		
Most common agents	Number	Percent	Most common agents	Number	Percent
Alcohols	66	24.9	Antidepressants	9	12.0
Ethanol	66	24.9	Citalopram	4	5.3
			Bupropion	2	2.7
			Fluoxetine	2	2.7
			Fluvoxamine	1	1.3
			Sertraline	1	1.3
			Venlafaxine	1	1.3
Opioids	51	19.2	Anticonvulsants	8	10.7
Heroin	14	5.2	Carbamazepine	3	4.0
Oxycodone	7	2.6	Lamotrigine	3	4.0
Dextromethorphan	5	1.9	Topiramate	1	1.3
			Valproate	1	1.3
Sedative-hypnotics	47	17.7	Envenomation	8	10.7
Clonazepam	13	4.9	Agkistrodon	2	2.7
Alprazolam	10	3.8	Crotalus	2	2.7
Carisoprodol	4	1.5	Loxosceles	2	2.7
Lorazepam	4	1.5	Scorpion (unknown species)	1	1.3
Zolpidem	4	1.5	Snake (unknown species)	1	1.3

Agents are listed in order of declining frequency. Percentages do not add up to 100 % since only the top 3 substance/toxin classes are represented

observation stay (Table 5). Antidotes were administered to 39.2 % of adult patients and 20.0 % of pediatric patients. Pharmacologic support was provided to 23.8 and 18.7 % of adult and pediatric patients, respectively. Non-pharmacologic support was provided to 18.1 and 18.7 % of adult and pediatric patients, respectively. Twenty-three percent of adult patients received two or more toxicological treatments, and 17.3 % of pediatric patients received two or more toxicological treatments during their stay in an observation unit. Eight of the 13 (61.5 %) patients with snake envenomation received Crotalidae Polyvalent Immune Fab (Ovine), with no apparent difference in the administration of antivenom between adult (5/8, 62.5 %) and pediatric (3/5, 60.0 %) patients. Ten out of the three hundred and forty (2.9 %) patients required intervention for life-threatening conditions and are described in Table 6.

Discussion

Observation units, whether they are located within or adjacent to an emergency department, offer clinicians an alternative in which to render care to patients. Their use has become increasingly popular due to their ability to decompress emergency departments and inpatient beds and provide cost-effective, high-quality care [2]. In many ways, poisoned patients are suitable candidates for observation management: (1) the toxicodynamic properties of most toxicants are fairly predictable [11], (2) patients with unknown ingestions or who have ingested a substance with sustained-release properties can be monitored for delayed toxicity [16], (3) the vast majority of these patients are likely to be discharged within 24 h [11, 13, 14, 17], (4) only a small percentage of poisoned patients fail observation and require inpatient admission [11–14, 17], and (5) these patients can receive support to address emotional and psychiatric issues [16].

While the number of dedicated observation units in hospitals is growing across the USA [18, 19], very few studies have exclusively evaluated the utilization or experience of observation units for poisoned patients [11–14]. Findings from these studies, while useful, are limited for several reasons. First, all of the studies were performed at a single institution [11–14]. Second, two of the studies focused only on pediatric patients [11, 14]. Third, none of the studies evaluated the reasons for exposure, fully delineated the classes of substances or toxins that patients were exposed to, fully examined associated signs and symptoms, or provided information on toxicological treatments administered to patients [11–14].

There were some surprising findings from this study. The first is the variability of the use of certain antidotes in poisoned patients managed in an observation unit. As an example, we found that physostigmine was used in 19 cases; however, only nine patients were recorded as having an anticholinergic

Table 4 Signs and symptoms in adult and pediatric patients as recorded by the medical toxicologist

Adult patients (>18 years) (*n*=265) Organ system	Number	Percent	Pediatric patients (≤18 years) (*n*=75) Organ system	Number	Percent
Nervous system	138	52.0	Nervous system	40	53.3
Coma/central nervous system depression	59	22.3	Coma/central nervous system depression	18	24.0
Delirium/toxic psychosis	38	14.3	Agitation	10	13.3
Hyperreflexia/myoclonus/clonus/tremor	12	4.5	Hyperreflexia/myoclonus/clonus/tremor	4	5.3
Agitation	10	3.8	Delirium/toxic psychosis	3	4.0
Seizures	7	2.6	Hallucinations	2	2.7
Hallucinations	4	1.5	Extrapyramidal symptoms/dystonia/rigidity	1	1.3
Numbness/paresthesias	3	1.1	Seizures	1	1.3
Weakness/paralysis	3	1.1	Weakness/paralysis	1	1.3
Extrapyramidal symptoms/dystonia/rigidity	1	0.4			
Peripheral Neuropathy	1	0.4			
Toxidrome	45	17.0	Toxidrome	16	21.3
Sedative-hypnotic	28	10.6	Sedative-hypnotic	9	12.0
Anticholinergic	6	2.3	Anticholinergic	3	4.0
Serotonin syndrome	5	1.9	Opioid	1	1.3
Opioid	3	1.1	Serotonin syndrome	1	1.3
Cholinergic	1	0.4	Sympatholytic	1	1.3
Sympathomimetic syndrome	1	0.4	Sympathomimetic syndrome	1	1.3
Washout syndrome	1	0.4			
Major vital sign abnormalities	39	14.7	Major vital sign abnormalities	13	17.3
Hypotension (SBP<80)	13	4.9	Tachycardia (P>140)	6	8.0
Hypertension (SBP>200 and/or DBP>120)	9	3.4	Hypotension (SBP<80)	5	6.7
Tachycardia (P>140)	8	3.0	Hypertension (SBP>200 and/or DBP>120)	1	1.3
Bradycardia (P<50)	8	3.0	Bradycardia (P<50)	1	1.3
Bradypnea (R<10)	1	0.4			
Metabolic	22	7.9	Dermatologic	6	8.0
Metabolic acidosis (pH<7.2)	10	3.8	Rash	2	2.7
Hypoglycemia (BG<50)	5	1.9	Angioedema	2	2.7
Elevated anion Gap (AG>20)	5	1.9	Blisters	2	2.7
Elevated osmolal gap (OG>20)	2	0.8			
Gastrointestinal/hepatic	18	6.8	Metabolic	5	6.7
Hepatotoxicity (AST>1000)	14	5.3	Metabolic acidosis (pH<7.2)	3	4.0
Gastrointestinal bleed	3	1.1	Hypoglycemia (BG<50)	1	1.3
Pancreatitis (lipase>100)	1	0.4	Elevated anion gap (AG>20)	1	1.3
Renal/muscle	19	7.2	Pulmonary	4	5.3
Acute kidney injury (creat>2.0)	13	4.9	Aspiration pneumonitis	2	2.7
Rhabdomyolysis (CPK>1000)	4	1.5	Respiratory depression	2	2.7
Hematologic	13	4.9	Cardiovascular	1	1.3
Significant leukocytosis (WBC>20,000)	6	2.3	Prolonged QTc (≥500 ms)	1	1.3
Thrombocytopenia (PLTs<20,000)	4	1.5			
Significant coagulopathy (PT>15)	2	0.8			
Hemolysis (Hgb<10)	1	0.4			
Pulmonary	10	3.8	Hematologic	1	1.3
Aspiration pneumonitis	6	2.3	Significant leukocytosis (WBC>20,000)	1	1.3
Respiratory depression	3	1.1			
Acute lung injury/acute respiratory distress syndrome	1	0.4			
Cardiovascular	10	3.8			
Prolonged QTc (≥500 ms)	8	3.0			

Table 4 (continued)

Adult patients (>18 years) (n=265) Organ system	Number	Percent	Pediatric patients (≤18 years) (n=75) Organ system	Number	Percent
Ventricular dysrhythmias	1	0.4			
Prolonged QRS (≥120 ms)	1	0.4			
Dermatologic	9	3.4			
Rash	4	1.5			
Blisters	3	1.1			
Angioedema	2	0.8			
No signs or symptoms	80	30.2	No signs or symptoms	24	32.0
Two or more organ systems affected	73	27.5	Two or more organ systems affected	19	25.3

Signs and symptoms are categorized by organ system and declining order of frequency. Percentages were calculated based on the number of adult or pediatric patients. Several patients may have had two or more organ systems affected; thus, the percentages do not add up to 100 %

toxidrome. Further analysis revealed that one participating site was responsible for administering physostigmine in 94.7 % of cases.

The second finding relates to those instances in which the medical toxicologist could not determine which substance or toxin class a patient had been exposed to. These cases were placed in an "unknown" category and accounted for 8.7 % of adult and 13.3 % of pediatric patients (Table 2). None of these patients required intervention for a life-threatening condition. While the percentage of these "unknown" cases seems disproportionately high, Callelo et al. reported that the substance or toxin class could not be determined in 6.1 % of pediatric patients managed in an observation unit [11]. Considering that it is not always possible to deduce the type of exposure for poisoned patients, some patients with an "unknown" exposure may be appropriate for managing in an observation unit.

The third and most concerning findings are those patients who required intervention for life-threatening conditions (Table 6). The potential for deterioration in a poisoned patient's clinical condition is always a concern; however, comprehensive data regarding the safety of the use of observation units for the treatment of poisoned patients is lacking. Previous studies have reported an unplanned hospitalization rate for poisoned patients managed in an observation unit ranging from 2.2 to 5.9 % [11, 12, 14].

While this study did not directly address patients who failed their observation stay, we did identify several cases (2.9 %) that required intervention for life-threatening conditions. Because of the descriptive nature of this study, it was not possible to determine which variables (e.g., toxin characteristics, evidence of end-organ toxicity, preexisting medical conditions, physical dependency, amount ingested, or observation unit capabilities) may have contributed to the clinical deterioration in this subset of patients. Clinical deterioration or unplanned hospitalization might be unpredictable for a small percentage of poisoned patients cared for in an observation unit. In other words, some poisoned patients will become more ill while being managed in an observation unit. However, to mitigate the risk for clinical deterioration, it is important for physicians to consider the aforementioned variables before placing a poisoned patient in an observation unit.

The results of our study and others [11, 12] suggest that observation units may be underutilized for managing poisoned patients. However, our data may be skewed toward more serious poisonings since it is comprised of cases that involved the consultation of a board-certified medical toxicologist. Additionally, not all cases of patients cared for in an observation unit may have been entered into the ToxIC Registry by participating sites during the study period.

Finally, this study provides a unique perspective on recent trends about the use of observation units for poisoned patients and whose care involved consultation by a board-certified medical toxicologist. Additionally, it provides a snapshot of the reasons for exposure, classes of substances or toxins that a patient was exposed to, associated signs and symptoms, and toxicological treatment provided. However, readers must be cautioned that the results of this study were generated from "top-level" data gathered from the registry. Individual patient charts from participating sites were not studied. Therefore, we were unable to determine how patients were selected for placement into an observation unit, which treatment protocols were in place, and what resources were available for patient care. Further study is necessary to help develop predictive factors and clinical guidelines to better identify toxicological patients that can be safely managed in an observation unit.

Limitations

Our study has several important limitations. This is a descriptive study and is therefore limited in its scope. The generalizability of the results may not be applicable to many healthcare facilities since the ToxIC Registry primarily captures cases from academic and tertiary care referral centers. Data may

Table 5 Treatments reported to have been used in poisoned patients cared for in an observation unit

Adult patients (>18 years) (n=265)			Pediatric patients (≤18 years) (n=75)		
Treatment	Number	Percent	Treatment	Number	Percent
Antidotes	104	39.2	Antidotes	15	20.0
Naloxone/nalmefene	31	11.7	Naloxone/nalmefene	3	4.0
Physostigmine	17	6.4	Flumazenil	3	4.0
Flumazenil	13	4.9	*N*-acetylcysteine	3	4.0
Thiamine	13	4.9	Sodium bicarbonate	2	2.7
N-acetylcysteine	9	3.4	Physostigmine	2	2.7
Folate	6	2.3	Glucagon	1	1.3
Sodium bicarbonate	4	1.5	Fomepizole	1	1.3
Octreotide	3	1.1			
Fomepizole	2	0.8			
Carnitine	2	0.8			
Atropine	1	0.4			
Vitamin K	1	0.4			
Pharmacologic support	63	23.8	Pharmacologic support	14	18.7
Benzodiazepines	25	9.4	Benzodiazepines	8	10.7
Antipsychotics	11	4.2	Opioids	2	2.7
Opioids	5	1.9	Antiemetics	1	1.3
Vasopressors	3	1.1	Steroids	1	1.3
Glucose	3	1.1	Vasopressors	1	1.3
Anticonvulsants	3	1.1	Antihistamines	1	1.3
Steroids	2	0.8			
Antihypertensives	2	0.8			
Buprenorphine	2	0.8			
Clonidine	2	0.8			
Albuterol	1	0.4			
Magnesium	1	0.4			
Folinic acid	1	0.4			
Hydroxyzine	1	0.4			
Phenobarbitol	1	0.4			
Non-pharmacologic support	48	18.1	Non-pharmacologic support	14	18.7
IV fluids	41	15.5	IV fluids	13	17.3
Intubation	4	1.5	EGD	1	1.3
CPR	2	0.8			
Wound care	1	0.4			
Decontamination	6	2.3	Decontamination	5	6.7
Activated charcoal	4	1.5	Activated charcoal	5	6.7
Whole bowel irrigation	1	0.4			
Irrigation	1	0.4			
Antivenom	5	1.9	Antivenom	3	4.0
Crotalidae Polyvalent Immune Fab (Ovine)	5	1.9	Crotalidae Polyvalent Immune Fab (Ovine)	3	4.0
Elimination	4	1.5			
Multi-dose activated charcoal	2	0.8			
Urinary alkalinization	2	0.8			
No treatment received	119	44.9	No treatment received	40	53.3
Received two or more treatments	61	23.0	Received two or more treatments	13	17.3

Treatments are listed in order of declining frequency. Patients may have received more than one treatment; thus, percentages do not add up to 100 %

Table 6 Case characteristics in which an intervention was necessary for a life-threatening condition

Patient (sex, age)	Reason(s) for exposure	Agent(s)	Signs and symptoms	Treatment(s)
Male, 34 years	Unintentional—pharmaceutical	Clonidine	Bradycardia, coma/CNS depression	Atropine
Female, 21 years	Adverse drug event, (medication error resulting in harm)	Bupivacaine	Seizures	Intubation
Male, 23 years	Drug abuse—prescription	Methadone	Aspiration pneumonitis, coma/CNS depression, delirium/toxic psychosis, acute kidney injury	Intubation, naloxone/nalmefene
Male, 64 years	Withdrawal—EtOH	Ethanol	Unknown	Intubation, antipsychotics, benzodiazepines, phenobarbital, clonidine
Female, 47 years	Intentional—pharmaceutical	Tramadol, hydralazine valproate, hydroxyzine	Ventricular dysrhythmias, prolonged QRS, prolonged QTc, coma/CNS depression, seizures, metabolic acidosis, elevated anion gap	CPR, intubation, activated charcoal
Male, 27 years	Drug abuse—illicit	Heroin	Opioid toxidrome	CPR, naloxone/nalmefene
Female, 20 years	Intentional—pharmaceutical	Methadone, clonazepam	Opioid toxidrome, hypotension, respiratory depression, coma/CNS depression, metabolic acidosis, acute kidney injury, rhabdomyolysis	Vasopressors, IV fluids, sodium bicarbonate
Female, 64 years	Intentional—pharmaceutical	Amlodipine, benazepril, metformin	Hypotension, bradycardia	Vasopressors, IV fluids
Male, 48 years	Intentional—pharmaceutical, EtOH abuse	Ethanol, lithium, clonazepam	Sedative-hypnotic, delirium/toxic psychosis	Vasopressors, anticonvulsants
Male, 17 years	Adverse drug reaction (undesirable effect of a medication used in a normal dose)	Septocaine	Angioedema	Vasopressors, opioids, steroids, antihistamines

represent poisonings caused by agents that clinicians may not be comfortable managing in an observation unit without consultation from a medical toxicologist. Outcomes such as unplanned inpatient admission, length of stay, and adverse rate event were not directly evaluated. Patients were not followed up after discharge from the observation unit. Finally, error may have been introduced into the data since the registry relies on individual sites to report all of their cases.

Conclusions

The results of this study demonstrate that a wide variety of poisoned patients has been cared for in an observation unit in consultation with a board-certified medical toxicologist. Patterns for the reasons for exposure, agents responsible for the exposure, and toxicological treatments will continue to evolve. Further study is needed to help better identify those poisoned patients who can be appropriately managed in an observation unit.

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