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ORIGINAL ARTICLE

The Toxicology Investigators Consortium Case Registry—the 2019 Annual Report

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Abstract

The Toxicology Investigators Consortium (ToxIC) Registry was established by the American College of Medical Toxicology (ACMT) in 2010. The Registry collects data from participating sites with the agreement that all bedside medical toxicology consultation will be entered. This tenth annual report summarizes the Registry's 2019 data and activity with its additional 7177 cases. Cases were identified for inclusion in this report by a query of the ToxIC database for any case entered from 1 January to 31 December 2019. Detailed data was collected from these cases and aggregated to provide information which included demographics, reason for medical toxicology evaluation, agent and agent class, clinical signs and symptoms, treatments and antidotes administered, mortality, and whether life support was withdrawn. 50.7% of cases were female, 48.5% were male, and 0.8% were transgender. Non-opioid analgesics was the most commonly reported agent class, followed by opioid and antidepressant classes. Acetaminophen was once again the most common agent reported. There were 91 fatalities, comprising 1.3% of all Registry cases. Major trends in demographics and exposure characteristics remained similar to past years' reports. Sub-analyses were conducted to describe exposures in cases of self-harm, gender differences in substance use disorder, and trends in addiction medicine and pain management consultations.

Keywords Poisoning · Overdose · Surveillance · Epidemiology · Medical toxicology

Introduction

The year 2019 marked the 10th full year of operation of the Toxicology Investigators Consortium (ToxIC), symbolized by continued growth, robust data collection, and an expanding research program. In 2019, the Registry also rapidly deployed a focused clinical surveillance tool centered on the evolution of vaping-related pulmonary injury and continued to generate peer-reviewed publications and presentations at national and international meetings. The current report provides data on our clinical experience over 2019.

Beyond a compilation of our clinical data, this year we are highlighting some of our experiences in the important realm of self-harm attempts, substance abuse, and addiction medicine. Specifically, we are examining (1) differences in substances used for self-harm attempts based on age; (2) the gender-related experience in patients we have cared for with substance-misuse-related diagnoses; and (3) year-to-year trends and reasons for addiction medicine consultations.

In 2019, 7177 individual cases were entered into the ToxIC database deriving from 37 sites comprised of 70 separate health care facilities. By December 31, 2019, there were a total of 73,340 cases in the ToxIC database.

Nine full ToxIC publications spanning four journals were published in 2019, and 12 published ToxIC abstracts were presented at both national and international meetings. These are enumerated on the ToxIC website: https: www.ToxICRegistry.org.

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The following new ToxIC research projects were approved and initiated in 2019:

1. Comparison of physostigmine and dexmedetomidine for treatment of delirium in suspected anticholinergic poisoning
2. Treatment interventions in calcium channel blocker toxicity
3. Poisonings among transgender patients
4. Characterization of Z-drug toxicity
5. Assessment of whether the addition of dantrolene sodium to benzodiazepines in treating neuroleptic malignant syndrome improves clinical outcome
6. Methamphetamine, cocaine, and other drugs of abuse co-exposures
7. An assessment of the utility of provoked urine specimens
8. Toxic hyperthermia and the risk factors associated with increased morbidity and mortality
9. High-dose insulin euglycemia therapy use in pediatric patients with calcium channel blocker overdose
10. Clozapine-induced myocarditis and troponin elevation
11. Methylene blue usage in medical toxicology practice
12. Characteristics of kratom poisoning in the USA
13. Pulmonary puzzle: depicting patterns of use and presenting symptoms in vaping associated pulmonary injury

2019 saw the dramatic onset of a novel respiratory illness related to vaping. In response, ToxIC designed a focused intensive data collection on this topic with input from stakeholders including the US Food and Drug Administration (FDA). That study will be published separately; however, a short overview of the data collected is presented here.

The ToxIC consortium continued to expand its collaboration with the FDA on areas of interest to the Agency; 2019 was the third year of this collaboration.

In addition to the main Case Registry, ToxIC maintains 5 sub-registries representing detailed and highly focused data collections. The topics of these sub-registries are:

1. North American snakebites
2. Pediatric marijuana and opioid toxicity
3. Extracorporeal substance removal
4. Lipid resuscitation therapy
5. Plant and mushroom toxicity

2019 was the fifth and final full year of our clinical data collection for the National Institutes of Health (NIH)–funded study of the cardiovascular consequences of drug overdose. At the end of 2019, the data collection on Quality Metrics via the ToxIC Registry was terminated.

In 2019, ToxIC was supported by the NIH, the FDA, and a corporate contract with BTG International.

Methods

The operation, Health Insurance Portability and Accountability Act compliance, and institutional review board approvals have been described in prior publications.[1, 2]

A new query was added to the Case Registry to capture likely cases of vaping-related pulmonary disease. If answered in the affirmative, the investigator is directed to a supplementary data entry form with fields related to the type of substance vaped, time frames of use and symptom onset, frequency of use, flavorings of the substance(s) vaped, source of cartridges, other substances used, relevant medical history, symptoms, details of diagnostic testing, treatments, and outcomes.

Because the data collection on quality metrics in medical toxicology was terminated at the end of 2019, associated questions on the data base were removed.

Results

In 2019, there were a total of 7177 cases reporting toxicologic exposures to the ToxIC Registry from 37 sites. This is an increase in total cases compared to 2018.[3] Table 1 lists all individual sites that contributed cases in 2019.

Demographics

Tables 2 and 3 summarize selective demographics for age and gender, and race and ethnicity, respectively. In 2019, 50.7% of cases involved female patients and 0.8% involved transgender or gender-non-conforming patients (38 female to male, 16 male to female, 3 gender non-conforming). Sixty-eight patients (0.9%) were pregnant. Age distribution was similar to that of previous years.[2–4] The majority of patients were adults age 19–65 (62.1%) followed by adolescents age 13–18 (20.6%). Children (≤12 years of age) made up 11.1%; 5.8% of cases involved older adults (> 65 years of age).

The most commonly reported race was Caucasian (63.8%), followed by Black/African (13.7%) and Asian (3.4%). Race was reported as unknown/uncertain in 15.7% of cases, a decrease from the previous 3 years.[2–4] Hispanic ethnicity was reported in 12.5% of cases; 19.1% of cases reported ethnicity as unknown/uncertain. Race and ethnicity are self-reported by patients, or in cases in which a patient is unable to report, it may be determined by the examining medical toxicologist to the best of their ability.

Table 4 details the referral source of inpatient and outpatient medical toxicology encounters. The majority (53.7%) of inpatient cases were generated by the Emergency Department, and very few cases were referred

from poison centers (0.7%) or outpatient physicians (0%). Outpatient encounters were primarily referred by primary care and other outpatient physicians (68.0%), followed by self-referrals (10.0%). These trends were similar to those of previous years.[2–4]

Tables 5 and 6 describe the reason for the toxicology encounter and the details of intentional pharmaceutical exposures, respectively. Consistent with previous years,[2–4] intentional pharmaceutical exposures were by far the most common reason for medical toxicology encounters (52.4%). Addiction medicine consult was a new reason for encounter in 2018 and more than doubled in 2019 (2.7% to 6.6%).[3] Within the intentional pharmaceutical exposures, the majority of cases were again an attempt at self-harm (70.5%), primarily suicide attempts (86.2%).

Cases involving intent for self-harm ($N = 2630$) are described in detail in this year's report. Demographics in cases of self-harm differed somewhat from those of the general Registry discussed above. Notably, teens age 13–18 represented a higher proportion of cases of self-harm than in that of the general Registry, making up 39.5% of the cases of self-harm. Interestingly, this age group represented only 20.6% of the general Registry. Additionally, women accounted for a larger percentage of cases of self-harm than in the general Registry (65.0% vs 50.7%). Race demographics were similar to that of the general Registry. See Tables 7 and 8 for demographic data of cases involving self-harm.

Agent Classes

In 2019, of the 7177 cases entered into the ToxIC Registry, 2105 (29.3%) cases involved multiple agents for a total of 9792 individual agent entries. Consistent with previous years,[2–4] the non-opioid analgesic class was the most common (14.1%) class of drugs reported. In 2019, for the first time, the opioid class became the second most common agent class reported (13.4%), followed by the antidepressant (10.2%) and sedative-hypnotic/muscle relaxant (8.4%) classes. Table 9 details the contribution of each agent class to the Registry. Cholinergic and chelating agents represented new exposure classes in 2019, each with one entry.

Self-Harm Intent Agent Classes

Table 10 presents the agent classes for cases in which there was intent for self-harm. There were 2630 cases (36.6%) reporting 4590 individual agents of exposure. More than one agent was reported in 1164 (44.3%) cases. The top three agent classes were analgesic (22.8%), antidepressant (17.1%), and sedative hypnotic/muscle relaxant (9.5%). Notably, opioids were the ninth most common agent class reported, representing only 3.2% of agents involving self-harm, compared to 13.4% in the general Registry.

See Table 11 for the top agent classes by age group for self-harm cases. Teens age 13–18 represented a higher proportion of cases of self-harm than in that of the general Registry. In teens, the top two agent classes were the analgesic (29.5%) and antidepressant (19.9%) classes, similar in ranking to all age groups for self-harm. Differing from the larger Registry, anticholinergics were reported with more frequency in cases of self-harm in teens (12.4%, the third most common class) and opioids were proportionally underrepresented (1.2%) in this age group. Bupropion was the most common antidepressant agent involved in self-harm attempts in teens (20.5%). There were 7 deaths in teens; the agents associated with fatalities were analgesics (acetaminophen and aspirin), anticholinergics (diphenhydramine), and herbals (caffeine).

Adults and older adults had higher relative presence of drugs of abuse (opioids, sedative hypnotics, and ethanol) compared to children and teens.

Analgesics

Table 12 presents the non-opioid analgesics, the largest class in the Registry. Acetaminophen was again the most commonly reported agent (58.5%),[2–5] followed by ibuprofen (12.9%) and gabapentin (10.1%). Aspirin and acetylsalicylic acid are listed separately in the Registry; when combined, they compose the third most common agent reported (11.6%).

Opioids

Table 13 describes the opioid class. Similar to previous years, heroin was again the most common agent in the class (37.9%).[3, 4] The relative contribution of fentanyl increased again this year, now representing the second most common opioid reported (14.6%). Oxycodone's relative contribution remained similar to that of last year (12.5%),[3] but it dropped to the third most common agent reported behind fentanyl. Tramadol numbers fell this year compared to 2018 (3.9% vs 8.1%).[3] Other opioid agents remained fairly stable compared to those of prior years.

Overall, opioids represented 13.4% of agents reported to the Registry. In cases of self-harm, opioids represented 0.7% of agents for children, 1.2% for teens, 4.0% for adults, and 13.3% for older adults.

Antidepressants

Table 14 describes the antidepressant class. SSRIs (38.2%) and other antidepressants (37.0%) represented the majority of this class. Sertraline (12.7%) was the

Table 1 Participating institutions providing cases to ToxIC in 2019.

State or country	City	Hospitals
Arizona	Phoenix	Banner-University Medical Center Phoenix
	Phoenix	Phoenix Children's Hospital
California	Fresno	Community Regional Medical Center
	Loma Linda	Loma Linda University Medical Center
	Los Angeles	Keck Medical Center of USC
	Los Angeles	University of Southern California Verdugo Hills
	Sacramento	University of California Davis Medical Center
	San Diego	Rady Children's Hospital
	San Diego	San Diego VA Medical Center
	San Diego	Scripps Mercy Hospital
	San Diego	University of California San Diego-Hillcrest
	San Diego	University of California San Diego-Thornton
Colorado	Denver	Colorado Children's Hospital
	Denver	Denver Health Medical Center
	Denver	Porter and Littleton Hospital Swedish Hospital
	Denver	Swedish Hospital
	Denver	University of Colorado Medical Center
Connecticut	Hartford	Hartford Hospital
Georgia	Atlanta	Children's Healthcare of Atlanta Egleston
	Atlanta	Children's Healthcare of Atlanta Hughes Spalding
	Atlanta	Grady Health System
	Atlanta	Grady Memorial Hospital
Illinois	Evanston	Evanston North Shore University Health System
	Chicago	UIC-Rush-Cook County Health
Indiana	Indianapolis	IU-Eskenazi Hospital
	Indianapolis	IU-Indiana University Hospital
	Indianapolis	IU-Methodist Hospital-Indianapolis
	Indianapolis	IU-Riley Hospital for Children
Kentucky	Lexington	University of Kentucky Chandler Medical Center
Massachusetts	Boston	Beth Israel Boston
	Boston	Boston Children's Hospital
	Worcester	University of Massachusetts Memorial Medical Center
Michigan	Grand Rapids	Spectrum Health Hospitals
Mississippi	Jackson	University of Mississippi Medical Center
Missouri	Kansas City	Children's Mercy Hospitals and Clinics
	St. Louis	Washington University School of Medicine in St Louis
Nebraska	Omaha	University of Nebraska Medical Center
New Jersey	Newark	Rutgers/New Jersey Medical School
New Mexico	Albuquerque	University of New Mexico
New York	Albany	Albany Medical Center
	Rochester	Strong Memorial Hospital
	Syracuse	Upstate Medical University-Downtown Campus
North Carolina	Charlotte	Carolinas Medical Center
Oregon	Portland	Doernbecher Children's Hospital
	Portland	Oregon Health & Science University Hospital
Pennsylvania	Allentown	Lehigh Valley Hospital Cedar Crest
	Allentown	Lehigh Valley Hospital Muhlenberg
	Allentown	Lehigh Valley-17th Street
	Philadelphia	Hahnemann University Hospital

Table 1 (continued)

State or country	City	Hospitals
	Philadelphia	Mercy Fitzgerald Hospital
	Philadelphia	Mercy Hospital of Philadelphia
	Philadelphia	St. Christopher's Hospital for Children
	Pittsburgh	UPMC Children's Hospital of Pittsburgh
	Pittsburgh	UPMC Magee Women's Hospital
	Pittsburgh	UPMC Mercy Hospital
	Pittsburgh	UPMC Presbyterian/Shadyside
Texas	Dallas	Children's Medical Center Dallas
	Dallas	Parkland Memorial Hospital
	Dallas	University of Texas Southwestern Clinic
	Dallas	William P Clements University Hospital
	Houston	Ben Taub General Hospital
	Houston	Texas Children's Hospital
Virginia	Richmond	Virginia Commonwealth University Medical Center
Wisconsin	Milwaukee	Children's Hospital of Wisconsin
	Milwaukee	Froedtert Memorial Lutheran Hospital
Canada	Calgary	Alberta Children's Hospital
		Foothills Medical Centre
		Peter Lougheed Centre
Israel	Haifa	Rambam Health Care Campus
Thailand	Bangkok	Vajira Hospital

most common SSRI reported, and bupropion (21.4%) was the most common other antidepressant. In 2019, there was a decrease in other antidepressants and an increase in SNRIs reported compared to previous years.[3, 4]

Table 2 ToxIC case demographics—age and gender.

	N (%)
Gender	
Male	3478 (48.5)
Female	3642 (50.7)
Transgender	
Male to female	16 (0.2)
Female to male	38 (0.5)
Gender non-conforming	3 (0)
Pregnant	68 (0.9)
Age (years)	
< 2	241 (3.4)
2–6	327 (4.6)
7–12	227 (3.2)
13–18	1478 (20.6)
19–65	4456 (62.1)
66–89	407 (5.7)
> 89	11 (0.2)
Unknown	30 (0.4)
Total	7177 (100)

Sedative Hypnotics

Table 15 presents the sedative hypnotic/muscle relaxant class. Benzodiazepines (primarily alprazolam (21.1%) and clonazepam (14.2%)) and muscle relaxants (primarily baclofen

Table 3 ToxIC case demographics—race and Hispanic ethnicity.

	N (%)
Race	
Caucasian	4578 (63.8)
Black/African	981 (13.7)
Asian	245 (3.4)
American Indian/Alaska Native	100 (1.4)
Native Hawaiian or Pacific Islander	4 (0.1)
Mixed	130 (1.8)
Other	15 (0.2)
Unknown/uncertain	1124 (15.7)
Total	7177 (100)
Hispanic ethnicity[a]	
Hispanic	900 (12.5)
Non-Hispanic	4903 (68.3)
Unknown	1374 (19.1)
Total	7177 (100)

[a] Hispanic ethnicity as indicated exclusive of race

Table 4 ToxIC Registry case referral sources by inpatient/outpatient status.

	N (%)
Emergency Department (ED) or inpatient (IP)[a]	
ED	3695 (53.7)
Admitting service	2086 (30.3)
Request from another hospital service (not ED)	451 (6.6)
Outside hospital transfer	550 (8.0)
Poison Center	48 (0.7)
Primary care provider or other outpatient treating physician	2 (0.0)
Employer/independent medical evaluation	2 (0.0)
Self-referral	51 (0.7)
ED/IP total	6885 (100)
Outpatient (OP)/clinic/office consultation[b]	
ED	11 (3.8)
Admitting service	0 (0.0)
Request from another hospital service (not ED)	3 (1.0)
Outside hospital transfer	1 (0.3)
Poison Center	23 (7.9)
Primary care provider or other OP physician	198 (68.0)
Employer/independent medical evaluation	26 (8.9)
Self-referral	29 (10.0)
OP total	291 (100)

[a] Percentage based on the total number of cases ($N = 6885$) seen by a medical toxicologist as consultant (ED or IP) or as attending (IP)

[b] Percentage based on the total number of cases ($N = 291$) seen by a medical toxicologist as outpatient, clinic visit, or office consultation

(12.9%) and cyclobenzaprine (10.8%)) were the most common subtypes, similar to those of previous years.[3, 4] Other sedatives, Z-drugs, and barbiturates were again less common.

Toxic Alcohols and Ethanol

Table 16 describes data on ethanol and toxic alcohols. Ethanol was considered its own agent class, consistent with prior years and was the fifth most commonly reported agent class. After ethanol, the most commonly reported alcohols and glycols were ethylene glycol (45.3%) and isopropanol (28.0%). Methanol and miscellaneous alcohols each made up 13.3% of the class.

Sympathomimetics

Table 17 presents the sympathomimetic class. Cocaine (33.8%), methamphetamine (33.5%), and amphetamine (10.1%) were the most commonly reported agents in the class again this year.[3]

Anticholinergic/Antihistamine

Table 18 describes the anticholinergic/antihistamine class. Consistent with previous years,[3, 4] diphenhydramine (57.1%), followed by hydroxyzine (15.9%), remains the most commonly reported agent in this class.

Cardiovascular Agents

Table 19 shows data on the cardiovascular class. For the third consecutive year in the Registry, sympatholytics (28.2%) outnumber beta-blockers (25.1%) as the most common subclass of cardiovascular agents,[2–4] followed by calcium channel blockers (16.6%). Clonidine (21.3%) and metoprolol (9.1%) were the most common sympatholytic and beta-blocker agents, respectively. Amlodipine (10.3%) was the most common calcium channel blocker.

Antipsychotics

Table 20 details the antipsychotic class. Trends in the antipsychotic class were similar to those of previous years.[3, 4] The atypicals, led by quetiapine (46.6%) and olanzapine (13.2%), represent the majority of cases reported.

Anticonvulsants, Mood Stabilizers, and Lithium

Table 21 presents data on anticonvulsants, mood stabilizers, and lithium. Consistent with past years, lithium

Table 5 Reason for medical toxicology encounter.

	N (%)
Intentional exposure—pharmaceutical	3550 (52.4)
Intentional exposure—non-pharmaceutical	909 (12.7)
Unintentional exposure—pharmaceutical	513 (7.1)
Unintentional exposure—non-pharmaceutical	312 (4.3)
Addiction medicine consultation	475 (6.6)
Organ system dysfunction	279 (3.9)
Envenomation—snake	253 (3.5)
Withdrawal—ethanol	183 (2.5)
Withdrawal—opioid	152 (2.1)
Interpretation of toxicology lab data	121 (1.7)
Environmental evaluation	111 (1.5)
Ethanol abuse	92 (1.3)
Occupational evaluation	65 (0.9)
Withdrawal—sedative/hypnotic	48 (0.7)
Malicious/criminal	36 (0.5)
Envenomation—spider	35 (0.5)
Withdrawal—other	18 (0.3)
Withdrawal—cocaine/amphetamine	6 (0.1)
Envenomation—scorpion	4 (0.1)
Envenomation—other	7 (0.1)
Marine /fish poisoning	5 (0.1)
Blank	3 (0.0)
Total	7177 (100)

Table 6 Detailed reason for encounter—intentional pharmaceutical exposure.

	N (%)
Reason for intentional pharmaceutical exposure subgroup[a]	
Attempt at self-harm	2550 (70.5)
Misuse/abuse	509 (14.1)
Therapeutic use	316 (8.7)
Unknown	241 (6.7)
Total	3616 (100)
Attempt at self-harm—suicidal intent subclassification[b]	
Suicidal intent	2189 (86.2)
Suicidal intent unknown	270 (10.6)
No suicidal intent	82 (3.2)
Total	2541 (100)

[a] Percentage based on the total number of cases ($N = 3616$) indicating primary reason for encounter due to intentional pharmaceutical exposure

[b] Percentage based on the total number of cases indicating attempt at self-harm ($N = 2541$)

Table 7 ToxIC self-harm case demographics—age and gender.

	N (%)
Gender	
Male	875 (33.3)
Female	1710 (65.0)
Transgender	
Male to female	13 (0.5)
Female to male	29 (1.1)
Gender non-conforming	3 (0.1)
Pregnant	12 (0.7)
Age (years)	
< 2	2 (0.1)
2–6	6 (0.2)
7–12	98 (3.7)
13–18	1038 (39.5)
19–65	1390 (52.9)
66–89	77 (2.9)
> 89	3 (0.1)
Unknown	16 (0.6)
Total	2630 (100)

was considered as its own agent class and made up just over 1% of reported agents in the Registry. Among anti-convulsants and mood stabilizers, lamotrigine and valproic acid were the most commonly reported, together making up almost half (47.0%) of the class. Carbamazepine and phenytoin were the next most common, each making up 10.0% of agents in this class.

Table 8 ToxIC self-harm case demographics—race and Hispanic ethnicity.

	N (%)
Race	
Caucasian	1722 (65.5)
Black/African	319 (12.1)
Asian	80 (3.0)
American Indian/Alaska Native	29 (1.1)
Native Hawaiian or Pacific Islander	1 (< 0.1)
Mixed	56 (2.1)
Other	4 (0.2)
Unknown/uncertain	419 (15.9)
Total	2630 (100)
Hispanic ethnicity[a]	
Hispanic	334 (12.7)
Non-Hispanic	1797 (68.3)
Unknown	499 (19.0)
Total	2630 (100)

[a] Hispanic ethnicity as indicated exclusive of race

Table 9 Agent classes involved in medical toxicology consultation.

	N (%)[a]
Analgesic	1383 (14.1)
Opioid	1312 (13.4)
Antidepressant	996 (10.2)
Sedative-hypnotic/muscle relaxant	818 (8.4)
Ethanol	705 (7.2)
Sympathomimetic	633 (6.5)
Anticholinergic/antihistamine	580 (5.9)
Cardiovascular	525 (5.4)
Antipsychotic	479 (4.9)
Anticonvulsant	340 (3.5)
Psychoactive	330 (3.4)
Envenomation and marine	272 (2.8)
Diabetic medication	147 (1.5)
Metals	124 (1.3)
Lithium	112 (1.1)
Herbal products/dietary supplements	101 (1.0)
Cough and cold products	99 (1.0)
Caustic	94 (1.0)
Toxic alcohols	75 (0.8)
Gases/irritants/vapors/dusts	75 (0.8)
Plants and fungi	67 (0.7)
Hydrocarbon	64 (0.7)
Household products	62 (0.6)
Antimicrobials	62 (0.6)
Unknown agent	55 (0.6)
GI	45 (0.5)
Anticoagulant	37 (0.4)
Chemotherapeutic and immune	35 (0.4)
Insecticide	29 (0.3)
Anesthetic	28 (0.3)
Endocrine	24 (0.3)
Other pharmaceutical product	22 (0.2)
Other nonpharmaceutical product	20 (0.2)
Anti-parkinsonism drugs	9 (0.0)
Rodenticide	7 (0.0)
Pulmonary	7 (0.0)
Amphetamine-like hallucinogen	6 (0.0)
Ingested foreign body	4 (0.0)
Herbicide	4 (0.0)
WMD/riot agent/radiological	3 (0.0)
Cholinergic	1 (0.0)
Chelator	1 (0.0)
Total	9792 (100)

WMD weapons of mass destruction

[a] Percentages are based on total number of reported agent entries ($N = 9792$) in 2019; 2105 cases (29.3%) reported multiple agents

Table 10 ToxIC 2019—ranked agent classes for cases of self-harm.

	Exposure rank	Totals	%[a]
Analgesic	1	1045	22.8%
Antidepressant	2	785	17.1%
Sedative-hypnotic/muscle relaxant	3	438	9.5%
Anticholinergic/antihistamine	4	431	9.4%
Antipsychotic	5	348	7.6%
Cardiovascular	6	294	6.4%
Anticonvulsant	7	219	4.8%
Alcohol ethanol	8	175	3.8%
Opioid	9	149	3.2%
Sympathomimetic	10	135	2.9%
Diabetic med	11	74	1.6%
Herbals/dietary supplements/vitamins	12	53	1.2%
Cough and cold	13	51	1.1%
Lithium	13	51	1.1%
Alcohol toxic	15	40	0.9%
Caustic	16	39	0.8%
Antimicrobial	17	36	0.8%
GI	18	32	0.7%
Household	19	28	0.6%
Unknown class	20	23	0.5%
Anticoagulant	21	20	0.4%
Metals	21	20	0.4%
Endocrine	23	18	0.4%
Chemotherapeutic and immune	24	17	0.4%
Psychoactive	24	17	0.4%
Other pharmaceuticals	26	12	0.3%
Gases/vapors/irritants/dusts	27	7	0.2%
Hydrocarbon	28	6	0.1%
Insecticide	28	6	0.1%
Anesthetic	30	5	0.1%
Parkinson's med	31	4	0.1%
Plants and fungi	32	3	0.1%
Pulmonary	32	3	0.1%
Rodenticide	32	3	0.1%
Foreign objects	35	1	< 0.1%
Herbicide	35	1	< 0.1%
Other nonpharmaceutical	35	1	< 0.1%
Totals		4590	100.0%

[a] Percentages are based on total number of reported agent entries in cases of self-harm in 2019 ($N = 4590$); 1164 cases (44.3%) reported multiple agents

Psychoactives

Table 22 presents data on the psychoactive class including the amphetamine-like hallucinogen methylenedioxy

Table 11 ToxIC 2019—top 10 ranked agent classes for cases of self-harm by age.

Adults (19–65 years), $N = 1390$ cases	Teens (13–18 years), $N = 1038$ cases	Children (0–12 years), $N = 106$ cases	Older adults (≥ 66 years), $N = 80$ cases
Analgesic (18.1%)[a]	Analgesic (29.5%)[b]	Analgesic (27.8%)[c]	Analgesic (22.5%)[d]
Antidepressant (15.7%)	Antidepressant (19.9%)	Antidepressant (18.5%)	Sedative-hypnotic/muscle relaxant (14.5%)
Sedative-hypnotic/muscle relaxant (12.8%)	Anticholinergic/antihistamine (12.4%)	Anticholinergic/antihistamine (9.3)%	Opioid (13.3%)
Antipsychotic (9.3%)	Cardiovascular (5.9%)	Cardiovascular (7.9%)	Antidepressant (11.0%)
Anticholinergic/antihistamine (7.7%)	Antipsychotic (5.5%)	Antipsychotic (5.3%)	Cardiovascular (9.2%)
Cardiovascular (6.5%)	Sedative-hypnotic/muscle relaxant (4.4%)	Sedative-hypnotic/muscle relaxant (5.3%)	Anticholinergic/antihistamine (4.6%)
Alcohol ethanol (5.9%)	Anticonvulsant (4.4%)	Anticonvulsant (4.6%)	Anticonvulsant (4.0%)
Anticonvulsant (5.1%)	Sympathomimetic (3.3%)	Antimicrobials (3.3%)	Antipsychotic (4.0%)
Opioid (4.0%)	Cough and cold (1.7%)	Herbals/dietary supplements/vitamins (3.3%)	Alcohol toxic (3.5%)
Sympathomimetic (2.8%)	Herbals/dietary supplements/vitamins (1.5%)	Cough and cold (2.6%)	Alcohol ethanol (2.9%)

[a, b, c, d] Percentages are based on total number of reported agent entries in each age group 2019 ($N = 2570^a$, 1696^b, 151^c, 173^d). Cases may report more than one agent entry. Sixteen cases of self-harm did not report age

methamphetamine (Molly). Similar to 2018, Molly exposures remained low, with 6 cases reported.[3, 4] Similar to the previous two years, marijuana cases (29.7%) surpassed synthetic cannabinoid cases (9.4%), reflecting a continued decrease in relative synthetic cannabinoid cases.[3, 4] This year, tetrahydrocannabinol exposures increased to 16.7% of psychoactives from < 1% in 2018.[3] When combined, all non-synthetic cannabinoid product exposures represented 63.6% of the psychoactive class. Reported cases of nicotine (7.9%) increased again in 2019, up from 3.1% the previous year.[3]

Table 12 Analgesics.

	N (%)
Acetaminophen	809 (58.5)
Ibuprofen	178 (12.9)
Gabapentin	140 (10.1)
Aspirin	95 (6.9)
Acetylsalicylic acid	66 (4.8)
Naproxen	27 (2.0)
Pregabalin	16 (1.2)
Salicylic acid	16 (1.2)
Analgesic unspecified	12 (0.9)
Meloxicam	6 (0.4)
Miscellaneous[a]	14 (1.0)
Class total	1383 (100)

[a] Includes aminophenazone, diclofenac, indomethacin, magnesium salicylate, mefenamic acid, methylsalicylate, oil of wintergreen, salicylamide, and unspecified NSAID

Envenomations and Marine Poisonings

Table 23 shows data on envenomations and marine poisonings. Snake envenomations represented by *Crotalus* (43.4%), snake unspecified (18.8%), and *Agkistrodon* (16.9%) were the top three exposures reported to this class. Again in 2019,

Table 13 Opioids.

	N (%)
Heroin	497 (37.9)
Fentanyl	192 (14.6)
Oxycodone	164 (12.5)
Buprenorphine	95 (7.2)
Opioid unspecified	75 (5.7)
Methadone	74 (5.6)
Hydrocodone	55 (4.2)
Tramadol	51 (3.9)
Morphine	32 (2.4)
Naloxone	26 (2.0)
Hydromorphone	13 (1.0)
Naltrexone	8 (0.6)
Codeine	7 (0.5)
Acetyl fentanyl	5 (0.4)
Miscellaneous[a]	18 (1.4)
Class total	1312 (100)

[a] Includes carfentanil, diphenoxylate, loperamide, meperidine, N-allyl norfentanyl, norfentanyl, opioid tincture, oxymorphone, propoxyphene, and tapentadol

Loxosceles exposures were the fourth most common exposure in this class (7.7%).[3, 4]

Diabetic Agents

Table 24 presents the diabetic medication agent class. Metformin was the most common agent at 32.0% of the agent class, followed by insulin (26.5%) and glipizide (20.4%). The sulfonylureas glipizide, glimepiride, and glyburide together made up 36.0% of the class.

Metals

Table 25 presents the metal class. Lithium is its own agent class and is reported with the anticonvulsants and mood stabilizers. Trends were similar to those of previous years with lead (29.8%) and iron (16.1%) representing the majority of reported cases.[3, 4] Notably, there was a relative decrease in

Table 14 Antidepressant agents.

	N (%)
Selective serotonin reuptake inhibitors (SSRIs)	381 (38.2)
Sertraline	126 (12.7)
Fluoxetine	99 (9.9)
Escitalopram	74 (7.4)
Citalopram	55 (5.5)
Paroxetine	22 (2.2)
Fluvoxamine	5 (0.5)
Other antidepressants	369 (37.0)
Bupropion	213 (21.4)
Trazodone	127 (12.8)
Mirtazapine	19 (1.9)
Antidepressant unspecified	7 (0.7)
Miscellaneous[a]	< 5 (< 0.5)
Tricyclic antidepressants (TCAs)	117 (11.7)
Amitriptyline	84 (8.4)
Nortriptyline	16 (1.6)
Doxepin	13 (1.3)
Miscellaneous[b]	< 5 (< 0.5)
Serotonin-norepinephrine reuptake inhibitors (SNRIs)	128 (12.9)
Venlafaxine	78 (7.8)
Duloxetine	41 (4.1)
Desvenlafaxine	7 (0.7)
Miscellaneous[c]	< 5 (< 0.5)
Monoamine oxidase inhibitor (MAOIs)	1 (0.1)
Phenelzine	1 (0.1)
Class total	996 (100)

[a] Includes vortioxetine and tranylcypromine

[b] Includes protriptyline, clomipramine, desipramine, and noxiptiline

[c] Includes milnacipran and levomilnacipran

Table 15 Sedative-hypnotic/muscle relaxants by type.

	N (%)
Benzodiazepine	443 (54.3)
Alprazolam	172 (21.1)
Clonazepam	116 (14.2)
Lorazepam	64 (7.8)
Diazepam	41 (5.0)
Benzodiazepine unspecified	26 (3.2)
Temazepam	15 (1.8)
Miscellaneous[a]	9 (1.1)
Muscle relaxant	248 (30.4)
Baclofen	105 (12.9)
Cyclobenzaprine	88 (10.8)
Tizanidine	28 (3.4)
Methocarbamol	12 (1.5)
Carisoprodol	12 (1.5)
Metaxalone	3 (0.4)
Other sedatives	59 (7.2)
Buspirone	34 (4.2)
Sed-hypnotic/muscle relaxant unspecified	16 (2.0)
Miscellaneous[b]	9 (1.1)
Non-benzodiazepine agonists ("Z" drugs)	44 (5.4)
Zolpidem	41 (5.0)
Eszopiclone	3 (0.4)
Barbiturates	22 (2.7)
Butalbital	12 (1.5)
Phenobarbital	5 (0.6)
Miscellaneous[c]	5 (0.6)
Class total	816 (100)

[a] Includes chlordiazepoxide, oxazepam, triazolam, midazolam, and flurazepam

[b] Includes phenibut (beta-phenyl-gamma-aminobutyric acid), propofol, orphenadrine, meprobamate, etizolam, and aminobutyric acid

[c] Includes barbituate unspecified and pentobarbital

Table 16 Ethanol and toxic alcohols.

	N (%)
Ethanol[a]	705 (100)
Nonethanol alcohols and glycols	
Ethylene glycol	34 (45.3)
Isopropanol	21 (28.0)
Methanol	10 (13.3)
Miscellaneous[b]	10 (13.3)
Class total	75 (100)

[a] Ethanol is considered a separate agent class

[b] Includes benzyl alcohol, butyl ethylene glycol, diethylene glycol, ethylene glycol monomethyl ether (EGME, 1-methoxyethanol), propylene glycol, toxic alcohol unspecified, and triethylene glycol mono butyl ether

Table 17 Sympathomimetic agents.

	N (%)
Cocaine	214 (33.8)
Methamphetamine	212 (33.5)
Amphetamine	64 (10.1)
Methylphenidate	41 (6.5)
Dextroamphetamine	29 (4.6)
Sympathomimetic unspecified	17 (2.7)
Lisdexamfetamine	13 (2.1)
MDMA (methylenedioxy-N-methamphetamine, Ecstasy)	11 (1.7)
Dexmethylphenidate	5 (0.8)
Pseudoephedrine	5 (0.8)
Atomoxetine	5 (0.8)
Miscellaneous[a]	17 (2.7)
Class total	633 (100)

[a] Includes phenylephrine, epinephrine, tetrahydrozoline, phentermine, methylethcathinone, norpseudoephedrine, diethylpropion, propylhexedrine, clenbuterol, and methylenedioxypyrovalerone (MDPY)

iron cases reported in 2019 compared to last year (24.8%).[3] Relative contributions of cobalt (12.1%) and mercury (12.1%) to the metal class increased this year (both 4.0% in 2018).[3]

Herbal Products and Dietary Supplements

Table 26 details herbal products and dietary supplements. Caffeine was again the most commonly reported agent

Table 18 Anticholinergic and antihistamine agents.

	N (%)
Diphenhydramine	331 (57.1)
Hydroxyzine	92 (15.9)
Doxylamine	32 (5.5)
Chlorpheniramine	20 (3.4)
Benztropine	15 (2.6)
Loratadine	11 (1.9)
Cetirizine	11 (1.9)
Promethazine	10 (1.7)
Anticholinergic unspecified	8 (1.4)
Dimenhydrinate	8 (1.4)
Dicyclomine	7 (1.2)
Pyrilamine	6 (1.0)
Miscellaneous[a]	29 (5)
Class total	580 (100)

[a] Includes brompheniramine, oxybutynin, atropine, cyproheptadine, fexofenadine, glycopyrrolate, hyoscyamine, meclizine, antihistamine unspecified, cyclopentolate, tolterodine, and solifenacin

Table 19 Cardiovascular agents.

	N (%)
Alpha-2 Agonist	148 (28.2)
Clonidine	112 (21.3)
Guanfacine	35 (6.7)
Dexmedetomidine	1 (0.2)
Beta-blockers	132 (25.1)
Metoprolol	48 (9.1)
Propranolol	46 (8.8)
Carvedilol	20 (3.8)
Atenolol	8 (1.5)
Labetalol	5 (1.0)
Miscellaneous[a]	5 (1)
Calcium channel blocker	87 (16.6)
Amlodipine	54 (10.3)
Diltiazem	16 (3.0)
Verapamil	11 (2.1)
Nifedipine	5 (1.0)
Calcium channel blocker unspecified	1 (0.2)
ACEI/ARB	54 (10.3)
Lisinopril	35 (6.7)
Losartan	12 (2.3)
Miscellaneous[b]	7 (1.3)
Cardiac glycosides	28 (5.3)
Digoxin	28 (5.3)
Other antihypertensives and vasodilators	25 (4.8)
Prazosin	15 (2.9)
Miscellaneous[c]	10 (1.9)
Antidysrhythmics and other CV agents	20 (3.8)
Cardiovascular agent unspecified	6 (1.1)
Flecainide	5 (1.0)
Miscellaneous[d]	9 (1.7)
Diuretics	17 (3.2)
Hydrochlorothiazide	8 (1.5)
Furosemide	5 (1.0)
Miscellaneous[e]	4 (0.8)
Antihyperlipidemic	14 (2.7)
Atorvastatin	7 (1.3)
Miscellaneous[f]	7 (1.3)
Class total	525 (100)

[a] Includes nadolol, timolol, nebivolol, and bisoprolol

[b] Includes valsartan, benazepril, and enalapril

[c] Includes isosorbide, tamsulosin, hydralazine, sacubitril, isobutyl nitrite, and doxazosin

[d] Includes amiodarone, midodrine, propafenone, ivabradine, and dofetilide

[e] Includes spironolactone, torsemide, and chlorthalidone

[f] Includes simvastatin, pravastatin, rosuvastatin, lovastatin, and fenofibrate

Table 20 Antipsychotic agents.

	N (%)
Quetiapine	223 (46.6)
Olanzapine	63 (13.2)
Aripiprazole	43 (9.0)
Risperidone	41 (8.6)
Haloperidol	28 (5.8)
Lurasidone	17 (3.5)
Clozapine	13 (2.7)
Ziprasidone	11 (2.3)
Cariprazine	6 (1.3)
Fluphenazine	6 (1.3)
Brexpiprazole	6 (1.3)
Prochlorperazine	5 (1.0)
Paliperidone	5 (1.0)
Chlorpromazine	5 (1.0)
Miscellaneous[a]	7 (1.5)
Class total	479 (100)

[a] Includes asenapine, clotiapine, antipsychotic unspecified, thiothixene, perphenazine, and thioridazine

(37.6%)[3] followed by melatonin (24.8%). Infrequently reported miscellaneous agents made up 37.6% of the agent class.

Household Agents

Table 27 describes household agents reported to the Registry. Soaps and detergents (19.4%), cleaning solutions and disinfectants (14.5%), sodium hypochlorite ≤6% (14.5%), and laundry detergent pods (14.5%) were the most commonly reported agents in this class.

Table21 Anticonvulsants and mood stabilizers.

	N (%)
Lithium[a]	112 (100)
Lamotrigine	88 (25.9)
Valproic acid	71 (20.9)
Carbamazepine	34 (10.0)
Phenytoin	34 (10.0)
Oxcarbazepine	30 (8.8)
Topiramate	25 (7.4)
Levetiracetam	16 (4.7)
Anticonvulsant unspecified	11 (3.2)
Lacosamide	9 (2.6)
Clobazam	6 (1.8)
Divalproex	6 (1.8)
Miscellaneous[b]	10 (2.9)
Class total	340 (100)

[a] Lithium is considered a separate agent class

[b] Includes citalopram, fosphenytoin, perampanel, primidone, rufinamide, and zonisamide

Gases, Irritants, Vapors, and Dusts

Table 28 describes the gas, irritant, vapor, and dust class. Carbon monoxide was again the most commonly reported agent in this class (49.3%),[2–5] followed by smoke (9.3%).

Plants and Fungi

Table 29 presents data for plant and fungi exposures for the Registry in 2019. Mold was again the most common exposure (47.8%).[3] *Mitragyna speciosa* (kratom) (16.4%) was the second most common exposure, up from 12.1% in 2018.[3] Infrequent miscellaneous agents made up 35.8% of the class.

Cough and Cold Preparations

Table S1 details data on cough and cold preparations reported to the Registry. Dextromethorphan was by far the most commonly reported agent, making up 74.7% of the class.

Table 22 Psychoactive agents.

	N (%)
Molly—amphetamine-like hallucinogen[a]	6 (100)
Marijuana	98 (29.7)
Tetrahydrocannabinol	55 (16.7)
Cannabinoid synthetic	31 (9.4)
Cannabinoid nonsynthetic	27 (8.2)
Nicotine	26 (7.9)
Delta-9-tetrahydrocannabinol	21 (6.4)
LSD	15 (4.5)
Gamma hydroxybutyrate	11 (3.3)
Phencyclidine	10 (3.0)
Cannabidiol	8 (2.4)
Hallucinogenic amphetamines	7 (2.1)
Psychoactive unspecified	5 (1.5)
Miscellaneous[b]	16 (4.8)
Class total	330 (100)

LSD lysergic acid diethylamide

[a] Amphetamine-like hallucinogens are considered a separate agent class

[b] Includes ketamine, donepezil, methylenedioxymethamphetamine, hallucinogen unspecified, tryptamine, gamma butyrolactone, disulfram, and pharmaceutical cannabidiol

Table 23 Envenomations.

	N (%)
Crotalus (rattlesnake)	118 (43.4)
Snake unspecified	51 (18.8)
Agkistrodon (copperhead, cottonmouth/water moccasin)	46 (16.9)
Loxosceles (recluse spiders)	21 (7.7)
Trimeresurus unspecified (pit viper unspecified)	7 (2.6)
Latrodectus (widow spiders)	6 (2.2)
Spider unspecified	5 (1.8)
Miscellaneous[a]	18 (6.6)
Class total	272 (100)

[a] Includes *Trimeresurus albolabris* (var Pit viper incl white lipped, green tree), palytoxin, stingray, Centruroides (var Scorpion incl Bark), Hymenoptera (bees, wasps, ants), animal bite unspecified, ciguatera poisoning, *Nerodia erythrogaster* (plain-bellied water snake), scorpion unspecified, and *Naja kaouthia* (monocled cobra)

Caustics

Table S2 presents the caustic agent class. Sodium hypochlorite unknown concentration was the most common agent reported in this class (13.8%).

Hydrocarbons

Table S3 presents the hydrocarbon agent class. The largest contributor to the class was unspecified hydrocarbons with 14.1% of the agent class. Petroleum distillates (12.5%) were the next most commonly reported agents.

Antimicrobials

Table S4 presents data on antimicrobial agents. In 2019, amoxicillin was the most commonly reported agent (12.9%) followed by valacyclovir (9.7%) and dapsone (8.1%).

Table 24 Diabetic medications.

	N (%)
Metformin	47 (32.0)
Insulin	39 (26.5)
Glipizide	30 (20.4)
Glimepiride	16 (10.9)
Glyburide	7 (4.8)
Miscellaneous[a]	8 (5.4)
Class Total	147 (100)

[a] Includes diabetic medication unspecified, diazoxide, linagliptin, liraglutide, and sulfonylurea unspecified

Table 25 Metals.

	N (%)
Lead	37 (29.8)
Iron	20 (16.1)
Cobalt	15 (12.1)
Mercury	15 (12.1)
Arsenic	7 (5.6)
Chromium	7 (5.6)
Gadolinium	5 (4.0)
Miscellaneous[a]	18 (14.5)
Class total	124 (100)

[a] Includes magnesium, thallium, metal unspecified, cadmium, barium, zinc metal, aluminum, nickel, selenium, antimony, and copper

Gastrointestinal Agents

Table S5 presents gastrointestinal agents. Ondansetron (26.7%), omeprazole (13.3%), and pantoprazole (11.1%) were the most commonly reported agents. Ranitidine exposures decreased in 2019 (4.4%) compared to last year (20.0%).[3]

Insecticides, Herbicides, Rodenticides, and Fungicides.

Table S6 presents the pesticide (insecticide, herbicide, rodenticide, and fungicide) class. There were 28 insecticides reported, 35.7% of which were miscellaneous agents. There were 7 rodenticides reported; rodenticides unspecified composed 57.1% of rodenticides. Glyphosate represented 75% of the 4 herbicides reported. No fungicides were reported.

Table 26 Herbal agents and dietary supplements.

	N (%)
Caffeine	38 (37.6)
Melatonin	25 (24.8)
Miscellaneous[a]	38 (37.6)
Class total	101 (100)

[a] Includes alpha lipoic acid, *ashwangandha*, citronella oil, dietary supplement unspecified, essential oil unspecified, eucalyptus oil, eugenol (clove oil), Garcinia cambogia, green tea extract, herbal (dietary) multibotanical, herbals/dietary supplement/vitamins unspecified, lemongrass oil, potassium, St. John's wort, senna, thymol, vitamin A, vitamin B_3 (niacin), vitamin B_9 (folic acid), vitamin D, vitamin E (tocopherol), vitamin unspecified, and yerba mate green tea extract

Table 27 Household agents.

	N (%)
Soaps and detergents	12 (19.4)
Cleaning solutions and disinfectants	9 (14.5)
Laundry detergent pod	9 (14.5)
Sodium hypochlorite ≤ 6%	9 (14.5)
Miscellaneous[a]	23 (37.1)
Class total	62 (100)

[a] Includes ammonia < 10%, car wax, carpet cleaner, deodorants/antiperspirants, dishwasher detergent, dishwater detergent, drain cleaner (irritant), hair product, hand sanitizer unspecified, mouthwash, paint, perfume, shaving cream, talc, toothpaste, and windshield washer fluid

Anticoagulants

Table S7 details anticoagulant class exposures. Warfarin was the most commonly reported agent (43.2%) followed by apixaban (21.6%) and rivaroxaban (18.9%).

Chemotherapeutic and Immunological Agents

Table S8 describes chemotherapeutic and immunological agents. Methotrexate (25.7%), colchicine (17.1%), and hydroxychloroquine (14.3%) were the three most commonly reported agents. Relative methotrexate exposures increased compared to those of 2018.[3]

Anesthetics

Table S9 describes the 28 anesthetic class exposures. Lidocaine (25.0%) was the most commonly reported agent.

Endocrine

Table S10 describes the 24 endocrine agents reported. Levothyroxine was the most frequently reported agent in this class (41.7%) followed by prednisone (25.0%).

Table 28 Gases, irritants, vapors, and dusts.

	N (%)
Carbon monoxide	37 (49.3)
Smoke	7 (9.3)
Natural gas	5 (4.5)
Gases/vapors/irritants/dusts unspecified	5 (6.7)
Miscellaneous[a]	21 (28.0)
Class total	75 (100)

[a] Includes chlorine, hydrogen sulfide, radon, acetonitrile, carbon dioxide, skunk spray, petroleum vapors, ethylene oxide, sulfur dioxide, cyanide, dust, nitrogen oxides, chloramine, duster (canned air), fumes/vapors/gases unspecified, and polyurethane vapors

Table 29 Plants and fungi.

	N (%)
Mold	32 (47.8)
Mitragyna speciosa (kratom)	11 (16.4)
Miscellaneous[a]	24 (35.8)
Class total	67 (100)

[a] Includes mushroom, other/unknown, *Ricinus communis* (castor beans), mushroom, psilocybin, mushroom, *Hericium enrinaceus* (lion's mane), *Amanita phalloides*, betel nut, citronella (*Cymbopogon* species, lemongrass genus), dandelion, digitalis, morning glory (*Ipomoea violacea*), almond (*Prunus amygdalus*), mushroom, cordyceps (*Cordyseps sinensis*), taxus (yew), mushroom, *Inonotus obliquus* (Chaga), *Nerium oleander*, phytolacca (pokeweed), plants and fungi unspecified, skullcap (scutellaria), and mushroom, *Ganoderma lucidum* (reishi)

Other Pharmaceuticals

Table S11 presents the other pharmaceutical product agent class. The majority of the class (63.6%) was made up of infrequently reported miscellaneous agents. Unspecified pharmaceutical products were the most commonly reported agent (22.7%).

Other Non-pharmaceuticals

Table S12 describes the other non-pharmaceutical class. Miscellaneous agents made up 70.0% of this class.

Anti-Parkinsonism Agents

Table S13 presents the anti-parkinsonism agent class, containing 9 entries. Reported agents included pramipexole, ropinirole, levodopa/carbidopa, and selegiline.

Pulmonary Agents

Table S14 describes reported pulmonary agents. Montelukast was the most common agent reported (71.4%).

Foreign Bodies

Table S15 details the 4 foreign body ingestions reported to the Registry in 2019 including water beads, cigarette butts, magnets, and razor blades.

Weapons of Mass Destruction.

Table S16 describes the 3 agents in the weapons of mass destruction class. Botulinum toxin represented 66.7% of the class.

Cholinergics

Table S17 describes the single cholinergic/parasympathetic agent reported, cholinergic/parasympathetic unspecified.

Chelators

Table S18 describes the single chelator agent reported, trientine (100%).

Clinical Signs and Symptoms

The clinical signs and symptoms categories describe a diverse range of abnormal clinical findings. In order to be reported as being present, predefined criteria must be met for each category. For example, tachycardia is defined as a heart rate greater than 140 beats per minute. Additionally, each case may report more than one abnormality within a group or across groups. For example, a single case entry may have multiple vital sign abnormalities or may have both a vital sign abnormality and a neurologic abnormality. The percentages for these categories and their individual signs and symptoms are calculated relative to the total number of Registry cases (N = 7177). It is therefore possible for the total to be more than 100%.

Toxidromes

Table 30 reports the 2044 toxidromes reported to the Registry in 2019. Consistent with previous years, the sedative-hypnotic toxidrome was the most common (10.7%).[2–4] The next top four toxidromes were also unchanged from 2018: anticholinergic (6.1%), sympathomimetic (4.0%), opioid (2.6%), and serotonin syndrome (2.6%).[3]

Table 30 Toxidromes.

	N (%)[a]
Sedative-hypnotic	770 (10.7)
Anticholinergic	437 (6.1)
Sympathomimetic	289 (4.0)
Serotonin syndrome	186 (2.6)
Opioid	184 (2.6)
Alcoholic ketoacidosis	71 (1.0)
Sympatholytic	53 (0.7)
Washout syndrome	25 (0.3)
Cholinergic	10 (0.1)
NMS	7 (0.1)
Anticonvulsant hypersensitivity	5 (< 0.1)
Miscellaneous[b]	7 (0.1)
Total	2044 (28.5)

NMS neuroleptic malignant syndrome

[a] Percentage based on the total number of cases reported to the Registry in 2019 (N = 7177)

[b] Includes overlap syndromes and cannabinoid hyperemesis

Major Vital Sign Abnormalities

Table 31 presents the 1820 vital sign abnormalities reported to the Registry in 2019. Trends were similar to those of previous years.[2–4] Tachycardia (11.1%), hypotension (5.8%), and bradycardia (3.7%) were the most common vital sign abnormalities reported.

Clinical Signs and Symptoms—Neurologic

Table 32 describes the 5284 neurologic clinical signs and symptoms reported to the Registry in 2019. Coma/CNS depression (27.6%), agitation (15.6%), and delirium/toxic psychosis (10.8%) remained the most commonly reported signs.[3]

Clinical Signs and Symptoms—Cardiovascular and Pulmonary

Table 33 presents the 610 cardiovascular and 890 pulmonary clinical signs reported to the Registry in 2019. QTc prolongation (5.1%) and respiratory depression (8.3%) remained the most common signs in their respective categories this year.[3]

Clinical Signs—Other Organ Systems

Table 34 presents the other organ system clinical signs which include metabolic, renal and musculoskeletal, hematological, gastrointestinal and hepatic, and dermatological. Metabolic abnormalities were again the most frequently reported, and among these, an elevated anion gap (4.2%) and metabolic acidosis (3.7%) were the most common.[3] Renal and

Table 31 Major vital sign abnormalities.

	N (%)[a]
Tachycardia (HR > 140)	794 (11.1)
Hypotension (systolic BP < 80 mmHg)	416 (5.8)
Bradycardia (HR < 50)	266 (3.7)
Bradypnea (RR < 10)	160 (2.2)
Hypertension (systolic BP > 200 mmHg and/or diastolic BP > 120 mmHg)	151 (2.1)
Hyperthermia (temp > 105 °F)	33 (0.5)
Total	1820 (25.4)

HR heart rate, *BP* blood pressure, *RR* respiratory rate

[a] Percentage based on the total number of cases reported to the Registry in 2019 (N = 7177). There were 1521 unique cases (21.2% of all Registry cases) reporting at least one major vital sign abnormality. Cases may be associated with more than one major vital sign abnormality

Table 32 Clinical signs—neurologic.

	N (%)[a]
Coma/CNS depression	1981 (27.6)
Agitation	1123 (15.6)
Delirium/toxic psychosis	776 (10.8)
Hyperflexia/myoclonus/clonus/tremor	533 (7.4)
Seizures	398 (5.5)
Hallucinations	251 (3.5)
Numbness/paresthesia	78 (1.1)
EPS/dystonia/rigidity	66 (0.9)
Weakness/paralysis	63 (0.9)
Peripheral neuropathy (objective)	15 (0.2)
Total	5284 (73.6)

[a] Percentage based on the total number of cases reported to the Registry in 2019 ($N = 7177$); 3685 Registry cases (51.3%) reported at least one neurologic clinical effect. Cases may have reported multiple effects

musculoskeletal abnormalities were the next most commonly reported, with acute kidney injury (4.3%) and rhabdomyolysis (3.4%) reported with similar frequencies. Coagulopathy was the most commonly reported hematological abnormality (2.0%). Hepatotoxicity was the most common gastrointestinal and hepatic abnormality (2.8%). Other gastrointestinal and hepatic abnormalities were less common, each reported in less than 1% of total Registry cases. Among cases reporting any clinical sign, dermatological abnormalities were less frequently reported, with rash being the most commonly reported sign among these (1.6%).

Table 33 Clinical signs—cardiovascular and pulmonary.

	N (%)[a]
Cardiovascular	
Prolonged QTc (≥ 500 ms)	364 (5.1)
Prolonged QRS (≥ 120 ms)	105 (1.5)
Myocardial injury or infarction	64 (1.4)
Ventricular dysrhythmia	55 (0.8)
AV block (> 1st degree)	22 (0.3)
Total	610 (8.5)
Pulmonary	
Respiratory depression	597 (8.3)
Aspiration pneumonitis	130 (1.8)
Acute lung injury/ARDS	117 (1.6)
Asthma/reactive airway disease	46 (0.6)
Total	890 (12.4)

ARDS acute respiratory distress syndrome

[a] Percentage based on the total number of cases reported to the Registry in 2019 ($N = 7177$); 1291 Registry cases (18.0%) reported at least one cardiac or pulmonary clinical effect. Cases may be associated with more than one sign or symptom

Fatalities

Tables 35 and 36 present cases in which fatalities were reported in 2019. Table 35 includes cases in which a single agent was reported; Table 36 includes cases involving multiple agents. Table S19 in the Supplementary materials presents those fatalities in which it is unknown whether there was a related toxicologic exposure.

There were 91 fatalities in 2019, comprising 1.3% of Registry cases. Forty-seven cases involved single-agent exposures, 23 involved multiple agents, and in 21 cases it was unknown if there was a toxicologic exposure. There were 28 fatalities in cases of self-harm (1.1%), a percentage similar to that of the general Registry.

There were 18 fatalities (19.8%) involving opioids, a decrease from 2018 in which opioids were reported in 34.0% of

Table 34 Clinical signs—other organ systems.

	N (%)[a]
Metabolic	714 (10.0)
Elevated anion gap (> 20)	299 (4.2)
Metabolic acidosis (pH < 7.2)	268 (3.7)
Hypoglycemia (glucose <50 mg/dL)	113 (1.6)
Elevated osmole gap (> 20)	34 (0.5)
Renal/musculoskeletal	549 (7.6)
Acute kidney injury (creatinine > 2.0 mg/dL)	308 (4.3)
Rhabdomyolysis (CPK > 1000 IU/L)	241 (3.4)
Hematological	397 (5.5)
Coagulopathy (PT > 15 s)	141 (2.0)
Leukocytosis (WBC > 20 K/μL)	90 (1.3)
Thrombocytopenia (platelets < 100 K/μL)	79 (1.1)
Hemolysis (Hgb < 10 g/dL)	59 (0.8)
Methemoglobinemia (MetHgb ≥ 2%)	19 (0.3)
Pancytopenia	9 (0.1)
Gastrointestinal/hepatic	323 (4.5)
Hepatotoxicity (AST ≥ 1000 IU/L)	199 (2.8)
Pancreatitis	54 (0.8)
Gastrointestinal bleeding	45 (0.6)
Corrosive injury	22 (0.3)
Intestinal ischemia	3 (0.0)
Dermatological	230 (3.2)
Rash	115 (1.6)
Blister/bullae	75 (1.0)
Necrosis	31 (0.4)
Angioedema	9 (0.1)

CPK creatine phosphokinase, *PT* prothrombin time, *WBC* white blood cells, *AST* aspartate aminotransferase

[a] Percentage equals the number of cases reporting specific clinical signs compared to the total number of Registry cases in 2019 ($N = 7177$). Cases may be associated with more than one sign or symptom

Table 35 2019 fatalities reported in ToxIC Registry with known toxicological exposure: single agent.

Age /gender[a]	Agents involved	Clinical findings	Life support withdrawn	Brain death confirmed	Treatment[b]
14F	Acetaminophen	HPT	Unknown		NAC
15F	Acetaminophen	None	No		NAC
32F	Acetaminophen	DLM, HGY, MA, HPT, CPT	Unknown		Vitamin K
36F	Acetaminophen	HT, CNS, DLM, HGY, MA, AG, HPT, GIB, PLT, AKI	Yes	No	Folate, NAC, thiamine, continuous renal replacement, intubation, IV fluids
37F	Acetaminophen	HT, TC, HY, QTC, ALI, CNS, MA, HPT, AKI	Yes	No	NAC, $NaHCO_3$, vasopressors (norepinephrine, vasopressin), glucose > 5%, intubation, IV fluids
46F	Acetaminophen	TC, QTC, ALI, CNS, MA, AG, HPT, GII, CPT, PLT, WBC, AKI	No		NAC, $NaHCO_3$, vitamin K, vasopressors (norepinephrine), beta-blockers, opioids, CPR, intubation, IV fluids
46F	Acetaminophen	HT, AP, RD, CNS, HPT	Unknown		NAC, vasopressors (norepinephrine, vasopressin), intubation, IV fluids
48M	Acetaminophen	HYT, RD, MA, AG, HPT, CPT, PLT, WBC, AKI	No		NAC, CPR, intubation, IV fluids
51M	Acetaminophen	RD, CNS, MA, AG, HPT, CPT, AKI	Yes	No	NAC, vasopressors (epinephrine, vasopressin), continuous renal replacement
67F	Acetaminophen	PNC	No		NAC
72M	Acetaminophen	WBC	Unknown		NAC, opioids, IV fluids
77F	Acetaminophen	HT, CNS, MA, HPT, AKI	No		NAC, vasopressors (norepinephrine), continuous renal replacement, intubation, IV fluids
> 89F	Acetaminophen	Sedative-hypnotic toxidrome, CNS, HPT	No		NAC
58F	Antimony	SZ	Yes	Yes	None
4M	Baclofen	None	No		IV fluids
18F	Benzonatate	HT, HY, CNS, MA, AG	Yes	Yes	Naloxone/nalmefene, anticonvulsants, benzodiazepines, CPR, intubation
> 89F	Carpet cleaner	HT, MI, RD, MA, HYS, CPT	No		Intubation
14moF	Cocaine	Sympathomimetic syndrome, HT, TC, VD, QRS, QTC, RD, CNS, SZ, MA, AG, CPT	Yes	Yes	$NaHCO_3$, vasopressors (epinephrine), anticonvulsants, CPR, intubation, IV fluids
33M	Cocaine	HT, MI, ALI, CNS, SZ, MA, AKI	Yes	No	None
15M	Diphenhydramine	TC, VD, QRS, CNS, DLM, SZ, MA, AG, WBC, RBM	No		$NaHCO_3$, vasopressors (norepinephrine), benzodiazepines, opioids, CPR, intubation, IV fluids
15F	Diphenhydramine	Anticholinergic toxidrome, HTN, TC, QTC, CNS, MA, AG	Yes	Yes	Activated charcoal
17F	Ethanol	Sedative-hypnotic toxidrome, HT, BP, AP, RD, CNS, MA, AG	Yes	Yes	CPR, intubation, IV fluids
65M	Ethanol	DLM	Yes	No	Benzodiazepines, intubation, IV fluids
20M	Fentanyl	Opioid toxidrome, HT, BP, VD, MI, ALI, RD, CNS, MA, AG, AKI	Unknown		$NaHCO_3$, vasopressors (epinephrine, norepinephrine), continuous renal replacement, CPR, intubation, IV fluids
21M	Fentanyl	HT, VD, MI, AP, RD, CNS, MA, AG, HPT, GII, WBC, AKI	No		NAC, $NaHCO_3$, vasopressors (epinephrine, norepinephrine, vasopressin), antiarrhythmics, benzodiazepines, neuromuscular blockers, CPR, cardioversion, intubation
34F	Fentanyl	Opioid toxidrome, HT, BP, MI, ALI, RD, CNS, MA, HPT, AKI	Yes	No	Flumazenil, naloxone/nalmefene, vasopressors (epinephrine, norepinephrine), CPR, intubation, IV fluids
50M	Fentanyl	Opioid toxidrome, BP, RD, CNS, HPT, AKI, RBM	Yes	No	NAC, naloxone/nalmefene, vasopressors (phenylephrine), antihypertensives, benzodiazepines, beta blockers, opioids, hemodialysis, intubation, IV fluids

Table 35 (continued)

Age /gender[a]	Agents involved	Clinical findings	Life support withdrawn	Brain death confirmed	Treatment[b]
18M	Flecainide	HT, BC, QRS, QTC, CNS	No		$NaHCO_3$, vasopressors (epinephrine), antiarrhythmics, steroids, CPR, intubation, IV fluids
27F	Heroin	Sedative-hypnotic toxidrome, AKI	No		Lipid therapy, NAC, naloxone/nalmefene, vasopressors, CPR, intubation, IV fluids
31M	Heroin	VD, RD, CNS	Yes	Yes	Naloxone/nalmefene, anticonvulsants, benzodiazepines, neuromuscular blockers, opioids, CPR, intubation, IV fluids
39M	Heroin	HTN, QRS, QTC, RD, CNS, MA, PNC	Yes	Yes	Naloxone/nalmefene, vasopressors (epinephrine), benzodiazepines, opioids, intubation, IV fluids
41F	Heroin	Opioid toxidrome, AP, CNS, RFX	Yes	Yes	None
60F	Heroin	HTN, BP, VD, MI, RD, CNS, MA, AG, WBC	No		Naloxone/nalmefene, nitrites, $NaHCO_3$, bronchodilators, antihypertensives, benzodiazepines, opioids, IV fluids
13M	Loxosceles (recluse spider)	RS	No		None
40M	Metformin	HT, RD, CNS, MA, AG	No		$NaHCO_3$, vasopressors (epinephrine, norepinephrine, vasopressin), hemodialysis, CPR, intubation, IV fluids
48M	Metformin	HT, TC, AGT, MA, AG, GIB, WBC, AKI	No		Calcium, $NaHCO_3$, vasopressors (norepinephrine), hemodialysis, continuous renal replacement, CPR, intubation, IV fluids
55M	Methanol	Sedative-hypnotic toxidrome, HGY, AG, OG, AKI	Yes	Yes	Fomepizole, vasopressors (epinephrine, norepinephrine), continuous renal replacement, CPR, IV fluids
85F	Methotrexate	HT, CNS, PLT, PCT	Yes	No	Folate, benzodiazepines, steroids
> 89F	Methotrexate	DLM, HYS, CPT, PLT, RS, BL	No		Folate, vasopressors (norepinephrine), IV fluids
16F	Oxycodone	Opioid toxidrome, HT, VD, RD, CNS, MA, HPT, WBC	Yes	Yes	Naloxone/nalmefene, vasopressors (norepinephrine), intubation, IV fluids
65F	Phenytoin	HYT, SZ, WBC	Yes	Yes	MDAC
61F	Quetiapine	Sedative-hypnotic toxidrome, HT, VD, RD	Yes	No	Lipid therapy, vasopressors (epinephrine), intubation, IV fluids
69F	Salicylic acid	TC	No		$NaHCO_3$, IV fluids
43F	Smoke	RAD, CNS	Yes	Yes	Hydroxocobalamin, HBO, intubation, IV fluids
21M	Tetrahydrocannabinol	ALI, CNS, AKI	No		Vasopressors (norepinephrine, vasopressin, dopamine), antiarrhythmics, opioids, steroids, continuous renal replacement, ECMO, intubation, IV fluids
33F	Verapamil	Sedative-hypnotic toxidrome, HT, BC, AVB, RAD, CNS, MA, AG, CPT, AKI	Yes	No	HIE, vasopressors (epinephrine, norepinephrine, vasopressin), activated charcoal, continuous renal replacement, intubation, IV fluids
47F	Verapamil	HT, BC, VD, QRS, QTC, AVB, ALI, AP, RD, CNS, MA, AKI	No		Calcium, glucagon, HIE, lipid therapy, $NaHCO_3$, vasopressors (epinephrine, norepinephrine, vasopressin, dopamine), glucose >5%, intubation, IV fluids, pacemaker

Based on the response from the medical toxicologist "Did the patient have a toxicological exposure?" equals yes with known agent(s)

AG anion gap, *AGT* agitation, *AKI* acute kidney injury, *ALI* acute lung injury/ARDS, *AP* aspiration pneumonitis, *AVB* AV block, *BC* bradycardia, *BL* blisters/bullae, *BP* bradypnea, *CNS* coma/CNS depression, *CPT* coagulopathy, *CRV* corrosive injury, *DLM* delirium, *GIB* GI bleeding, *GII* intestinal ischemia, *HGY* hypoglycemia, *HPT* hepatoxicity, *HT* hypotension, *HTN* hypertension, *HYS* hemolysis, *HY* hypothermia, *HYT* hyperthermia, *MA* metabolic acidosis, *MI* myocardial injury/ischemia, *OG* osmolar gap, *PCT* pancytopenia, *PLT* thrombocytopenia, *PNC* pancreatitis, *QTC* QTc prolongation, *RAD* asthma/reactive airway disease, *RBM* rhabdomyolysis, *RD* respiratory depression, *RFX* hyperreflexia/tremor, *RS* rash, *SZ* seizures, *TC* tachycardia, *VD* ventricular dysrhythmia, *WBC* leukocytosis, *CPR* cardiopulmonary resuscitation, *ECMO* extracorporeal membrane oxygenation, *HBO* hyperbaric oxygenation, *HIE* high-dose insulin euglycemic therapy, *MDAC* multiple-dose activated charcoal, *NAC* n-acetyl cysteine, *$NaHCO_3$* sodium bicarbonate

[a] Age in years unless otherwise stated

[b] Pharmacological and non-pharmacological support as reported by medical toxicologist

Table 36 2019 fatalities reported in ToxIC Registry with known toxicological exposure: multiple agents.

Age/ gender[a]	Agents involved	Clinical findings	Life support withdrawn	Brain death confirmed	Treatment[b]
15F	Acetaminophen, caffeine	V	Unknown		NAC
16F	Acetaminophen, aspirin, caffeine	None	No		None
17M	Acetaminophen, anticholinergic unspecified	Anticholinergic toxidrome, AGT, V	No		NAC, IV fluids
61M	Acetaminophen, opioid unspecified	HT, MI, RD, CNS, MA, AG, GIB, AKI	No		NAC, vasopressors (norepinephrine), intubation, IV fluids
75M	Acetaminophen, donepezil, levothyroxine, lisinopril, tamsulosin	HT, BC, RD	No		Glucagon, methylene blue, NAC, vasopressors (epinephrine, norepinephrine, vasopressin, phenylephrine), continuous renal replacement therapy, intubation
79F	Acetaminophen, codeine	RD, CNS, MA, HPT, PNC	Yes	Yes	NAC, vasopressors (dobutamine)
60F	Acetylsalicylic acid, ethanol	HT, TC, BC, QRS, RD, CNS, SZ, MA, AG, HPT, CPT, RBM	No		Calcium, Fab for digoxin, methylene blue, naloxone/nalmefene, $NaHCO_3$, vitamin K, vasopressors, antiarrhythmics, benzodiazepines, glucose > 5%, steroids, activated charcoal, hemodialysis, intubation
49M	Amlodipine, nortriptyline, duloxetine, meloxicam	HT, RD, CNS, MA, AKI	Yes	Unknown	Calcium, glucagon, HIE, lipid therapy, methylene blue, vasopressors (epinephrine, norepinephrine, vasopressin, phenylephrine, dopamine, dobutamine), benzodiazepines, neuromuscular blockers, opioids, intubation, IV fluids
67M	Amlodipine, lorazepam	BC, QRS, RD, CNS, MA, AG, CPT, AKI, RBM	Yes	Yes	Atropine, calcium, glucagon, HIE, $NaHCO_3$, vasopressors (epinephrine, norepinephrine), benzodiazepines, glucose > 5%, neuromuscular blockers, intubation, IV fluids
70M	Amlodipine, aspirin, fluoxetine	HT, ALI, CNS, DLM, AKI	No		Calcium, glucagon, hydroxocobalamin, HIE, lipid therapy, methylene blue, $NaHCO_3$, hemodialysis, continuous renal replacement therapy, IV fluids
68M	Baclofen, clonidine, hydromorphone, bupivacaine	Sedative-hypnotic toxidrome, CNS, WBC, AKI	Yes	Yes	IV fluids, opioids
31M	Cocaine, ethanol	AGT, DLM	Unknown		IV fluids
37M	Cocaine, opioid unspecified	HTN, HT, BP, QTC, AP, RD, CNS, MA, AG, HPT, WBC, RBM	Yes	Yes	Vasopressors (norepinephrine, vasopressin), intubation, IV fluids
83F	Digoxin, diltiazem, metoprolol	HT, BC, CNS	Yes	Unknown	Fab for digoxin, glucagon, vasopressors (dopamine), IV fluids
58F	Ethanol, valacyclovir	HTN, HT, QTC, CNS, SZ, MA, AKI	Yes	Yes	Thiamine, vasopressors (norepinephrine), antihypertensives, benzodiazepines, opioids, vasodilators, intubation, IV fluids
67F	Ethanol, alprazolam,	Serotonin syndrome, BC, ALI, AGT, HCN, RFX, HYS	Yes	Yes	Antipsychotics, benzodiazepines
34F	Fentanyl, norfentanyl	Opioid toxidrome, RD, CNS, SZ, AG, WBC	Yes	Yes	Naloxone/nalmefene, benzodiazepines
66F	Glimepiride, tramadol	AGT, HGY	No		Octreotide, glucose > 5%, IV fluids
87F	Haloperidol, thiothixene, aripiprazole	EPS	No		IV fluids
63F	Hydrocodone, tramadol, ibuprofen	Sedative-hypnotic toxidrome, HT, ALI, CNS, HPT, RBM	Yes	Yes	NAC, naloxone/nalmefene, intubation, IV fluids
21F	Oxycodone, ibuprofen, aripiprazole,	HT, QRS, MI, ALI, AP, RD, CNS, HGY, MA, PNC, CRV, GIB, CPT, PLT, AKI	No		Calcium, glucagon, vasopressors (isoproterenol), glucose > 5%, intubation, IV fluids

Table 36 (continued)

Age/ gender[a]	Agents involved	Clinical findings	Life support withdrawn	Brain death confirmed	Treatment[b]
	fluoxetine, propranolol				
65M	Tamsulosin, emtricitabine, darunavir, elvitegravir	HT	Unknown		Vasopressors (norepinephrine)
60M	Ziprasidone, alprazolam	Sedative-hypnotic toxidrome, HT, BP, QRS, QTC, RD, CNS, MA	Yes	Yes	Lipid therapy, vasopressors (dopamine), CPR, intubation

Based on response from Medical Toxicologist "Did the patient have a toxicological exposure?" equals yes with known agent(s)

AG anion gap, *AGT* agitation, *ALI* acute lung injury/ARDS, *AKI* acute kidney injury, *AP* aspiration pneumonitis, *BC* bradycardia, *BP* bradypnea, *CNS* coma/CNS depression, *CPT* coagulopathy, *CRV* corrosive injury, *DLM* delirium, *EPS* dystonia, *GIB* GI bleeding, *HCN* hallucinations, *HGY* hypoglycemia, *HLS* hemolysis, *HPT* hepatoxicity, *HT* hypotension, *HTN* hypertension, *HYS* hemolysis, *MA* metabolic acidosis, *MI* myocardial infarction, *PLT* thrombocytopenia, *PNC* pancreatitis, *QRS* QRS prolongation, *QTC* QTc prolongation, *RBM* rhabdomyolysis, *RD* respiratory depression, *RFX* hyperreflexia/tremor, *SZ* seizures, *TC* tachycardia, *V* vomiting, *WBC* leukocytosis, *CPR* cardiopulmonary resuscitation, *HIE* high-dose insulin euglycemic therapy, *NAC* n-acetyl cysteine, $NaHCO_3$ sodium bicarbonate

[a] Age listed in years unless otherwise stated

[b] Pharmacological and non-pharmacological support as reported by medical toxicologist

Registry deaths.[3] Fentanyl was reported in 5 deaths (5.5%) this year compared to 9.4% in 2018[3]; 10 deaths (11.0%) were reported as single-opioid ingestions in 2019.

Acetaminophen was the most common agent involved in both single- and multiple-agent fatalities; there were 19 fatalities (20.9%) involving acetaminophen, 13 as a single agent. A single envenomation death was reported after *Loxosceles* envenomation in a 13-year-old. A single-agent tetrahydrocannabinol death was reported in a 21-year-old who presented with acute lung injury, acute kidney injury, and CNS depression. He was treated with vasopressors, opioids, antiarrhythmics, steroids, IV fluid resuscitation, endotracheal intubation, continuous renal replacement therapy, and ECMO.

In 2019, there were 14 pediatric (age 0–18 years) deaths due to a known toxicologic exposure (20.0%), compared to 13.3% in 2018.[3] The age range was 14 months to 18 years. Eleven were single-agent exposures and 3 involved multiple agents. Five (35.7%) involved acetaminophen, 2 as single agent ingestions. Only one death in a pediatric patient involved opioids and was reported as a single agent oxycodone ingestion in a 16-year-old. One single agent ethanol death was reported in a 17-year-old. Two deaths in pre-teens (≤12 years of age) were reported and involved single-agent exposures of baclofen and cocaine in a 4-year-old and 14-month-old, respectively.

There were 44 fatality cases in which life support was withdrawn, representing 0.6% of Registry cases. It was unknown whether life support was withdrawn in an additional 14 cases. Brain death was declared in 27 cases.

Adverse Drug Reactions

Table 37 presents the common drugs associated with adverse drug reactions reported to the Registry in 2019. Three hundred two (302) ADRs (4.2% of Registry cases) were reported in 2019, representing nearly a doubling from last year (2.3% of Registry cases).[3] Lithium was again the most common drug reported (5.6%), similar to that of previous years,[2–4] followed by digoxin (3.6%).

Treatment

Antidotal Therapy

Table 38 describes the 2410 antidotes reported to the Registry in 2019. Similar to previous years, N-acetylcysteine (31.2%), followed by naloxone/nalmefene (13.7%), were the two most common antidotes reported.[3, 4] This year, thiamine advanced to the third most common antidote reported (11.5%), overtaking sodium bicarbonate (9.5%).

Antivenom Therapy

Table 39 presents data on antivenom therapies reported to the Registry. Crotalidae polyvalent immune fab (ovine) made up the majority (73.9%) of antivenom administered; however, it was less common than in 2018 (94.2%).[3] Anavip Fab2 antivenom was a new antivenom in 2019 and made up 19.9% of this class.

Table 37 Most common drugs associated with adverse drug reactions.

	N (%)
Lithium	17 (5.6)
Digoxin	11 (3.6)
Haloperidol	8 (2.6)
Fentanyl	8 (2.6)
Metoprolol	8 (2.6)
Phenytoin	7 (2.3)
Quetiapine	7 (2.3)
Metformin	6 (2.0)
Baclofen	5 (1.7)
Lidocaine	5 (1.7)
Tramadol	5 (1.7)
Glipizide	5 (1.7)
Valproic acid	5 (1.7)
Glimepiride	5 (1.7)
Gabapentin	5 (1.7)
Acetaminophen	5 (1.7)
Clonidine	5 (1.7)
Miscellaneous[a]	185 (61.3)
Total	302 (100)

[a] Includes escitalopram, morphine, lamotrigine, citalopram, ethanol, alprazolam, fluphenazine, clonazepam, olanzapine, methotrexate, methadone, diphenhydramine, duloxetine, diltiazem, bupropion, venlafaxine, nortriptyline, cariprazine, sertraline, doxylamine, dapsone, carvedilol, lorazepam, benzocaine, lisinopril, aripiprazole, ibuprofen, benztropine, topiramate, amlodipine, verapamil, vortioxetine, ziprasidone, fluoxetine, unknown, nadolol, bupivacaine, prochlorperazine, oxcarbazepine, oxybutynin, oxycodone, cyclobenzaprine, paroxetine, buspirone, ceftriaxone, flecainide, cefazolin, anticholinergic unspecified, clarithromycin, epinephrine, antivenom unspecified, cannabinoid nonsynthetic, amiodarone, digitalis, dofetilide, divalproex, disulfiram, caffeine, atomoxetine, atorvastatin, cocaine, butalbital, crotalus (rattlesnake), diazoxide, dextromethorphan, doxepin, snake unspecified, ipilimumab, pharmaceutical cannabidiol, phenylephrine, pramipexole, prilocaine, propofol, risperidone, ropivacaine, scopolamine, oseltamivir, sevoflurane, opioid unspecified, succinylcholine, sympathomimetic unspecified, thiothixene, timolol, tizanidine, tranylcypromine, trazodone, unspecified pharmaceutical, vitamin B3 (niacin), warfarin, sed-hypnotic/muscle relaxant unspecified, liraglutide, fluvoxamine, herbal (dietary) multibotanical, herbals/dietary supps/vitamins unspecified, hydralazine, hydrochlorothiazide, hydroxyzine, insulin, iodine monochloride, iron, paliperidone, linezolid, fluconazole, lurasidone, magnesium, marijuana, melatonin, meperidine, metronidazole, minocycline, n-acetylcysteine, naltrexone, nivolumab, and zolpidem

Pharmacologic Supportive Care

Table 40 describes the 3157 pharmacologic supportive care treatments reported in 2019. Benzodiazepines were again the most commonly reported agents (51.2%)[3] followed by opioids (13.0%) and vasopressors (10.0%).

Table 38 Antidotal therapy.

	N (%)[a]
N-Acetylcysteine	751 (31.2)
Naloxone/nalmefene	331 (13.7)
Thiamine	276 (11.5)
Sodium bicarbonate	230 (9.5)
Folate	192 (8.0)
Fomepizole	85 (3.5)
Physostigmine	77 (3.2)
Glucagon	73 (3.0)
Calcium	64 (2.7)
Atropine	44 (1.8)
Flumazenil	36 (1.5)
Insulin-euglycemic therapy	35 (1.5)
Cyproheptadine	30 (1.2)
Octreotide	29 (1.2)
Lipid resuscitation therapy	27 (1.1)
Carnitine	25 (1.1)
Vitamin K	20 (0.8)
Methylene blue	19 (0.8)
Fab for digoxin	19 (0.8)
Pyridoxine	16 (0.7)
2-PAM	6 (0.2)
Hydroxocobalamin	6 (0.2)
Dantrolene	4 (0.2)
Ethanol	3 (0.1)
Bromocriptine	3 (0.1)
Nitrites	3 (0.1)
Anticoagulation reversal	1 (< 0.1)
Andexanet	1 (< 0.1)
Botulinum antitoxin	1 (< 0.1)
Factor replacement	1 (< 0.1)
Protamine	1 (< 0.1)
Silimarin	1 (< 0.1)
Total	2410 (100)

[a] Percentages are based on the total number of antidotes administered ($N = 2410$); 1889 (26.3%) Registry cases received at least one antidote. Cases may have involved the use of multiple antidotes

Non-pharmacologic Supportive Care

Table 41 presents non-pharmacologic supportive care treatments reported to the Registry in 2019. The top two agents, IV fluid resuscitation (72.6%) and intubation/ventilatory

Table 39 Antivenom therapy.

	N (%)[a]
Crotalidae polyvalent immune fab (ovine)	167 (73.9)
Crotalidae immune fab_2 (equine)	45 (19.9)
Other snake antivenom	9 (4.0)
Spider antivenom	3 (1.3)
Scorpion antivenom	2 (0.9)
Total	226 (100)

[a] Percentages are based on the total number of antivenom treatments administered ($N = 226$); 196 Registry cases (2.7%) received at least one antivenom treatment. Cases may have involved the use of more than one antivenom

Table 40 Supportive care—pharmacologic.

	N (%)[a]
Benzodiazepines	1615 (51.2)
Opioids	410 (13.0)
Vasopressors	316 (10.0)
Antipsychotics	225 (7.1)
Glucose > 5%	151 (4.8)
Anticonvulsants	99 (3.1)
Neuromuscular blockers	87 (2.8)
Antihypertensives	82 (2.6)
Steroids	63 (2.0)
Beta-blockers	40 (1.3)
Albuterol and other bronchodilators	39 (1.2)
Antiarrhythmics	24 (0.8)
Vasodilators	6 (0.2)
Total	3157 (100)

[a] Percentages are based on the total number of pharmacologic interventions (*N* = 3157); 2290 Registry cases (31.9%) received at least one pharmacologic intervention. Cases may have involved the use of multiple interventions

management (23.9%), remain unchanged from last year and represent the large majority of agents in this category.[3]

Chelation Therapy Administered

Table 42 presents data on chelation therapy administered. There were 20 cases involving chelation reported in 2019, made up largely by DMSA (70.0%) and deferoxamine (20.0%).

Table 41 Supportive care—nonpharmacologic.

	N (%)[a]
IV fluid resuscitation	2560 (72.6)
Intubation/ventilatory management	843 (23.9)
CPR	43 (1.2)
Transfusion	30 (0.9)
ECMO	16 (0.5)
Hyperbaric oxygen	10 (0.3)
Cardioversion	8 (0.2)
Pacemaker	8 (0.2)
Therapeutic hypothermia	8 (0.2)
Cardiopulmonary bypass	1 (< 0.1)
Total	3527 (100)

CPR cardiopulmonary resuscitation, *ECMO* extracorporeal membrane oxygenation

[a] Percentages are based on the total number of treatments administered (*N* = 3527); 2822 Registry cases (39.3%) received at least one form of nonpharmacologic treatment. Cases may have involved the use of multiple forms of nonpharmacologic treatment

Table 42 Chelation therapy.

	N (%)[a]
DMSA	14 (70.0)
Deferoxamine	4 (20.0)
EDTA	1 (5.0)
Dimercaprol	1 (5.0)
Total	20 (100)

DMSA dimercaptosuccinic acid, *EDTA* ethylenediamine-tetraacetic acid

[a] Percentages are out of the total number of chelation treatments administered (*N* = 20); 19 Registry cases (0.3%) received at least one form of chelation treatment. Cases may have received multiple chelation treatments

Decontamination Interventions Administered

Table 43 describes the 235 decontamination interventions administered. Activated charcoal again represented the significant majority (81.3%) in this class.[3]

Enhanced Elimination Interventions Administered

Table 44 presents the enhanced elimination interventions reported. Hemodialysis for toxin removal (32.1%), followed by urinary alkalinization (27.0%) and continuous renal replacement therapy (20.9%), topped the reported interventions in this class.

Discussion

This report describes the 10th year of data collected for the Toxicology Investigators Consortium Registry. After several years of down-trending numbers reported to the Registry, in 2019, reported registry cases have increased from the previous year.[3] Notably, this increase in case numbers was not at the expense of quality, as the Registry has continued to increase quality control measures each year.

Table 43 Supportive care—decontamination.

	N (%)[a]
Activated charcoal	191 (81.3)
Whole bowel irrigation	22 (9.4)
Irrigation	11 (4.7)
Gastric lavage	11 (4.7)
Total	235 (100)

[a] Percentage based on the total number of decontamination interventions (*N* = 235); 221 Registry cases (3.1%) received at least one decontamination intervention. Cases may have involved the use of multiple interventions

Table 44 Enhanced elimination.

	N (%)[a]
Hemodialysis (toxin removal)	63 (32.1)
Urinary alkalinization	53 (27.0)
Continuous renal replacement therapy	41 (20.9)
Hemodialysis (other indication)	30 (15.3)
Multiple-dose activation charcoal	7 (3.6)
Exchange transfusion	2 (1.0)
Total	196 (100)

[a] Percentages are based on the total number of treatments administered (*N* = 196); 177 Registry cases (2.5%) received at least one form of enhanced elimination

Although the Registry is not strictly population based, it represents a wide geographic distribution of cases evaluated in person by medical toxicologists. These data can be used in conjunction with data from other registries including the National Poison Data System to provide a more detailed picture of poisoning trends, novel exposures, and their public health implications.

Trends in novel exposures were not described in this report but are being collected and analyzed to be reported separately. A summary of the 10-year Registry experience will also be reported separately.

Table 45 ToxIC EVALI demographics, use patterns, and outcomes.

	N (%)
Age	Range 13–55 years Mean 22.7 years
Sex	
Male	29 (65.9)
Female	15 (34.1)
No prior pulmonary or cardiac disease	38 (86.4)
Products vaped	
THC only	23 (52.3)
Nicotine only	2 (4.5)
Both THC and nicotine	15 (34.1)
Flavoring only	1 (2.3)
Unknown	3 (6.8)
Treatment	
BIPAP	9 (20.5)
Intubation	13 (29.5)
Extracorporeal membrane oxygenation	2 (4.5)
Chest tubes	3 (6.8)
Steroids	39 (88.6)
Intensive care unit admission	19 (43.2)
Death	1 (2.3)
Total	44 (100)

Overall, this annual report finds trends in agent classes, agents, demographics, types of encounters, clinical signs and symptoms, and treatments to be largely unchanged from previous years. Notable findings or trends in the Registry are discussed below.

Addiction medicine consults have been recorded in the Registry for two years and are increasing in number.[3] Further details of addiction medicine consults are described below.

The relative opioid cases continued to increase in 2019, making the opioid class the second most common agent class reported to the Registry for the first time in Registry history. In fact, the opioid class nearly eclipsed the non-opioid analgesics as the most common class in the Registry this year and may do so in 2020 based on recent trends. Overall, this is consistent with the larger trend of increasing opioid exposures reported to the Registry over time.

Fentanyl continues to represent a growing percentage of the opioid class reported to the Registry, rising to the second most common opioid this year. Although tramadol numbers fell, other oral opioids such as oxycodone and hydrocodone remained stable in 2019.

Again in 2019, there was an increase in psychoactive substances reported. Similar to last year, this increase was largely driven by an increase in non-synthetic cannabinoids including marijuana. Combined, various cannabinoid agents represented 63.0% of the psychoactive class, trending up from 55.0% in 2018.[3] Nicotine exposures have also shown a consistent increase over the last two years, with a relative doubling in 2019 compared to 2018.[3, 4] This is likely multifactorial but may in part be reflective of national trends of increased use of vaping tobacco and cannabinoid products.

Vaping Exposures

In July 2019, an epidemic of vaping-related respiratory failure was reported in Illinois and Wisconsin.[6] The illness termed "e-cigarette, or vaping, product-use associated lung injury", or EVALI, has affected thousands of patients, including otherwise healthy adolescents and young adults. The leading etiology of EVALI is THC oil contamination with vitamin E acetate[7]; however the exact pathophysiology is unknown. With input from the Federal Drug Administration and Centers for Disease Control (CDC), the Toxicology Investigators Consortium (ToxIC) committee created an EVALI surveillance form to gather more information on these cases. Within a month of the Center for Disease Control and Prevention's Health Advisory release, on October 10, 2019, the EVALI form was incorporated into REDCap. Medical toxicologists submitted suspected vaping cases they treated from July 2019 onward. Seven toxic sites entered data on 44 patients between October 10 and December 31, 2019. See Table 45 for case details.

Table 46 Intentional pharmaceutical misuse/abuse to "get high" by age group and sex/gender.

	Female N (%)[a]	Male N (%)[a]	Transgender[d] N (%)[a]
Age 7–12			
Antidepressants	6 (5.4)	0 (0)	0 (0)
Herbals/dietary supplements/vitamins	2 (1.8)	0 (0)	0 (0)
Cough and cold medication	1 (0.9)	0 (0)	0 (0)
Total	9 (8.0)	0 (0)	0 (0)
Age 13–18			
Antipsychotics	5 (4.5)	4 (3.6)	0 (0)
Cough and cold medication	2 (1.8)	2 (1.8)	M → F: 1 (0.9)
Lithium	4 (3.6)	1 (0.9)	0 (0)
Miscellaneous[b]	6 (5.4)	1 (0.9)	F → M: 1 (0.9)
Total	17 (15.2)	8 (7.1)	F → M: 1 (0.9); M → F: 1 (0.9)
Age ≥ 19			
Antidepressants	13 (11.6)	11 (9.8)	M → F: 1 (0.9)
Cardiovascular	9 (8.0)	5 (4.5)	0 (0)
Diabetic medication	7 (6.3)	5 (4.5)	0 (0)
Miscellaneous[c]	16 (14.3)	9 (8.0)	0 (0)
Total	45 (40.2)	30 (26.8)	M → F: 1 (0.9)
Misuse/abuse to "get high" total	71 (63.4)	38 (33.9)	3 (2.7)

[a] Percent of total number of cases ($N = 112$) with misuse/abuse to "get high"

[b] Includes diabetic medication, herbals/dietary supplements/vitamins, caustic, and cardiovascular

[c] Includes antipsychotics, chemotherapeutic, household product, caustic, herbals/dietary supplements/vitamins, cough & cold medication, antimicrobial, and gastrointestinal

[d] M → F is transgender male to female; F → M is transgender female to male

Table 47 Intentional non-pharmaceutical misuse/abuse to "get high" by age group and sex/gender.

	Female *N* (%)[a]	Male *N* (%)[a]	Transgender[d] *N* (%)[a]
Age 7–12			
Opioid	0 (0)	1 (0.2)	0 (0)
Total	0 (0)	1 (0.2)	0 (0)
Age 13–18			
Psychoactive	10 (2.3)	32 (7.2)	0 (0)
Alcohol ethanol	3 (0.7)	10 (2.3)	0 (0)
Sympathomimetic	3 (0.7)	5 (1.1)	0 (0)
Miscellaneous[b]	2 (0.5)	13 (2.9)	0 (0)
Total	18 (4.0)	60 (13.5)	0 (0)
Age ≥ 19			
Opioids	46 (10.4)	87 (19.6)	M → F: 1 (0.2)
Sympathomimetic	19 (4.3)	67 (15.1)	0 (0)
Psychoactive	17 (3.8)	50 (11.3)	0 (0)
Miscellaneous[c]	21 (4.7)	56 (12.6)	0 (0)
Total	103 (23.3)	260 (58.7)	M → F: 1 (0.2)
Total	121 (27.3)	321 (72.5)	M → F: 1 (0.2)

Cases with age unknown were excluded from this table

[a] Percent based on total number of cases ($N = 443$) with misuse/abuse to "get high"

[b] Includes opioids, toxic alcohol, amphetamine-like hallucinogen, plant and fungi, sedative hypnotic, and unknown

[c] Includes ethanol, sedative hypnotic, amphetamine-like hallucinogen, toxic alcohol, analgesic, anesthetics, cough and cold, gases/vapors/irritants/dusts, hydrocarbons, diabetic, plants and fungi, unknown, not reported, and other

[d] M → F is transgender male to female; F → M is transgender female to male

Self-Harm Intent

Cases in which there was intent for self-harm are described in detail in this report (Tables 7, 8, 10, and 11). Self-harm cases represented 36.6% of Registry cases and included polysubstance ingestions in nearly half of reported cases (44.3%). The analgesic class was the most common agent class reported both for cases of self-harm and to the Registry as a whole. In general, the top agent classes reported with intent for self-harm followed closely with that of the general Registry with one major exception: opioids. The opioid class represented 13.4% of Registry agents (second most common class) but only 3.2% of agents in the category of self-harm intent (ninth most common class). This highlights the likely accidental nature of many serious opioid overdoses. Focusing opioid education and intervention efforts on preventing accidental overdoses continues to warrant substantial attention.

Although women represented half of Registry cases, they were over-represented (65.0%) in cases of self-harm compared to men. Also interesting was the significant proportion of cases reporting self-harm in teens 13–18 years of age (39.5%), nearly twice the representation of this age group compared to the general Registry (20.6%). In teens, analgesics, antidepressants, and anticholinergics represented the majority of agents involved in self-harm (61.8%). Opioids, however, represented a distinctly low percentage of agents in this group (1.2%). There was a marked age-related difference in self-harm attempts with opioid and benzodiazepine exposures, both of which increased with age. For opioids, there were very few self-harm cases in children (0.7%) and teens (1.2%), but a moderate number in adults (4.0%) and significant number in older adults (13.3%). For benzodiazepines, there were moderate numbers in children (5.3%) and teens (4.4%), but more significant numbers in adults (12.8%) and older adults (14.5%). The reason for this is uncertain; however, access to medications may play a role. Children and teens are less commonly prescribed opioids or benzodiazepines but may have easier access to over-the-counter medications like analgesics and anticholinergics, and some teens may be prescribed antidepressants. Parents' awareness of dangers of opioids and benzodiazepines may be higher than for other prescription medications and may influence safe storage and supervision practices. As such, increased safety measures may be needed, such as keeping these medications out of reach of children and teens.

Interestingly, the percent of deaths in cases of intent for self-harm (1.1%) did not differ significantly from the Registry as a whole (1.3%).

Substance Use Disorder and Gender

Encounters for intentional misuse/abuse of a substance without intent at self-harm, and with "attempt to illicit a pleasurable sensation (e.g. to get 'high')" and/or with "attempt to avoid withdrawal" are reported by age group and sex/gender in Table 46 (pharmaceuticals) and Table 47 (non-pharmaceuticals).

Females represented 63.4% of cases where pharmaceuticals were used to "get high" and 80% of cases where pharmaceuticals were used to avoid withdrawal. Among cases where non-pharmaceuticals were misused/abused: males represented 72.3% of cases where intent was to "get high," 78.9% of cases where intent was to avoid withdrawal, and 63.8% of cases where use was both to "get high" and avoid withdrawal. Some substances reported did not necessarily have a mechanism of action consistent with the intent of the exposure which may indicate a lack of understanding of potential effects.

Drug concealment cases were 83.9% male. Males also comprised the majority of cases of ethanol abuse (64.1%); there were no ethanol abuse cases reported in transgender individuals. 82.6% of ethanol abuse cases were in the age group 19–65 years.

Males comprised the majority of cases of ethanol (77%) and cocaine/amphetamine (66.7%) withdrawal cases. Opioid and sedative-hypnotic withdrawal cases did not demonstrate a gender predominance (50.7% and 51.5% female, respectively). There were no cases of withdrawal in transgender individuals.

Addiction Medicine and Substance Use Disorder Consultation

This report marks the second year that the ToxIC Registry collected data to specifically evaluate the care of patients with addiction (ADM) and substance use disorder (SUD). Notably, these data identify cases in which the primary reason for consultation was related to addiction and not another toxicologic indication. In 2019, there were 476 cases in which the primary reason for consultation was addiction, nearly a doubling from the 244 cases in 2018. The majority of these cases (323 cases, 69%) arose as consults from inpatient or admitting services, followed by consults from the Emergency Department (142 cases, 30%). The mean age was 42 years and 44% were female. Opioid agonist therapy initiation was the most common reason for consultation (62%) followed by pain management (83 cases, 18%), counseling (44 cases, 9%), alcohol dependence pharmacotherapy (31 cases, 7%), and opioid antagonist therapy initiation (6 cases, 1%). This breakdown is similar to that of 2018. Incomplete data resulted in some categories not adding to 100%.

In addition to ADM and SUD cases, there were an additional 92 cases primarily related to alcohol abuse and 407 to withdrawal. Of the withdrawal cases, 183 (45%) involved ethanol, 152 (37%) opiates, 48 (12%) sedative-hypnotics, 18 (4%) other, and 6 (1%) stimulants. This is similar to 2018 in which the majority of withdrawal cases were secondary to

ethanol and opiate use. Overall, these numbers represent a dramatic increase in bedside medical toxicology expertise consultation for substance use disorder, pain management, and addiction.

Limitations

The ToxIC Registry is a unique prospective database of cases in which bedside consultation is performed by medical toxicologists, allowing an informed relationship between exposures and clinical outcomes. There are, however, some limitations within the Registry. One of these is a possible bias towards inclusion of more severe case presentations, since cases are only included if they undergo subspecialty bedside consultation. Cases for which a medical toxicology consultation was not requested are not reported and may represent a group with less severe illness. Therefore, the Registry likely represents a different population from other data sources such as poison control centers. There may also be a disproportionate number of certain cases reported based on regional variations in drug use, abuse, and other toxic exposures. The ToxIC Registry includes sites from multiple, diverse locations, but the entire country is not uniformly represented. Larger academic medical centers with greater amounts of medical toxicology faculty may be over-represented in the database.

Additionally, there may be a reporting bias towards more complicated or interesting cases at the level of individual sites. Although the specific intent of the Registry, as defined in written agreements with all sites, is to obtain a consecutive sample of all cases at a given site, individual cases may be missed. Data regarding substances of exposure or species of envenomation relies heavily on patient self-report and may be misclassified. Willingness to disclose this information may be particularly true of illicit drug exposure. Lastly, the Registry strives to continually improve the quality of data collected. While member sites are instructed to complete all applicable data fields, there are still a number of cases and data fields with incomplete information. This remains an issue for collection of race and ethnicity, for example. Efforts continue to support quality data collection and follow up on missing data where applicable.

Conclusions

The ToxIC Registry continues to be unique among databases in that it represents prospective data collected from cases evaluated at the bedside by medical toxicologists. Although this feature limits extrapolation to the population as a whole, it increases the potential for high quality data and for increased correlation between exposure cases and clinical findings. Continued quality improvement and surveillance efforts remain areas of focus for the Registry.

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