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ORIGINAL ARTICLE

The Toxicology Investigators Consortium 2024 Annual Report

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Abstract
Established in 2010, the American College of Medical Toxicology (ACMT) Toxicology Investigators Consortium (ToxIC) Core Registry has systematically captured data from in-hospital and clinic-based medical toxicology physician consultations across the United States (US) and internationally. The ToxIC Core Registry contains deidentified patient data, including patient demographics, reason for medical toxicology evaluation, exposure agents, clinical signs and symptoms, treatments and antidotes administered, and mortality outcomes. This fifteenth annual report provides data from 8,868 patients entered into the Core Registry in 2024, bringing the total number of cases to 111,276 between 2010 and 2024. These cases were submitted by 41 participating sites encompassing 67 distinct hospitals over 23 US states and 3 international countries. In 2024, ethanol was the most commonly reported exposure agent class (17.8%), followed by opioids (15.8%), non-opioid analgesics (10.5%), and sympathomimetic agents (7.6%). A total of 107 fatalities were reported, corresponding to a case fatality rate of 1.2%. Additional descriptive analyses in this annual report were conducted to describe trends for opioid and psychoactive exposures between 2010 and 2024.

Keywords Poisoning · Overdose · Surveillance · Epidemiology · Medical toxicology

Introduction

The Toxicology Investigators Consortium (ToxIC) is a multicenter toxicosurveillance and research network. The ToxIC Core Registry was established in 2010 by the American College of Medical Toxicology (ACMT) as a tool for clinical toxicology research and toxico-surveillance [1, 2]. It prospectively collects data on patients evaluated by medical toxicology physicians in both inpatient and ambulatory settings. The Core Registry began with four sites in 2010, and by 2024, ToxIC has grown to 41 participating sites encompassing 67 hospitals. In 2024, participating sites enrolled 8,868 new cases. As of December 31, 2024, a total of 111,276 cases have been entered into the ToxIC Core Registry since its inception. Since 2020, ToxIC has launched several additional multicenter projects such as the Fentalog Study (2020–2025) which consists of suspected opioid overdose cases presenting to the emergency department (ED), the Drug Overdose Toxico-Surveillance (DOTS) Reporting Program (2022–2024) which enrolled patients presenting with suspected stimulant or opioid overdoses, and the Real-world Examination of Naloxone for Drug Overdose Reversal (RENDOR) project (2023 - current) which assesses opioid antagonist use by bystanders, community members, and emergency medical services (EMS) personnel in the pre-hospital setting.

ToxIC Core Registry and Sub-registries

The ToxIC Core Registry, which comprises cases with medical toxicology physician consultations, has several associated sub-registries that gather detailed data about the patient's exposure or treatment.

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The North American Snakebite Registry (NASBR) includes patients presenting with snakebites who have been treated by medical toxicology physicians (Principal Investigator (PI): Anne-Michelle Ruha, MD, funded by SERB Pharmaceuticals). Celebrating its 11th year, in 2024 the NASBR hit the highest cases reported in a single year of 318 with comprehensive data on the circumstances surrounding the snakebite, clinical manifestations, and responses to treatment. By the end of 2024, participating investigators have published 12 peer reviewed manuscripts and 25 abstracts, including the novel comparison between late hemotoxicity after Fab and F(ab')2 antivenom treatment after rattlesnake bite [3].

The Novel Opioid and Stimulant Exposures (NOSE) project (PI: Meghan Spyres, MD) was initiated in 2021. In 2024, the American Academy of Addiction Psychiatry (AAAP) received a 3-year grant continuation (1H79TI088037) from the Substance Abuse and Mental Health Services Administration (SAMHSA) to support ongoing efforts through the Opioid Response Network (ORN). The ORN provides education and training to enhance efforts addressing prevention, treatment, recovery, and harm reduction for opioid and stimulant use disorders [4]. The NOSE project elicits focused data within the Core Registry identifying cases involving exposures to novel substances, particularly opioids and stimulants. Quarterly reports are coordinated by the AAAP and distributed through the ORN to highlight real-time case clusters and emerging exposure trends. In 2024, ToxIC NOSE briefs addressed topics including buprenorphine associated precipitated withdrawal, the use of medications for opioid use disorder during pregnancy, and tianeptine exposures. These reports are publicly available at www.acmt.net/nose/.

The CDC-funded (75D30123C16380) sub-registry on opioid use disorder (OUD) was launched in 2024. This OUD sub-registry captures expanded data on medication for opioid use disorder (MOUD) initiation and maintenance practices, naloxone distribution on discharge, and reasons for MOUD selection among cases seen by medical toxicologists in the inpatient setting for opioid overdose, withdrawal, or other opioid-related indications.

Two additional ongoing sub-registries within the ToxIC Core Registry are the Natural Toxins Registry: Mushrooms and Plants, and the Extracorporeal Therapies Registry, both of which continued to expand in 2024. The Natural Toxins Registry captures detailed information on mushroom and plant exposures, including associated clinical effects, contextual details surrounding the exposure, and the treatments administered. The Extracorporeal Therapies Registry focuses on the use of extracorporeal treatments, including indications for use, specific modalities used, relevant laboratory values, and the patient's clinical response to treatment.

Additional ToxIC Multicenter Projectsoiti

In addition to the ToxIC Core Registry and its associated sub-registries, ToxIC has initiated several multicenter projects designed to prospectively identify emerging substances. These projects enroll patients outside of medical toxicology consultations, allowing for broader case identification. Notably, these projects provide opportunities for medical toxicologists to serve as PIs at participating sites, promoting leadership and active involvement in multicenter medical toxicology research.

ToxIC Fentalog Study

The ToxIC Fentalog Study is a 5-year, national multicenter investigation of suspected opioid-related overdoses (PI: Alex Manini, National Institutes of Health/National Institute on Drug Abuse 5R01DA048009 and supplemental funding from the Centers for Disease Control and Prevention R01DA048009-05S1). This study aims to assess the prevalence of fentanyl and its analogs (fentalogs), and to explore the contribution of fentalogs, novel psychoactive substances, adulterants, and other co-exposures to the clinical presentation and treatment of opioid overdose. Eligible patients are those who present to the ED with a suspected opioid overdose at one of 10 participating sites, provided that residual waste blood specimens are available. Qualitative toxicological analysis is conducted using liquid chromatography quadrupole time-of-flight mass spectroscopy (LC-QTOF-MS) by the Center for Forensic Science Research and Education (CFSRE). Between 2020 and 2024, 2,261 patients were entered in the ToxIC Fentalog Study. By the end of 2024, this project has yielded 41 scientific presentations and 9 published peer-reviewed manuscripts, including the first publication to describe the clinical effects of medetomidine that was published in 2024 [5].

Drug Overdose Toxico-Surveillance (DOTS) Reporting Program

In 2024, ToxIC completed a 2-year project funded by the U.S. Food and Drug Administration (75F40122D00028), known as the DOTS Reporting Program. The DOTS Program aimed to characterize the sociodemographic characteristics, clinical presentations, interventions, and contextual factors associated with opioid and/or stimulant overdoses among patients presenting to 17 participating medical centers across the United States. By integrating patient interviews, chart reviews, and laboratory confirmation, the project sought to inform regulatory science and public health messaging. Eligible patients aged 13 and older who presented to a participating ED following a suspected opioid

and/or stimulant overdose were approached for informed consent. Upon enrollment, a detailed patient interview was conducted to capture information on the overdose event such as the suspected drug taken, route of administration, history of use, and source of the drug. Blood was collected and sent to CFSRE where qualitative toxicology testing was performed via LC-QTOF-MS and quantitative analyses via liquid chromatography tandem quadrupole mass spectrometry. The DOTS Program concluded in September 2024, with 995 patients enrolled across all participating sites with completed qualitative and quantitative toxicology results.

Real-world Examination of Naloxone for Drug Overdose Reversal (RENDOR)

The RENDOR project (U.S. Food and Drug Administration, 75F40123C00184) was launched in 2024 to assesses the use of opioid antagonist in the pre-hospital setting. RENDOR is unique for focusing on pre-EMS administrations of opioid antagonists, such as naloxone administered by bystanders, non-medical first responders (e.g., police or fire), and community members. RENDOR employs structured EMS data collection at five DOTS sites to capture detailed information on the circumstances of overdose events, naloxone dosing, and patient responses to naloxone administration. Data on naloxone administered by EMS is also collected, providing additional granularity beyond existing EMS surveillance programs. By the end of 2024, participating sites had submitted a total of 814 cases.

ToxIC Publications and Presentations

ToxIC's peer-reviewed publications and presentations continued to grow in 2024. Thirteen publications spanning 10 different journals were published in 2024, and 37 scientific presentations were given at national and international meetings. This represents the most diverse peer-reviewed journals accepted by ToxIC investigators to date. These publications and scientific presentations are listed on the ToxIC website: https://www.acmt.net/toxic/publications/.

Changes to the ToxIC Core Registry in 2024

In 2024, data collection was expanded to include an additional CDC-funded (75D30123C16380) sub-registry on opioid use disorder (OUD). This OUD sub-registry captures targeted data on treatment for patients treated by medical toxicologists for opioid toxicity or withdrawal. Additional updates to the Core Registry included: (1) the addition of "perceived dietary, wellness, or lifestyle benefits," as a reason for exposure for intentional pharmaceutical and intentional non-pharmaceutical exposures, (2) the inclusion of transplacental and transmammary in the exposure agent section, (3) a new question regarding organ donation in fatality cases, and (4) the addition of nalmefene to the list of antidote treatment options.

Annual Report Objectives

The objective of this annual report is to summarize the cases entered into the ToxIC Core Registry in 2024. In addition to reporting the Core Registry data, yearly trends for opioid and psychoactive exposures between 2010 and 2024 were conducted.

Methods

Medical toxicology physicians at participating healthcare sites contribute deidentified patient information to the ToxIC Core Registry based on medical toxicology consultations and evaluations conducted as part of standard patient care. Each site typically represents a medical toxicology practice group, which may provide consultation services across multiple hospitals in one geographical area.

Medical toxicology consultations within the Core Registry include both in-person and telemedicine encounters. Telemedicine practices vary by site, reflecting institutional resources and case-specific circumstances. Patients may be evaluated directly via video conferencing at the bedside. However, in situations where video consultation is not possible (e.g., transfer to hospital units without video capability or if the patient is unavailable due to a procedure), consultations may be conducted through review of available clinical documentation (vital signs, provider notes, laboratory results) and discussion with the primary treating team regarding the patient's bedside assessment. Regardless of modality, all telemedicine encounters included in the Core Registry represent a formal medical toxicology consultation in which the toxicologist performed an evaluation and/or provided clinical recommendations.

All data entered into the Core Registry reflect information from the patient's electronic medical record (EMR) and the physician's direct evaluation of the patient during their consultation, incorporating available evidence such as prehospital reports, patient self-report or family reported history, presence of the product of exposure, clinical presentation, physical examination findings,

ancillary data, and/or laboratory testing results. Agents of exposure and/or withdrawal are documented by the medical toxicologist utilizing the same multi-source approach. Reasons for the medical toxicology encounter may include up to 2 reasons, such as opioid withdrawal and addiction medicine evaluation, when applicable. Patient race and ethnicity are recorded based on self-report or hospital registration documentation within the EMR. Figure 1 provides an overview of the Core Registry data elements.

Data collection and management are conducted using REDCap (Research Electronic Data Capture) tools hosted by Vanderbilt University [6]. REDCap is a secure, web-based software platform that supports research data capture through: (1) an intuitive interface for validated data entry, (2) audit trails for data tracking, (3) automated export functions for statistical software, and (4) interoperability with external sources.

All Core Registry data, including entries from sub-registries, undergo routine quality assurance review by ToxIC staff. Any inconsistencies or missing data are queried back to the entering site for clarification or correction. ToxIC leadership and staff maintain communication with all sites to review patient accrual, address data entry challenges, ensure data quality, and share project opportunities. Additional information on the ToxIC program can be found at www.toxicregistry.org.

All ToxIC projects have been reviewed by a central institutional review board (IRB), the Western Copernicus Group IRB. Each participating site obtains approval from a corresponding local IRB. All collected data are deidentified and compliant with the Health Insurance Portability and Accountability Act.

Statistical Analysis

ToxIC Core Registry data from January 1, 2024 to December 31, 2024 were extracted from REDCap and exported into Microsoft Excel for analysis. Descriptive statistics were used to calculate absolute and relative frequencies for sociodemographic characteristics, medical toxicology consultation referral sources, hospitalization course, reasons for encounter, exposure and treatment details, and mortality outcomes. To protect confidentiality, small cell sizes (<5 cases) for specific agent exposures were collapsed into "miscellaneous" categories with details provided in table footnotes where applicable.

Additional analyses for yearly trends for opioid and psychoactive exposures between 2010 and 2024 were conducted.

Results

In 2024, a total of 8,868 cases of toxicologic exposures were reported to the ToxIC Core Registry from 41 participating sites across 67 hospitals. Five new sites joined the Core Registry in 2024, expanding participation to include hospitals in Chicago, Detroit, Falls Church, Fort Worth, Milwaukee, and New York City. Contributing hospitals for 2024 are listed in Table 1.

Sociodemographic Characteristics

Tables 2, 3, and 4 summarize demographics for sex, age, and race/ethnicity. In 2024, 45.6% of cases involved female patients, 52.8% were male, and 1.6% of patients identified

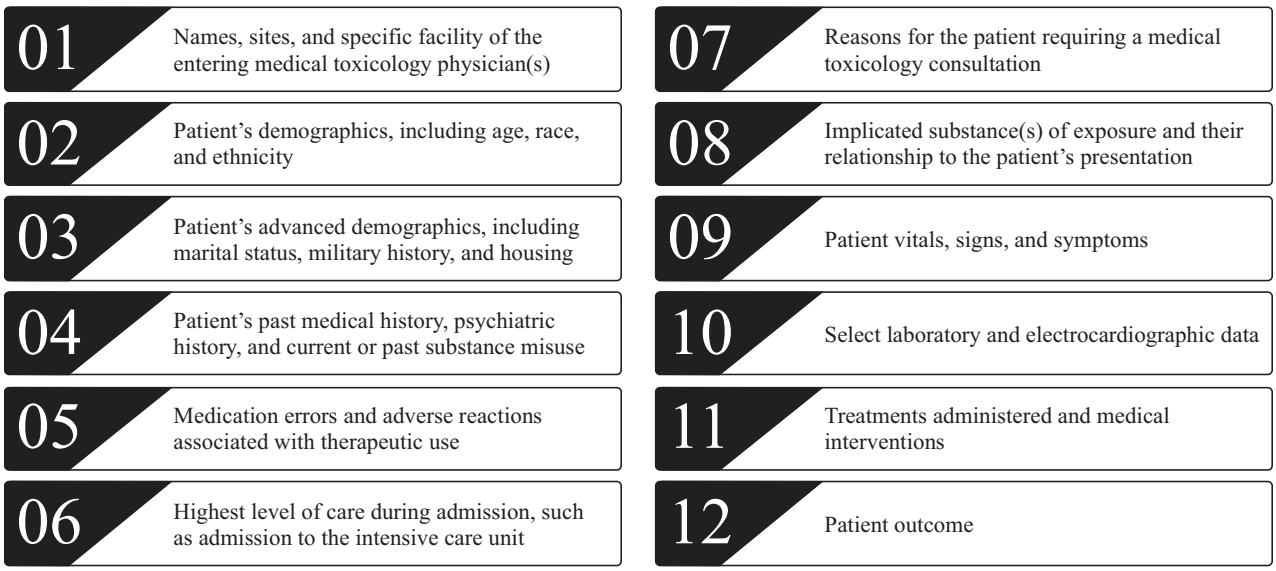

Fig. 1 Core Registry data collection elements

Table 1 Participating institutions providing cases to the ToxIC Core Registry in 2024

State or Country	City	Hospitals
Alabama	Birmingham	Children's of Alabama
		University of Alabama Birmingham Hospital
Arizona	Phoenix	Banner - University Medical Center Phoenix
		Phoenix Children's Hospital
Arkansas	Little Rock	Arkansas Children's Hospital
California	Loma Linda	Loma Linda University Medical Center
	Los Angeles	Olive View University of California Los Angeles Medical Center
		Ronald Reagan University of California Los Angeles Medical Center
		University of California Los Angeles Santa Monica Medical Center
	Sacramento	University of California Davis Medical Center
Colorado	Denver	Children's Hospital Colorado
		Denver Health Medical Center
		Advent Health Porter
		Swedish Medical Center
		University of Colorado Hospital
Florida	Jacksonville	University of Florida Health Jacksonville
Georgia	Atlanta	Children's Healthcare of Atlanta - Hughes Spalding Hospital
		Grady Memorial Hospital
Illinois	Chicago	University of Illinois Chicago Medical Center*
Indiana	Indianapolis	Indiana University Health - Methodist Hospital
		Riley Hospital for Children
Kansas	Kansas City	University of Kansas Medical Center
Kentucky	Lexington	University of Kentucky Albert B. Chandler Hospital
Massachusetts	Boston	Beth Israel Deaconess Medical Center
		Boston Children's Hospital
	Worcester	University of Massachusetts Memorial Medical Center
Michigan	Detroit	Children's Hospital of Michigan*
		Detroit Medical Center - Detroit Receiving Hospital*
		Detroit Medical Center - Harper University Hospital*
	Grand Rapids	Corewell Health
Mississippi	Jackson	University of Mississippi Medical Center
Missouri	Kansas City	Children's Mercy Hospital
	St. Louis	Missouri Baptist Medical Center
		Barnes-Jewish Hospital
New Jersey	Newark	Rutgers New Jersey Medical School - University Hospital
New York	Albany	Albany Medical Center
	Bronx	New York City Health + Hospitals - Jacobi*
		New York City Health + Hospitals - North Central Bronx*
	New York	New York - Presbyterian Weill Cornell Medical Center
		New York - Presbyterian Lower Manhattan Hospital
	Rochester	Strong Memorial Hospital
	Syracuse	Upstate University Hospital - Downtown Campus
North Carolina	Charlotte	Carolinas Medical Center
Oregon	Portland	Oregon Health & Science University Hospital
Pennsylvania	Bethlehem	Lehigh Valley Hospital - Cedar Crest
		Lehigh Valley Hospital - Muhlenberg
	Philadelphia	Jefferson Einstein Philadelphia Hospital
	Pittsburgh	University of Pittsburgh Medical Center Magee - Women's Hospital
		University of Pittsburgh Medical Center Mercy
		University of Pittsburgh Medical Center Shadyside
	York	York Hospital
Texas	Dallas	Children's Medical Center Dallas
		Children's Medical Center Plano
		Parkland Memorial Hospital
		William P. Clements Jr University Hospital

Table 1 (continued)

State or Country	City	Hospitals
	Fort Worth	John Peter Smith Hospital*
	Houston	HCA Houston Kingwood
		Woman's Hospital of Texas
Virginia	Charlottesville	University of Virginia Medical Center
	Falls Church	Inova Fairfax Hospital*
Wisconsin	Milwaukee	Children's Wisconsin*
		Froedtert Memorial Lutheran Hospital*
Canada	Calgary	Foothills Medical Centre
		Peter Lougheed Centre
England	London	Guy's and St Thomas' NHS Foundation Trust
		St Thomas' Hospital
Thailand	Bangkok	Vajira Hospital

*New participating ToxIC sites in 2024

Table 2 Patient sex and pregnancy status

	N (%)
Sex[a]	
Female	4044 (45.6)
Male	4685 (52.8)
Transgender or non-binary	139 (1.6)
Pregnant	147 (3.6)[b]

[a] Percentages based on total number of cases (*N*=8868) seen by a medical toxicologist

[b] Percentage based on number of cases in female patients (*N*=4044)

Table 3 Patient age category

	N (%)[a]
Less than 2 years old	271 (3.1)
2–6 years old	395 (4.4)
7–12 years old	257 (2.9)
13–18 years old	1380 (15.5)
19–65 years old	5595 (63.1)
66–89 years old	928 (10.5)
Over 89 years old	15 (0.2)
Age unknown	27 (0.3)

[a] Percentages based on total number of cases (*N*=8868) seen by a medical toxicologist

Table 4 Patient race/ethnicity

	N (%)[a]
Non-Hispanic White	5534 (62.4)
Black/African American	1340 (15.1)
Hispanic	1177 (13.3)
Asian	265 (3.0)
American Indian/Alaskan Native	136 (1.5)
Mixed, not otherwise specified	91 (1.0)
Native Hawaiian/Pacific Islander	21 (0.2)
Other, not otherwise specified	14 (0.2)
Race unknown	290 (3.3)

[a] Percentages based on total number of cases (*N*=8868) seen by a medical toxicologist

as transgender or non-binary. One hundred forty-seven patients (3.6%) were pregnant. The majority of patients were adults aged 19–65 (63.1%), followed by adolescents aged 13–18 (15.5%). Children aged 12 years of and younger accounted for 10.4% of cases, and older adults over 65 years of age comprised 10.7% of cases. The predominant race and ethnicity was Non-Hispanic White (62.4%), followed by Black/African American (15.1%), Hispanic (13.3%), Asian (3.0%), American Indian/Alaskan Native (1.5%), and Native Hawaiian/Pacific Islander (0.2%).

Patient marital status, military service, and housing situation are collected for patients over 12 years of age and are presented in Table 5. Among patients with known marital status, the majority of patients were single (65.7%), followed by those who were married or had a long-term partner (22.0%), and those who were divorced or separated (9.6%). Among those with known military service status (*N*=4,146), the majority (97.9%) reported no previous military service. Of the 2.1% who reported prior military service, 84.3% were retired or had former military service. Housing status was documented in 93.8% of cases, with 89.8% reporting secure housing, defined as a home or stable living situation. Patients classified as undomiciled or unhoused made up 7.7%. Compared to 2023, patients with reported secured housing decreased by 2.2% (92.0% in 2023 vs. 89.8% in 2024) and undomiciled individuals increased by 1.9% (5.8% in 2023 vs. 7.7% in 2024) [7].

Source of Medical Toxicology Referral, Location of Patient during Hospitalization, and Reasons for Encounter

Table 6 outlines the medical toxicology consultation referral source for both inpatient and outpatient encounters. The majority (50.9%) of inpatient cases originated from ED referrals, followed by an inpatient admitting or non-admitting service (43.9%). In previous annual reports, admitting

Table 5 Patient marital status, military service, and housing situation

	N (%)
Marital Status	
Total reported marital status	**7114 (89.9)**[a]
Single	4673 (65.7)[b]
Married or long-term partner	1567 (22.0)[b]
Divorced or separated	683 (9.6)[b]
Widowed	191 (2.7)[b]
Military Service	
Total reported military service	**4146 (52.4)**[a]
No, previous military service	4057 (97.9)[c]
Yes, previous military service	89 (2.1)[c]
Former/retired	75 (84.3)[d]
Current (including reserves)	9 (10.1)[d]
Unknown if former/current	5 (5.6)[d]
Housing Status	
Total reported housing status	**8320 (93.8)**[e]
Secured housing (home or stable living situation)	7468 (89.8)[f]
Undomiciled (homelessness, unhoused)	640 (7.7)[f]
Non-criminal supervised care (foster, group home, nursing home)	109 (1.3)[f]
Rehabilitation or psychiatric facility	66 (0.8)[f]
Correctional related facility (jail, prison, incarceration)	37 (0.4)[f]

[a] Percentages based on patients age > 12 years old (*N* = 7918)

[b] Percentages based on total cases reporting known marital status (*N* = 7114)

[c] Percentages based on total cases reporting known military service (*N* = 4146)

[d] Percentages based on total cases reporting yes, previous military service (*N* = 89)

[e] Percentages based on total reported cases (*N* = 8868)

[f] Percentages based on total cases reporting known housing status (*N* = 8320)

Table 6 Case referral sources by inpatient/ outpatient status

	N (%)
Emergency Department (ED) or an Inpatient Unit[a]	
ED	4426 (50.9)
Inpatient service (admitting or non-admitting)	3813 (43.9)
Outside hospital transfer	437 (5.0)
Self-referral	8 (0.1)
Primary care provider or other outpatient physician	3 (0.1)
Employer medical evaluation	0 (0.0)
Outpatient Clinic/Office Consultation[b]	
Primary care provider or other outpatient physician	139 (76.8)
Self-referral	29 (16.0)
Employer medical evaluation	12 (6.6)
ED	1 (0.6)

[a] Percentages based on total number of cases (*N* = 8687) seen by a medical toxicologist as an inpatient

[b] Percentages based on total number of cases (*N* = 181) seen by a medical toxicologist as an outpatient, including clinic visits or office consultations

Table 7 Locations of patient during hospitalization and inpatient mental health placement

	N (%)[a]
ED	7102 (81.8)
Hospital floor	5169 (59.5)
Critical care unit	2769 (31.9)
Observation unit	478 (5.5)
Inpatient mental health facility[b]	1578 (18.2)

[a] Percentages based on total number of cases (*N* = 8687) seen by a medical toxicologist as an inpatient. Case entries may include more than one hospital location

[b] Inpatient mental health facility includes facility at participating hospital or transfer to an outside facility

and non-admitting services were classified as separate types of referral sources, however they have been combined for the 2024 report. Inpatient consultations originating from primary care or other outpatient physician referrals (0.1%) were infrequent. Conversely, for outpatient medical toxicology consultations, primary care and other outpatient physicians were the primary referral sources (76.8%), followed by self-referrals (16.0%), and employer medical evaluations (6.6%).

Table 7 provides an overview of all patient locations during hospitalization. The majority of patients spent time in the ED (80.1%), followed by the hospital floor (58.3%), and the critical care unit (31.2%). A smaller proportion of patients were placed in an observation unit during their hospitalization (5.4%). Patients may have moved through more than one hospital location during their hospitalization. Inpatient mental health facility placement occurred in 18.2% of cases.

Table 8 outlines telemedicine encounters. Telemedicine medical toxicology consultations occurred in the inpatient setting in the majority of cases (97.8%). Most referrals originated from an inpatient admitting or non-admitting service (53.9%), followed by the ED (43.4%). This increased proportion of telemedicine medical toxicology consultations initiated by inpatient services represents a new trend observed since the implementation of this section in 2020 [7–10]. A small portion of referrals came from primary care providers or other outpatient treating physicians (1.7%). Telemedicine consultations were conducted through video (55.7%), by chart review only (34.5%), or via phone encounters with patients (9.8%). The most common reasons for a telemedicine consultation included the patient being at a remote or offsite location (49.0%), the medical toxicologist not having admitting or bedside consultation privileges (27.1%), and the consultation being after hours for bedside evaluations (12.3%). Consultation reimbursement

Table 8 Telemedicine encounters

	N (%)
Inpatient Medical Toxicology Consultation[a]	655 (97.8)
Outpatient Medical Toxicology Consultation[a]	15 (2.2)
Source of Telemedicine Referral[a]	
Inpatient service (admitting or non-admitting)	361 (53.9)
ED	291 (43.4)
Primary care provider or other outpatient physician	11 (1.7)
Outside hospital transfer	4 (0.6)
Self-referral	2 (0.3)
Employer/Independent medical evaluation	1 (0.1)
Nature of Telemedicine Consultation[a]	
Patient encounter via video/internet	373 (55.7)
Chart review only	231 (34.5)
Patient encounter over the phone	66 (9.8)
Reason for Telemedicine Encounter[b]	
Patient at remote/offsite location	347 (49.0)
No admitting or bedside consultation privileges	192 (27.1)
After hours for bedside consultation	87 (12.3)
Non-toxic/minimally toxic exposure not requiring bedside evaluation	38 (5.4)
Patient in operating room for surgery or procedure	20 (2.8)
Timing constraint due patient transfer or discharge	13 (1.8)
Change in hospital/facility policy	6 (0.9)
Inclement Weather	5 (0.7)
Telemedicine Consult Billing[a]	
Yes	582 (86.8)
No	60 (9.0)
Unknown	28 (4.2)

[a] Percentages based on total cases indicating a telemedicine consultation (*N* = 670)

[b] Percentages based on total number of reasons for telemedicine encounter (*N* = 708). Case entries may include more than one reason for a telemedicine encounter

for telemedicine visits were reported in 86.8% of cases, and 9% of cases were not billed.

Tables 9 and 10 present the reasons for medical toxicology consultation encounters and details of intentional pharmaceutical exposures. Intentional pharmaceutical exposures remain the most common reason for medical toxicology consultations, accounting for 27.1% of cases in the Core Registry. In 2024, ethanol withdrawal (14.6%) and ethanol misuse (12.1%) were the second and third most common consultation reasons, respectively. Among intentional pharmaceutical exposures (*N* = 2,873), the majority of cases were associated with self-harm attempts (71.9%), predominantly suicide attempts (88.3%). Misuse accounted for 14.1% of

Table 9 Reason for medical toxicology encounter

	N (%)[a]
Intentional exposure - pharmaceutical	2901 (27.1)
Withdrawal - ethanol	1559 (14.6)
Ethanol misuse	1295 (12.1)
Addiction medicine consultation	878 (8.2)
Withdrawal - opioid	859 (8)
Intentional exposure - non-pharmaceutical	708 (6.6)
Unintentional exposure - pharmaceutical	502 (4.7)
Organ system dysfunction	501 (4.7)
Unintentional exposure - non-pharmaceutical	454 (4.2)
Envenomation - snake	315 (2.9)
Interpretation of toxicology lab data	299 (2.8)
Withdrawal - sedative/hypnotic	134 (1.3)
Environmental evaluation	79 (0.7)
Withdrawal - cocaine/amphetamine	70 (0.7)
Envenomation - spider	54 (0.5)
Envenomation - other	31 (0.3)
Withdrawal - other	28 (0.3)
Occupational evaluation	15 (0.1)
Malicious/criminal	8 (0.1)
Envenomation - scorpion	6 (0.1)
Marine/fish poisoning	2 (0)

[a] Percentages based on total number of reasons for toxicology encounter (*N* = 10698); 1830 Core Registry cases (20.6%) reported a second reason for encounter. Case entries may include more than one reason for a medical toxicology encounter

Table 10 Detailed reason for Encounter - Intentional pharmaceutical exposure[a]

	N (%)
Reason for Intentional Pharmaceutical Exposure Subgroup[b]	
Attempt at self-harm	2067 (71.9)
Misuse	404 (14.1)
Therapeutic use	280 (9.7)
Unknown	131 (4.6)
Perceived dietary, wellness, or lifestyle benefits	9 (0.3)
Attempt at Self-harm - Suicidal Intent Subclassification[c]	
Suicidal intent	1826 (88.3)
Suicidal intent unknown	154 (7.5)
No suicidal intent	87 (4.2)

[a] Twenty-eight cases listed more than one reason for encounter due to intentional pharmaceutical exposure

[b] Percentages based on number of cases reporting intentional pharmaceutical exposure (*N* = 2873)

[c] Percentages based on number of cases indicating attempt at self-harm (*N* = 2067)

intentional pharmaceutical exposures. Notably, the newly added intentional pharmaceutical exposure category, "perceived dietary, wellness, or lifestyle benefits," accounted for 0.3% of these intentional pharmaceutical exposures.

Table 11 Addiction medicine consultations[a]

	N (%)[b]
Opioid agonist therapy	574 (66.6)
Pain management	113 (13.1)
Counseling and support only	94 (10.9)
Alcohol dependence pharmacotherapy	77 (8.9)
Opioid antagonist therapy	20 (2.3)

[a] Sixteen cases listed more than one reason for encounter due to addiction medicine consultations

[b] Percentages based on total number indicating addiction medicine consultations (*N* = 862)

Table 11 outlines addiction medicine consultations reported by medical toxicology physicians in 2024. Consultations were predominantly related to opioid agonist therapy (66.6%), followed by pain management (13.1%), and counseling and support (10.9%). In 2024, pain management surpassed counseling and support as an addiction medicine consultation reason, following a steady increase since 2021 (7.9% in 2021 vs. 8.7% in 2022 vs. 10.7% in 2023) [7–9].

Agent Classes

Toxicologic exposure by agent class reported to the Core Registry are summarized in Table 12. Of the 8,868 cases entered into the Core Registry in 2024, 8,019 involved at least one known agent of exposure. For the second consecutive year, ethanol remained the most frequently reported exposure overall (17.8%) [7]. This was followed by opioids (15.8%), non-opioid analgesics (10.5%), sympathomimetics (7.6%), and antidepressants (7.6%). Single agent exposures accounted for 5,790 (65.3%) cases. Table 13 describes the top 10 single agent exposure classes reported in 2024. Consistent with findings from 2023, ethanol was the most common single agent exposure in 2024 (28.9%), followed by opioids (16.1%), non-opioid analgesics (9.4%), envenomations (6.3%), and antidepressants (4.9%) [7].

Ethanol and Toxic Alcohols

Table 14 presents data on ethanol and toxic alcohol exposures reported in 2024. Ethanol (*N* = 2,084) was the most frequently reported agent overall (28.9%) and as a single agent exposure (17.8%). Among non-ethanol toxic alcohol exposures (*N* = 56), isopropyl alcohol accounted for the highest proportion of cases (44.6%), followed by ethylene glycol (33.9%) and methanol (7.1%). Miscellaneous toxic alcohols comprised 10.8% of non-ethanol exposures and included agents such as acetone, alcohol ethoxylate, denatured ethanol, diethylene glycol, and glycol ethers.

Table 12 Exposure agent classes reported in medical toxicology consultations

	N (%)[a]
Ethanol	2084 (17.8)
Opioid	1842 (15.8)
Analgesic	1225 (10.5)
Sympathomimetic	886 (7.6)
Antidepressant	884 (7.6)
Sedative-hypnotic/muscle relaxant	706 (6.1)
Cardiovascular	642 (5.5)
Anticholinergic/antihistamine	603 (5.2)
Psychoactive	475 (4.1)
Antipsychotic	407 (3.5)
Envenomation	366 (3.1)
Anticonvulsant	225 (1.9)
Lithium	113 (1.0)
Herbal products/dietary supplements	107 (0.9)
Metals	107 (0.9)
Diabetic medication	105 (0.9)
Gases/irritants/vapors/dusts	99 (0.8)
Cough and cold products	86 (0.7)
Antimicrobials	70 (0.6)
Plants and fungi	70 (0.6)
Caustic	68 (0.6)
Toxic alcohols	56 (0.5)
Unknown class	50 (0.4)
Gastrointestinal	49 (0.4)
Household products	49 (0.4)
Other pharmaceutical product	48 (0.4)
Hydrocarbon	41 (0.4)
Endocrine	39 (0.3)
Anesthetic	36 (0.3)
Chemotherapeutic and immune	36 (0.3)
Other non-pharmaceutical product	36 (0.3)
Insecticide	14 (0.1)
Anticoagulant	13 (0.1)
Ingested foreign body	9 (0.1)
Rodenticide	9 (0.1)
Pulmonary	8 (0.1)
Herbicide	7 (0.1)
Anti-parkinsonism drugs	4 (0.0)
Marine toxin	3 (0.0)
Chelators	2 (0.0)
Fungicide	1 (0.0)
WMD[b]/riot agent/radiological	1 (0.0)
Cholinergic	0 (0.0)
Photosensitizing agents	0 (0.0)

[a] Percentages based on total number of reported agent entries (*N* = 11681); 8019 Core Registry cases reported at least 1 agent and 5790 of those cases (65.3%) reported a single agent

[b] *WMD*: Weapon of Mass Destruction

Opioids

Table 15 outlines the details of opioid exposure agents reported in 2024 (*N* = 1,842). Fentanyl exposures were more

Table 13 Top 10 single agent exposure classes

Rank	Single Agents	*N* (%)[a]
1	Ethanol	1673 (28.9)
2	Opioid	935 (16.1)
3	Analgesic	545 (9.4)
4	Envenomation	365 (6.3)
5	Antidepressant	282 (4.9)
6	Psychoactive	254 (4.4)
7	Sympathomimetic	237 (4.1)
8	Anticholinergic/antihistamine	215 (3.7)
9	Cardiovascular	188 (3.2)
10	Sedative-hypnotic/muscle relaxant	171 (3.0)

[a] Percentages based on cases reporting a single agent (*N*=5790)

Table 14 Ethanol and toxic alcohols

	N (%)
Ethanol[a]	2084 (100)
Toxic alcohols[b]	
Isopropanol	25 (44.6)
Ethylene glycol	19 (33.9)
Methanol	4 (7.1)
Toxic alcohol unspecified	2 (3.6)
Miscellaneous[c]	6 (10.8)

[a] Ethanol is considered a separate agent class

[b] Percentages based on total number of reported toxic alcohol (non-ethanol alcohols and glycols) class entries (*N*=56)

[c] Includes acetone, alcohol ethoxylate, denatured ethanol, diethylene glycol, and glycol ethers

Table 15 Opioids

	N (%)[a]
Fentanyl	1082 (58.7)
Methadone	144 (7.8)
Oxycodone	142 (7.7)
Buprenorphine	125 (6.8)
Heroin	113 (6.1)
Opioid Unspecified	45 (2.4)
Morphine	37 (2.0)
Tramadol	35 (1.9)
Naloxone	30 (1.6)
Hydrocodone	29 (1.6)
Hydromorphone	23 (1.2)
Codeine	15 (0.8)
Dihydrocodeine	5 (0.3)
Naltrexone	3 (0.2)
Fluorofentanyl	2 (0.1)
Tapentadol	2 (0.1)
Meperidine	2 (0.1)
Norfentanyl	2 (0.1)
Loperamide	2 (0.1)
Miscellaneous[b]	4 (0.4)

[a] Percentages based on total number of reported opioid class entries (*N*=1842)

[b] Includes butyrylfentanyl, bucinnazine, butanoyl-4-fluorofentanyl, and samidorphan

common than all other opioids combined accounting for 58.7% of all opioid related cases. The next most frequently reported opioids were methadone (7.8%), oxycodone (7.7%), buprenorphine (6.8%), and heroin (6.1%).

Non-Opioid Analgesics

Table 16 summarizes analgesic exposures reported in 2024 (*N*=1,225). Acetaminophen was the most frequently non-opioid analgesic reported to the Core Registry (62.4%). The next most commonly reported non-opioid analgesics were ibuprofen (14.7%), gabapentin (8.8%), and acetylsalicylic acid (7.1%). The miscellaneous category includes a small number of cases (0.8%) involving agents such as celecoxib, etoricoxib, flurbiprofen, indomethacin, magnesium salicylate, mefenamic acid, mesalamine, salsalate, and ziconotide.

Sympathomimetic Agents

Table 17 provides the frequency of sympathomimetic agent exposures (*N*=886). Methamphetamine is the most prevalent sympathomimetic exposure (42.9%), followed by cocaine (34.4%), amphetamine (6.6%) and methylphenidate (4.3%).

Antidepressants

Table 18 displays the frequencies of antidepressant exposures in 2024 (*N*=884), further subcategorized by antidepressant class. In 2024, for the first time since 2018, other antidepressants (43.3%) emerged as the most commonly reported antidepressant class, dominated by bupropion

Table 16 Analgesics

	N (%)[a]
Acetaminophen	765 (62.4)
Ibuprofen	180 (14.7)
Gabapentin	108 (8.8)
Acetylsalicylic acid	87 (7.1)
Pregabalin	25 (2.0)
Naproxen	22 (1.8)
Meloxicam	9 (0.7)
Salicylic acid	8 (0.7)
Phenazopyridine	5 (0.4)
Acemetacin	3 (0.2)
Diclofenac	2 (0.2)
Oil of wintergreen	2 (0.2)
Miscellaneous[b]	9 (0.8)

[a] Percentages based on total number of reported analgesic class entries (*N*=1225)

[b] Includes celecoxib, etoricoxib, flurbiprofen, indomethacin, magnesium salicylate, mefenamic acid, mesalamine, salsalate, and ziconotide

Table 17 Sympathomimetic agents

	N (%)[a]
Methamphetamine	380 (42.9)
Cocaine	305 (34.4)
Amphetamine	58 (6.6)
Methylphenidate	38 (4.3)
Dextroamphetamine	25 (2.8)
Lisdexamfetamine	20 (2.3)
3,4-Methylenedioxymethamphetamine (MDMA)	16 (1.8)
Dexmethylphenidate	9 (1.0)
Sympathomimetic unspecified	7 (0.8)
Atomoxetine	6 (0.7)
Phentermine	5 (0.6)
Phenylephrine	3 (0.3)
Pseudoephedrine	3 (0.3)
Miscellaneous[b]	11 (1.2)

[a] Percentages based on total number of reported sympathomimetic class entries (*N* = 886)

[b] Includes 3-fluoroethamphetamine, 6-(2-aminopropyl)benzofuran, 25I-NBOMe, alpha-pyrrolidinohexiophenone, benzoylecgonine, butylone, epinephrine, mixed amphetamine salts, serdexmethylphenidate, tetrahydrozoline, and viloxazine

(25.5%) and trazodone (13.9%) [7–12]. Selective serotonin reuptake inhibitors accounted for 37.1% of exposures, followed by serotonin norepinephrine reuptake inhibitors comprising 10.9% of cases. Tricyclic antidepressants represented only 8.6% of all antidepressant exposures. Notably, within the tricyclic antidepressant class, cases involving tianeptine increased in 2024, although they still comprised only 0.8% of cases in this class.

Clinical Signs and Symptoms

Toxidromes

Table 19 summarizes cases in which one or more toxidromes were documented, representing 21.1% of all entries in the Core Registry in 2024. Opioid toxidromes were the most frequently reported (7.7%) followed by anticholinergic (3.7%), sedative-hypnotic (3.6%), and sympathomimetic (2.4%) toxidromes.

Major Vital Sign Abnormalities

Table 20 presents major vital sign abnormalities, which were reported in 21.9% of Core Registry cases. Tachycardia (10.9%) was the most frequently reported abnormality, followed by hypotension (5.3%) and bradycardia (4.0%).

Clinical Signs and Symptoms – Neurologic

Table 21 indicates neurologic signs and symptoms reported to the Core Registry in 2024, with 45.3% of cases

Table 18 Antidepressants

	N (%)[a]
Other antidepressants	384 (43.4)
Bupropion	225 (25.5)
Trazodone	123 (13.9)
Mirtazapine	30 (3.4)
Unknown antidepressant	2 (0.2)
Miscellaneous[b]	4 (0.4)
Selective serotonin reuptake inhibitors (SSRIs)	**328 (37.1)**
Sertraline	116 (13.1)
Escitalopram	90 (10.2)
Fluoxetine	81 (9.1)
Citalopram	27 (3.1)
Paroxetine	9 (1.0)
Fluvoxamine	5 (0.6)
Serotonin-norepinephrine reuptake inhibitors (SNRIs)	**96 (10.9)**
Venlafaxine	49 (5.5)
Duloxetine	42 (4.8)
Desvenlafaxine	4 (0.5)
Miscellaneous[c]	1 (0.1)
Tricyclic Antidepressants (TCAs)	**76 (8.6)**
Amitriptyline	40 (4.5)
Doxepin	15 (1.7)
Nortriptyline	11 (1.2)
Tianeptine	7 (0.8)
Clomipramine	2 (0.2)
Miscellaneous[d]	1 (0.1)

[a] Percentages based on total number of reported antidepressant class entries (*N* = 884)

[b] Includes buspirone, tandospirone, tranylcypromine, and vortioxetine

[c] Includes milnacipran

[d] Includes imipramine

associated with at least one or more neurologic effects. Coma/CNS depression (17.3%) was the most commonly encountered neurologic clinical effect followed by agitation (13.4%), hyperreflexia/myoclonus/clonus/tremor (13.1%), delirium/toxic psychosis (6.6%), and seizures (6.1%).

Clinical Signs and Symptoms – Pulmonary and Cardiovascular

Table 22 displays cardiovascular and pulmonary signs and symptoms, making up 8.8% and 7.6% of all Core Registry cases in 2024, respectively. QTc prolongation (6.3%) and respiratory depression (5.9%) were the most encountered cardiovascular and pulmonary effects.

Table 19 Toxidromes

	N (%)[a]
Cases with one or more toxidromes reported	1872 (21.1)
Total Reported Toxidromes[b]	
Opioid	680 (7.7)
Anticholinergic	331 (3.7)
Sedative-hypnotic	315 (3.6)
Sympathomimetic	217 (2.4)
Serotonin syndrome	154 (1.7)
Alcoholic ketoacidosis	139 (1.6)
Sympatholytic	45 (0.5)
Washout syndrome	30 (0.3)
Cannabinoid hyperemesis	14 (0.2)
Neuroleptic malignant syndrome	8 (0.1)
Cholinergic	5 (0.1)
Anticonvulsant hypersensitivity	5 (0.1)
Overlap syndromes	2 (0.0)

[a] Percentages based on number of cases reporting toxidromes relative to total number of Core Registry cases (*N*=8868)

[b] Cases may be associated with more than one toxidrome

Table 20 Major vital sign abnormalities

	N (%)[a]
Cases with one or more major vital sign abnormality	1946 (21.9)
Total Reported Major Vital Sign Abnormalities[b]	
Tachycardia (HR[c] >140 beats per minute)	963 (10.9)
Hypotension (systolic BP[d] < 80 mmHg)	469 (5.3)
Bradycardia (HR[c] < 50 beats per minute)	356 (4.0)
Hypertension (systolic BP[d] >200 mmHg and/or diastolic BP[d] >120 mmHg)	346 (3.9)
Bradypnea (RR[e] <10 breaths per minute)	148 (1.7)
Hyperthermia (temperature > 105° F)	33 (0.4)

[a] Percentages based on number of cases reporting major vital sign abnormalities relative to the total number of Core Registry cases (*N*=8868)

[b] Cases may be associated with more than one major vital sign abnormality

[c] *HR*: heart rate

[d] *BP*: blood pressure

[e] *RR*: respiratory rate

Table 21 Clinical Signs and Symptoms – Neurologic

	N (%)[a]
Cases with one or more neurologic effects	4014 (45.3)
Total Reported Neurologic Clinical Effects[b]	
Coma/CNS depression	1531 (17.3)
Agitation	1191 (13.4)
Hyperreflexia/Myoclonus/Clonus/Tremor	1165 (13.1)
Delirium/Toxic psychosis	582 (6.6)
Seizures	532 (6.0)
Hallucinations	364 (4.1)
Weakness/Paralysis	111 (1.3)
Numbness/Paresthesia	58 (0.7)
EPS/Dystonia/Rigidity	57 (0.6)
Peripheral neuropathy (objective)	22 (0.2)

[a] Percentages based on number of cases reporting neurologic effects relative to total number of Core Registry cases (*N*=8868)

[b] Cases may be associated with more than one neurologic effect

Table 22 Clinical Signs – Cardiovascular and Pulmonary

	N (%)[a]
Cardiovascular	
Cases with one or more cardiovascular effects	776 (8.8)
Total Reported Cardiovascular Effects[b]	
Prolonged QTc (≥500 ms)	555 (6.3)
Prolonged QRS (≥120 ms)	205 (2.3)
Myocardial injury or infarction	77 (0.9)
Ventricular dysrhythmia	49 (0.6)
AV Block (>1 st degree)	16 (0.2)
Pulmonary	
Cases with one or more pulmonary effects	675 (7.6)
Total Reported Pulmonary Effects[b]	
Respiratory depression	524 (5.9)
Aspiration pneumonitis	138 (1.6)
Acute lung injury/ARDS[c]	47 (0.5)
Asthma/Reactive airway disease	31 (0.3)

[a] Percentages based on number of cases reporting cardiovascular or pulmonary effects relative to total number of Core Registry cases (*N*=8868)

[b] Cases may be associated with more than one cardiovascular or pulmonary effect

[c] *ARDS*: Acute respiratory distress syndrome

Clinical Signs and Symptoms – Other Organ Systems

Table 23 summarizes all of the other signs and symptoms reported in the Core Registry in 2024 by organ system. This included hematologic (9.2%), metabolic (7.8%), renal/musculoskeletal (6.8%), gastrointestinal/hepatic (5.8%), and dermatologic (2.4%) presentations. The most frequently reported clinical effects by organ system were coagulopathy (3.8%), metabolic acidosis (4.1%), acute kidney injury (4.5%), hepatotoxicity with an ALT 100-1,000 IU/L (3.5%), and rash (1.3%), respectively.

Treatment

Antidotal Therapy

Table 24 describes the antidotes administered to patients entered into the Core Registry in 2024. Thiamine (34.1%), folate (29.2%), and N-acetylcysteine (12.1%) remained the three most commonly reported antidotal therapies [7, 8].

Table 23 Clinical Signs – Other Organ Systems

	N (%)[a]
Hematologic	
Cases with one or more hematologic effects	815 (9.2)
Total Reported Hematologic Clinical Effects[b]	
Coagulopathy (PT[c] >15 s)	336 (3.8)
Hemolysis (Hgb[d] < 10 g/dL)	297 (3.3)
Thrombocytopenia (platelets < 100 K/μL)	202 (2.3)
Leukocytosis (WBC[e] >20 K/μL)	168 (1.9)
Methemoglobinemia (MetHgb ≥ 2%)	30 (0.3)
Pancytopenia	22 (0.2)
Metabolic	
Cases with one or more metabolic effects	696 (7.8)
Total Reported Metabolic Clinical Effects[b]	
Metabolic acidosis (pH < 7.2)	367 (4.1)
Elevated anion gap (> 20)	361 (4.1)
Hypoglycemia (glucose < 50 mg/dL)	105 (1.2)
Elevated osmole gap (> 20)	25 (0.3)
Renal/Musculoskeletal	
Cases with one or more renal/musculoskeletal effects	599 (6.8)
Total Reported Renal/Musculoskeletal Clinical Effects[b]	
Acute kidney injury (creatinine > 2.0 mg/dL)	395 (4.5)
Rhabdomyolysis (CPK[f] >1000 IU/L)	283 (3.2)
Gastrointestinal/Hepatic	
Cases with one or more gastrointestinal/hepatic effects	518 (5.8)
Total Reported Gastrointestinal/Hepatic Clinical Effects[b]	
Hepatotoxicity (ALT[g] 100–1000 IU/L)	314 (3.5)
Hepatotoxicity (AST[h] ≥ 1000 IU/L)	155 (1.7)
Hepatotoxicity (ALT[g] ≥ 1000 IU/L)	99 (1.1)
Gastrointestinal bleeding	48 (0.5)
Pancreatitis	25 (0.3)
Corrosive injury	20 (0.2)
Intestinal ischemia	3 (0.0)
Dermatologic	
Cases with one or more dermatologic effects	211 (2.4)
Total Reported Dermatologic Clinical Effects[b]	
Rash	117 (1.3)
Angioedema	50 (0.6)
Blister/Bullae	49 (0.6)
Necrosis	45 (0.5)

[a] Percentages based on number of cases reporting other organ system effects relative to total number of Core Registry cases (*N* = 8868)

[b] Cases may be associated with more than category effect

[c] *PT*: prothrombin time

[d] *Hgb*: hemoglobin

[e] *WBC*: white blood cells

[f] *CPK*: creatine phosphokinase

[g] *ALT*: alanine transaminase

[h] *AST*: aspartate aminotransferase

Table 24 Antidotal therapy

	N (%)[a]
Thiamine	1946 (34.1)
Folate	1669 (29.2)
N-acetylcysteine	688 (12.1)
Naloxone	510 (8.9)
Sodium bicarbonate	240 (4.2)
Fomepizole	126 (2.2)
Calcium	79 (1.4)
Rivastigmine	65 (1.2)
Glucagon	45 (0.8)
Methylene blue	45 (0.8)
Atropine	36 (0.6)
Octreotide	31 (0.5)
Insulin-euglycemic therapy	30 (0.5)
Vitamin K	29 (0.5)
Lipid resuscitation therapy	27 (0.5)
Physostigmine	24 (0.4)
Hydroxocobalamin	23 (0.4)
Cyproheptadine	19 (0.4)
Digoxin immune fab	14 (0.3)
Nalmefene	12 (0.2)
Carnitine	11 (0.2)
Flumazenil	11 (0.2)
Pyridoxine	8 (0.1)
Thiosulfate	6 (0.1)
Dantrolene	5 (0.1)
Botulinum antitoxin	3 (0.1)
2-PAM	2 (0.0)
Anticoagulation reversal agent	2 (0.0)
Factor replacement	2 (0.0)
Nitrites	1 (0.0)
Bromocriptine	0 (0.0)
Ethanol	0 (0.0)
Protamine	0 (0.0)

[a] Percentages based on total number of antidote treatments administered (*N* = 5709); 3555 Core Registry cases (40.1%) received at least one antidote. Cases may have involved the use of multiple antidotes

Antivenom Treatment

Table 25 highlights the antivenom treatments administered in 2024. For the second consecutive year, the majority of envenomation cases were treated with Crotalidae immune fab_2 (equine), accounting for 50.0% of antivenom administrations, followed by Crotalidae polyvalent immune fab (ovine), which comprised 43.0% [7].

Pharmacologic Supportive Care

Table 26 describes the pharmacologic supportive care treatments reported in 2024. At least one pharmacologic intervention was administered in 44.3% of all cases. Benzodiazepines (40.3%), phenobarbital (14.6%), and opioids

Table 25 Antivenom treatment

	N (%)[a]
Crotalidae immune fab_2 (equine)	122 (50.0)
Crotalidae polyvalent immune fab (ovine)	105 (43.0)
Spider antivenom	8 (3.3)
Other snake antivenom	6 (2.5)
Scorpion antivenom	3 (1.2)

[a] Percentages based on total number of antivenom treatments administered (*N* = 244); 234 Core Registry cases (2.6%) received at least one antivenom treatment. Cases may have involved the use of multiple antivenom treatments

Table 26 Supportive Care – Pharmacologic

	N (%)[a]
Benzodiazepines	2635 (40.3)
Phenobarbital	959 (14.6)
Opioids	746 (11.4)
Propofol	416 (6.4)
Vasopressors	350 (5.3)
Antipsychotics	295 (4.5)
Dexmedetomidine	295 (4.5)
Anticonvulsants	167 (2.5)
Neuromuscular blockers	138 (2.1)
Ketamine	108 (1.7)
Antihypertensives	98 (1.5)
Glucose > 5%	97 (1.5)
Albuterol and other bronchodilators	71 (1.1)
Steroids	68 (1.0)
Beta-blockers	56 (0.9)
Antiarrhythmics	33 (0.5)
Vasodilators	13 (0.2)

[a] Percentages based on total number of pharmacologic interventions (*N* = 6545); 3927 Core Registry cases (44.3%) received at least one pharmacologic intervention. Cases may have involved the use of multiple interventions

Table 27 Supportive Care – Non-pharmacologic

	N (%)[a]
IV fluid resuscitation	4663 (84.9)
Intubation	692 (12.6)
CPR[b]	44 (0.8)
Transfusion	30 (0.5)
ECMO[c]	23 (0.4)
Hyperbaric oxygen	22 (0.4)
Cardioversion	6 (0.1)
Pacemaker	5 (0.1)
Therapeutic hypothermia	3 (0.1)
Transplantation	3 (0.1)
Balloon pump	1 (0.0)
Bypass	1 (0.0)

[a] Percentages based on total number of treatments administered (*N* = 5493); 4873 Core Registry cases (55.0%) received at least one non-pharmacologic treatment. Cases may have involved the use of multiple forms of treatment

[b] *CPR*: Cardiopulmonary resuscitation

[c] *ECMO*: extracorporeal membrane oxygenation

Table 28 Chelation therapy

	N (%)[a]
DMSA[b]	12 (57.1)
Deferoxamine	6 (28.6)
BAL[c]	2 (9.5)
EDTA[d]	1 (4.8)

[a] Percentages based on total number of chelation treatments administered (*N* = 21); 20 Core Registry cases (0.2%) received at least one chelation treatment

[b] *DMSA*: dimercaptosuccinic acid

[c] *BAL*: British anti-Lewisite (dimercaprol)

[d] *EDTA*: Ethylenediaminetetraacetic acid

(11.4%) remain the top three most commonly reported pharmacologic treatments.

Non-pharmacologic Supportive Care

Table 27 summarizes the non-pharmacologic supportive care treatments reported in 2024. At least one non-pharmacologic intervention was administered in 55.0% of cases reported to the Core Registry in 2024. Intravenous fluid resuscitation (84.9%) and intubation/ventilatory management (12.6%) were the predominant non-pharmacologic supportive care treatments.

Chelation Therapy

Table 28 details chelation therapy administered in 2024. At least one chelation treatment was administered in 0.2% of all Core Registry cases. The two most common chelating agents were dimercaptosuccinic acid (57.1%) and deferoxamine (28.6%).

Decontamination Interventions

Table 29 depicts decontamination interventions, occurring in 2.5% of cases reported to the Core Registry in 2024. Among the decontamination interventions reported, activated charcoal was the most common (80.0%). Whole bowel irrigation was utilized in 10.6% of cases receiving decontamination. More than one decontamination modality was employed in 4 patients.

Enhanced Elimination Interventions

Table 30 displays enhanced elimination interventions performed in 2024, administered in 1.7% of all cases. The most frequent mechanism of enhanced elimination was hemodialysis for toxin removal (34.9%), followed by continuous renal replacement therapy (28.4%), hemodialysis performed for non-toxin removal indications (16.6%), and urinary alkalinization (13.6%). Multiple-dose activated charcoal represented 3.0% of cases that received enhanced elimination.

Table 29 Decontamination interventions

	N (%)[a]
Activated charcoal	189 (80.0)
Whole bowel irrigation	25 (10.6)
Irrigation	11 (4.7)
Gastric lavage	11 (4.7)

[a]Percentages based on total number of decontamination interventions (N = 236); 222 Core Registry cases (2.5%) received at least one decontamination intervention. Cases may have involved the use of multiple interventions

Table 30 Enhanced elimination

	N (%)[a]
Hemodialysis for toxin removal	59 (34.9)
Continuous renal replacement therapy	48 (28.4)
Hemodialysis with other indication	28 (16.6)
Urinary alkalinization	23 (13.6)
Exchange transfusion	6 (3.5)
Multiple-dose activated charcoal	5 (3.0)

[a]Percentages based on total number of treatments administered (N = 169); 146 Core Registry cases (1.7%) received at least one enhanced elimination intervention. Cases may have involved the use of multiple interventions

Table 31 Addiction medicine treatments

	N (%)[a]
Naloxone overdose prevention kit or prescription	729 (19.0)
Nicotine replacement therapy (patch, gum, etc.)	723 (18.8)
Buprenorphine/naloxone dual formulations (e.g. Suboxone)	720 (18.7)
Methadone	431 (11.2)
Clonidine	385 (10.0)
Naltrexone	371 (9.7)
Acamprosate	232 (6.0)
Buprenorphine without an opioid antagonist (e.g. Subutex)	228 (5.9)
Outpatient substance use services/recovery care	18 (0.5)
Disulfiram	9 (0.2)

[a] Percentages based on total number of treatments administered (*N* = 3846); 2560 Core Registry cases (28.9%) received at least one addiction medicine treatment. Cases may have involved the use of multiple addiction medicine treatments

Addiction Medicine Treatments

Table 31 presents addiction medicine specific treatments administered by medical toxicologists in the Core Registry in 2024. At least one addiction medicine treatment was administered in 28.9% of all Core Registry cases. The most common addiction medicine treatment was a naloxone overdose prevention kit or prescription which was given to 19.0% of patients during the visit associated with a medical toxicology consultation. This was followed by nicotine replacement therapy (18.8%), buprenorphine/naloxone dual formulations (18.7%), methadone (11.2%) and clonidine (10.0%). Disulfiram was the least frequently reported addiction medicine therapy in 2024, accounting for only 0.2% of cases, a substantial decline from 9.5% in 2023 [7]. Compared to 2023, acamprosate administration decreased by 15.2% (21.2% in 2023 vs. 6.0% in 2024), while nicotine replacement therapy increased by 16.2% (2.6% in 2023 vs. 18.8% in 2024) [7].

Fatalities

In 2024, 107 fatalities were reported, accounting for 1.2% of Core Registry cases. Single agent exposures were implicated in 58 deaths (Table 32), while multiple agents were involved in 29 cases (Table 33). An additional 20 fatalities were reported with unknown toxicological exposures (Table 34). Life support was withdrawn in 57 cases, representing 53.3% of all fatality cases in 2024. Brain death was declared in 28 (26.2%) of these cases. In 2024, a newly implemented question regarding organ donation revealed that 16 (15.0%) of overdose fatalities resulted in organ donation.

Ethanol was the most commonly implicated agent in single agent fatalities, with 12 reported cases (20.7% of single agent fatalities and 11.2% of all fatalities). Opioids and analgesics were each involved in 10 single agent fatalities (each representing 17.2% of single agent fatalities and 9.4% of all fatalities). A combination including an opioid and sympathomimetic agent was implicated in 6 cases (20.7% of multiple agent fatalities and 5.6% of all fatalities).

Among all fatalities, 6 pediatric deaths (between age 4–17 years) were reported to the Core Registry (5.6%), a significant decline from the previous year (5.6% in 2024 vs. 16.3% in 2023) [7]. Notably, a single agent fentanyl related death was reported in a 4-year-old whose clinical signs and symptoms included coma/CNS depression, hypotension, ventricular dysrhythmia, and cardiac arrest. Phenazopyridine was associated with one single agent fatality in a 17-year-old. This patient manifested hypotension, tachycardia, seizures, coagulopathy, methemoglobinemia, and hepatotoxicity.

Special Analysis: Opioid and Sedative-Hypnotic Exposures between 2010 and 2024

Figure 2 illustrates the trends in opioid and sedative-hypnotic exposures as a percentage of all cases reported to the Core Registry between 2010 and 2024. Medical toxicologists have consistently encountered a higher percentage of patients with opioid exposures compared to sedative-hypnotic exposures across this time period. While opioid exposures have increased gradually over this fifteen-year period, the percentage of sedative-hypnotic exposures among all cases in the Core Registry have decreased from 17.6% in 2010 to 7.1% in 2024.

Table 32 2024 fatalities reported in toxic core registry with known toxicological exposure[a]: single agent

Age/Gender[b]	Race/Ethnicity	Agents Involved	Clinical Findings[c]	Life Support Withdrawn	Brain Death Confirmed	Treatment[d]
17 F	Non-Hispanic White	Acetaminophen	AG, AKI, ALI, BP, CNS, CPT, DLM, HGY, HPT, HT, MA	Yes	Yes	Anticonvulsants, benzodiazepines, exchange transfusion, fomepizole, hemodialysis for toxin removal, IV fluid resuscitation, NAC, $NaHCO_3$, plasmapheresis, transfusion, vasopressors (epinephrine, norepinephrine, vasopressin)
30 F	Non-Hispanic White	Acetaminophen	AG, AKI, CNS, CPT, GIB, HGY, HPT, HT, MA, PLT, SZ, TC	No		Anticonvulsants, benzodiazepines, continuous renal replacement therapy, fomepizole, glucose > 5%, hydroxocobalamin, intubation, IV fluid resuscitation, methylene blue, NAC, NMB, vasopressors (angiotensin, epinephrine, norepinephrine, phenylephrine, vasopressin)
31 F	Black/African American	Acetaminophen	CA, HPT, MA, QTC	No		Continuous renal replacement therapy, CPR, fomepizole, glucose > 5%, intubation, IV fluid resuscitation, NAC, plasmapheresis, steroids, transfusion, vasopressors (dobutamine, norepinephrine, vasopressin)
31 TG NB	Non-Hispanic White	Acetaminophen	AKI, CNS, CPT, HGY, HPT, HT	No		Continuous renal replacement therapy, glucose > 5%, hemodialysis, intubation, IV fluid resuscitation, NAC, vasopressors (phenylephrine)
39 M	Non-Hispanic White	Acetaminophen	AG, CNS, CPT, HGY, HT, MA, RD, WBC	Yes	No	Fomepizole, hydroxocobalamin, IV fluid resuscitation, NAC, vasopressors (angiotensin, norepinephrine, vasopressin)
45 F	Non-Hispanic White	Acetaminophen	AG, AKI, CNS, CPT, HPT, HT, MA, TC	No		Glucose > 5%, NAC, vasopressors (norepinephrine)
57 F	Non-Hispanic White	Acetaminophen	CNS, RBM	Yes	Yes	NAC, vitamin K
57 F	Non-Hispanic White	Acetaminophen	AGT, CPT, HPT, HT, PLT, RD	Yes	No	Fomepizole, intubation, NAC
58 M	Black/African American	Acetaminophen	AG, AKI, ALI, BC, CA, CNS, HPT, HT, HYS, MA, PNC	No		Atropine, calcium, continuous renal replacement therapy, CPR, fomepizole, glucose > 5%, hemodialysis, intubation, IV fluid resuscitation, NAC, $NaHCO_3$, opioids, transfusion, vasopressors (norepinephrine, vasopressin)
Unknown	Asian	Acetaminophen	AG, AKI, CNS, CPT, HYS, WBC	Unknown		IV fluid resuscitation, NAC
63 M	Non-Hispanic White	Alprazolam	AGT, CNS, CPT, HYS, QTC	Yes	Unknown	Dexmedetomidine, folate, glucagon, intubation, IV fluid resuscitation, thiamine
19 M	Non-Hispanic White	Amphetamine	None	Yes	Yes	None
53 F	Non-Hispanic White	Buprenorphine	HYS	No		Buprenorphine, IV fluid resuscitation
57 F	Non-Hispanic White	Bupropion	AGT, HAL, HT, QRS, QTC, RD, SZ	Yes	Yes	Activated charcoal, antiarrhythmics, benzodiazepines, ECMO, intubation, IV fluid resuscitation, lipid resuscitation therapy, $NaHCO_3$, NMB, vasopressors (angiotensin, norepinephrine, vasopressin)

Table 32 (continued)

Age/Gender[b]	Race/Ethnicity	Agents Involved	Clinical Findings[c]	Life Support Withdrawn	Brain Death Confirmed	Treatment[d]
67 M	Black/African American	Carbon monoxide	CNS	Yes	No	None
25 M	Hispanic	Cocaine	AKI, CA, CNS, HT, MA, QRS, RD, SZ, TC	Yes	Yes	Benzodiazepines, CPR, intubation, IV fluid resuscitation, $NaHCO_3$, naloxone, propofol, vasopressors (epinephrine, norepinephrine)
48 TG FTM	Non-Hispanic White	Colchicine	AG, AKI, ALI, HPT, HTN, MA, RBM, WBC	No		Activated charcoal, IV fluid resuscitation
63 F	Non-Hispanic White	Digoxin	CPT, GIB, HAL, HT, HYS	No		Digoxin immune fab, IV fluid resuscitation, $NaHCO_3$
> 89 F	Non-Hispanic White	Digoxin	AKI, BC, CNS, GIB, HTN	Yes	Yes	Digoxin immune fab, IV fluid resuscitation, $NaHCO_3$
26 F	Non-Hispanic White	Diquat	AGT, CNS, HT, MA, RD, SZ, TC	Unknown		Benzodiazepines, intubation, IV fluid resuscitation, $NaHCO_3$, NAC, opioids, phenobarbital, propofol, vasopressors (norepinephrine)
33 M	Unknown	Ethanol	BC, CNS, CPT, HYS, MA, TC	Yes	Yes	Folate, intubation, IV fluid resuscitation, NMB, propofol, thiamine, vasopressors (norepinephrine, phenylephrine)
35 F	Non-Hispanic White	Ethanol	CNS, HT	Yes	Yes	Folate, thiamine
36 M	Non-Hispanic White	Ethanol	BC, CPT, DLM, GIB, HYS, MI, TC	No		Acamprosate, benzodiazepines, folate, intubation, IV fluid resuscitation, octreotide, thiamine, vasopressors (norepinephrine, phenylephrine)
36 M	Non-Hispanic White	Ethanol	CPT, HYS	Yes	Yes	Acamprosate, benzodiazepines, folate, IV fluid resuscitation, thiamine
47 F	Non-Hispanic White	Ethanol	AK, CPT, GII, HPT, HYS, PLT	Unknown		Benzodiazepines, continuous renal replacement therapy, folate, IV fluid resuscitation, propofol, thiamine
47 M	Non-Hispanic White	Ethanol	CNS, CPT	No		Benzodiazepines, folate, IV fluid resuscitation, thiamine
55 M	Non-Hispanic White	Ethanol	CPT, HPT	Yes	Unknown	Acamprosate, benzodiazepines, folate, IV fluid resuscitation, nicotine replacement therapy (e.g. patch), thiamine
59 M	Unknown	Ethanol	MI	No		Folate, intubation, IV fluid resuscitation, $NaHCO_3$, phenobarbital, propofol, thiamine
65 M	Non-Hispanic White	Ethanol	AG, AKI, PAR	No		Folate, IV fluid resuscitation, phenobarbital, thiamine
68 M	Hispanic	Ethanol	CNS	Yes	Yes	Benzodiazepines, folate, intubation, IV fluid resuscitation, propofol, thiamine
68 M	Non-Hispanic White	Ethanol	QRS	No		Benzodiazepines, folate, intubation, IV fluid resuscitation, NMB, propofol, thiamine
69 M	Non-Hispanic White	Ethanol	AG, AKI, CPT, HPT, HYS, MA, QRS, TC, WBC	No		None
60 M	Non-Hispanic White	Ethylene glycol	AG, CNS, HT, MA	Yes	Yes	Continuous renal replacement therapy, fomepizole, NMB, pyridoxine, thiamine, vasopressors (unknown)

Table 32 (continued)

Age/Gender[b]	Race/Ethnicity	Agents Involved	Clinical Findings[c]	Life Support Withdrawn	Brain Death Confirmed	Treatment[d]
4 M	Black/African American	Fentanyl	AG, CA, CNS, HT, MA, OT, VD	Yes	Yes	Calcium, cardioversion, CPR, intubation, IV fluid resuscitation, nalmefene, NMB, vasopressors (epinephrine, norepinephrine)
21 F	Non-Hispanic White	Fentanyl	OT, SZ, VD	Yes	Yes	Benzodiazepines, IV fluid resuscitation, naloxone, propofol, vasopressors (norepinephrine)
28 F	Non-Hispanic White	Fentanyl	BC, CNS, OT, RD	Unknown		None
34 F	Non-Hispanic White	Fentanyl	AG, AKI, CNS, CPT, HYS, MA, PLT, WBC	No		Anticonvulsants, clonidine, IV fluid resuscitation, naloxone
54 M	Non-Hispanic White	Fentanyl	OT	Unknown		Buprenorphine, naloxone
57 F	Non-Hispanic White	Fentanyl	AGT	Yes	No	Clonidine, IV fluid resuscitation, methadone, opioids
61 M	Non-Hispanic White	Fentanyl	AG, AKI, ALI, BC, CA, CNS, HPT, HT, MI, OT, RD	Yes	Yes	Anticonvulsants, benzodiazepines, CPR, intubation, naloxone, propofol
36 M	Unknown	Fluorouracil	PCT, PLT, RS	No		None
65 M	Asian	Lamotrigine	CNS, HT, MA, NEC, TC	Yes	No	Intubation, IV fluid resuscitation, transplantation, vasopressors (norepinephrine)
19 M	Mixed NOS	Lidocaine	AKI, CA, CNS, HT, MA, QRS, RD, SZ, VD	Yes	Yes	Benzodiazepines, cardioversion, CPR, IV fluid resuscitation, lipid resuscitation therapy, $NaHCO_3$, propofol, therapeutic hypothermia
70 M	Hispanic	Metformin	AG, CNS, HT, MA, RD, WBC	Yes	No	Continuous renal replacement therapy, methylene blue, $NaHCO_3$, steroids, vasopressors (epinephrine, norepinephrine, vasopressin)
72 F	Non-Hispanic White	Metformin	AG, AKI, CNS, HGY, HT, MA, TC	No		Continuous renal replacement therapy, hemodialysis for toxin removal, IV fluid resuscitation, $NaHCO_3$, vasopressors (epinephrine, norepinephrine, vasopressin)
73 M	Non-Hispanic White	Metformin	AG, AKI, HGY, HPT, HT, MA, QRS, QTC	Yes	No	Continuous renal replacement therapy, intubation, NAC, vasopressors (epinephrine, norepinephrine)
76 M	Non-Hispanic White	Metformin	AG, QTC	Yes	Unknown	Benzodiazepines, continuous renal replacement therapy, fomepizole, intubation, IV fluid resuscitation
77 F	Hispanic	Metformin	AG, AKI, HYS, QTC	No		Benzodiazepines, continuous renal replacement therapy, intubation, IV fluid resuscitation, NMB, octreotide, thiamine, vasopressors (epinephrine, norepinephrine, phenylephrine)
55 M	Hispanic	Methamphetamine	CNS, HYT, MA, RBM, SYS	Unknown		Continuous renal replacement therapy, fomepizole, intubation, IV fluid resuscitation, NAC, opioids
66 F	Non-Hispanic White	Methotrexate	AKI, BL, PCT, PLT, RS	Yes	No	Continuous renal replacement therapy, $NaHCO_3$, urinary alkalinization

Table 32 (continued)

Age/Gender[b]	Race/Ethnicity	Agents Involved	Clinical Findings[c]	Life Support Withdrawn	Brain Death Confirmed	Treatment[d]
78 F	Hispanic	Methotrexate	AKI, PCT, PLT	Yes	Unknown	Exchange transfusion, folate, intubation, IV fluid resuscitation, steroids, transfusion, vasopressors (epinephrine, norepinephrine, phenylephrine, vasopressin)
70 M	Non-Hispanic White	Morphine	None	Unknown		None
17 TG NB	Non-Hispanic White	Phenazopyridine	CPT, HPT, HT, MHG, SZ, TC	No		Intubation, IV fluid resuscitation, methylene blue, vasopressors (epinephrine, norepinephrine)
88 F	Non-Hispanic White	Quetiapine	BP, CNS, HT, HYS, HY, MA, QRS, RBM, RD, SHS	Yes	Unknown	Flumazenil, intubation, IV fluid resuscitation, naloxone
33 M	Non-Hispanic White	Unspecified sympathomimetic	AG, AGT, AKI, AP, CA, CNS, DLM, HAL, HGY, HPT, HT, MA, MI, QTC, RBM, RD, SYS, SZ, VD, WBC	Yes	No	Anticonvulsants, benzodiazepines, cardioversion, CPR, fomepizole, intubation, IV fluid resuscitation, $NaHCO_3$, NMB, propofol, thiamine
81 F	Non-Hispanic White	Tramadol	AP, MA, QRS, RD, SZ	No		Benzodiazepines, IV fluid resuscitation, $NaHCO_3$, naloxone
21 M	Non-Hispanic White	Unknown agent	CA, CNS, HPT, HT, MA, MI, OT, PAR, QTC, RD	Yes	Unknown	Buprenorphine, CPR, naloxone, opioids, therapeutic hypothermia
49 F	Non-Hispanic White	Unspecified pharmaceutical	AKI, CA, CNS, HPT, HT, MA, QTC, RD	Yes	Yes	CPR, intubation, IV fluid resuscitation, NAC, opioids, propofol, vasopressors (norepinephrine, vasopressin)

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

[b] Age in years unless otherwise stated. M: male, F: female, TG: transgender, NB: non-binary, FTM: female to male

[c] AG: anion gap, AGT: agitation, AK: alcoholic ketoacidosis, AKI: acute kidney injury, ALI: acute lung injury/ARDS, AP: aspiration pneumonitis, BC: bradycardia, BL: blisters/bullae, BP: bradypnea, CA: cardiac arrest, CNS: coma/CNS depression, CPT: coagulopathy, DLM: delirium, GIB: GI bleeding, GII: intestinal ischemia, HAL: hallucination, HGY: hypoglycemia, HPT: hepatoxicity, HT: hypotension, HTN: hypertension, HYS: hemolysis, HY: hypothermia, HYT: hyperthermia, MA: metabolic acidosis, MHG: methemoglobinemia, MI: myocardial injury/ischemia, NEC: dermal necrosis, OT: opioid toxidrome, PAR: paralysis/weakness, PCT: pancytopenia, PLT: thrombocytopenia, PNC: pancreatitis, QRS: QRS prolongation, QTC: QTc prolongation, RBM: rhabdomyolysis, RD: respiratory depression, RS: rash, SHS: sedative-hypnotic syndrome, SYS: sympathomimetic syndrome, SZ: seizures, TC: tachycardia, VD: ventricular dysrhythmia, WBC: leukocytosis

[d] Pharmacological and Non-pharmacological support as reported by Medical Toxicologist; CPR: cardiopulmonary resuscitation, ECMO: extra-corporeal membrane oxygenation, NAC: n-acetyl cysteine, $NaHCO_3$: sodium bicarbonate, NMB: neuromuscular blockers

Comparison of the 2024 Annual Report To Previous Annual Reports

In 2024, ethanol was the leading exposure agent reported to the ToxIC Core Registry (17.8%), marking the second time it has held this position. Ethanol withdrawal also remained the second most common reason for encounter (14.6%) [7]. Additionally, ethanol was implicated in a notable proportion of both single agent and multiple agent fatalities, accounting for 11.2% of all fatality cases.

Fentanyl exposures surpassed all other opioids combined for the fourth consecutive year, representing 58.7% of all opioid exposures, a striking increase to a decade earlier when fentanyl accounted for just 10.5% of opioid exposures [13]. Naloxone administration has remained stable since 2020, consistently ranking in the top 5 most utilized antidotes every year [7–10].

Table 33 2024 fatalities reported in toxic core registry with known toxicological exposure[a]: multiple agents

Age/Gender[b]	Race/Ethnicity	Agents Involved	Clinical Findings[c]	Life Support Withdrawn	Brain Death Confirmed	Treatment[d]
78 F	Non-Hispanic White	Acetaminophen, amlodipine, benazepril	BC, HGY, HT, MA, QRS	No		Atropine, calcium, glucagon, glucose > 5%, hydroxocobalamin, NMB, steroids, vasopressors (epinephrine, norepinephrine, phenylephrine, vasopressin)
16 F	Non-Hispanic White	Acetaminophen, amlodipine	AKI, CNS, HPT, HT, MA, QTC, TC	Yes	Yes	Benzodiazepines, calcium, continuous renal replacement therapy, fomepizole, IV fluid resuscitation, NAC, $NaHCO_3$, opioids, propofol, steroids, transfusion, vasopressors (epinephrine, norepinephrine, vasopressin), vitamin K
75 F	Non-Hispanic White	Acetaminophen, benzonatate, dextromethorphan	AGT, CPT, DLM, HPT	No		IV fluid resuscitation, NAC
42 F	Non-Hispanic White	Acetaminophen, citalopram, diphenhydramine	AG, AKI, CNS, HPT, HT, MA, RD, TC	Unknown		Intubation, IV fluid resuscitation, NAC, NMB, vasopressors (norepinephrine, vasopressin)
28 F	Non-Hispanic White	Acetaminophen, ethanol	AGT, CA, CNS, HGY, HPT, HT, MA, QTC, RD, SZ, TC	Yes	Yes	CPR, hydroxocobalamin, intubation, IV fluid resuscitation, methylene blue, NAC, vasopressors (epinephrine, norepinephrine, phenylephrine, vasopressin)
51 M	Non-Hispanic White	Acetaminophen, hydrocodone	None	No		Benzodiazepines, dexmedetomidine, IV fluid resuscitation
66 F	Non-Hispanic White	Amlodipine, hydrochlorothiazide, hydroxyzine	AG, AVB, CNS, HPT, HT, MA, PLT, RBM, RD, WBC	Yes	No	Calcium, continuous renal replacement therapy, ECMO, glucose > 5%, HIE, intubation, IV fluid resuscitation, lipid resuscitation therapy, methylene blue, NMB, opioids, propofol, vasopressors (epinephrine, norepinephrine, phenylephrine, vasopressin)
57 F	Non-Hispanic White	Amlodipine, hydrochlorothiazide, irbesartan	ALI, CNS, HT, MA, QTC, RD	No		Benzodiazepines, calcium, ECMO, HIE, IV fluid resuscitation, ketamine, lipid resuscitation therapy, methylene blue, vasopressors (epinephrine, norepinephrine, phenylephrine, vasopressin)
59 M	Non-Hispanic White	Amlodipine, lisinopril	AGT, AKI, CNS, HT	Yes	Unknown	Calcium, ECMO, glucose > 5%, HIE, vasopressors (angiotensin, epinephrine, norepinephrine, vasopressin)
48 F	Hispanic	Amlodipine, losartan, metoprolol	AKI, BC, CNS, HT, RD	Yes	Unknown	Calcium, ECMO, HIE, hydroxocobalamin, intubation, IV fluid resuscitation, lipid resuscitation therapy, methylene blue, vasopressors (angiotensin, epinephrine, norepinephrine, vasopressin)
25 M	Black/African American	Amphetamine, opioid unspecified, oxycodone, fentanyl	AG, BP, CA, CNS, HPT, HT, HTN, MA, OT, RD, SYS, TC, VD	Yes	Yes	Benzodiazepines, beta-blockers, bronchodilators, CPR, intubation, IV fluid resuscitation, $NaHCO_3$, naloxone, propofol, vasodilators, vitamin K
53 M	Black/African American	Aripiprazole, escitalopram	AP, DLM, MA, QTC, RFX, SS, SZ, TC	Yes	No	Benzodiazepines, ECMO, intubation, IV fluid resuscitation, $NaHCO_3$, NMB, propofol, vasopressors (epinephrine, norepinephrine, phenylephrine, vasopressin)

Table 33 (continued)

Age/Gender[b]	Race/Ethnicity	Agents Involved	Clinical Findings[c]	Life Support Withdrawn	Brain Death Confirmed	Treatment[d]
69 F	Black/African American	Baclofen, duloxetine, linezolid	CNS, HTN, HYT, MA, RBM, RD, SS, TC, VD, WS	No		None
33 M	Non-Hispanic White	Buprenorphine, heroin, marijuana	OT, PLT	No		Buprenorphine, opioids
30 F	Non-Hispanic White	Buspirone, duloxetine, trazodone	AKI, CNS, RD, SS, TC	Yes	Yes	IV fluid resuscitation, vasopressors (unknown)
35 M	Hispanic	Cannabinoid synthetic, heroin	AG, AGT, AKI, HPT, MA, RBM, SYS, TC	No		Antipsychotics, benzodiazepines, buprenorphine, intubation, IV fluid resuscitation, vasopressors (epinephrine, norepinephrine, vasopressin
48 M	Black/African American	Carvedilol, colchicine	BC, CNS, HT, MA, TC, VD	Yes	Unknown	Activated charcoal, calcium, glucagon, HIE, intubation, IV fluid resuscitation, lipid resuscitation therapy, $NaHCO_3$, vasopressors (epinephrine, norepinephrine, vasopressin)
56 M	Black/African American	Cocaine, fentanyl, phencyclidine	AKI, AP, CNS, OT, RBM, RD	Yes	No	Antipsychotics, benzodiazepines, intubation, naloxone, opioids, vasopressors (norepinephrine)
43 M	Hispanic	Cocaine, fentanyl	BP, CNS, HT, OT, RD, SZ	Yes	No	Anticonvulsants, benzodiazepines, intubation, naloxone, NMB, opioids, propofol
49 M	Non-Hispanic White	Cocaine, fentanyl	AGT, AKI, AP, CNS, RBM, RFX, RS, SS, TC	Yes	No	Continuous renal replacement therapy, intubation, IV fluid resuscitation, naloxone
57 M	Non-Hispanic White	Cocaine, methamphetamine	AKI, CA, CNS, HTN, MA, RD, TC	Unknown		None
30 TG FTM	Non-Hispanic White	Cyclobenzaprine, doxepin, haloperidol, linaclotide	AG, AP, BC, BP, CA, CNS, CPT, EPS, HT, HYS, MA, MI, PCT, PLT, QRS, QTC, RBM, RD, SZ, VD	Yes	No	Antiarrhythmics, benzodiazepines, continuous renal replacement therapy, CPR, ECMO, intubation, IV fluid resuscitation, lipid resuscitation therapy, $NaHCO_3$, NMB, opioids, propofol, vasopressors (epinephrine, norepinephrine, vasopressin)
27 M	Asian	Dexmedetomidine, sodium azide	AG, AKI, BC, DLM, HT, MA, QTC	Yes	No	Balloon pump, ECMO, gastric lavage, hemodialysis for toxin removal, hydroxocobalamin, methylene blue, $NaHCO_3$, propofol, vasopressors (angiotensin, epinephrine, norepinephrine, vasopressin)
77 F	Non-Hispanic White	Digoxin, torsemide	AKI, CPT, HT, QRS	No		IV fluid resuscitation, vasopressors (norepinephrine)
30 M	Hispanic	Ethanol, unknown agent	AG, BC, CA, CNS, HT, MHG, RD, SHS	No		Atropine, calcium, CPR, methylene blue, naloxone, vasopressors (norepinephrine)
32 M	Non-Hispanic White	Fentanyl, methamphetamine, tetrahydrocannabinol	BC, CA, CNS, OT, RD, TC	Unknown		None
28 F	Non-Hispanic White	Fentanyl, methamphetamine	AG, BC, CPT, QRS, QTC	No		None

Table 33 (continued)

Age/Gender[b]	Race/Ethnicity	Agents Involved	Clinical Findings[c]	Life Support Withdrawn	Brain Death Confirmed	Treatment[d]
74 F	Non-Hispanic White	Hydrocodone, metformin	AKI, CNS, DLM, HYS, MA, RBM, WBC	Yes	Yes	Calcium, IV fluid resuscitation, $NaHCO_3$, thiamine, vasopressors (norepinephrine)
16 F	Asian	Hydroxychloroquine, mycophenolate	AKI, CA, CPT, HPT, HT, HYS, MA, PLT, RBM	Yes	No	Anticonvulsants, benzodiazepines, calcium, CPR, fomepizole, hemodialysis, intubation, IV fluid resuscitation, NAC, $NaHCO_3$, NMB, opioids, steroids, transfusion, vasopressors (epinephrine, norepinephrine)

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

[b] Age in years unless otherwise stated. M: male, F: female, TG: transgender, FTM: female to male

[c] AG: anion gap, AGT: agitation, AKI: acute kidney injury, ALI: acute lung injury/ARDS, AP: aspiration pneumonitis, AVB: AV block, BC: bradycardia, BP: bradypnea, CA: cardiac arrest, CNS: coma/CNS depression, CPT: coagulopathy, DLM: delirium, EPS: extrapyramidal symptoms/dystonia/rigidity, HGY: hypoglycemia, HPT: hepatoxicity, HT: hypotension, HTN: hypertension, HYS: hemolysis, HYT: hyperthermia, MA: metabolic acidosis, MHG: methemoglobinemia, MI: myocardial injury/ischemia, OT: opioid toxidrome, PCT: pancytopenia, PLT: thrombocytopenia, QRS: QRS prolongation, QTC: QTc prolongation, RBM: rhabdomyolysis, RD: respiratory depression, RFX: hyperreflexia/clonus/tremor, RS: rash, SHS: sedative-hypnotic syndrome, SS: serotonin syndrome, SYS: sympathomimetic syndrome, SZ: seizures, TC: tachycardia, VD: ventricular dysrhythmia, WBC: leukocytosis, WS: washout syndrome

[d] Pharmacological and Non-pharmacological support as reported by Medical Toxicologist; CPR: cardiopulmonary resuscitation, ECMO: extracorporeal membrane oxygenation, HIE: high dose insulin euglycemic therapy, NAC: n-acetyl cysteine, $NaHCO_3$: sodium bicarbonate, NMB: neuromuscular blockers

Acetaminophen has remained the most commonly reported non-opioid analgesic for the fifteenth consecutive year, constituting 62.4% of this category in 2024 [7–20]. Among sympathomimetic agents, methamphetamine and cocaine have also held the top two positions as the most frequently reported agents in this class over the past five years [7–11].

While intentional pharmaceutical exposures continued to represent the leading reason for medical toxicology encounters, their proportion has declined since 2010 and is now the lowest recorded since the registry's inception in 2010, dropping from 42% in 2010 to a historic low of 27.1% in 2024 [7–20].

A total of 107 fatalities reported to the Core Registry in 2024, representing 1.2% of all cases. This is similar to the fatalities reported in 2023 (1.3%) [7]. For the second consecutive time in the ToxIC Core Registry, ethanol was the most common agent class reported in single agent fatalities (20.7% of single agent fatalities). The frequency of pediatric deaths (age 0–17 years) reported to the Core Registry has decreased considerably from the previous year (16.3% in 2023 vs. 5.6% in 2024) [7].

Discussion

In addition to the Core Registry, ToxIC has launched several multicenter projects focused on toxico-surveillance of opioid and stimulant overdoses, as well as the identification of new and emerging substances [2]. The ToxIC Fentalog Study, implemented in 2020, has become a critical source of non-fatal overdose data and is featured by the Centers for Disease Control and Prevention through a dedicated online dashboard [21]. By the end of 2024, the Fentalog Study resulted in over 41 scientific presentations and 9 published peer-reviewed manuscripts, including the first report to describe the clinical effects of medetomidine among a patient cohort published in 2024 [5]. The DOTS Reporting Program was a 2-year project across 17 sites within the United States that concluded in 2024. By the project's end, 995 patients presenting as an opioid or stimulant overdose were enrolled, with data collection including detailed interviews, chart reviews, and laboratory confirmation of substances related to the overdose. Building on this work, the RENDOR project launched in 2024, expanding data collection to include EMS reports at five DOTS sites. RENDOR captures granular information on the circumstances of overdose events, naloxone dosing, and patient responses to naloxone administration by bystanders, non-medical first responders (e.g., police or fire), and EMS personnel. These projects exemplify ToxIC's mission to create opportunities for medical toxicologists to engage in and lead research initiatives within the field of medical toxicology.

This annual report describes the fifteenth year of data collection for the ToxIC Core Registry. Core Registry case numbers increased this year (7,392 in 2023 vs. 8,868 in 2024) [7]. The Core Registry's participating sites continue to grow, adding new sites from 6 more areas across the United States in 2024. Since the beginning in 2010, the ToxIC Core Registry has grown to over 110,000 cases.

Table 34 2024 fatalities reported in toxic core registry with unknown toxicological exposure[a]

Age/Gender[b]	Race/Ethnicity	Clinical Findings[c]	Life Support Withdrawn	Brain Death Confirmed	Treatment[d]
8 F	Unknown	None	Yes	Yes	None
25 M	Black/African American	AKI, CNS, HT, MI, TC	Yes	Yes	Intubation, naloxone, vasopressors (epinephrine, norepinephrine, vasopressin)
26 M	Black/African American	AG, AKI, CA, CPT, HT, PLT, QRS, RBM, SZ, TC, VD, WBC	No		CPR, intubation, IV fluid resuscitation, $NaHCO_3$
30 M	Unknown	None	Yes	Yes	None
33 M	Unknown	None	Yes	No	Buprenorphine
39 M	Non-Hispanic White	None	No		None
45 F	Black/African American	AG, AKI, CA, CNS, HPT, HT, HTN, HYS, HYT, MA, PCT, PLT, RBM, SYS, TC, WBC	Yes	Yes	Benzodiazepines, CPR, NAC, vasopressors (epinephrine, norepinephrine)
47 F	Mixed NOS	AG, AKI, CNS, CPT, HT, HTN, HY, MA, PCT, PLT, RBM, TC	Yes	Yes	Fomepizole, vasodilators, vasopressors (norepinephrine)
53 M	Black/African American	None	Unknown		None
54 M	Non-Hispanic White	AKI, CA, CPT, HPT, HT, HTN, MA, QRS, QTC, TC	Yes	Unknown	Intubation, IV fluid resuscitation, NAC, naloxone
58 F	Black/African American	AP, HTN, HYT, SYS, TC	Unknown		None
63 F	Non-Hispanic White	CNS, CPT, HT, PN, RD	No		None
66 M	Non-Hispanic White	AKI, CNS, HK, HPT, MA, QTC	Unknown		Antiarrhythmics, bronchodilators, continuous renal replacement therapy, intubation, NAC, $NaHCO_3$, opioids, propofol, steroids, vasopressors (epinephrine, norepinephrine, phenylephrine, vasopressin)
67 M	Non-Hispanic White	AG, CPT, HPT, MA, MI	Yes	Yes	None
68 F	Unknown	CNS, TC	No		None
71 F	Black/African American	RD	Unknown		None
72 M	Non-Hispanic White	AKI, QTC	Yes	Yes	Intubation, IV fluid resuscitation, propofol, thiamine, vasopressors (norepinephrine)
73 F	Hispanic	AG, AKI, CPT, HYS, MA, QRS, QTC, TC	No		Calcium, intubation, IV fluid resuscitation, $NaHCO_3$
77 M	Mixed NOS	AKI, TC	Unknown		None
86 F	Non-Hispanic White	CNS, HT, PLT, QRS	Yes	Unknown	None

[a] Based on response from Medical Toxicologist "Did the patient have a toxicological exposure?" equals No or Unknown

[b] Age in years unless otherwise stated. M: male, F: female

[c] AG: anion gap, AKI: acute kidney injury, AP: aspiration pneumonitis, CA: cardiac arrest, CNS: coma/CNS depression, CPT: coagulopathy, HK: hyperkalemia, HPT: hepatoxicity, HT: hypotension, HTN: hypertension, HYS: hemolysis, HYT: hyperthermia, MA: metabolic acidosis, MI: myocardial injury/ischemia, PCT: pancytopenia, PLT: thrombocytopenia, PN: peripheral neuropathy, QRS: QRS prolongation, QTC: QTc prolongation, RBM: rhabdomyolysis, RD: respiratory depression, SYS: sympathomimetic syndrome, SZ: seizures, TC: tachycardia, VD: ventricular dysrhythmia, WBC: leukocytosis

[d] Pharmacological and Non-pharmacological support as reported by Medical Toxicologist; CPR: cardiopulmonary resuscitation, NAC: n-acetyl cysteine, $NaHCO_3$: sodium bicarbonate

In 2024, the Core Registry had several additions to the main data collection itself, including adding a new question regarding organ donation in fatality cases. In addition, data collection was expanded to include a new sub-registry on OUD to collect targeted data on treatment for patients treated by medical toxicologists for opioid toxicity or withdrawal. This new sub-registry has the potential to evaluate medical toxicology OUD treatment practice patterns across the country, further strengthening the Core Registry data to increase our understanding of medical toxicology practice and patient outcomes.

In 2024, ethanol was the most commonly reported exposure to the ToxIC Core Registry, accounting for 17.8% of all cases. This marks only the second time since the registry's

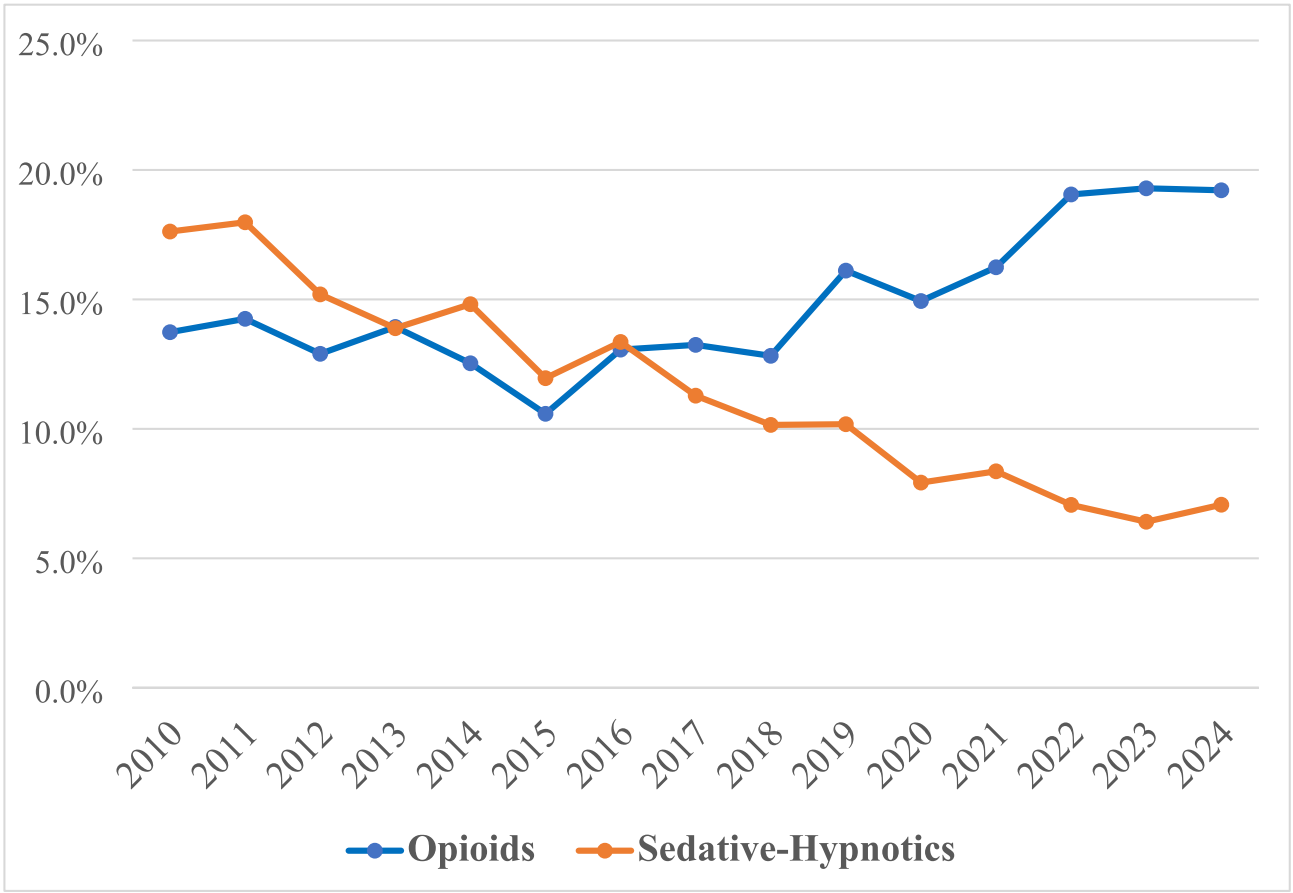

Fig. 2 Percentage of Medical Toxicology Consults with Opioid and Sedative-Hypnotic Exposures by Year

inception that ethanol has held the top position, reflecting a continued rise in both use and related complications that may require a medical toxicologist's management. Ethanol withdrawal remained the second most common reason for toxicology consultation (14.6%) [7], highlighting the persistent burden of alcohol use disorder in hospital settings. Ethanol was also implicated in 11.2% of all fatality cases, and it remained the most common agent involved in single-agent fatalities (20.7%), reinforcing findings from previous studies that demonstrate the substantial morbidity and mortality associated with alcohol-related conditions [22, 23]. This is consistent with national data indicating that alcohol remains a leading cause of preventable death in the United States, contributing to over 140,000 deaths annually, including both acute poisonings and chronic health effects [24].

Fentanyl exposures continued their upward trajectory, accounting for 58.7% of all opioid exposures in 2024, a substantial increase from just 10.5% a decade earlier [13]. This mirrors national surveillance trends showing that fentanyl has largely displaced other opioids in the illicit drug market and is now responsible for the majority of opioid-related overdose deaths in the United States [25, 26]. The Drug Enforcement Administration (DEA) has repeatedly reported the increasing prevalence of illicitly manufactured fentanyl, often in combination with other substances, further complicating the clinical presentation and management of overdose [27]. Despite this increase in fentanyl-related cases, naloxone administration has remained relatively stable since 2020 and continues to rank among the top five most utilized antidotes, reflecting its continued critical role in reversing opioid overdoses [7–10].

Acetaminophen remained the most frequently reported non-opioid analgesic for the fifteenth consecutive year, comprising 62.4% of this category in 2024 [7–20]. This long-standing trend aligns with data from the National Poison Data System that has consistently identified acetaminophen as a leading cause of poisoning [28]. Its ubiquity in over-the-counter products and narrow therapeutic index contribute to its persistent presence in patients seen by medical toxicologists. Similarly, methamphetamine and cocaine continued to dominate the sympathomimetic class, a pattern observed nationally and supported by the 2024 National Survey on Drug Use and Health released by the Substance Abuse and Mental Health Services Administration (SAMHSA) [29].

Notably, the proportion of toxicology encounters attributed to intentional pharmaceutical exposures declined significantly, reaching a historic low of 27.1% in 2024, down from 42% in 2010 [7–20]. This decrease may reflect a relative rise in illicit and non-pharmaceutical exposures, including those related to fentanyl, synthetic cannabinoids, and designer stimulants, which have emerged prominently in recent years [30]. The shifting landscape of exposures seen by medical toxicologists may also be influenced by changes in prescribing practices, improved drug monitoring programs, and evolving patterns in substance misuse.

Fatalities reported to the Core Registry remained consistent with previous years, with 107 deaths in 2024 (1.2% of all cases), closely aligning with the 1.3% reported in 2023 [7]. Ethanol's role as the most frequent single-agent cause of death further highlights its lethality. The proportion of pediatric deaths (age 0–17 years) decreased substantially, from 16.3% in 2023 to 5.6% in 2024 [7]. This contrasts with recent national concerns about rising pediatric fatalities related to opioids and may be due to variability in medical toxicology consultation patient populations across institutions [31].

Taken together, these findings reinforce ToxIC's important role in advancing the understanding of toxicologic trends, especially among complex patients seen by medical toxicologists. While aligned with broader epidemiologic data from poison centers and public health agencies, the Core Registry adds clinical granularity, offering valuable insights into substance-specific trends, emerging threats, and outcomes over time.

Limitations

The ToxIC Core Registry is a database that prospectively captures cases involving bedside consultations performed by medical toxicologists, supporting a detailed and clinically informed understanding of the relationship between toxicologic exposures and patient outcomes. Although it is not population-based, the Core Registry reflects a broad geographic distribution of cases assessed by medical toxicology physicians. These data collected can complement findings from other registries and epidemiological studies to yield a more comprehensive perspective on poisoning trends, emerging substances, and their public health impact. Nevertheless, several limitations should be acknowledged. The Core Registry may be subject to selection bias towards more severe or complex case presentations that require medical toxicology specialty management. As a result, the patient population represented in the Core Registry is likely more complex compared to other data sources.

One of the Core Registry's strengths is that each patient receives a direct clinical assessment by a medical toxicology physician, and thus data entry is informed by first-hand evaluation and expert interpretation of the toxicological exposure. However geographic representation may be uneven due to the overrepresentation of tertiary academic centers where many practicing medical toxicologists are based. Additionally, there is a potential for reporting bias, with a tendency to include more unusual or complicated cases at some sites. This is mitigated by written agreements requiring the entry of all consecutive cases. Variability may also exist in how sites report the highest level of care, particularly with respect to admissions to observation units versus inpatient floors.

Exposure information often relies on patient self-report, which may be constrained by recall bias, limited knowledge, or unwillingness to disclose. In addition, confirmatory testing is not uniformly available or reported.

Finally, while the Core Registry continually works to improve data quality, challenges persist in achieving complete data capture for some demographic and social variables, including race/ethnicity, marital status, military service, and housing situation.

Conclusions

The ToxIC program originated as a multi-center consortium centered around the Core Registry, which captures data from medical toxicology consultations. Over time, ToxIC has continued to expand beyond its original framework, incorporating projects that extend outside this traditional medical toxicology consultation-based model [2]. In 2024, ToxIC data reflected notable shifts in toxicologic exposures and outcomes. Ethanol emerged as the leading exposure agent and remained a significant contributor to both encounters and fatalities. Fentanyl continued to dominate opioid exposures, while acetaminophen maintained its long-standing position as the most reported non-opioid analgesic. Despite intentional pharmaceutical exposures remaining the most common reason for toxicology consultation, their proportion reached a record low. Overall fatality rates remained stable, with a considerable reduction in pediatric deaths compared to 2023. These trends underscore the evolving landscape of toxicologic risk and the importance of continued toxico-surveillance through the ToxIC Core Registry.

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Declarations

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References

1. Wax PM, Kleinschmidt KC, Brent J, ACMT ToxIC Case Registry Investigators. The toxicology investigators consortium (ToxIC) registry. J Med Toxicol. 2011;7(4):259–65.
2. Brent J, Wax P, Culbreth R, Campleman S, Aldy K. From patient registry to multi-center research consortium: the toxicology investigators consortium (ToxIC) turns fifteen. J Med Toxicol. 2024;20(3):293–8.
3. Spyres MB, Padilla GK, Gerkin RD, Hoyte CO, Wolk BJ, Ruha AM, et al. Late hemotoxicity following North American rattlesnake envenomation treated with crotalidae immune F(ab')2 (equine) antivenom and crotalidae immune polyvalent fab (ovine) antivenom reported to the North American snakebite sub-registry. Clin Toxicol Phila. 2022;60(7):838–42.
4. Opioid Response Network. About Us [Internet]. 2025 [cited 2025 Aug 10]. Available from: https://opioidresponsenetwork.org/about-us/
5. Schwarz E, Buchanan J, Aldy K, Shulman J, Krotulski A, Walton S, et al. Notes from the field: detection of Medetomidine among patients evaluated in emergency departments for suspected opioid overdoses — Missouri, Colorado, and Pennsylvania, September 2020–December 2023. MMWR Morb Mortal Wkly Rep. 2024;73(30):672–4.
6. Harris PA, Taylor R, Minor BL, Elliott V, Fernandez M, O'Neal L, et al. The REDCap consortium: Building an international community of software platform partners. J Biomed Inf. 2019;95:103208.
7. Hughes A, Amaducci A, Campleman S, Li S, Costantini M, Spyres M, et al. The toxicology investigators consortium 2023 annual report. J Med Toxicol. 2024;20(3):350–80.
8. Amaducci AM, Campleman SL, Li S, Karshenas DL, Spyres MB, Farrugia LA, et al. The toxicology investigators consortium 2022 annual report. J Med Toxicol. 2023;19(4):313–40.
9. Love JS, Karshenas DL, Spyres MB, Farrugia LA, Kang AM, Nguyen H, et al. The toxicology investigators consortium case Registry-The 2021 annual report. J Med Toxicol. 2022;18(4):267–96.
10. Spyres MB, Aldy K, Farrugia LA, Kang AM, Love JS, Campleman SL, et al. The toxicology investigators consortium 2020 annual report. J Med Toxicol. 2021;17(4):333–62.
11. Spyres MB, Farrugia LA, Kang AM, Aldy K, Calello DP, Campleman SL, et al. The toxicology investigators consortium case registry-the 2019 annual report. J Med Toxicol. 2020;16(4):361–87.
12. Spyres MB, Farrugia LA, Kang AM, Calello DP, Campleman SL, Pizon A, et al. The toxicology investigators consortium case registry-the 2018 annual report. J Med Toxicol. 2019;15(4):228–54.
13. Rhyee SH, Farrugia L, Campleman SL, Wax PM, Brent J, Toxicology Investigators Consortium. The toxicology investigators consortium case registry-the 2014 experience. J Med Toxicol. 2015;11(4):388–409.

14. Farrugia LA, Rhyee SH, Campleman SL, Judge B, Kao L, Pizon A, et al. The toxicology investigators consortium case registry-the 2017 annual report. J Med Toxicol. 2018;14(3):182–211.
15. Farrugia LA, Rhyee SH, Calello DP, Campleman SL, Riederer AM, Malashock HR, et al. The toxicology investigators consortium case registry-the 2016 experience. J Med Toxicol. 2017;13(3):203–26.
16. Farrugia LA, Rhyee SH, Campleman SL, Ruha AM, Weigand T, Wax PM, et al. The toxicology investigators consortium case registry-the 2015 experience. J Med Toxicol. 2016;12(3):224–47.
17. Rhyee SH, Farrugia L, Wiegand T, Smith EA, Wax PM, Brent J. The toxicology investigators consortium case registry-the 2013 experience. J Med Toxicol. 2014;10(4):342–59.
18. Wiegand T, Wax P, Smith E, Hart K, Brent J. The toxicology investigators consortium case registry-the 2012 experience. J Med Toxicol. 2013;9(4):380–404.
19. Wiegand TJ, Wax PM, Schwartz T, Finkelstein Y, Gorodetsky R, Brent J. The toxicology investigators consortium case registry-the 2011 experience. J Med Toxicol. 2012;8(4):360–77.
20. Brent J, Wax PM, Schwartz T, Kleinschmidt KC, Engebretsen K, Beuhler M. The toxicology investigators consortium case registry-the 2010 experience. J Med Toxicol. 2011;7(4):266–76.
21. Centers for Disease Control and Prevention. The Fentalog Study: A Subset of Nonfatal Suspected Opioid-Involved Overdoses with Toxicology Testing [Internet]. 2025 [cited 2025 Aug 10]. Available from: https://www.cdc.gov/overdose-prevention/data-research/facts-stats/fentalog-study-dashboard.html
22. White AM, Castle IP, Hingson RW, Powell PA. Using death certificates to explore changes in alcohol-related mortality in the united states, 1999 to 2017. Alcohol Clin Exp Res. 2020;44(1):178–87.
23. Esser MB, Sherk A, Liu Y, Naimi TS, Stockwell T, Stahre M, et al. Deaths and years of potential life lost from excessive alcohol use—United states, 2011–2015. MMWR Morb Mortal Wkly Rep. 2020;69(39):1428–33.
24. Centers for Disease Control and Prevention, Facts About US. Deaths from Excessive Alcohol Use [Internet]. 2024 [cited 2025 Aug 10]. Available from: https://www.cdc.gov/alcohol/facts-stats/?CDC_AAref_Val=https://www.cdc.gov/alcohol/features/excessive-alcohol-deaths.html
25. O'Donnell J, Tanz LJ, Gladden RM, Davis NL, Bitting J. Trends in and characteristics of drug overdose deaths involving illicitly manufactured fentanyls - United states, 2019–2020. MMWR Morb Mortal Wkly Rep. 2021;70(50):1740–46.
26. Centers for Disease Control and Prevention. National Center for Health Statistics. Provisional Drug Overdose Death Counts [Internet]. 2025 [cited 2025 Aug 10]. Available from: https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm
27. Drug Enforcement Administration. 2025 National Drug Threat Assessment [Internet]. 2025 [cited 2025 Aug 10]. Available from: https://www.dea.gov/sites/default/files/2025-07/2025NationalDrugThreatAssessment.pdf
28. Gummin DD, Mowry JB, Beuhler MC, Spyker DA, Rivers LJ, Feldman R et al. 2023 Annual Report of the National Poison Data System (NPDS) from America's Poison Centers: 41st Annual Report. Clin Toxicol (Phila). 2024;62(12):793–1027.
29. Substance Abuse and Mental Health Services Administration. Key Substance Use and Mental Health Indicators in the United States: Results from the 2024 National Survey on Drug Use and Health [Internet]. 2024 [cited 2025 Aug 10]. Available from: https://www.samhsa.gov/data/sites/default/files/reports/rpt56287/2024-nsduh-annual-national-report.pdf
30. Prekupec MP, Mansky PA, Baumann MH. Misuse of novel synthetic opioids: a deadly new trend. J Addict Med. 2017;11(4):256–65.
31. Sandelich S, Hooley G, Hsu G, Rose E, Ruttan T, Schwarz ES, et al. Acute opioid overdose in pediatric patients. JACEP Open. 2024;5(2):e13134.